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Topics

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S1 P45 Raluca SOMOGHI, Violeta PURCAR, Raluca IANCHIS, Bogdan TRICĂ, Sabina G. NIŢU, Cristian PETCU, Cristina L. NISTOR, Elvira ALEXANDRESCU, Cătălina GÎFU, Simona CĂPRĂRESCU, *MORPHOLOGY OF ZnO NANOSTRUCTURED MATERIALS OBTAINED THROUGH SOL-GEL PROCESS*

S1 P46 Mădălin BUNOIU, Ioan BICA, Gabriel PASCU, Maria BĂLĂȘOIU, Laurențiu IORDĂCONIU, Liviu CHIRIGIU, Larisa Marina Elisabeth CHIRIGIU, *ELECTROCONDUCTIVE MAGNETORHEOLOGICAL SUSPENSIONS BASED ON CARBONYL IRON AND SILICONE OIL*

S1 P47 Raluca IANCHIS, Sabina Georgiana NITU, Cristina Lavinia NISTOR, Violeta PURCAR, Ioana Catalina GIFU, Elvira ALEXANDRESCU, Claudia Mihaela NINCIULEANU, Cristian PETCU, *AQUEOS DISPERSION OF SILICA COMPLEX SYSTEMS OBTAINED FROM RENEWABLE MATERIAL*S

S1 P48 Radu Claudiu FIERASCU, Irina FIERASCU, Nicolae STANICA, Cristian-Andi NICOLAE, Raluca SOMOGHI, Cristina Elena DINU-PIRVU, Valentina ANUTA, *INORGANIC/ORGANIC CORE-SHELL MAGNETIC MATERIALS FOR REMOVAL OF ENDOCRINE DISRUPTING PHARMACEUTICALS FROM WATER*

S1 P49 Irina FIERASCU, Radu Claudiu FIERASCU, Alina ORTAN, Dragos Alexandru MIREA, Cezar MORARESCU, *INTEGRATED METHODOLOGY FOR THE NON-DESTRUCTIVE CHARACTERISATION OF CULTURAL HERITAGE ARTIFACTS*

S1 P50 Fabien BÉNÉDIC, Benoit BAUDRILLART, Jocelyn ACHARD, *LOW-TEMPERATURE/LARGE-AREA NANOCRYSTALLINE DIAMOND FILM DEPOSITION*

S1 P51 Anca DUMBRAVĂ, Atoumane NDIAYE, Jeanina LUNGU, Adrian GEORGESCU, Petre PANAIT, Corneliu I. OPREA, Florin MOSCALU, Issakha YOUM, Mihai A. GÎRȚU, *A COMPARISON BETWEEN NATURAL SOURCES OF ANTHOCYANINS AS PIGMENTS FOR DSSCs*

S1 P52 Magdalena GALATANU, Monica ENCULESCU, George RUIU, Cristian STANCU, Gheorghe DINESCU, Andrei GALATANU, *FUNCTIONAL INTERFACES IN W-TI AND W-V LAMINATES*

S1 P53 Magdalena GALATANU, Monica ENCULESCU, George RUIU, Andrei GALATANU, *HIGH TEMPERATURE THERMO-PHYSICAL PROPERTIES OF CU-BASED THERMAL BARRIER COMPOSITES*

S1 P54 Adrian GEORGESCU, Jeanina LUNGU, *AUTOMATED SYSTEM USED IN THE CHARACTERIZATION OF PHOTOVOLTAIC CELLS*

SECTION 2 Laser, Plasma and Radiation Physics and Applications

Invited Lectures

S2 L1 Cristian P. LUNGU, *FUSION PLASMA INTERACTIONS WITH MATERIALS*

S2 L2 Corneliu POROSNICU, Bogdan BUTOI, Paul DINCA, Ionut JEPU, Oana Gloria POMPILIAN, Cristian LUNGU, Maria DIACONU, Gabriela SOREANU, Igor CRETESCU, *TVA OBTAINED CU/AG THIN FILMS WITH ANTIMICROBIAL PROPRIETIES FOR USE IN SMART VENTILATION SYSTEMS*

S2 L3 S.A. IRIMICIUC, S. GURLUI, P. NICA, M. AGOP, C. FOCSA, *EXPERIMENTAL AND THEORETICAL INVESTIGATIONS ON THE DYNAMICS OF TRANSIENT PLASMA PLUMES GENERATED BY LASER ABLATION IN VARIOUS TEMPORAL REGIMES*

S2 L4 O. BRINZA, S. FARHAT, A. TALLAIRE, R. ISSAOUI, J. ACHARD, *CARBON BASED MATERIALS SYNTHESIZED BY MICROWAVE PLASMA ENHANCED CHEMICAL VAPOR DEPOSITION*

S2 L5 Ivaylo HINKOV, Samir FARHAT, Katya PASHOVA, *SYNTHESIS OF NANOMATERIALS: MODELING, SIMULATION AND SCALE-UP*

S2 L6 Alina VLADESCU, Lidia CONSTANTIN, Mariana BRAIC, Mihai BALACEANU, Anca PARAU, Viorel BRAIC, *CARBIDE PROTECTIVE COATINGS FOR SEVERE ENVIRONMENTS*

S2 L7 Vilma BURSIKOVA, Lukas ZABRANSKY, Jiri BURSIK, Pavel SOUCEK, Jan DUGACEK, Pavel STAHEL, Milan SVOBODA, Eva SVABENSKA, Petr VASINA, *MECHANICAL PROPERTIES AND THERMAL STABILITY OF BORON CARBIDE BASED COATINGS*

S2 L8 Michal ZANÁŠKA, Pavel KUDRNA, Milan TICHÝ, *THE AC PROBES FOR DIAGNOSTICS OF PROCESSING PLASMAS*

S2 L9 R. Vladoiu, A. Mandes, V. Dinca-Balan, STUDIES ON THE BINARY FILMS BASED ON TITANIUM BY THERMIONIC VACUUM ARC (TVA) METHOD

S2 L10 Lenka ZAJÍČKOVÁ, Pavel ONDRAČKA, Mireille RICHARD-PLOUET, Stéphane ELISABETH, David HOLEC, David NEČAS, Agnès GRANIER, Antoine GOULLET, *STRUCTURAL AND OPTICAL STUDY OF $Ti_xSi_{(1-x)}O_2$ FILMS PREPARED BY PLASMA ENHANCED CVD*

Oral presentations

S2 O1 Mahmoud MORADI, Hosein ARABI, *LASER SURFACE HARDENING OF AISI 410 STAINLESS STEEL BY USING HIGH POWER DIODE LASER*

S2 O2 Mustafa Kemal BAHAR, *EFFECTS OF LASER RADIATION FIELD ON ENERGIES OF HYRDOGEN ATOM IN DEBYE PLASMA MODELED BY HULTHEN POTENTIAL*

S2 O3 Dan CHICEA, LINEAR AND NONLINEAR FIT IN DLS TIME SERIES PROCESSING

S2 O4 Bogdan BUTOI, Corneliu POROSNICU, Paul DINCA, Ionut JEPU, Oana Gloria POMPILIAN, Cristian LUNGU, *DCMS AND HIPIMS DEPOSITION OF W AND WN THIN FILMS FOR DEUTERIUM DESORBTION STUDY*

S2 O5 Paul DINCA, Oana Gloria POMPILIAN, Corneliu POROSNICU, Bogdan BUTOI, Ion BURDUCEA, and Cristian P. LUNGU, THE INFLUENCE OF AR/D RATIO ON D RETENTION IN BERYLLIUM THIN FILMS OBTAINED BY DIRECT CURRENT MAGNETRON SPUTTERING METHOD

S2 O6 Branko SKORIC, Aleksandar MILETIC, Pal TEREK, Lazar KOVACEVIC and Dragan KUKURUZOVIC, *NANO EFECTS OF ION IMPLANTATION ON HARD COATINGS*

Posters

S2 P1 Simona BRAJNICOV, Anca BONCIU ,Valentina MARASCU, Antoniu MOLDOVAN, Valentina DINCA and Maria DINESCU, *BIOFUNCTIONAL PLCL BASED-COATING OBTAINED BY MATRIX ASSISTED PULSED LASER EVAPORATION*

S2 P2 Mohemad BENHADDAD, Foued KERROUR, Ouanessa BENABBES, Abdeali SAOULI, *STUDY OF DOPING CONCENTRATION EFFECT ON NONLINEAR AND DISPERSION CHARACTERISTICS OF PHOTONIC CRYSTAL FIBER (PCF)*

S2 P3 N. D. Scarisoreanu, V. Ion, A. Andrei, A. Bercea, V.Dinca, M. Dinescu, *MULTIFUNCTIONALITY OF LEAD-FREE PIEZOELECTRIC (BA1−XCAX)(ZRYTI1−Y)O3 THIN FILM OBTAINED BY LASER TECHNIQUES*

S2 P4 Aurelia MANDES, Rodica VLADOIU, Virginia DINCA, Gabriel PRODAN, C*HARACTERIZATION OF THE ADVANCED TANTALUM OXIDE COATINGS DEPOSITED BY TVA METHOD FOR INDUSTRIAL APPLICATIONS*

S2 P5 Virginia DINCA-BALAN, Rodica VLADOIU, Aurelia MANDES, Gabriel PRODAN, *CARBON DOPED FILMS OBTAINED BY THERMIONIC VACUUM ARC METHOD*

S2 P6 K. Pashova, X. Aubert, F. Bénédic, I. Hinkov and S. Farhat, *ANALYSIS OF EMISSION SPECTRA FROM PLASMA ENHANCED CHEMICAL VAPOR DEPOSITION IN PRODUCTION OF GRAPHENE*

S2 P7 Nicoleta UDREA, Catalin M. TICOS, *NONLINEAR OSCILLATIONS OF DUST ROD PARTICLES TRAPPED IN THE SHEATH OF LOW DENSITY PLASMA*

S2 P8 Cătălin M. TICOŞ, Magdalena GALAŢANU, Andrei GALAŢANU, Cătălin LUCULESCU, Adrian SCURTU, Nicoleta UDREA, Dorina TICOŞ, CRACKS AND NANODROPLETS PRODUCED ON TUNGSTEN SURFACE BY DENSE PLASMA JETS

S2 P9 V.CIUPINĂ, I.PRIOTEASA, L.PETRĂŞESCU, C. POROSNICU, I.MUSTATA, C.P.LUNGU, E.VASILE, D. ILIE, *CUCOFE THIN FILMS WITH MAGNETORESISTIVE PROPERTIES.*

S2 P10 Dorel ALBU, Victor CIUPINA, Jeanina LUNGU, Gabriel SOCOL, Ion N. MIHĂILESCU, *MATRIX ASSISTED PULSED LASER EVAPORATION OF TiO2 FOR DYE SENSITIZED SOLAR CELLS*

S2 P11 Radu MANU, Victor CIUPINĂ, Gabriel PRODAN, Lucian PETRĂŞESCU, NicoletaVINETICU, Oana BRANCOVEANU, Daniela ILIE, Iulian PRIOTEASA, *ON THE OPTIMIZATION OF THE QUALITY OF ELECTRON DIFFRACTION IMAGE IN CHARACTERISATION OF THIN FILMS USING THE PRECESSION SYSTEM*

S2 P12 Anca NICAREL, Steluța POPESCU, Victor CIUPINA, *TUNING MICROSTRUCTURE AND ELECTRICAL PROPERTIES OF COMPLEX SUBSTITUTED PZT THIN FILMS DEPOSITED BY PULSED LASER DEPOSITION*

S2 P13 Cornel STAICU, Paul DINCA, Oana Gloria POMPILIAN, Corneliu POROSNICU, Ion BURDUCEA, Bogdan BUTOI and Cristian P. LUNGU, CHARACTERIZATION AND THE ANTIBACTERIAL PROPERTIES OF THIN FILMS AND THE CU/AG OBTAINED BY THERMIONIC VACUUM ARC METHOD

S2 P14 Oana POMPILIAN, Paul DINCA, Bogdan BUTOI, Corneliu POROSNICU, Ana NICULESCU and Cristian P. LUNGU, *POST-MORTEM ANALYSES OF SELECTED SAMPLES CUT FROM TILES EXPOSED TO JET PLASMA*

SECTION 3 Nuclear and sub-Nuclear Physics and Applications

Invited Lectures

S3 L1 G. H. BORDBAR and M. A. RASTKHADIV, *THERMODYNAMIC PROPERTIES OF LIQUID 3HE CONFINED IN A SINGLE WALL CARBON NANOTUBE*

S3 L2 Maria BALASOIU, Olexander IVANKOV, Sergei KICHANOV, Sergei STOLYAR, Ana PANTELICA, Dan PANTELICA, Dorina ARANGHEL, Claudia CHILOM, Doina GAZDARU, Aurel POPESCU, Rodica VLADOIU, Yuriy RAIKHER, *STRUCTURAL AND COMPOSITIONAL SPECIFICATIONS ON BIOGENIC FERRIHYDRITE NANOPARTICLES PRODUCTION*

S3 L3 Nicolae MARGINEAN, *MULTIPLE SHAPES AT ZERO SPIN IN THE NEUTRON-RICH NUCLEUS ^{66}NI*

S3 L4 Dana NICULAE, Cornelia NITIPIR, Doina DRAGANESCU, Filip Daniel PUICEA, *MEDICAL APPLICATIONS OF BETA AND ALPHA EMITTERS RADIONUCLIDES – ADVANTAGES AND LIMITATIONS OF SYSTEMIC RADIOTHERAPY*

S3 L5 Sergey KOZHEVNIKOV, NEUTRON PLANAR WAVEGUIDES

S3 L6 Mohammad Javad TAHMASEBI BIRGANI, *AN INTRODUCTION ON NOVEL METHOD TO ELIMINATE THE PHOTON CONTAMINATION DURING ELECTRON BEAM CANCER THERAPY USING MAGNETIC FIELD*

S3 L7 Egor LYCHAGIN, *ULTRACOLD NEUTRONS (UCN) AND INVESTIGATION OF UCNs INELASTIC SCATTERING WITH SMALL ENERGY TRANSFER AT SURFACE OF SOLIDS AND LIQUIDS*

S3 L8 CARUNTU Daniela, KAVEY Benard, COSTANZO Tommaso and CARUNTU Gabriel, *MONODISPERSE PEROVSKITE NANOCRYSTALS FOR APPLICATIONS IN ENERGY STORAGE AND FLEXIBLE ELECTRONICS*

Oral presentations

S3 O1 Andreea MITU, Marius DUMITRU, Florian DUMITRACHE, Nicolae MĂRGINEAN, Maria DINESCU3, Gheorghe CĂTA-DANIL, *HIGH GRADE DECONTAMINATION OF Ni TARGETS FOR SUB-BARRIER TRANSFER REACTIONS*

S3 O2 Alina IONESCU, Sorin PASCU, THOMAS FAESTERMANN, Ralf HERTENBERGER, Constantin MIHAI, Radu MIHAI, Cristina NIȚĂ, Octavian SIMA , Andrei TURTURICĂ, Hans-Friederich WIRTH, *COMPLETE ANGULAR DISTRIBUTION MEASUREMENTS FOR THE STUDY OF ^{156}Gd*

S3 O3 Laura RADULESCU, Mariana PETRIS, Mihai PETROVICI, Victor SIMION, *CBM-TOF INNER WALL DESIGN FOR SIS100*

S3 O4 Radu Emanuel MIHAI, Răzvan LICĂ, Doru DELION, Nicolae MĂRGINEAN, Dorel BUCURESCU, Cristian COSTACHE, Dan FILIPESCU, Nicoleta FLOREA, Ioana GHEORGHE, Tudor GLODARIU, Raluca MĂRGINEAN, Constantin MIHAI, Iani MITU, Alexandru NEGREȚ, Cristina Roxana NIȚĂ, Adina OLĂCEL, Sorin PASCU, Lucian STROE, Rares SUVAILA, Sebastian TOMA, Andrei TURTURICĂ, *LIFETIME MEASUREMENT OF THE FIRST 1- STATE IN 50MN THROUGH THE IN-BEAM FEST TECHNIQUE*

S3 O5 Bogdan CONSTANTINESCU, Petre T. FRANGOPOL, *40 YEARS OF ARCHAEOMETRY AT HORIA HULUBEI NATIONAL INSTITUTE FOR NUCLEAR PHYSICS AND ENGINEERING*

S3 O6 Cristian COSTACHE, Sorin PASCU, Nicolae MĂRGINEAN, Marian BOROMIZA, Dorel BUCURESCU, Dan FILIPESCU, Ioana GHEORGHE, Dan Gabriel GHIȚĂ, Tudor GLODARIU, Alina IONESCU, Răzvan LICĂ, Raluca MĂRGINEAN, Constantin MIHAI, Radu Emanuel MIHAI, Andreea MITU, Alexandru NEGREȚ, Cristina Roxana NIȚĂ, Adina OLĂCEL, Andreea OPREA, Pavel PETKOV, Tiberiu SAVA, Christophe SOTTY, Lucian STAN, Lucian STROE, Andreea ȘERBAN, Irina ȘTIRU, Rareș ȘUVĂILĂ, Sebastian TOMA, Andrei TURTURICĂ, Sorin UJENIUC, Nicolae Victor ZAMFIR, *IN-BEAM FEST MEASUREMENTS USING THE ROSPHERE SPECTROMETER: THE CASE OF ^{206}PO*

S3 O7 Vlad-Mihai PLĂCINTĂ, Lucian Nicolae COJOCARIU, *TEST BENCH DESIGN FOR EVALUATING THE PERFORMANCE OF MULTI-ANODE PHOTOMULTIPLIER TUBES*

S3 O8 A. O. Pavelescu, I. Iorga, R. Deju, M. Dragusin, *TOTAL EFFECTIVE DOSE EQUIVALENT ASSESSMENT USING RESRAD CODE FOR THE DISMANTLING OPERATIONS OF THE ALUMINIUM VESSEL OF THE IFIN-HH VVR-S REACTOR FROM MAGURELE, ROMANIA*

S3 O9 Simona ILIE, Dana NICULAE, Calin A. UR, *ASSESSMENT OF RADIOISOTOPES PRODUCTION FOR MEDICAL APPLICATIONS AT ELI-NP*

S3 O10 Alexandru ENE, *STUDY OF STRANGE AND BEAUTY PARTICLES PRODUCTION IN PP INTERACTIONS AT SQRT(S)=13 TEV USING PYTHIA*

S3 O11 Liviu Stefan CRACIUN, Constantin Augustin-Dan PISTOL, Cristina IONESCU, Laurentiu TEODORESCU, Dana NICULAE, *PREPARATION AND CHARACTERIZATION OF NICKEL TARGETS FOR CYCLOTRON PRODUCTION OF PET RADIOISOTOPE ^{64}Cu*

S3 O12 Mihai MARCIU, Virgil BARAN, Roxana ZUS, *DYNAMICAL EFFECTS OF THE SYMMETRY ENERGY FOR THE HEAVY-ION REACTION 124SN+64NI AT 35/45 AMeV*

S3 O13 Marin DINCA, Luiza Diana MITREA, *DYNAMIC INVESTIGATION BY NEUTRON AND GAMMA IMAGING OF A COFFEE MAKER*

S3 O14 A. ATTARZADEH, M.J. TAHMASEBI BIRGANI, S.MOHAMMADI, P.PARVARESH, *ALPHA DECAY HALF LIVE CALCULATIONS OF DEFORMED HEAVY NUCLEI BY CONSIDERING*

Posters

S3 P1 Daniela CRISTEA-STAN, Bogdan CONSTANTINESCU, Zita SZIKSZAI, *ANCIENT BRONZE AND SILVER METALLURGY STUDIES BY MICRO-PIXE*

S3 P2 Tatiana Lychagina, Dmitry Nikolayev, Cristian Dragolici, Maria Balasoiu, Laura Ionascu, Mihaela Nicu, Felicia Dragolici, *NEUTRON DIFFRACTION STUDY OF CONCRETE STRUCTURES*

S3 P3 Maria-Valentina ILIE , Tiberiu Bogdan SAVA, *RADIOCARBON DATING APPLICATIONS OF ACCELERATOR MASS SPECTROMETRY*

S3 P4 Evelina IONESCU, Daniela GURAU, Radu DEJU, Adrian ZORLIU, *MANAGEMENT OF MATERIALS THAT ARISE FROM DECOMMISSIONING THE VESSELS OF THE VVR-S REACTOR*

S3 P5 Mihaela NICU, Laura IONASCU, Felicia DRAGOLICI, Gheorghe DOGARU and Elena NEACSU, *XRD STUDIES AND MECHANICAL BEHAVIOUR OF CEMENT EMBEDDING MATRICES CONTAINING NICKEL FERROCYANIDE SORBENTS*

S3 P6 Violeta PINTILIE, Antoaneta ENE, Lucian Puiu GEORGESCU, Oana ANDREI, *THE EVALUATION OF THE GROSS ALPHA AND THE GROSS BETA ACTIVITIES FROM FOODSTUFF*

S3 P7 Violeta PINTILIE, Antoaneta ENE, Lucian Puiu GEORGESCU, Dana Iulia MORARU, Oana ANDREI, DETERMINATION OF NATURAL RADIONUCLIDES IN MILK

S3 P8 Laurenţiu TEODORESCU, *A FILAMENT SUPPLY PROTECTION CIRCUIT FOR THE EMISSION TUBE OF THE RF POWER AMPLIFIER FOR CYCLOTRON APPLICATIONS*

S3 P9 Liviu Stefan CRACIUN, Constantin Augustin-Dan PISTOL, Cristina IONESCU, *DESIGN OF A HIGH EFFICIENCY MULTI-LAYERED RADIATION SHIELDING*

S3 P10 Gheorghe DOGARU, Felicia DRAGOLICI, Mihaela NICU, Laura IONASCU, Elena NEACSU, *OPTIMISED SOLUTIONS FOR SUPER-COMPACTION OF RADIOACTIVE WASTE*

S3 P11 Daniela Maria DOGARU, Gheorghe DOGARU, *IMPROVEMENT OF THE REGULATORY FRAMEWORK IN THE FIELD OF RADIOACTIVE WASTE AND DECOMMISSIONING*

S3 P12 Laurenţiu TEODORESCU, Tiberiu Relu EŞANU, Liviu Ştefan CRĂCIUN, *A MEASUREMENT METHOD OF THE TARGET BEAM CURRENT BY USING A FAULTY COLLIMATOR IN CYCLOTRON APPLICATIONS*

S3 P13 Antoaneta ENE, Marina V. FRONTASYEVA, Ana PANTELICĂ, *COMBINED NUCLEAR TECHNIQUES FOR TRACE ELEMENT ANALYSIS IN ENVIRONMENTAL AND MATERIALS SCIENCE*

S3 P14 Liviu Stefan CRACIUN, *MEDICAL RADIOISOTOPE PRODUCTION AND MULTI-DISCIPLINARY RESEARCH ACTIVITIES WITH A PET CYCLOTRON*

S3 P15 Ana PANTELICĂ, Paul IONESCU, Dan PANTELICĂ, Andreea MITU, Andrei APOSTOL, Vasile-Daniel MOŞU, Cezar MORĂRESCU, Andrei RUGINĂ, *INVESTIGATION OF MAJOR AND MINOR ELEMENTS IN TREE LEAVES THICK TARGET SAMPLES BY PIXE, PIGE, AND RBS ANALYTICAL TECHNIQUES*

S3 P16 Ana PANTELICĂ, Marina V. FRONTASYEVA, My TRINH, Otilia Ana CULICOV, Inga ZINICOVSCAIA, Dan PANTELICA, Andrei APOSTOL, Dan-Gabriel GHITA, *COMPARISON OF ION BEAM ANALYSIS (IBA) AND INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS (INAA) TECHNIQUES ON TREE LEAVES SAMPLES*

S3 P17 Özgür AYTAN, M. Erhan EMIRHAN, Aziz KURT, Aysegul ERTOPRAK, Yesim OKTEM, Baki AKKUS, *DETERMINATION OF RADON CONCENTRATION LEVELS IN WELL WATERS NEAR THE NORTH ANATOLIAN FAULT ZONE, IN GÖNEN / BALIKESIR, TURKEY*

S3 P18 Mihaela MANEA, Dragos MIREA, Florina ZORILA, Rares SUVAILA, Radu ANDREI, Cezar MORARESCU, Mihalis CUTRUBINIS, Valentin MOISE, Livius TRACHE, *ARTWORKS CHARACTERIZATION AT IFIN-HH – AN AUTHENTICATION OPPORTUNITY FOR ROMANIAN PAINTINGS*

S3 P19 Maria BALASOIU, Ioan BICA, Dmitro SOLOVIOV, Vitaly TURCENKO, O. L. ORELOVICH, Madalin BUNOIU, *ON THE STRUCTURE OF MAGNETORHEOLOGICAL ELASTOMERS*

S3 P20 C. I. ANGHEL and I. SILIȘTEANU, SIMPLE PHENOMENOLOGICAL FORMULA FOR A HALF-LIVES OF SUPERHEAVY NUCLEI

S3 P21 Nadezhda BELOZEROVA, Sergey KICHANOV, Evgenii LUKIN, Denis KOZLENKO, Zdenek JIRAK, Boris SAVENKO, *INVESTIGATION OF CRYSTAL AND MAGNETIC STRUCTURES OF NANOSTRUCTURED MANGANITES AT HIGH PRESSURE BY MEANS OF NEUTRON DIFFRACTION*

SECTION 4 Cross-disciplinary Applications of Physics

Invited Lectures

S4 L1 Dmitry Nikolayev, Tatiana Lychagina, Alexey Pakhnevich, Maria Balasoiu, Liviu Miron, *NEUTRON QUANTITATIVE TEXTURE ANALYSIS OF THE BIVALVIA MOLLUSCS SHELLS*

Oral presentations

S4 O1 Dana Alina MAGDAS, Adriana DEHELEAN, Ioana FEHER, Romulus PUSCAS, *THE OPTIMAL NUTRITIONAL VALUE OF LETTUCE PLANTS DURING THE GROWING STAGES*

S4 O2 L. E. Chilug, R. A. Leonte, V. Lavric, D. Niculae, A. Raicu, D. Draganescu, E. A.Min, R. M. Serban and G. Manda, *BIOPHYSICAL STUDIES OF GOLD NANOPARTICLES FUNCTIONALIZED WITH 68Ga-DOTA CONJUGATED PEPTIDES AS IMPROVED TUMOUR TARGETING SYSTEM*

S4 O3 Cem TOZLU, Adem MUTLU, M. Zeliha YİĞİT, Mustafa CAN, *ANODE INTERFACIAL MODIFICATION BY SELF-ASSEMBLED MONOLAYER IN ORGANIC SOLAR CELL*

Posters

S4 P1 Costel COTIRLAN-SIMIONIUC, Catalin Constantin NEGRILA, Adrian Stefan MANEA, Adrian RIZEA, Constantin MARIN: *RECONFIGURABLE PLASMONIC METASURFACES PROVIDE GREAT FLEXIBILITY IN THE DESIGN OF PHOTONIC DEVICES*

S4 P2 Mihaela RĂCUCIU, *BIOEFFECTS OF MAGNETIC NANOPARTICLES PRESENCE IN THE CULTURE SOIL OF LAVANDULA ANGUSTIFOLIA*

S4 P3 Mihaela RĂCUCIU, Horea OLOŞUTEAN, *50HZ SINUSOIDAL MAGNETIC FIELD EFFECTS ON WATER PROPERTIES*

S4 P4 Marcela Elisabeta BARBINTA-PATRASCU, Nicoleta BADEA, Camelia UNGUREANU, Cornelia NICHITA, Stefan Marian IORDACHE, Marioara CONSTANTIN, Stefan ANTOHE, *BIO-ACTIVITY OF ORGANIC/INORGANIC PHYTO-GENERATED COMPOSITES IN BIO-INSPIRED SYSTEMS*

S4 P5 Claudia G. CHILOM, Mihaela BACALUM, Radu MARIN, Mirela M. STANESCU, Monica FLORESCU, *INTERACTIONS OF HUMAN SERUM ALBUMIN WITH FOLIC ACID*

S4 P6 Faisal AL-BEHADILI, Mustafa ALHUSSAINY, Adriana BALAN, Sanda VOINEA, Catalin CEAUS, Ana CUCU, Georgeta NEAGU, Cornelia NICHITA, *PHYSICOCHEMICAL AND MORPHOLOGICAL ANALYSIS OF BIOHYBRIDS BASED ON CHITOSAN AND HERBAL EXTRACTS*

S4 P7 Iulian-Vlad ICHIM, Andrei Vasile NASTUTA, Catalin AGHEORGHIESEI, *HAND GESTURE MONITORING USING LOW-COST OPEN-SOURCE MICROCONTROLLERS COUPLED WITH FORCE SENSITIVE RESISTORS AND ELECTROMYOGRAPHY SENSORS*

S4 P8 Ana Maria CONSTANTINESCU, Camelia UNGUREANU, Mihaela BACALUM, Viorel IFTIMIE, Marcela Elisabeta BARBINTA-PATRASCU, *BIO-NANOMETALS IN MEDICAL APPLICATIONS*

S4 P9 Dan CHICEA, *DYNAMIC LIGHT SCATTERING TIME SERIES GENERATION USING HARMONIC FUNCTIONS*

S4 P10 Yulia GORSHKOVA, Ermuhammad DUSHANOV, *KINETIC OF ORGANOSULFUR COMPAUNDS INTERACTION WITH UNILAMELLAR PHOSPHOLIPID VESICLES*

S4 P11 Iulian BANCUTA, Oana Roxana BANCUTA, Tanta SETNESCU, Andrei CHILIAN, Radu SETNESCU, Anca GHEBOIANU, I. V. POPESCU, Otilia CULICOV, *ICP-MS and AAS METHODS APPLIED ON THE SEWAGE SLUDGES FROM DAMBOVITA COUNTY*

S4 P12 Mihaela MIC, Adrian Pîrnău, Maria Miclăuș, Mariana Palage, Catalin Araniciu, Silvia Neamțu, Calin Floare, Mircea Bogdan, *MOLECULAR INTERACTION BETWEEN DRUGS WITH ANTIMICROBIAL ACTIVITY AND MACROMOLECULAR RECEPTORS*

S4 P13 Adrian PÎRNĂU, Mihaela MIC, Silvia Neamțu, Calin G Floare, Mircea Bogdan, *QUANTITATIVE ANALYSIS OF ZIDOVUDINE – HSA INTERACTION BASED ON ITC CALORIMETRY, FLUORESCENCE AND NMR SPECTROSCOPY*

S4 P14 Alexandra CIORÎȚĂ, Maria SUCIU, Loredana OLAR,Claudiu MIRESCU, Septimiu TRIPON, Izabell CRĂCIUNESCU, Lucian BARBU-TUDORAN, TIME-DEPENDENT ORGAN RESPONSE TO SPIONS IN RATS

S4 P15 Florina Lucica ZORILA, Bogdan ZORILA, Maria Mihaela MANEA, *SPECTROSCOPIC STUDY OF MEMBRANE FLUIDITY MODIFICATIONS INDUCED BY DIFFERENT DECONTAMINATION TREATMENTS ON ESCHERICHIA COLI*

S4 P16 Bogdan ZORILA, *MODELS APPLIED TO STEADY STATE AND TIME RESOLVED FLUORESCENCE DATA ANALYSIS TO OBTAIN WATER-TO-LIPID PARTITION FREE ENERGY. AN EXPERIMENTAL APPROACH.*

SECTION 5 Engineering and Industrial Physics

Invited Lectures

S5 L1 Gheorghe V. CIMPOCA, Alin BUCURICA, Ioana DULAMA, Ion V POPESCU, *CHARACTERIZATION OF METAL NANOPARTICLES IN WATER WITH QUARTZ CRYSTAL MICROBALANCE*

S5 L2 Vlad-Andrei ANTOHE and Luc PIRAUX, *COMPLEX ARRAYS OF NANOWIRES & NANOTUBES. FROM NANOFABRICATION TOWARD* NEXT GENERATION DEVICES

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ABSTRACTS

S0 – PLENARY SESSION

SO 01

BIOFLEXOELECTRICITY: ACTIVE INTERFACE OF THE CELL WITH THE ENVIRONMENT

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Phenomenon of bioflexoelectricity has been postulated, discovered and investigated by us in the last 40 years. In this lecture the theory and experiments of biomembrane flexoelectricity are reviewed. Flexoelectricity is a reciprocal relation between electricity and mechanics in soft lyotropic systems, i.e., in case of membranes, between curvature and polarization. Experimental evidence of model and biomembrane flexoelectricity (including the direct and the converse flexoelectric effects) is reported. The biological implications of flexoelectricity are underlined. Flexoelectricity enables membrane structures to function like soft micro- and nanomachines, sensors and actuators, thus providing important input to nanoionics applications. Nanobio manifestations include membrane transport, membrane contact, mechanosensitivity, electromotility, hearing, nerve conduction, etc.

SO 02

PERSPECTIVES FOR NUCLEAR PHYSICS RESEARCH WITH GAMMA BEAMS AT ELI–NP

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Gamma beams at ELI–NP will be provided by a system using the inverse Compton scattering of visible laser pulses on relativistic electrons. Electrons will be provided by a radiofrequency linear accelerator operated at room temperature. The interaction lasers will be of cryo-cooled Yb:YAG J-class type and will provide visible light with 515 nm wavelength. The system is designed to be operated in two stages: one of low energy in which electrons are accelerated up to 300 MeV and the resulting gamma rays will have energies up to 3.5 MeV, and a second stage in which electrons will be further accelerated up to 720 MeV and the gamma-ray photons will reach up to 19.5 MeV energy. The main features of the gamma beams to be delivered at ELI–NP are: high spectral density of about 10^4 photons/s/eV, highly monochromatic (bandwidth of less than 0.5%), continuously tunable energy in the range 0.2 – 19.5 MeV, linear polarization more than 95%.

Photonuclear reactions experiments will largely benefit of the outstanding features of the gamma beams provided at ELI–NP. Among the main research topics to be performed with gamma beams one can list: study of the electromagnetic dipole response of rare nuclei, such as p–nuclei, and actinides; measurements of reaction cross sections of astrophysical interest following (gamma,p) or (gamma,alpha) photo–disintegration processes; fission transmission resonances will be studied in the second and third potential minima through photo–fission experiments.

Applied physics studies with gamma beams are also considered. The gamma beams are promising tools for non–destructive active interrogation methods, industrial tomography with high–energy gamma rays, material physics studies positron beams and production of radioisotopes for medicine. The nondestructive and noninvasive analyses under study at ELI–NP use nuclear resonance fluorescence and computed tomography to perform quantitative assays of objects of various nature and composition. The high sensitivity of these measurements is guaranteed by the high spectral density of the gamma beam and the advanced gamma–ray detection systems under development at ELI–NP. In addition, two experimental setups specialized in nondestructive analyses based on transmission images or reconstructed tomograms will also be available at ELI-NP to analyze objects up to 150 kg using either pencil or cone beams.

An overview of the implementation of the gamma beam system and of the experimental setups will be given.

The Extreme Light Infrastructure – Nuclear Physics project is co–financed by the Romanian Government and the European Union through the Regional Development Fund.

Keywords: gamma beams, photonuclear reactions, industrial applications

ABSTRACTS

S1 – Materials Physics

- *Semiconductors, Dielectrics and Organic Materials*
- *Spintronics, Magnetism and Superconductivity*
- *Crystal growth, Surfaces, Interfaces and Thin Films*
- *Polymers and Amorphous Materials*

S1 L1

NITROGEN DOPED SILICON-CARBON MULTILAYER PROTECTIVE COATINGS ON CARBON

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Protective nitrogen doped Si-C multilayer coatings on carbon, used to improve the oxidation resistance of carbon, were obtained by Thermionic Vacuum Arc (TVA) method. The initial carbon layer having a thickness of 100nm has been deposed on a silicon substrate in the absence of nitrogen, and then a 3nm Si thin film to cover carbon layer was deposed. Further, seven Si and C layers were alternatively deposed in the presence of nitrogen ions, each having a thickness of 40nm. In order to form silicon carbide at the interface between silicon and carbon layers, all carbon, silicon and nitrogen ions energy has increased up to 150eV. The characterization of microstructure, electrical and tribological properties of as-prepared N-Si-C multilayer structures were done using Transmission Electron Microscopy (TEM, STEM) techniques, Energy Dispersive X-Ray Spectroscopy (EDXS), Thermal Desorption Spectroscopy (TDS), electrical and tribological measurements. N-Si-C multilayer samples were investigated up to 1000^{o}C. Oxidation protection of carbon is based on the reaction between oxygen and silicon carbide, resulting in SiO_2 and CO_2, and also by reaction involving N, O and Si, resulting in silicon oxynitride (SiN_XO_Y) with a continuously variable composition, and on the other hand, since nitrogen acts as a trapping barrier for oxygen. The tribological measurements reveal that the friction coefficient on the N-Si-C structures used is smaller than friction coefficient on uncoated carbon layer. To perform electrical measurements, 80% silver filled two-component epoxy-based glue ohmic contacts were attached on the N-Si-C samples. Electrical conductivity was measured in constant current mode. The experimental data show the increase of conductivity with the increase of the nitrogen content. To explain the temperature behavior of electrical conductivity we assumed a thermally activated electric transport mechanism.

Keywords: N-Si-C multilayer structures, TVA method, TEM, STEM, EDXS, TDS, tribological measurements, electrical conductivity.

S1 L2

ENHANCEMENT OF THE ELECTROLUMINESCENCE OF ORGANIC LIGHT EMITTING DEVICES BASED ON Ir(ppy)$_3$ BY DOPING WITH METALIC AND MAGNETIC NANOPARTICLES

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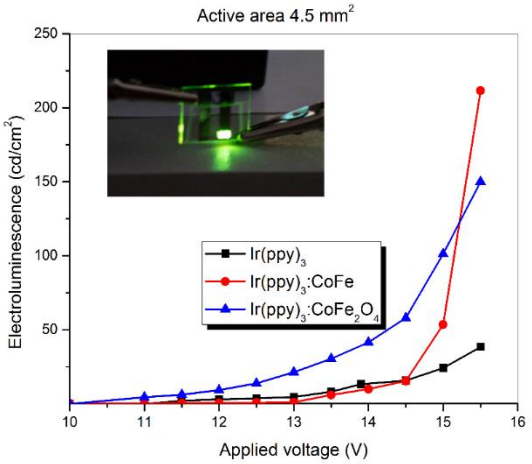
Magnetic nanoparticles embedded in the active layer of the Organic Light Emitting Diodes (OLEDs) significantly increases the electroluminescence and the charge transport without influencing the transparency of these devices. A brief comparison was done in order to identify which parameter influences these properties, by comparing the $CoFe_2O_4$ magnetic nanoparticles with $CoFe_2$ metallic magnetic nanoparticles, the later one being obtained by thermal reduction in hydrogen of cobalt ferrite nanoparticles. $CoFe_2$ have shown a better efficiency of the metallic nanoparticles where, probably the main advantage is the higher magnetization property instead of the coercive field.



Concerning the charge transport across the OLEDs, these nanoparticles reduces the electron injection, acting as filling traps, which directly increases the electroluminescence and the current at the same voltage. The good dispersion of $CoFe_2$ nanoparticles involves a better spatial distribution in the active layer ensuring uniform electroluminescence and charge transport in the whole active area of OLEDs.

Keywords: OLED, magnetic nanoparticles, electroluminescence, charge transport.

S1 L3

MAGNETIC CORRELATIONS IN RCo_2 COMPOUNDS ABOVE THE CURIE TEMPERATURES

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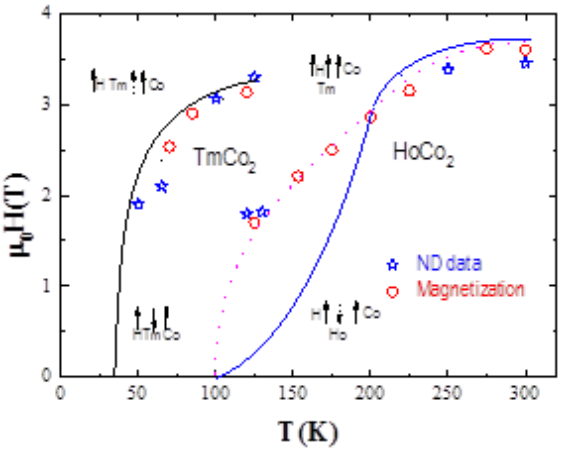
The magnetic behaviour of RCo_2 (R = Tb, Ho, Er, Tm) compounds, at $T > T_c$, are analysed starting from the complex and interdependent exchnage interactions at the level of unit cel. The induced cobalt moment at $T < T_c$ by, 4f-5d-3d exchnage path, is stabilized by Co3d-Co3d exchnage interactions. Concomitantly with the presence of cobalt moment, M_{Co}, an aditional polarizations is induced on R5d band by a reverse path. The above interdependet exchnage interactions are present also at $T > T_c$, their intensities being not enough to induce a short-range magnetic ordering, as previously proposed.

The succesive chnages in the orientations of R and Co moments as function of temperature and external field can be well described by a phenomenological thory based on the energies balance – Fig.1.

No magnetic ordered clusters are present at $T > T_c$ as evidenced from the analysis of quantum critical point.



Keywords: magnetic properties, rare-earth componds

S1 L4

MECHANICAL PROPERTIES OF NANOSCALED AMORPHOUS METALS

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It is well known that small structures with characteristic length scales down to the nanometer regime have different properties when compared to the those of the corresponding bulk structures. Furthermore, because of the spatial and temporal confinements the properties of nanostructures are experimentally difficult to study. Particularly, the atomistic mechanism of plastic deformation in amorphous metals cannot be properly resolved by experimental means yet. Thus, investigations of this crucial aspect have relied so far on computer simulations, a powerful tool to study the atomic-level mechanism of microscopic flow defects called shear bands. In this presentation, by using large-scale molecular dynamics simulations, we will provide an atomistic understanding of the deformation mechanisms of nanostructured metallic glass and differentiate the extrinsic size effects and aspect ratio contribution to plasticity [1]. A model for predicting the critical aspect ratio for the ductile-to-brittle transition will be also developed. Hence, we will propose a simple approach for guiding the design of nanosized metallic glasses as models for investigating mechanical properties under tensile loading, as shown in Fig. 1. Furthermore, we will disclose how structural rejuvenation of a large volume fraction of the amorphous nanostructure leads to enhanced tensile ductility.

The presented results shed light on the fundamental deformation mechanisms of nanoscaled metallic glasses and demarcate ductile and catastrophic failure.

[1] D. *Sopu, A. Foroughi, M. Stoica, J. Eckert,* Nanoletters 16, 4467 (2016)

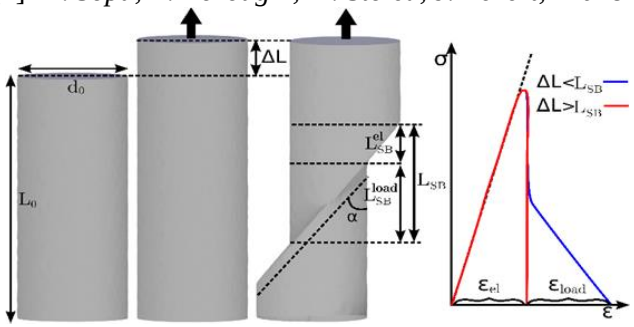

Fig. 1. Schematic illustration of the deformation mechanism. Nanowire has a cylindrical cross section. Only a nanowire with high aspect ratio, so that $\Delta L \geq L_{SB}$, shows brittle-like fracture

S1 L5

EPR INVESTIGATION OF SOME FERRITE NANOPARTICLES AND THIN FILMS

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Spinel ferrites (MFe_2O_4; M = Co, Ni, Zn, Mg etc.) are one of the most studied oxides due to their interesting magnetic properties, high chemical and thermal stability [1-3]. Electron paramagnetic resonance spectroscopy, EPR, is a useful tool in the study of magnetic state in ferrite nanoparticles and thin films.

Some simple and mixed ferrite nanoparticles were prepared by sol-gel auto-combustion method, annealled at different tempeatures (773K/2h, 973K/2h and 1173K/2h) and covered with carboxymethyl cellulose. Ferrite thin films were deposited on (100) Si, quartz and Al_2O_3 substrates by PLD or spin-coating methods. Structural informatin was obtained from X-ray diffraction, X-ray photoelectron spectroscopy and transmission electron microscopy..

EPR investigation of spinel ferrites, obtained as nanoparticles or thin films, evidence the influence of the nature of M and dopant elements and annealing processes on their magnetic properties (Fig.1 a, b).

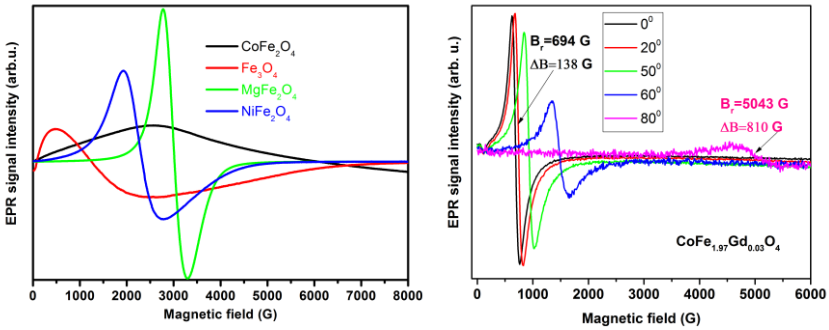

Fig.1.a) Room temperature EPR signals for some ferrite nanoparticles b) Angular dependence of EPR spectrum of Gd doped cobalt ferrite thin film.

The EPR studies revealed that the variation of the resonance line width is caused by the microscopic magnetic interactions inside the thin films and that in the case of nanoparticles the magnetic dipole interaction among particles is very strong. The temperature dependence of the magnetic properties of ferrites nanoparticles and thin films is also studied.

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Keywords: EPR, ferrite nanoparticles, ferrite thin films, magnetic properties
Acknowledgements: This study was partially supported by the JINR project No.58, theme 04-4-1121-2015/2017.

S1 L6

THE STRUCTURAL ASPECTS OF PHYSICAL PROPERTIES FORMING IN MATERIALS: NEUTRON SCATTERING STUDIES

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A search for novel materials demonstrating challenging physical properties and phenomena, which are prospective for development of new technologies is one of primary topics in modern multidisciplinary scientific research in the fields of materials science, condensed matter physics, chemistry, biophysics, medicine, etc.

In order to reveal the key features of formation of physical properties of crystalline, nanostructured and massive materials, one needs to apply research methods allowing to obtain information at different scopic level: micro, nano or micron scale. Neutron scattering methods –diffraction, small angle scattering and radiography offer wide range opportunities for research of materials. Neutrons have a number of specific properties, making them distinguished from other elementary particles – absence of electric charge, presence of magnetic moment, different scattering amplitude for different isotopes of one atom, large penetrating depth, energy comparable with energy of dynamic lattice excitations.

This is a short overview of interesting scientific results obtained by neutron scattering on the basic facilities of the high flux pulse IBR-2 reactor. These results extend from studies of structural and magnetic phase transitions at high pressure, or the peculiarities of nanostructural organization in optical materials, to studies of the structural inhomogeneities in the turbine blades or iron-stone meteorites. Those reported results are brilliant examples of the possibilities of neutron facilities at the IBR-2 reactor for a research of the structural organization of any materials.

S1 L7

MAGNETIC PROPERTIES IN RADICAL-BASED SYSTEMS

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Starting from the premises that systems with 2D pattern are best suited to grow thin films, provide that a topological match with the host material is fulfilled, we apply principles of the supramolecular chemistry to approach, as case studies, the magnetic behavior of layered systems based on ligand radicals assembled trough alkaline or lanthanide metal ions. The role of structural reasoning and modeling as guideline to property analysis is illustrated.

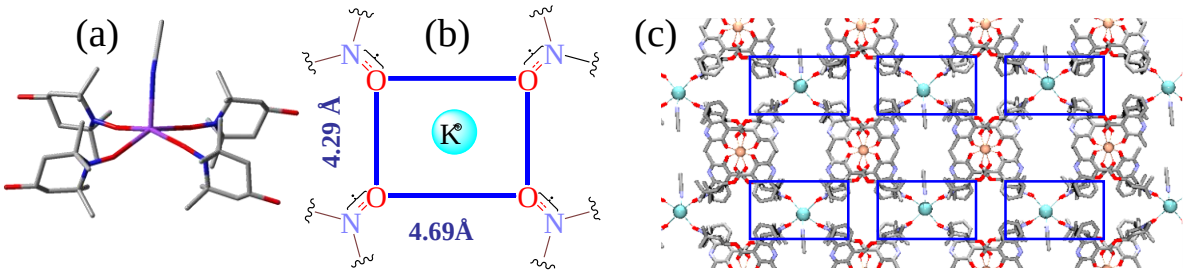

Figure. Molecular unit and supramolecular assembling of a four-radical system showing antiaromatic rectangular distortion: (a) the fragment consisting in the radical NO ends of the large ligands, coordinated to a potassium atom (having also an apical CH3CN ligand). (b) the scheme of the rectangular frame, (c) The 2D assembling, realized by the coordination of diketone ends of the ligand to yttrium(III) ions

Aside the hybrid organic-inorganic materials, we advance several considerations on graphenes with spin determined by topological factors. Our perspective underlines the fruitfulness of putting on equal footing the academic insight with application prospection, as well as the chemistry and physics of the considered systems.

Keywords: molecular magnetism, magnetic anisotropy, spin coupling
Acknowledgement. This work is supported by PNII-PCE grant from UEFISCDI

S1 O1

STRUCTURE AND STABILITY OF AQUEOUS FERROFLUIDS ACCORDING TO NEUTRON AND SYNCHROTRON RADIATION SCATTERING INVESTIGATIONS

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The theme of a comprehensive study of condensed matter containing nano-objects are regularly filled out by the persistent activity of numerous research groups from world scientific centers. In particular, many attempts are made in the present day material science to improve methods of controllable synthesis of complex colloidal systems containing nanoparticles with a characteristic size in the range of 1–100 nm. Espessially, this concerns magnetic fluids (or ferrofluids) where magnetic nanoparticles (MNPs) with single-domain state of magnetization are dispersed and stabilized in liquid carriers. MNPs have much prospect in biology and medicine due to their promising applications. For this purposes magnetic nanoparticles should be non-toxic and demonstrate superparamagnetic behavior. However, these properties can be affected by the aggregation processes during the synthesis of MFs, so that the final macroscopic properties of the systems can vary much depending on self-organization of MFs at nanoscale. Thus, the detailed characterization of the MF at nanoscale with respect to the stable aggregate formation could facilitate one to control macroscopic properties and widen the range of potential practical applications. With this respect, Small-Angle Neutron (SANS) and X-ray (SAXS) Scattering are ones of the actively used methods to probe at the nanoscale the structure of various complex colloidal solutions including magnetic fluids [1,2].

The basic requirement to ferrofluids for medical applications is their biocompatibility which is largely determined by the surfactant selected for a particles's stabilization in an aqueous medium. The effect of different types of surfactants (oleic acid, polysorbate-80 and sodium oleate) on the structure of water-based ferrofluids is presented, as well as the characteristic nano-scale parameters of MNPs (size distribution parameters, shell thikness) are estimated from the SANS and SAXS spectra. In addition, specification of the structure of MNP aggregates formed in a bio-mimicking medium based on agar-gel is considered as an example of modification of the liquid carrier [3,4].

Keywords: ferrofluids, magnetic liquids, small-angle neutron scattering.

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S1 O2

METAL OXIDES GROWN AS THIN FILMS BY PLD FOR ANTIREFLECTIVE COATINGS

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Thin films of metal oxides as HfO_2, Al_2O_3, SiO_2, Ta_2O_5 have been intensively used for numerous applications in microelectronics, biology, medicine, etc. In the last decade, the development of high power lasers led to necessity to have resistant optic components. To fulfill this demand, metal oxides are studied as antireflective coatings.

Multi-layers as SiO_2/HfO_2, SiO_2/Al_2O_3, SiO_2/Ta_2O_5, $HfO_2/SiO_2/HfO_2$ from metal oxides with different refractive indices were obtained on transparent substrates by pulsed laser deposition. Atomic force microscopy, transmission electron microscopy, secondary ion mass spectrometry, and spectro-ellipsometry techniques were used to investigate the properties of the resulting samples. The surfaces of heterostructures that contain HfO_2 as bottom layer, have lower roughness than those that have Al_2O_3 or Ta_2O_5 as bottom layer. The presence of HfO_2 layer induces a nanostructured growth at the surface. The surface of the top layer is dense, uniform and without droplets. The optical investigation performed on the three-layered sample ($HfO_2/SiO_2/HfO_2$) shows that the bottom layer has a refractive index close to the value of hafnia-bulk and the top layer has a lower refractive index due to the presence of voids.

Tests regarding the damage threshold of the heterostructures were made using a laser working at 775 nm wavelength, with 220 fs pulse duration. The heterostructures based on hafnia have a higher damage threshold than the other heterostuctures, being suitable for antireflective coatings able to resist to high power laser interaction.

Acknowledgement: Financial support from the Romanian National Nucleu Program – contract 4N/2016, the Romanian National Authority for Scientific Research, CNCS – UEFISCDI project number PN-II-PT-PCCA-2013-4-1870 (ARCOLAS), and PN-II-PT-PCCA-2013-4-1992 (SOLE) is gratefully acknowledged.-

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S1 O3

LASER PROCESSING OF POLYMERS: TOWARDS MEDICAL APPLICATIONS

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Matrix-assisted pulsed laser evaporation (MAPLE) is an attractive method for the deposition of organic thin films. In MAPLE, a polymer or a biomolecule, is suspended in a solvent in concentrations of 0.1-5%, and the mixture is frozen, resulting in a solid target. When the laser light irradiates the target, the solvent evaporates and the suspended material is collected on a substrate as a thin film.

The aim of this work is the application of MAPLE for the deposition of different polymers, i.e. polyisobutylene (PIB), ethylcellulose (EC), and hydroxypropyl methylcellulose (HPMC) polymers aiming their usage in proof-of-concept drug-delivery systems.

The MAPLE as deposited thin films are investigated using optical microscopy, atomic force microscopy, and scanning electron microscopy. Morphological investigations indicate that under a careful choice of the experimental parameters different domain structures such as islands or pits may be avoided and the prepared thin films indicated good physical stability. In addition, by tuning the experimental deposition parameters i.e. laser fluence, wavelength, etc. the formation of pores in the HPMC polymer thin films can be controlled. This is important as pores have been reported as the pathway for drug transport. More insight on surface morphology, drug distribution and content in the deposited thin films has been achieved by contact angle measurements, Fourier transformed infrared spectroscopy, and UV-VIS spectroscopy.

Our results indicate that the polymer thin films prepared by MAPLE represent an excellent alternative to the orally administered drugs.

S1 O4

PROPERTIES AND APPLICATIONS OF CLAY THIN FILMS

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Herein we report on the properties of thin films of clay materials grown by laser techniques. Two methods are used for the deposition of the lamellar materials: pulsed laser deposition (PLD) and matrix assisted pulsed laser evaporation (MAPLE). The investigated materials are montmorillonite (MMT cationic clays) and layered double hydroxides (LDH anionic clays). MMT clay is used as matrix for fertilizers; it can be a filter for heavy metals and many bacteria. In pharmaceutical industry and in medicine, MMT is used as inexpensive antiseptic, animal health supplement and poison antidote. LDHs, also known as hydrotalcites or anionic clays, can be used as chemical sensors, corrosion resistant coatings, components in optical and magnetic devices, for drug delivery etc. For all of these applications a crystalline controlled structure is needed.

The considered processing techniques are pulsed laser deposition PLD and matrix assisted pulsed laser evaporation MAPLE. The laser based methods are new, clean and environmentally safe; the laser technique offers also a good adhesion and controllable thickness of the films. The deposition parameters, especially the laser wavelength, play an important role in the composition and morphology of the films.

The structure and the morphology of the deposited films are evidenced by X-Ray Diffraction at Grazing Incidence (GI-XRD), Energy dispersive X-ray spectroscopy (EDX), Atomic Force Microscopy (AFM), Scanning Electron Microscopy (SEM) and Secondary Ions Mass Spectrometry (SIMS). The chemical structure is investigated by Fourier Transform Infrared Spectroscopy (FTIR).

The possible applications of the as deposited films, especially in electrochemical sensors, are presented and discussed.

Acknowledgements: This work was supported by the National Program 4N/2016, and grant of the Romanian National Authority for Scientific Research and Innovation, CNCS – UEFISCDI, project number PN-II-RU-TE-2014-4-0976 (contract TE 270/2015) – "DESYRE".

S1 O5

XAFS STUDY OF $Y_xSm_{1-x}BO_3$ OXIDE

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Influences of Y substitution on the electronic and crystal structure of the triclinic $SmBO_3$ sample were investigated by x-ray absorption fine structure spectroscopy (XAFS) technique for the general formula $Y_xSm_{1-x}BO_3$. With the substitution of Y^{3+} ions were detected to sit in Sm^{3+} coordinations, however did not preserve the triclinic structure. Polycrystalline structure were determined in the sample materials were determined. Both Samarium and Yttrium substituted samples were detected as linked to the BO_3 ligands, but apart from the Sm sites, Y atoms formed in hexagonal YBO_3 crystal structure. For the electronic structure study of the Y-substituted samples, XANES part of the XAFS spectra were used and it is revealed that 4*f* levels of Sm in the samples were inactive during bonding interaction and do not support strong coupling between neigboring Sm and Y atoms.

Keywords: Absorption spectroscopy; Electronic structure; Crystal Properties; Oxide
Acknowledgement: The authors would like to thank to Dr Prae Chirawatkul and the staff from SLRI (Siam Photon) both for their support and great hospitality.

S1 O6

NEW INVESTIGATIONS APPLIED ON ZnSe THIN FILMS AS WINDOW LAYERS IN CdTe BASED SOLAR CELLS

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Different thickness ZnSe thin films have been deposited on optical glass and ITO covered glass substrates using radio-frequency assisted magnetron sputtering (RF-MS). The sputtering time was varied (between 4 – 8 minute). In order to obtain ZnSe / CdTe heterojunctions in superstrate geometry, CdTe (cadmium telluride) thin films were deposited over ZnSe films by thermal vacuum evaporation (TVE). The structure of the sputtered ZnSe films was found to be cubic, films being highly textured. Crystallite sizes tend to increase with film thicknesses and sputtering times. Morphological studies proved that ZnSe films roughness decrease with increasing the sputtering time. Also by increasing the sputtering time surfaces of as-deposited ZnSe thin films have more symmetrical distributions of peaks. The optical band gap values decreased with the increase in film thickness. The film thickness and optical constants (refractive indices and extinction coefficients) were computed using spectroscopic ellipsometry. The increasing of refractive index with the increase of thickness is attributed to the increase in particle size. Electrical measurements (electrical resistivity, majority carrier concentration and Hall mobility) were performed and different conduction mechanisms were identified. The investigated ZnSe thin films were used to prepare the entire PV cell in superstrate configuration (with the structure glass/ITO/ZnSe/CdTe/$CdCl_2$/Cu:Au). The influence of ZnSe film thickness on spectral response of the structure ITO/ZnSe/CdTe was proved. After irradiation with alpha particles, although the parameters corresponding to I-V characteristics are not significantly changed, the photovoltaic response is strongly altered. Responsible for the observed effects are the trap centers associated with the structural defects induced by irradiations in the space charge regions of the structures.
Keywords: ZnSe buffer layers, spectroscopic ellipsometry, electrical measurements, alpha particle irradiations.
Acknowledgements: This work was supported by Romanian Executive Unit for Financing Higher Education, Research and Innovation (UEFISCDI) by PN-II-PCCA program, grant no. 288/2014.

S1 O7

IMPACT OF POLYETHYLENE GLYCOL ON THE STRUCTURE OF SODIUM OLEATE AQUEOUS MICELLE SOLUTIONS ACCORDING TO SMALL-ANGLE NEUTRON SCATTERING DATA

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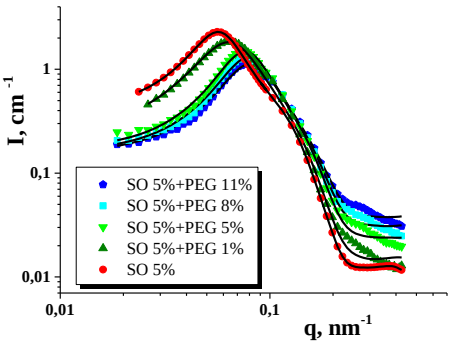
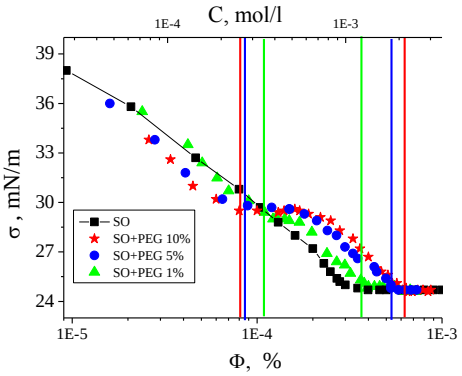
The structure and interaction parameters of micelles in aqueous solutions of anionic surfactant sodium oleate (SO) were studied by small-angle neutron scattering. The effect of addition of neutral, water soluble polymer polyetylene glycol (PEG) on micelle solution was investigated. The concentration dependences of a number of parameters (micelle aggregation number, degree of ionization, axial ratio, average size, charge, inverse screening length, surface potential on the surfactant concentration) were obtained and analyzed for the solutions without and with PEG [1]. The formation of surfactant-polymer complexes is concluded which is in agreement with the data on critical micellar concentration (CMC) and critical agregation concentration (CAC)

for different SO/PEG ratios obtained in complementary tensiometry experiments. The obtained results are particularly important for understanding the structure reorganization effect on addition of biocompatible PEG to water-based magnetic fluids where magnetic nanoparticles (magnetite) are coated with SO and placed in aqueous media with SO micelles [2].





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Keywords: surfactants, micelles, small-angle scattering, tensiometry.

S1O8

UNUSUAL HEATING RATE DEPENDENCE OF THERMOLUMINESCENCE GLOW PEAKS OF GAS SINGLE CRYSTALS

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Characterization of defect centers existing in GaS single crystals were studied by virtue of thermoluminescence (TL) experiments accomplished in the temperature ranges of 10-230 K. Two distinctive peaks centered at peak maximum temperatures of 91 and 146 K and one faint peak, like a shoulder, appeared around 175 K were detected from the TL emission of the crystal by heating the sample with a rate of 1.0 K/s. Among the analysis methods well-known from the TL theory, curve fitting method was applied to calculate the activation energy of trap levels related to those of obtained peaks and the thermal activation energy values of 52, 200 and 304 meV were established, respectively. Heating rate dependence of the observed peaks was studied by successfully achieved measurements with various heating rates between 0.2 and 1.0 K/s (See Figure). The shifts of the TL peaks to higher temperatures were obtained with increasing heating rate. Interestingly, both anomalous and normal heating rate behaviors of the peaks were observed together. Clearly, the intensity of the peak A diminished with raising heating rate as expected. However, the intensity of the peak B increased seven fold with implementation of the highest heating rate. This conduct was interpreted with semi-localized transition model [1]. Existence of such two different behavior of the TL peaks was firstly experienced. Moreover, distribution of the trap levels were investigated by employing different illumination temperatures ranging from 10 to 30 K. This resulted with increase of the activation energies of the trap levels from 52 to 90 meV, from 200 to 268 meV and from 304 to 469 meV, respectively, which can be ascribed to a quasi-continuous distribution [2].

Keywords: Semiconductors, single crystals, defects, luminescence.

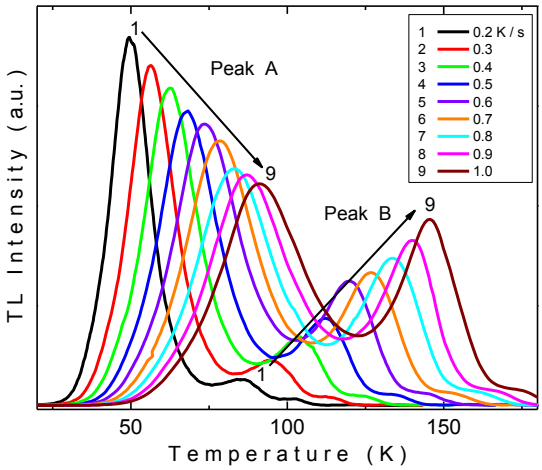

Figure. Experimental TL curves of GaS crystal with different heating rates between 0.2 and 1.0 K/s.

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S1 O9

SURFACE STRUCTURING OF A SEMI-ALIPHATIC POLYIMIDE THROUGH A LYOTROPIC MATRIX FOR PRELIMINARY TESTIG OF NEMATIC ALIGNMENT

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The use for polyimides in manufacturing flat pannel displays is widely known. Among the techniques involved in surface modulation, one can mention rubbing or UV exposure. In this work we present a relatively new method, developed for the first time in our previous works. Here we extend initial studies by exploiting the impact of polyimide precursor imidization at high temperatures. Before that the poly(amic acid) was textured by embedding in a sheared lyotropic matrix, which subsequently was removed with a selecive solvent. The resulted morphology after imidization procedure was examined by atomic force microscopy and optical microscopy. Some preliminary tests concerning nematic orientation on the new alignment layer were performed.

Keywords: polyimide, morphology, alignment, nematic

Acknowledgements: This work was supported by a grant from the Romanian National Authority for Scientific Research and Innovation, CNCS–UEFISCDI, project PN-II-RU-TE-2014-4-2976, no. 256/1.10.2015.

S1 O10

SPIN SUSCEPTIBILITY OF DISORDERED GAPPED GRAPHENE SYSTEMS

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Graphene, a two-dimensional carbon allotrope disposed in a hexagonal, honeycomb-like, lattice, is an intensely studied structure for its properties and its possible technological possibilities. In our study, we have calculated the spin susceptibility for the case of gapped graphene systems in the presence of disorder. The average single-particle density of states in gapped graphene with disorder was calculated, using the Born and the *T*-matrix approximations. We also considered the case in the unitary limit, where electrons are strongly scattered by impurities. The temperature dependence of the static spin susceptibility was analyzed. The influence of the chemical potential position and disorder is also discussed.

Keywords: Gapped graphene, Disorder, Spin susceptibility

References: I. Grosu, T.L. Biter**,** Physica E: Low-Dimensional Systems and Nanostructures **86** (2017), pp. 154-157, http://dx.doi.org/10.1016/j.physe.2016.09.010

S1 O11

CARBON MONOXIDE ADSORPTION ON LEAD ZIRCO-TITANATE PZT(001) SURFACES

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Atomically clean lead zirco-titanate $PbZr_{0.2}Ti_{0.8}O_3$(001) layers are synthesized on $SrRuO_3/SrTiO_3$(001) by pulsed laser deposition and *in situ* cleaned by annealing in oxygen atmosphere. These layers, which show no carbon contamination and well defined low energy electron diffraction (LEED) patterns exhibit a polarization oriented inwards $P^{(-)}$, visible by a band bending of all core levels towards lower binding energies; the fact that this shift is connected to the inwards polarization is certified by the fact that the magnitude of this shift decreases when the temperature is increased at temperatures near the Curie temperature, around 450 °C. Carbon monoxide adsorption on $P^{(-)}$ polarized surfaces saturates at about 0.25 carbon monolayers, and occurs in both molecular (oxidized) and dissociated (reduced) states of carbon, with a large majority of reduced state. The sticking of CO on the surface in ultrahigh vacuum is found to be directly related to the $P^{(-)}$ polarization state of the surface (Fig. 1). A simple electrostatic mechanism is proposed to explain these dissociation processes and the sticking of carbon on $P^{(-)}$ polarized areas [1]. The C 1s signal *vs*. temperature is fitted with a Langmuir model where the adsorption energy is proportional to the surface polarization. Carbon desorption when the polarization is lost proceeds most probably in form of CO_2, as the surface after desorption is depleted in oxygen. Upon carbon adsorption–desorption cycles, the ferroelectric surface reverses its polarization, owing to electrons provided by oxygen vacancies which are able to screen the depolarization field produced by positive fixed charges at the surface [3]. At variance with CO, polar contaminants (R-COOH) are found to stick preferentially to $P^{(+)}$ surfaces [3].

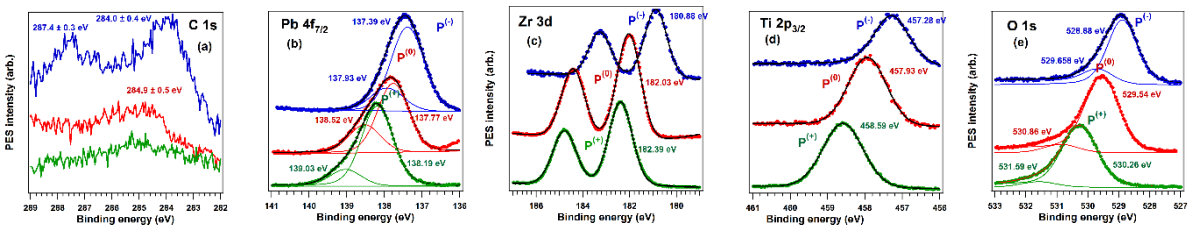

Figure 1. Core level photoelectron spectroscopy of PZT(001) with different out-of-plane polarizations after exposure to 6000 L carbon monoxide.

Keywords: ferroelectric thin-films, photoelectron spectroscopy, surface reactions.

Acknowledgements: Support at the experiment and useful discussions with Dr. Silvano Lizzit and Dr. Paolo Lacovig from Elettra, Trieste, are gratefully acknowledged. Access to the Elettra synchrotron radiation facility was possible through the Long Term Proposal No. 20130333. This work was supported by Romanian Ministry of Education–Executive Unit for Funding High Education, Research, Development and Innovation (MEN-UEFISCDI) through Projects PN-II-RU-TE-2014-4-0456 and PN-II-ID-PCCE-2011-2-0006.

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S1 O12

Mn_2-TYPE HEUSLER COMPOUNDS AS POSSIBLE HALF-METALLIC FULLY COMPENSATED FERRIMAGNETS

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We show detailed investigations on the electronic and magnetic properties of the Heusler compounds $Mn_{2-x}Co_xVAl$ (x = 0, 0.2, 0.6 and 1.0) with $L2_1$ structure and of the $Mn_2V_{1-x}Co_xAl$ (x = 0, 0.1,0.3 and 0.5) with Hg_2CuTi structure type. Polycrystalline samples obtained by induction melting of components under a purified Ar atmosphere have been studied by X-ray diffraction (XRD), X-ray photoemission spectroscopy (XPS) and magnetization measurements. In the $Mn_{2-x}Co_xVAl$ system, the Curie temperatures decrease with increasing Co content, ranging between 771 K (x = 0) and 254 K (x = 1.0). Indications about the magnetic moments decrese by Co doping have been obtained from XPS and magnetization measurements in the $L2_1$ Heusler system.

Additionally, electronic band structure calculations using the Korringa-Kohn-Rostoker (KKR) Greens function method have been performed. The substitutional disorder was accounted by the means of the Coherent Potential Approximation (CPA). The influence of the disorder and of the local environment on the electronic structure of the Heusler compounds is discussed by correlating the experimental and theoretical investigations. Our study may give indications about the possibility to obtain half-metallic fully compensated ferrimagnets (HMFi) in Heusler compounds of Mn_2-type.

Acknowledgement: The financial support of the UEFISCDI grant PN-II-RU-TE-2014-4-0009 is acknowledged.

Keywords: electronic band structure, magnetic properties, spin polarization, Heusler alloys

S1 O13

MAGNETIC PROPERTIES AND MAGNETOCALORIC EFFECT ON $Gd_{1-x}Ce_xCo_2$

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Structural, magnetic properties and magnetocaloric effect of $Gd_{1-x}Ce_xCo_2$ compounds have been investigated. The powder X-ray diffraction measurements show that all samples are single phase and crystallize in the cubic $MgCu_2$ (C15) structure. The lattice parameter was found to decrease slowly with the cerium content. The magnetic measurements were performed in magnetic fields up to 12 T in the temperature range 4-500 K. All the compounds are ferrimagnetically ordered, the Gd and Co moments being antiparalelly oriented. The Curie temperatures and the Co magnetic moments decreases when Ce content increases. These behaviours were attributed to the changes in the neighborhood of the Co atoms through substitution of Gd for

Ce which modify the contributions associated with R 5*d*–M 3*d* hybridization and finally the cobalt magnetic moment. The magnetic entropy changes, $\Delta S_M(T)$, peaks are broad and have a symmetrical shape around the transition temperatures, a behavior which is characteristic for materials exhibiting a second-order magnetic phase transition. The magnetic cooling efficiency was evaluated by calculating the relative cooling power (*RCP*) based on the magnetic entropy change. The possibility to use these materials for magnetic refrigeration devices in the room temperature range is also disscused.

S1 O14

INFLUENCE OF FERROMAGNETIC LAYER THICKNESS ON THE EXCHANGE BIAS IN Cr/$Fe_{65}Co_{35}$ BILAYERS

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In this work we investigate the influence of $Fe_{65}Co_{35}$ thickness on the exchange bias in Cr/$Fe_{65}Co_{35}$ thin films. Bilayers consisting of 100 nm of Cr and 9 to 100 nm of $Fe_{65}Co_{35}$ were deposited at room temperature on Si(100)/SiO_2 substrates using DC magnetron sputtering. Electronic structure calculations performed using the SPR-TB-KKR method [1,2] show that the magnetic moment of the $Fe_{65}Co_{35}$ interface layer increases with the number of deposited layers, while the topmost layer has a higher magnetic moment than the bulk. It was found that the Cr magnetic moments decrease with the addition of Co and with the number of deposited $Fe_{65}Co_{35}$ layers. X-ray diffraction results show that the $Fe_{65}Co_{35}$ layer grows in tune with the Cr layer. Magnetic measurements at 4 K – Figure 1 – show that the bias field and coercive field values at 4 K increase with decreasing $Fe_{65}Co_{35}$ thickness due to an increasingly stronger dipolar interaction at the interface and a large surface magnetic moment. The high exchange bias field values can be explained by the presence of interface disorder, which can lead to an uncompensated commensurate spin-density wave (SDW) in Cr at the interface [3]. The bias field decreases with temperature and vanishes around the blocking temperature of 40 K, when the interface coupling between Cr and $Fe_{65}Co_{35}$ becomes random due to thermal fluctuations.

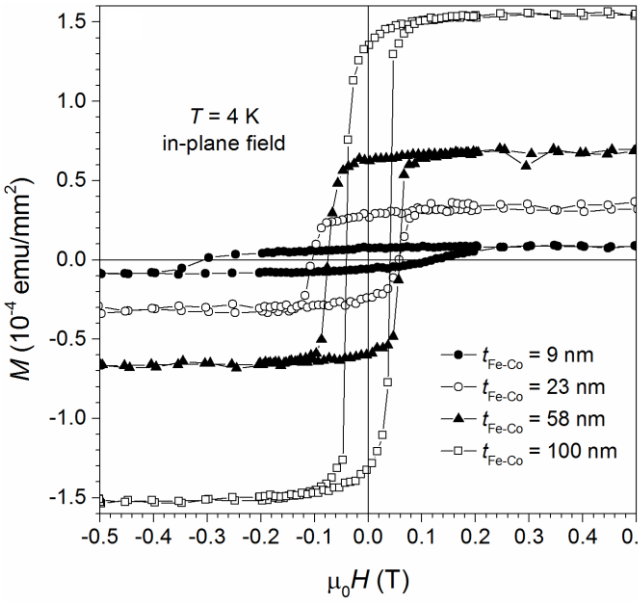

Figure 1. Hysteresis loops of the Cr/$Fe_{65}Co_{35}$ bilayer samples measured at 4 K.

Keywords: bilayers, thin films, exchange bias, magnetic properties.
Acknowledgment: This work was supported by the Romanian Ministry of Education and Research Grant PN-II-RU-TE-2014-4-2360.

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S1 O15

THE INVESTIGATION OF CRYSTAL AND MAGNETIC STRUCTURES OF Ba_2FeMoO_6 BY NEUTRON DIFFRACTION

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Double perovskites $A_2BB'O_6$ (where A = Sr, Ca, Ba ...; B = Fe, Cr ...; B '= Mo, W, Re ...) and their solid solutions attract the attention of researchers due to their unique physical properties, such as high values of the Curie temperature [1, 2] and semimetallic properties. Magnetoresistive properties of the tunnel type are manifested by these materials in weak magnetic fields [2] near room temperature [2, 3] that allows us to consider double perovskites as a serious alternative to already sufficiently well studied manganite-lanthanum perovskites. The aim of this work is the study of the influence of the temperature factor and high external pressure (up to 5 GPa) on the features of the crystalline and magnetic structure of the double perovskite Ba_2FeMoO_6. The scientific interest in the study of this material is associated with a rather large value of ionic radius of the Ba^{2+} (r = 1.75 Å) [4] of the double perovskite located in the A position and its effect on the distortion of the crystal lattice and, as a consequence, on the magnetic structure and functional properties.

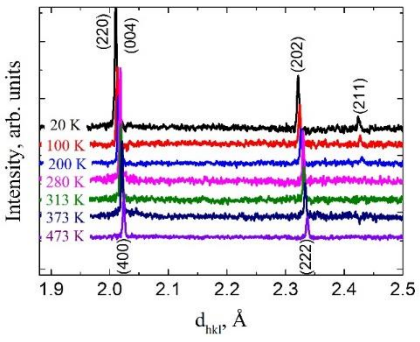

Fig. 1. ND patterns of Ba_2FeMoO_6.

The ceramic sample Ba_2FeMoO_6 has been fabricated by solid-phase synthesis at 900 °C (4 h) in air, and annealed at 1200 ° C (10 h) in an H_2/Ar flow with subsequent slowly cooled (~ 100 deg/h). According to neutron patterns (see Fig. 1) the sample is homogeneous. The cubic type (SG Fm-3m) of the crystal structure changes to a tetragonal (SG I4/mmm) at phase transition from paramagnetic to the ferrimagnetic state (Tc ~ 302 K). The increase of microstresses values in crystallites is observed when the temperature of the sample decreases.

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S1 O16

WIGNER CRYSTAL PHASES IN CONFINED CARBON NANOTUBES

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We present a detailed theoretical analysis of the Wigner crystal states in confined semiconducting carbon nanotubes. We show by robust scaling arguments as well as by detailed semi-microscopic calculations that the effective exchange interaction has an SU(4) symmetry, and can reach values even as large as J ∼ 100 K in weakly screened, small diameter nanotubes, close to the Wigner crystal - electron liquid crossover. Modeling the nanotube carefully and analyzing the magnetic structure of the inhomogeneous electron crystal, we recover the experimentally observed 'phase boundaries' of Deshpande and Bockrath [V. V. Deshpande and M. Bockrath, Nature Physics 4, 314 (2008)]. Spin-orbit coupling only slightly modifies these phase boundaries, but breaks the spin symmetry down to SU(2)×SU(2), and in Wigner molecules it gives rise to interesting excitation spectra, reflecting the underlying SU(4) as well as the residual SU(2)×SU(2) symmetries.
Keywords: Wigner crystal, Carbon nanotube

S1 O17

BIAS INDUCED NORMAL AND INVERTED HYSTERESIS IN PEROVSKITE SOLAR CELLS

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We investigate the bias induced *normal* (NH) and *inverted* (IH) hysteresis effects in perovskite solar cells obtained by successive spin-coating deposition of TiO_2 thin and meso-porous layers, $CH_3NH_3PbI_{3-x}Cl_x$ mixed halide perovskite and spiro-OMeTAD on comercial glass/FTO substrate, with Au electrodes [1]. We report the occurrence of NH and IH in the J-V characteristics in the same device structure, the behavior strictly depending on the pre-poling bias (V_{pol}), as indicated in Fig. 1.

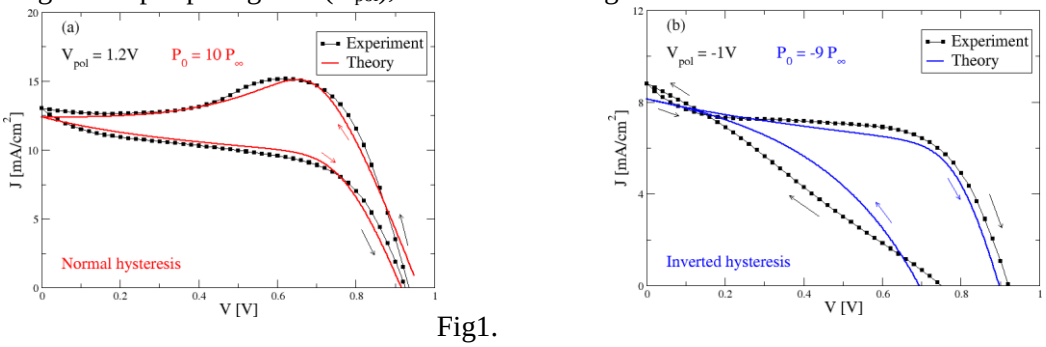

Fig1.
Dynamic electrical behavior of perovskite solar cells under bias pre-poling: (a) *normal* hysteresis and (b)

inverted hysteresis. Experimental reverse-forward J-V characteristics starting from V_{oc} are obtained by pre-poling at V_{pol} = 1.2V (NH) and -1V (IH), for a time tpol = 30s, which corresponds in the simulations to an initial polarization charge $P_0 = 10\ P_\infty$ (NH) and $-9\ P_\infty$ (IH), respectively.

The experimental J-V characteristics are consistently described by the dynamic electrical model (DEM) [2], subsequently reformulated as the surface polarization model [3]. Using a three step measurement protocol, which includes the *stabilization* of the open circuit bias (V_{oc}), bias *pre-poling* at V_{pol} for a time interval t_{pol}, followed by a reverse-forward scan starting from V_{oc} as actual *measurement*, we introduce a unified description of the dynamic hysteresis, which can be tuned from NH ($V_{pol}>V_{oc}$) to IH ($V_{pol}<0$). In this context we discuss the conditions for a correct evaluation of the solar cell power conversion efficiency (PCE).

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S1 O18

STUDIES ON GAMMA IRRADIATED HIGH NATURAL PHR MIX

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Polymers industry represents one of the most dynamic markets as they are being used from adhesives, coatings, foams and packaging materials to textile and industrial fibers, composites, electronic devices, biomedical devices etc. Today, the polymer industry has grown to be larger than the aluminum, copper and steel industries combined.

Some of medical/pharmaceutical and food industries require materials to have, at the same time, low quantities of toxic substances and to withstand cleaning treatments in order to achieve a standard microbial decontamination level or even a sterility level.

The scope of this paper is to study the mechanical behaviour of high natural rubber mix when irradiated with gamma rays. There were used concentrations of 60 phr, 80 phr and 100 phr of natural filler irradiated at two medium doses 91 kGy and 121.8 kGy. The objective is to identify the mixes which cross-link or, at least, are not affected by the radiation treatment.

The radiation treatment was carried out at IRASM department, SVST Co60 gamma industrial irradiator. The mechanical tests were performed on a Zwick Roell Z005 testing machine equipped with a 5 kN cell force. The tests were conducted according to ISO 37 with a constant load speed of 200 mm/min and all measurements were repeated for minimum five times.

The results indicated that the mechanical strength slightly decreas, for non-irradiated materials, along with the increase of natural filler from 13.1 N (at 60 phr) to 8.6 N (at 80 phr) and 6.18 N (at 100 phr) (fig. 1). When irradiated, the highest mechanical strength of 17.48 N was obtained at 100 kGy and 60 phr (fig. 2), higher than the non-irradiated material. For the rest of concentration mixes and doses there were not observed any important changes either in the direction of degradation or cross-linking of the material.

This research was financed through Nucleu Program PN 16 42 06/2016 and 2016-2017 PN 16 34 01 01 supported by Romanian Ministry of Education.

S1 O19

Ge NANOCRYSTALS AS CHARGE STORAGE NODES

IN NANO-FLOATING GATE CAPACITOR MEMORIES WITH CRYSTALLINE HfO_2

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There is a considerable research interest on the memory properties of trilayer structures with floating gate (FG) of Ge nanocrystals (NCs)/quantum dots (QDs) embedded in oxides (e.g. SiO_2, HfO_2, $TaZrO_x$) [1,2]. The memory properties are strongly influenced by FG morphology (NCs size, density including interface with surrounding oxide) and tunnel oxide characteristics (thickness, quality). Here we prove the efficiency of our approach for tailoring the FG morphology aiming to obtain performant memory properties. We prepare trilayer capacitors (*gate HfO_2/FG of Ge NCs or QDs in HfO_2/tunnel HfO_2/p-Si*) in which Ge NCs act as charge storage nodes and HfO_2 is crystalline [3,4]. We use magnetron sputtering for trilayer deposition followed by rapid thermal annealing for nanostructuring (Ge NCs formation and HfO_2 crystallization). We use two approaches in the step corresponding to deposition of intermediate layer, namely we sputter a continuous Ge layer or we co-sputter 70%Ge:30% HfO_2. The morphology investigations ((HR)TEM, HAADF-STEM, EDX, Raman, XPS) prove that by changing the composition of intermediate layer we achieve the tailoring of FG morphology. The annealed *HfO_2/Ge/HfO_2/p-Si* capacitors have a FG of ≈6 nm Ge NCs embedded in HfO_2, while the annealed *HfO_2/Ge-HfO_2/HfO_2/p-Si* ones present a FG of a single layer of ≈2.5 nm Ge QDs in HfO_2 that are arranged at the crossing of HfO_2 NCs boundaries. The structures functionality is confirmed by measuring capacitance-voltage (*C–V*) curves and retention time in capacitance-time (*C–t*) curves. The memory properties are only due to Ge NCs (i.e. *C–V* hysteresis loops with memory window ΔV independent on frequency) and the traps contribution is negligible (control structures with HfO_2 only show no hysteresis). The annealed *HfO_2/Ge/HfO_2/p-Si* capacitors show *C–V* hysteresis loop with $\Delta V \approx 1$ V. For the annealed *HfO_2/Ge-HfO_2/HfO_2/p-Si*, ΔV is greatly increased (≈4 V) and from *C–t* measurements we obtain a capacitance decrease with ≈15% in first 3–4 x 10^3 s, while by 10 years extrapolation the capacitance reaches 50%. These results demonstrate that the memory properties are strongly influenced by the FG morphology that in turn is dependent on the approach used for the deposition of intermediate layer. The strong improvement of memory properties in annealed *HfO_2/Ge-HfO_2/HfO_2/p-Si* capacitors is due to the FG morphology of single layer of Ge QDs well separated between each other in the crystalline HfO_2.

Keywords: Ge nanocrystals in crystalline HfO_2, nano-floating gate memory capacitors

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S1 O20

SEMICONDUCTOR HETEROJUNCTIONS WITH BEN DANIEL - DUKE BOUNDARY CONDITIONS

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Keywords: semiconductor heterojunctions, position-dependent mass, transcendental equations, algebraization

The energy spectrum of an electronic bound state in a semiconductor heterojunction with BenDaniel - Duke boundary conditions is obtained. The heterojunction will be assimilated with a square well. The effective

electron mass has a jump while crossing from a semiconductor to another one, but is constant in the same material.

The transcendental equations for the eigenenergy are approximated with an algebraic equation, which is solved exactly. The error of this approach is about 0.1%.

The physical significance of the solutions obtained in this way is discussed.

S1 O21

NEW PYRENE DERIVATIVES WITH POTENTIAL APPLICATIONS IN THE FIELD OF ORGANIC SOLAR CELLS

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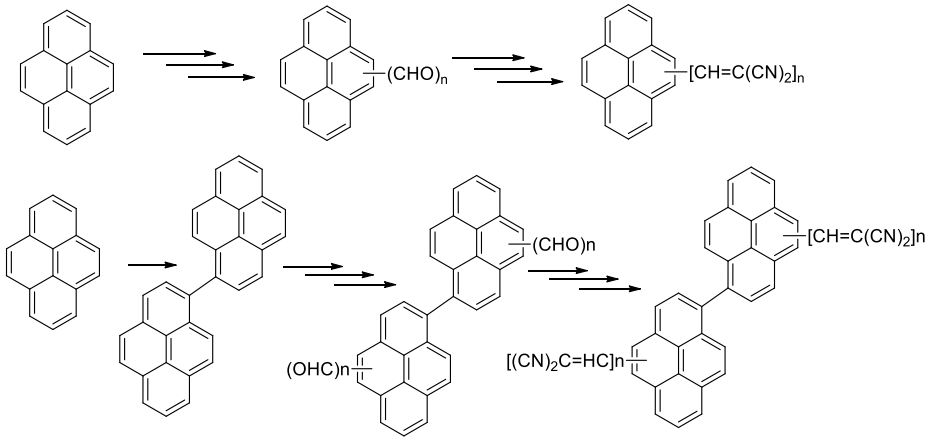
The synthesis and structural analysis of several mono-, di-, tri-, and tetrasubstituted derivatives of pyrene are reported (Scheme 1). These compounds are exciting building blocks with potential applications in the fabrication of organic solar cells (OSC).



Scheme 1. Access to different pyrene and bipyrene derivatives

The synthesis of bipyrene, the formylation and condensation reactions with malonodinitrile were performed adapting classic procedures.

The structural investigations were based on multinuclear NMR experiments, (HR)MS spectra, while the photovoltaic properties were determined using absorption and emission spectra and cyclic voltammetry.

Keywords: pyrene, bipyrene, organic solar cells, photovoltaic properties

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S1 O22

LOW ENERGY ELECTRON DIFFRATION ON FERROELECTRICS: NEAR-SURFACE CHARGE ACCUMULATION AND DEAD LAYERS

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Low energy electron diffraction (LEED) is a surface sensitive technique used to characterize the crystallographic properties of the outermost layer in solids. LEED patterns provide conclusive information regarding the surface reconstruction of highly clean surfaces resulted from repetitive procedures of annealing, combined with the possibility to use also Ar^+ sputtering in order to get rid of all the contaminants from the surface. Free surfaces of ferroelectric thin films with polarization oriented out-of-plane exhibit a surface band bending which is expressed as $-eP\square/(\square_0\square_r)$, where e is the elementary charge, P is the polarization (positive when oriented outwards), $\square$ the surface thickness of the ferroelectric layer where the depolarization field is not fully compensated by accumulation of mobile charges near surface, $\square_0$ the permittivity of vacuum and $\square_r$ the dielectic constant of the material. We propose a theory of LEED patterns near a ferroelectric surface which provide values of a surface potential written as $-eP\square\square\square 2\square_0$) [1]. By combining X-ray photoelectron spectroscopy (XPS), LEED and macroscopic measurements of the polarization on ultraclean, single crystal ferroelectric thin films one is able to derive all three parameters P, $\square$ and $\square_r$. The result obtained on lead zirco-titanate PZT(001) with polarization oriented inwards [2] evidenced the formation of a ‚dead layer' with low values of P and $\square_r$ even for free ferroelectric surfaces, together with small values of $\square$ and the evidence of 2D electron gas accumulation on the surface. These results are fundamental for the mechanism of formation of dead layers even in absence of metal contacts or other chemical interactions and also may provide new concepts for electron transport on ferroelectric surfaces.

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S1 O23

INDUCED FEROMAGNETIC ORDER IN SnO_2 VIA CHARGE/SPIN TRANSFER AT THE INTERFACE WITH Fe_3O_4 AT NANOSCALE

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Core-shell Fe_3O_4@SnO_2 nanocomposites were prepared by covering magnetite (Fe_3O_4) nanoparticles with SnO_2 semiconductor through the use of the seeding method followed by a thermal treatment. XRD studies reveal that the synthesized composite nanoparticles contain mainly Fe_3O_4 and SnO_2 in different proportions [1]. XPS investigations evidenced the qualitative composition of composite nanoparticles and the presence of oxidation state Fe^{2+}, Fe^{3+} from Fe_3O_4 and Sn^{4+} as well as small quantities of Sn^{2+} from SnO_2. The composition of nanoparticles and their core-shell architecture were evidenced by XPS and ICP-AES. Magnetic studies also indicated that Fe_3O_4@SnO_2 samples exhibit superparamagnetic behavior at room temperature.

In certain cases the saturation magnetization of samples, when are calculated with respect to the Fe_3O_4 content expressed in Bohr magnetons / $f.u._{Fe3O4}$, have much more larger values than the maximum values admitted in magnetite [2,3]. The difference is attributed to an induced ferromagnetic order in SnO_2 via

charge/spin transfer at the interface generating carrier-mediated ferromagnetism. It appears that the properties of these nanocomposites are strongly influenced by the charge/spin transfer at the interface. For certain values of the wave vectors end energies at the interface, common Bloch solution of the Schrödinger equation on both sides of the interface do exist. Thus spin–down polarized states extend in both magnetite and SnO_2 nanocrystals and, by a RKKY-type mechanism generate magnetically ordered states inside SnO_2 nanocrystals thus increasing the overall magnetization.
The analysis of UV-Vis and photoluminescence (PL) spectra of Fe_3O_4@SnO_2 composites shows position modifications of SnO_2 impurity band gap levels in accordance with the charge /spin transfer between Fe_3O_4 and SnO_2 outer shell

Keywords: tin oxide, magnetite, composite nanoparticles, magnetic semiconductors

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Acknowledgments
Financial support from the National Authority for Scientific Research and Innovation - ANCSI, Core Programme, Project PN16-30-02 05 is gratefully acknowledged.

S1 P1

LASER TRANSFER OF FLEXIBLE SENSOR ARRAYS

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Polymer processing with high accuracy and reproducibility represents an emerging technology with great potential in applications aiming at the fabrication of micro-optical components, lab on chip devices, sensors or flexible micro-electronic devices.
Successful highly sensitive material printing requires several technological developments, i.e. a combination of laser system benefits with the flexibility of polymer material design which ultimately leads to the creation of reproducible patterns with micro and nano precision.
This work is focused on the application of the laser-induced forward transfer (LIFT) process assisted by a triazene polymer (TP) layer for the spatial transfer of carbon nanotubes (CNTs) and nanoparticle decorated carbon nanotubes for the fabrication of functional devices (i.e. sensors). Specifically, the following issues will be discussed: influence of the triazene polymer layer and its correlation with the laser fluence applied for the regular transfer of CNTs; electrical characteristics of the transferred patterns, integration of the transferred patterns into a chemiresistive system illustrating the potential of this technique as a main nozzle-free, contactless laser-assisted printing method.

This work was supported by a grant from UEFISCDI, project TE 25/2015.

S1 P2

IRON-YTTRIA-ZIRCONIA CERAMICS CONTAING CUBIC ZIRCONIA CRYSTALLINE PHASE

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The use of ceramic materials, such as tetragonal and/or cubic zirconia, ZrO_2 in dental applications is highly desirable because of their excellent properties, including improved biocompatibility, wear resistance, and chemical durability in addition to aesthetics. Cubic zirconium dioxide exists down to room temperatures when the concentration of yttria is higher than 10mol%.

This paper presents for the first time the stabilization of the cubic zirconia phase with 5mol% Fe_2O_3 content in the presence of higher Y_2O_3 content in the ceramic system with the $5Fe_2O_3 \cdot xY_2O_3 \cdot (95\text{-}x)ZrO_2$ composition where x=15, 20 and 25mol% Y_2O_3. The aim of the work was to determine correlations between changes in microstructure with spectroscopic properties of the stabilized zirconia by investigations of X-ray diffraction (XRD), Scanning Electron Microscopy (SEM), Fourier Transform Infrared (FTIR) spectroscopy, UltraViolet-Visible (UV-Vis) spectroscopy, Electron Paramagnetic Resonance (EPR) spectroscopy, Photoluminescence (PL) spectroscopy.

The analysis of the FTIR spectra indicates that the fractions of cubic zirconia phase and bridging oxygen ions as well as Fe-O-Zr and Fe-O-Y linkages were increased with increasing the Y_2O_3 content for all studied iron-ceramics.

UV-Vis indicate that the ceramic with higher Y_2O_3 (x=25 mol%) concentration contains a smaller concentration of oxygen vacancies and has the highest gap energy value.

As a result from PL spectra, we come to the conclusion that with the increase of oxygen vacancy concentration, the luminescent peak intensity decreases. In the given situation, ceramic sample with higher Y_2O_3 (x=25%) concentration contains a smaller concentration of oxygen vacancies.

The EPR absorption spectra reveal the presence of isolated Fe^{+3} ions in rhombical distorted octahedral sites in x=25 mol% Y_2O_3 sample. The EPR spectra are modified with decreasing the Y_2O_3 content, leading to the decrease of the resonance line centered at g~4.3 while the appearance of a broad line centered at about g~2, characteristic of clustered ions.

Acknowledgements: This research was supported by the Bridge Program Projects 2016 (PN-III-P2-2.1-BG-2016-0077 with No. 106BG/2016). Some authors are gratefully acknowledged.

S1 P3

CRYSTAL AND ELECTRONIC STRUCTURE OF $Sm_xFe_{1-x}BO_3$ OXIDE

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Samarium doped $FeBO_3$ samples were investigated with their electronic and crystal structure properties by XANES technique via the general formula $Sm_xFe_{1-x}BO_3$ (x has values as 0, 0.2, 0.5, 0.8 and 1). Phase transitions and polycrystalline characteristics in the crystal structures were determined via crystal structure analysis performed by the MAUD software. In the study, boron atoms were determined as the main role player in the molecular interplays due to its high affinity than metal atoms and desire to form strongly bonded BO_3 ligands. XANES study revealed high amount of available states on the hybridized *3d-5d* levels of Fe and Sm. Besdies, O K-edge spectra of the samples confirmed hybridization between Sm 5*d*-O 2*p*, like Fe *3d*-O *2p*.

Keywords: Absorption spectroscopy; Electronic structure; Crystal Properties; Oxide
Acknowledgement: The author would like to thank to Dr. Gunnar Ohrwall from MAX-lab. Beamline I1011 (Lund, Sweden), to Dr. Wantana Klyusubun and her staff from SLRI (Siam Photon) both for their technical support and great hospitality. This study is supported financially by "BAP-TTEF EEEME (OMÖ) 2012-7" project of Mersin University (Mersin, Turkiye). Additionally, the research leading to these results has received funding from the European Community's Seventh Framework Program (FP7/2007-2013) CALIPSO under grant agreement no 312284.

S1 P4

SHELLAC THIN FILMS PATTERNS PREPARED BY MAPLE

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Keywords: MAPLE, SHELLAC

Shellac is a biomaterial (a resin secreted by the female lac bug) used for various applications like glazing agent on pills, sweets and food industry in general or in pharmaceutical applications such as precise drug delivery. Due to its acidic properties (resisting stomach acids), shellac-coated pills may remain intact through the stomach and the small intestine until it reaches the colon with higher pH. This allows the transport of drugs into the colon for a local treatment of colonic diseases.
The aim of this work is to obtain shellac thin films and investigate their response to the acidic medium of the stomach. For this purpose, thin films of shellac are obtained on silicon substrates by MAPLE (matrix assisted pulsed laser evaporation) using methanol as matrix. In order to optimize the deposition parameters such as laser wavelength, laser fluence, etc. and to assess the chemical, morphological and optical properties, the shellac samples were investigated by Fourier transform infrared spectroscopy (FTIR), ellipsometry (ES), scanning electron microscopy (SEM) and atomic force microscopy (AFM) techniques. The MAPLE films are very adherent and smooth (0.5 nm RMS roughness for a 300 nm thick film).
The shellac thin films were immersed in simulated gastric fluid and FTIR and AFM analysis were performed at different time intervals, in order to gain information on the behavior of the films in acidic medium.

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S1 P5

THERMOLUMINESCENCE PROPERTIES OF GASE:MN SINGLE CRYSTALS

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Thermoluminescence (TL) characteristics of defect levels in mangan doped GaSe single crystals were investigated through low temperature (10-300 K) TL measurements performed with different heating rates ranging from 0.4 to 1.0 K/s. As shown from the figure, the TL spectra obtained by emitted luminescence from defect levels as heated with a constant rate of 1.0 K/s appeared with four discernible peaks with maximum temperatures (T_{max}) of 47, 102, 139 and 191 K. These peaks were utilized to apply the curve fitting (see Figure) and initial rise (see inset) analyzing methods and activation energies of trapping levels related to these peaks were found as 8, 34, 130 and 388 meV. The energy values were used to calculate the capture cross sections of each trap level and the values of 2.6×10^{-26}, 4.4×10^{-26}, 6.8×10^{-23} and 2.2×10^{-17} cm^2 were obtained. Heating rate variations of observed peaks were also studied for better comprehension of behavior of trap levels. Increasing heating rate resulted with increase of T_{max} value as expected and it led to decrease in TL intensity that can be ascribed to thermal quenching effect. Moreover, the distribution of trap level associated with the peak which has the highest T_{max} value was investigated and discrete, single trap characteristic was assigned by the help of the analysis achieved for the observed TL peaks with different stopping temperatures between 15 and 65 K.

Keywords: Semiconductors, single crystals, defects, luminescence.

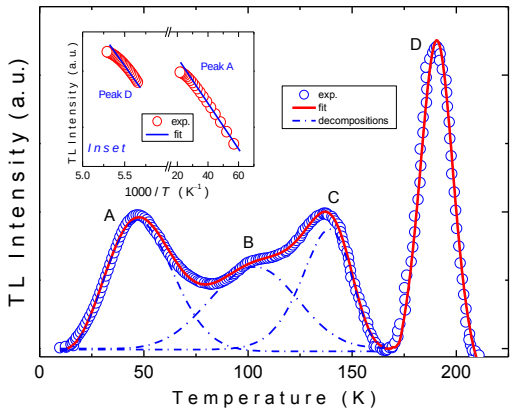

Figure. Experimental TL curve (circles) of GaSe:Mn crystal with heating rate of 1.0 K/s. Solid curve presents the fit to the experimental data. Dash-dotted lines represents the decomposed curves. Inset: TL intensity vs. 1000/*T*. The circles present the experimental data and the solid lines represent the theoretical fit.

S1 P6

ACTIVE MATERIALS BASED ON Ge NANOCRYSTALS IN OXIDES FOR TRILAYER MEMORY CAPACITORS AND PHOTOSENSITIVE STRUCTURES

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Ge nanocrystals (NCs) in oxides present interesting properties that make them suitable to be used as active materials in floating gate memory capacitors and VIS-NIR photosensing applications. The properties are greatly influenced by the morphology of active layer. In this work we prepare trilayer capacitors with floating gate of Ge NCs/QDs in crystalline HfO_2 with performant memory properties and structures with photoactive layer of Ge NCs embedded in TiO_2 matrix that are photosensitive in the VIS-NIR domain.

So, trilayers of *gate HfO_2/floating gate of Ge NCs in HfO_2/tunnel HfO_2/p-Si wafer* are obtained by magnetron sputtering deposition and subsequent rapid thermal annealing (RTA). The deposition consists in sputtering either HfO_2/Ge /HfO_2 or HfO_2/50%Ge-50%HfO_2/HfO_2 trilayer. By RTA, formation of Ge NCs and crystallization of HfO_2 are achieved. *Ge-TiO_2 films on SiO_2 buffer/n-Si* are also obtained by magnetron sputtering and RTA. The structures are complexly characterized, from point of view of morphology ((HR)TEM, HAADF-STEM, EDX, XPS) and structures functionality, i.e. capacitance-voltage (*C*–*V*) curves and retention time in capacitance-time curves on trilayer capacitors and photocurrent spectral distribution (I_{ph}–λ) and photocurrent-voltage (I_{ph}–*V*) curves on coplanar photosensitive structures.

The annealed capacitors have a floating gate of well separated Ge NCs in HfO_2, distanced from Si substrate by tunnel HfO_2 with precise thickness. The capacitors obtained by sputtering HfO_2 /50%Ge-50%HfO_2/HfO_2 present a floating gate with a higher density of Ge NCs and sharper interfaces with tunnel and gate HfO_2. We show that the charge storage is due only to the Ge NCs. The annealed HfO_2/Ge /HfO_2 capacitors have memory window $\Delta V \approx 1$ V and good retention time, i.e. capacitance decrease with 28% in first $4x10^3$ s. The annealed capacitors with sputtered HfO_2 /50%Ge-50%HfO_2/HfO_2 trilayer show improved properties, i.e. $\Delta V \approx 3.1$ V and a capacitance decrease with 14% in first 10^4 s.

The *Ge-TiO_2 films* are formed of anatase TiO_2 and cubic Ge NCs. The GeTiO_2 /SiO_2 buffer /n-Si wafer structures present two maxima at ≈900 and 1100 nm. The maximum at lower wavelength is due to Ge NCs, while the one at higher wavelength corresponds to Si bandgap by the surface photovoltage.

Keywords: Ge nanocrystals in crystalline HfO_2, floating gate memory capacitors, Ge nanocrystals in crystalline TiO_2, VIS-NIR photosensing applications

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S1 P7

REFRACTIVE INDEX DEPENDENCE ON WAVELENGTH OF SOME POLYIMIDES CONTAINING ALIPHATIC SEQUENCES

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Among the thermostable polymers, one can distinguish a special class of macromolecular compounds, namely polyimides. In this paper, several polyimides containing aliphatic sequences are investigatd in regard with their optical properties. The dependence of refractive index on incident light wavelength was experimentally determined. The magnitude of this optical parameter was correlated with chain conformation and backbone polarizability. The potential energy of interaction with a nematic liquid crystal was evaluated in order to check sample suitability as alignment layer. The achieved results are important in understanding the correlation between polymer structure and its interaction with visible electromagnetic radiations that impacts applicability as orientation support for liquid crystals.

Keywords: polyimide, refractive index, dispersion, liquid crystal

Acknowledgements: This work was supported by a grant from the Romanian National Authority for Scientific Research and Innovation, CNCS–UEFISCDI, project PN-II-RU-TE-2014-4-2976.

S1 P8

ANNEALED BISMUTH AND ANTIMONY TRIOXIDE SANDWICH FILMS WITH INCREASED REFRACTIVE INDEX AND VISIBLE RANGE ENERGY BANDGAP

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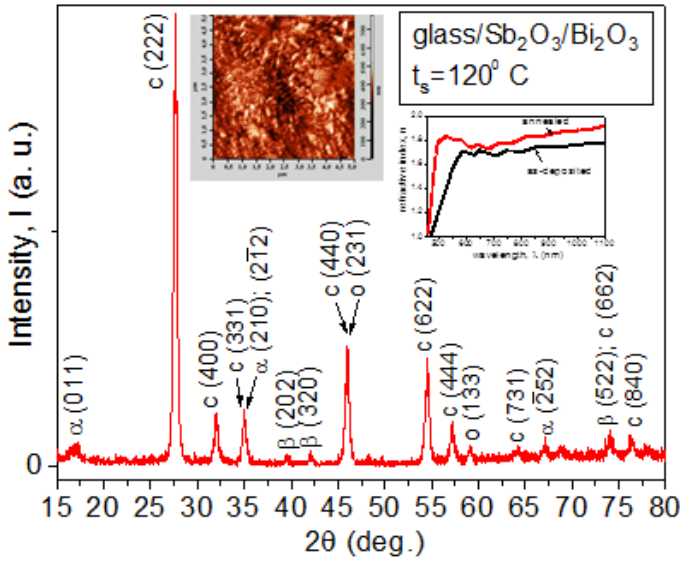
Bismuth trioxide is a material of interest as thin film due to its semiconducting behavior with high energy bandgap and good photo- and gas sensitivity. Still, very often, its structure is either amorphous or polycrystalline and polymorph, such that Bi_2O_3 thin films require post-deposition annealing for structural improvement and stabilization. As a continuation of a previous study, this paper presents the analysis of sandwich-type of bismuth trioxide and antimony trioxide deposited on glass, following their thermal treatment. The morpho-structural and optical properties of the annealed films were analyzed. Films stabilization was intended and acquired, together with increased transmittance, reflectance and refractive index. It was concluded that the films are uniformly deposited, with improved crystallinity and roughness decrease. The energy bandgap changes slightly upon annealing, being situated in the visible region, recommending such structures for solar and photovoltaic cells.

Keywords: bismuth trioxide, sandwich films, annealing, optical properties.

Synopsis (graphical abstract):



S1 P9

TEMPERATURE IMPACT ON METAL ADHESION AND VISCOELASTICITY OF SOME THERMOSTABLE POLYMERS

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Most thermostable polymers are used in various industrial applications, particularly in electronics, where the behavior at different temperatures is essential for device fiability. In this work, some polymers containing imidic or sulfone groups are investigated in solution and solid phase. Rheological properties at various temperatures are discussed in regard with sample chemical structure. This provides information on specimen degree of processability in the form of stable films. Such polymer layers often interfaced with metallic conductors in circuits so adhesion characteristics are assessed. The obtained results present importance in manufacturing electronic components of great reliability, including liquid crystal cells.

Keywords: thermostable polymer, viscoelasticity, adhesion, metal

Acknowledgements: This work was supported by a grant from the Romanian National Authority for Scientific Research and Innovation, CNCS–UEFISCDI, project PN-II-RU-TE-2014-4-2976, no. 256/1.10.2015.

S1 P10

THE EFFECT OF ANNEALING ON THE STRUCTURAL AND OPTICAL PROPERTIES OF ZnSe THIN FILMS

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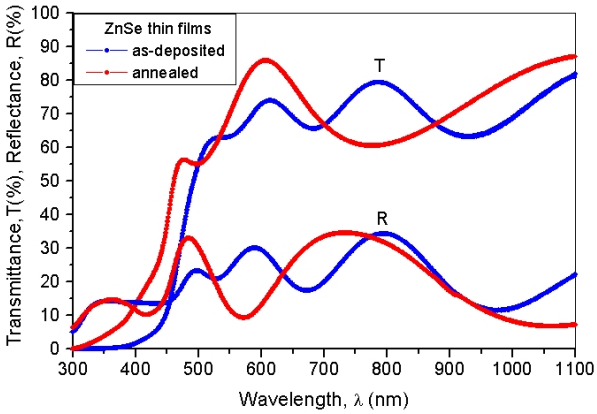
Zinc selenide (ZnSe) thin films were deposited onto well-cleaned glass substrate using the vacuum evaporation method. During deposition of the ZnSe thin films, the substrate temperature was kept constant at 300 K. As-deposited ZnSe thin films were annealed at 500 K for 1h in air. The crystalline structure of as-

deposited and annealed ZnSe thin films was characterized by XRD technique and SEM analysis. The transmittance and reflectance spectra were recorded in the wavelength region of 300 to 1100 nm using a double-beam spectrophotometer. These spectra were used to determine the optical constants such as absorption and extinction coefficient, refractive index and optical band gap of ZnSe thin films.

Keywords: zinc selenide, thin films, annealing, optical properties.

Synopsis (graphical abstract):



S1 P11

INFLUENCE OF ELECTRON IRRADIATION ON THE Yb^{3+}/Yb^{2+} CHARGE CONVERSION IN THE CaF_2:YbF_3 CRYSTALS

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Among many kind of materials, the interest in the YbF_3 doped CaF_2 crystals used as laser material is still growing due to their well known good optical properties. By doping a CaF_2 host with YbF_3, both Yb^{2+} and Yb^{3+} ions will coexist in the crystals. The Yb^{3+} ions substitute for Ca^{2+} ions and need charge compensation obtained by an interstitial fluor ion located in various positions giving rise to a rich multisite structure, which leads to broad IR absorption bands [1, 2]. On the other hand, the Yb^{2+} ions substitute for Ca^{2+} ions, therefore do not need charge compensation and posses cubic symmetry [3,4]. The optical absorption spectra of our crystals reveal the existence of both Yb^{2+} (in the near-UV) and Yb^{3+} ions (in near-IR domain). Due to their high UV emission band around 311 nm, the CaF_2:Yb^{2+} crystals can be a very good candidatate in psoriasis phototherapy [5, 6]. In order to enhance the Yb^{2+} ions concentration in CaF_2 crystals, various methods, such as γ-irradiation, chemical reduction, heating the crystal in hydrogen gas, x-ray, electronic beam irradiation, etc. were used [7]. A recent studies provide interesting methods for determination of Yb^{2+} ions concentration in CaF_2 crystals [8, 9]. Taking into account these results concerning the estimation of Yb^{3+}/Yb^{2} charge conversion in the CaF_2 crystals, the aim of this paper is to study the influence of 0.5 MeV electron beam irradiation on the Yb^{3+}/Yb^{2+} charge conversion in the CaF_2 crystals, in order to improve the emission intensity of Yb^{2+} ions in UV-VIS spectral region. The $Ca_{1-x}Yb_xF_{2-x}$ (x=0.0004÷0.0016) crystals have been grown using the conventional Bridgman technique. Transparent colorless crystals of about 10 mm in diameter, over 5-6 cm long were obtained in graphite crucible in vacuum (~10^{-1} Pa) using a shaped graphite furnace; the pulling rate was 4 mm/h. The room temperature absorption spectra have been obtained using a Shimadzu 1650PC spectrophotometer.

Keywords: CaF_2, spectroscopic properties, ytterbium fluoride, electron irradiation.

Acknowledgment. This work was supported by the Romanian Ministry of Education and Research, grant ELICRYS-2, Contract no.32-ELI/01.09.2016 in the frame of Capacities/RO-CERN (ELI-NP) program

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S1 P12

ENGINEERING AN AMORPHOUS DRUG TO CRYSTALLINE FORM

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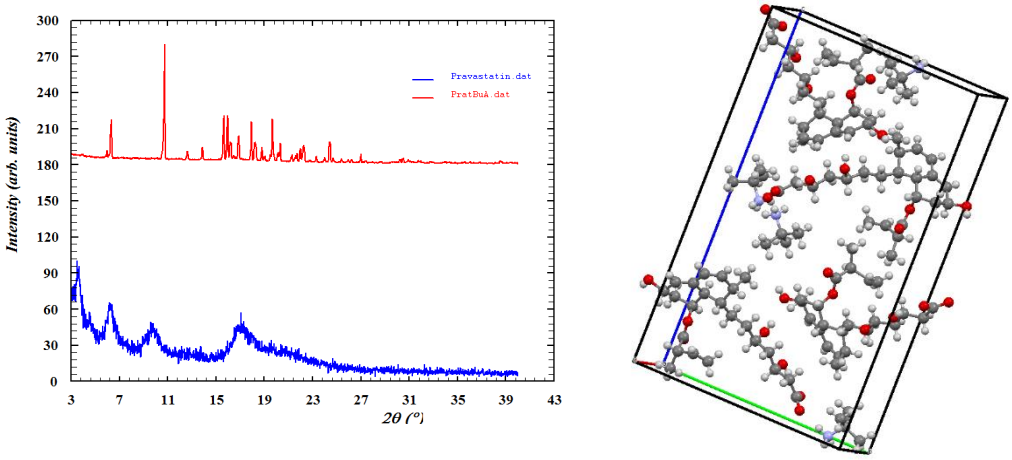
Pravastatin belongs to the drug class of statins, which are among the most frequently prescribed drugs for reducing mortality related to cardiovascular deseases as they significantly reduce the risk of heart attack in patients wih high cholesterol levels. Pravastatin is administered as its sodium salt, marketed as Pravachol. The physico-chemical properties of active pharmaceutical ingredients are directly liked to their crystalline form, as a minor change in their structure may lead to major changes of essential properties like solubility and bioavailability.

As both Pravastatin and Pravastatin sodium are amorphous, herein we report the preparation and structural characterization of a new crystalline form of pravastatin, namely a tert-butyl amine salt (PratBuA) - see Figure 1. The crystalline structure of PratBuA was determined by single-crystal X-Ray diffraction, whereas additional structural details are provided by solid state NMR spectroscopy . The stability under accelerated conditions (40ºC and 75% relative humidity) and the dissolution rate in aquaeous media have also been investigated.



a b

Figure 1. a) PXRD patterns of Pravastatin and PratBuA; b) Crystalline packing of PratBuA in the unit cell

Keywords: active pharmaceutical ingredient, crystal engineering
Acknowledgements: Financial support is gratefully acknowledged to PN-III-P2-2.1-PED-2016-1521 project

S1 P13

THE EFFECT OF THE SODIUM AND SILICIUM OXIDE DOPANTS

ON STABILIZATION OF THE CUBIC PHASE IN ZIRCONIA CERAMIC WITH HIGHER YTTRIA CONTENTS

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ZrO_2 exists in three crystalline polymorphs forms depending on the temperature: monoclinic, tetragonal and cubic phase. The monoclinic ZrO_2 phase exists for the temperature below 1170°C and room temperature. Tetragonal ZrO_2 crystalline phase is stabilized for the temperature range 1170-2370°C. The cubic ZrO_2 phase exists at temperature greater than 2370°C [1, 2]. To stabilize high temperature ZrO_2 crystalline phase, two main methods were used: one is the reduction of the crystallite size, and another is doping of the dopants [3].

The aim of this study was to clarify some dominant factors for the stable formation of the high temperature ZrO_2 crystalline phase in the ceramic system with the $5Na_2O{\cdot}10SiO_2{\cdot}xY_2O_3{\cdot}(85\text{-}x)ZrO_2$ composition where x = 5, 10 and 15mol% Y_2O_3. The obtained samples were characterized by using investigations of X-Ray Diffraction, FTIR and PL spectroscopies.

The IR analysis indicates in the region situated between 400 and 670cm^{-1} the Zr-O stretching vibrations corresponding to the cubic ZrO_2 crystalline phase and in the region between 800 and 1200cm^{-1} the Zr-O stretching vibrations due to various silicate structural units.

PL data indicate that the ceramic with higher Y_2O_3 concentration contains a smaller concentration of oxygen vacancies and has the highest gap energy value.

Sodium oxide and silicon dioxide addition leads to enhanced stabilization of the high temperature zirconia crystalline phase. The stabilization of the cubic ZrO_2 crystalline phase depends also on the content of yttrium trioxide.

Keywords: zirconia ceramic, XRD, FTIR and PL spectroscopies.

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S1 P14

NMR CRYSTALLOGRAPHY TECHNİQUES FOR STRUCTURAL CHARACTERİZATİON OF PHARMACEUTİCAL COMPOUNDS

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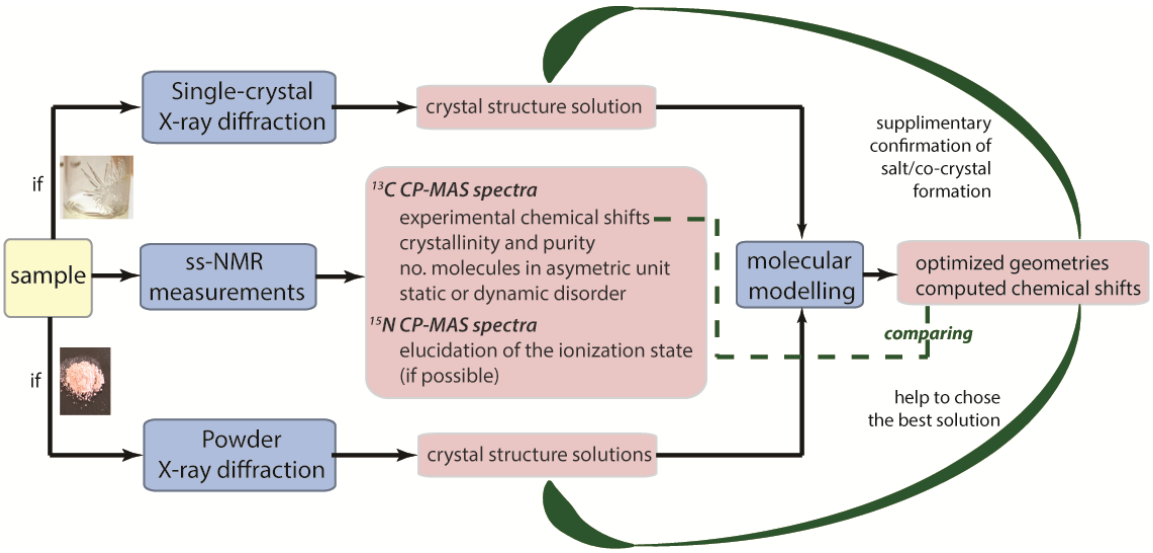
Keywords: X-ray diffraction, ss-NMR, crystallography technique, solid form

There are many situations in which the crystalline structure determined just from X- ray diffraction methods does not provide all the details concerning the non-covalent contacts which are of highly

importance especially in pharmaceutical industry: the knowledge and understanding of these interactions is of fundamental importance for the rational screening for new solid forms of active pharmaceutical ingredients.

An alternative approach developed in the last decades to fulfill these requirements is NMR-crystallography. This technique exploits the fact that local structural details are probed with the highest sensitivity by ss-NMR (solid state Nuclear Magnetic Resonance), whereas PXRD (X-Ray diffraction on powders) is very accurate in detecting long range ordering and crystal symmetries. Combining the two experimental techniques with first-principles quantum-mechanical calculations makes the whole approach more powerful for structural characterization at supramolecular scale by correlating the computed parameters with ss-NMR and PXRD observables (chemical shifts, intra- and intermolecular distances, crystal packing patterns, etc.). Although the main applications of NMR-crystallography are related to the removal of the ambiguities in crystal structure determination by PXRD , sometimes this technique can provide valuable information when the structure is solved from single-crystals. Here we illustrate this issue on the example of new solvate forms of Tadalafil.



Schematical representation of crystal structure refinement by NMR-crystallography approach.

Acknowledgements: Financial support is gratefully acknowledged to PN-III-P2-2.1-PED-2016-1521 project

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S1 P15

OPTICAL AND ELECTRICAL PROPERTIES OF $NA_{1/2}BI_{1/2}TIO_3$-$BATIO_3$ THIN FILMS

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Due to its excelent electrical properties the Na0.5Bi0.5TiO3 (NBT) and solid solution based on NBT can be considered of next generation of lead free environmental-friendly materials. The solid solution Na0.5Bi0.5 TiO3- x%BaTiO3 (NBT-x%BT) exhibit a morphotropic phase boundary (MPB) for 6<x<8. The electrical and optical properties of NBT-BT can be modified due the phase transition from rhombohedral (R) to tetragonal (T). Since the $Na_{1/2}Bi_{1/2}TiO_3$-$xBaTiO_3$ can be used in electronic and optoelectronic devices electrical and optical behavior must be well known. In our work we investigate the electrical and optical

properties of NBT-xBT thin films for 0<x<8. The films are obtained by Pulsed Laser Deposition (PLD) onto Pt/Si and Nb:SrTiO3 substrates by targetingt the NBT-BT ceramic. The optical properties of $Na_{1/2}Bi_{1/2}TiO_3$-$BaTiO_3$ thin films in the 400 − 1700 nm range of wavelengths have been investigated using spectroscopic ellipsometry (SE). The optical models were consisted by a stack of different layers. The thicknesses of the films and of their rough layer are extracted from Cauchy model (fig. 1) and compared with AFM results. The refractive index dispersion and the exctinction coefficient of NBT-BT were calculated using a single Lorentz oscillator. The dielectric behavior in the low range frequency (1KHz-1MHz) were investigate using an impedance analizer.

Keywords: Thin films, PLD, NBT-BT, spectroscopic ellipsometry

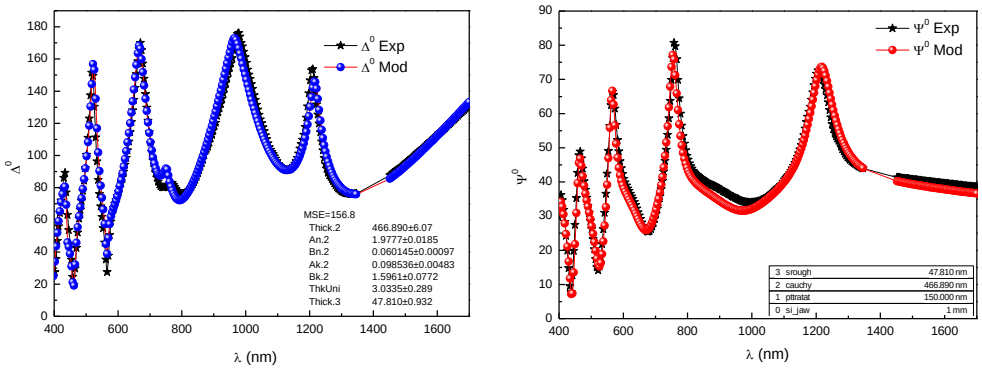

Fig 1 Experimental Ψ and Δ spectra for the BNBT thin layer growth on Pt/Si substrate at 0.1 mbar oxygen pressure and 650^0 Celsius temperature

Acknowledgment: This work has been financed by the National Authority for Research and Innovation in the frame of Nucleus programme contract 4N/2016 and the project PED 99/2017 (PROFILE)

S1 P16

ZIRCONIUM OXIDE BASED CERAMICS WITH POSSIBLE BIOMEDICAL APPLICATIONS

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Zirconium oxide based systems have been drawing increasing attention of the recherchers due to their unique properties which are promising for biomedical applications. Thus, ceramics based on ZrO_2 are well known for their low thermal conductivity, high fracture toughness and biocompatibility in comparison to other materials [1-3].

The $3HfO_2 \cdot 15SiO_2 \cdot xY_2O_3 \cdot (85\text{-}x)ZrO_2$ ceramic system where x=2, 7 and 12 mol%, was prepared and investigated. The obtained samples were characterised using X-ray diffraction and FT-IR and UV-Vis spectroscopies in order to obtained structural information concerning possible structural changes generated the gradual addition of Y_2O_3. The obtained data have provided information concerning the crystalline phases

characteristic of the studied ceramics, the basic structural groups that build up their network and the electronic transitions that occur in these samples.

Keywords: zirconium oxide, XRD, FT-IR, UV-Vis

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S1 P17

SYNTHESIS AND CHARACTERISATION OF MAGNETIC ELECTRICALLY INSULATED NANOPOWDERS

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The concept of more electrical aircraft architecture requires new magnetic materials, with improved magnetic and electrical properties. The paper investigates the soft magnetic materials based on FeCo/Al_2O_3 core-shell nanoparticles, synthesized by sol-gel technique. These nanomaterials combines the high saturation magnetisation of FeCo compound with the increased resistivity of Al_2O_3 and allow the decreasing of magnetic losses for the bulk sized components, compared with the currently available Fe-Si alloys, used as metallic punched sheets for the building of the magnetic cores in electrical machines. The main physical characteristics of the Fe-Co/Al_2O_3 prepared nanopowders are: saturation magnetisation in the range of 100 - 165 emu/g, coercivity around 14.35 kA/m and resistivity in the range of 5,50 - 17,50 Ω·m.

Keywords: soft magnetic nanopowders, electrically insulated, Fe-Co/Al_2O_3 nanoparticles

Acknowledgement: Financial support is gratefully acknowledged from the Romanian Space Agency: the Research, Development and Innovation STAR Programme - Technology Space and Advanced Research (ctr. STAR „Electric insulated soft magnetic nanomaterials for space applications. Upscale-demonstration of technology”).

S1 P18

THE INFLUENCE OF DEPOSITION PARAMETERS ON STRUCTURAL, OPTICAL AND ELECTRICAL PROPERTIES OF *RF* SPUTTERING *AZO* FILM

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Aluminium doped zinc oxide (*AZO*) were deposited by magnetron sputtering method on glass substrate with different power ranging from 100 to 200 W in step of 50 W using a ceramic (not sintered) target

$ZnO:Al_2O_3$ (98:2 wt. %). The *AZO* films are characterized by structural, optical and electrical investigations. The *XRD* pattern indicates the presence of single phase with hexagonal crystalline structure of ZnO. The *AZO* film deposited at 200 W exhibited the best *TCO* electrical and optical properties, reaching electrical resistivities of $1.20 \cdot 10^{-3}$ Ω·cm, charge mobility of 12.6 cm^2/Vs and 84% transparency in visible range.

Keywords: *AZO,* thin films, magnetron sputtering, *TCO*

Acknowledgement: Financial support is gratefully acknowledged from the Romania – JINR Dubna Scientific Bilateral Cooperation Programme: "ZnO complex multilayer system - deposition and investigation".

S1 P19

THE EFFECT OF TEMPERATURE AND PARTICLE CONCENTRATION, ON THE COMPLEX DIELECTRIC SUSCEPTIBILITY OF MAGNETIC FLUIDS

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In this paper, starting from a kerosene-based magnetic fluid sample with magnetite particles stabilized with oleic acid (sample A), two samples (denoted, B and C) by successive dilution (with a ratio magnetic fluid/kerosene of 1/1), were obtained.

For samples A, B and C, was made the magnetization curve using the inductive method [1]. The results shown that the dependence of the magnetization (*M*) versus the magnetic field (*H*), respect a Langevin type law, all the samples having superparamagnetic behavior [2].

The dielectric behavior of samples A, B and C and of a kerosene sample for comparison (denoted with D), it was analyzed. For this, the measurements of temperature dependence, of the real (χ') and imaginary (χ'') components of the complex dielectric susceptibility, $\chi(T)=\chi'(T)-i\chi''(T)$ of the samples [4], in the range between (25 - 80) ^{0}C and at a constant frequency of the electric field $f = 1$ *MHz*, were performed.

Based on the obtained values, $\chi'(T)$ and $\chi''(T)$ and using the Claussius-Mossotti equation [5], the temperature and particle concentration dependencies, of the complex polarizability of the samples, were determined.

The results give useful information about the polarization mechanism of the magnetic fluid samples and based on these measurements we have evaluated the dipolar effective moment of the particle dispersed in the magnetic fluids.

Keywords: magnetic fluid, complex dielectric susceptibility, Claussius-Mossotti equation, complex polarizability.

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S1 P20

INFLUENCE OF THE Cu DOPING ON THE ELECTRONIC STRUCTURE AND MAGNETIC PROPERTIES OF THE Mn_2VAl HEUSLER COMPOUND

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Detailed investigations on the electronic and magnetic properties of the Heusler compounds $Mn_{2-x}Cu_xVAl$ (x= 0, 0.1, 0.2, 0.5) with $L2_1$ structure have been performed. The $Mn_{2-x}Cu_xVAl$ ingots were prepared by induction melting of the high purity starting components under a purified Ar atmosphere. The resulting polycrystalline samples have been studied by X-ray diffraction (XRD) and magnetization measurements. The degrees of the B_2 and $L2_1$ atomic ordering were obtained by using the Takamura's extended order model [1] for Heusler compounds from the XRD patterns. The Curie temperatures decrease with increasing Cu content, ranging between 771 K (x = 0) and 580 K (x = 0.5). Additionally, electronic band structure calculations using the Korringa-Kohn-Rostoker (KKR) Greens function method have been performed. The substitutional disorder was accounted by the means of the Coherent Potential Approximation (CPA). The site occupation considered in the calculations has been correlated with those obtained by the XRD experiments. Our study gives insight on the evolution of the half-metallic fully compensated ferrimagnet (HMFi) character with disorder and Cu doping showing restrictions in the obtaining of a HMFi by doping with 3d metals.

Acknowledgement: The financial support of the UEFISCDI grant PN-II-RU-TE-2014-4-0009 is acknowledged.
Keywords: electronic band structure, magnetic properties, spin polarization, Heusler alloys

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S1 P21

IN-SITU INVESTIGATION OF DEPOSITION RATE AND LAYER THICKNESS FOR MATERIALS USED IN FUNCTIONAL COATINGS IN DC MAGNETRON SPUTTERING PROCESSES

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Magnetron sputtering has been used for thin film deposition due to its good induced properties to the coating layers. It represents a PVD process that has been generating improved features, such as, better adhesion to substrates, decreased stress in coating materials, cohesion between layers in case of multilayer coatings, high rates of deposition, maintaining of deposition material stoichiometry, etc.

In-situ measurement of certain characteristics for thin films *(deposition rate and thickness coatings)* has always been a permanent request so that to obtain thin films with preset features. Following this idea we investigated in-situ the sputtering deposition rate for materials used in functional coatings *(chemical elements: Ti, W, C; chemical compounds: WC, TiB_2)* and the thickness for the coatings we deposited for achievement of the tribological coatings.

The sputtering deposition rate at different flows of the working bombardment gas *(Ar)* and magnetron variable powers was evaluated both for metals with high deposition rates as also for metal compounds known for their unstable deposition rate in DC.

While for chemical elements *(Al, Ti, Ag, Cu, W)* the deposition rate had linear evolution with the working gas and magnetron power, in case of chemical compound materials with semimetal *behavior (TiB_2)* the instability of the deposition rate was strongly influenced by the gas flow especially in the reactive processes.

S1 P22

INVESTIGATION OF VARIOUS PROPRIETIES FOR SILICA-ZIRCONATE BASED CERAMICS

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Until now ZrO_2-based ceramics were widely used in various industrial applications (oxygen sensors, electrolytes in solid oxide fuel cells, thermal barrier coatings for jet engine turbines, refractories for steelmaking, etc.). Zirconia (ZrO_2) is also very attractive for biomedical applications (i.e., dental implants and ball heads of femoral implants). These multiple applications are based on some very important properties of the ZrO_2 such as its low thermal conductivity, high melting point, high level of hardness, chemical inertness, resistance to high temperature and corrosion and the amphoteric character [1-3].

The main objectiv of this research was to found a new zirconia based ceramic system with good technological properties for industry as well as for biomedical applications. A silica-zirconate ceramic system mixed with different concentrations of Y_2O_3 was prepared by melt-quenching technique. Y_2O_3 added to the studied samples in order to increases the chemical resistivity and the water rezistance of the studied silica-zirconate ceramics. As it is well known, yttrium stabilize the ZrO_2 and permits its use in dentistry for a long time [4].

Several investigation techniques such as the X-ray diffraction and FT-IR and UV-Vis spectroscopies were used to obtain structural information concerning the structural changes generated the gradual addition of ytrium oxide to the silica-zirconate matrix. The obtained data provide information concerning the crystalline phases that occur in the studied ceramics, the structural units and structural groups that build up the studied ceramic network and the electronic transitions that occur in these ceramics.

Keywords: zirconium oxide, spectroscopy, x-ray diffraction

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S1 P23

INVESTIGATION OF CRYSTALLINE AND MAGNETIC PROPERTIES of Fe-Cu BASED GRANULAR ALLOYS

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The granular magnetic materials have become very attractive for worldwide researchers, especially in the actual context of search for new magnetic materials for permanent magnets, without rare earths, based on cheaper and non-deficitary raw materials. In these composites, the magnetic fine particles, with sizes around of a few nanometers, are embedded by specific processing techniques, in a metallic or insulating matrix. Due of their microstructure and of the possibility to configurate the properties and the geometrical parameters, these materials possess different properties, and sometimes are more performing in comparison with their bulk counterparts. The research efforts focus on identifying of novel Fe-based alloys, with soft or hard magnetic properties. The Fe-Cu and Co-Cu binary systems seem to be promising candidates for the synthesis of granular alloys, with special magnetic properties.

The paper presents the results of complex investigation of the crystalline and magnetic properties of the Fe-Cu studied alloys, prepared by melt-spinning technique. Have been highlighted the changes on structural and magnetic properties, according to the different chemical composition of the studied alloys and processing technique used. Depending of the Fe content, the values of the specific magnetization are improved by annealing of melt-spun Fe-Cu alloys: the specific remanent magnetization M_r increases from 0.19 – 20.64 emu/g to 0.97 – 27.57 emu/g, the specific saturation magnetization M_S increases from 1.73 – 65.79 emu/g to 9.37 – 88.97 emu/g. The dependence of the coercivity on the Fe amount of the Fe-Cu alloys was studied taking into the account the changes occurred in the crystalline structure due to the distortion of Cu layer determined by the presence of Fe in the Cu matrix. Through measurements with use of the scattering and reflection of the polarized neutrons was determined also the dependence of depolarization on neutron wavelength for the Fe-Cu studied samples.

Keywords: Fe-Cu melt-spun alloys, granular alloys, magnetic composites

Acknowledgement: Financial support is gratefully acknowledged from the Romanian Authority for Scientific Research: the Romania – JINR Dubna Scientific Bilaterale Cooperation Programme (ctr. No. 32/2013 „Investigation of Crystalline and Magnetic Properties in Micro- and Nanostructured Systems Based Granular Alloys”).

S1 P24

THE ELECTRICAL PROPERTIES OF CREDNERITE $CuMn_{1-x}M_xO_2$ (M=Mg, Al; x=0 - 0.08)

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Samples of crednerite $CuMn_{1-x}M_xO_2$ (M=Mg, Al; x=0 - 0.08) have been prepared according to the slightly modified hydrothermal method initially set up by Zhang et al. [1]. The materials have been synthesized at T= 100°C for 24h starting from $Cu(NO_3)_2.3H_2O$, (1-x) $Mn(NO_3)_2.4H_2O$ and x $Mg(NO_3)_2.6H_2O$/ x $Al(NO_3).9H_2O$ in Teflon-lined stainless steel autoclaves. The materials have been characterized by X-Ray diffraction at room temperature and shows that they crystallize in the crednerite structure and by Raman spectroscopy where two Raman active modes are observed at ~ 300 and 700 cm^{-1}, characteristic to ABO_2 type compounds.

The phase, microstructure, and electric properties of the $CuMn_{1-x}M_xO_2$ (M=Mg, Al; x=0 - 0.08) samples were discussed using different cation substitution contents. From the temperature dependence of the electrical resistivity, which was measured in the range 300 – 400 K, we have evaluated the activation energy of the investigated samples. The values obtained for the activation energy stands between (0.30 – 0.75) eV and depend on the obtaining method of samples and M substituent type and the value x.

The frequency ($f=\omega/2\pi$) and temperature (T) dependencies of the complex impedance, over the ranges 20 Hz to 2 MHz and 30^0C to 100^0C, for investigated samples, are presented. Based on the complex impedance measurements, the electric and dielectric properties of the investigated samples are determined and correlated with the structure and composition of the samples.

Keywords: crednerite, X-Ray diffraction, Raman spectroscopy, electrical resistivity, complex impedance

Acknowledgments: This work was supported by a grant of the Romanian National Authority for Scientific Research and Innovation, CNCS – UEFISCDI, project number PN-II-RU-TE-2014-4-2179.

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S1 P25

THE INFLUENCE OF THE METAL CONCENTRATION IN THE TIO_2 BASED NANOCOMPOSITE COATINGS ON THEIR PHYSICAL PROPERTIES

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Titanium dioxide, with a most common crystal structure of anatase *(with a band gap energy of 3.2 eV, that corresponds to an absorption band in UV, near 385 nm)* and rutile *(with a band gap energy of 3.0 eV, that corresponds to an absorption band in VIS, near 410 nm)*, is one of the most widely studied metal oxide semiconductor due to its interesting properties: cheapness, non toxicity, chemical stability, high transparency, etc., and especially due to its various applications, such as achievement of the surfaces with self-sanitizing properties, by decomposition of the organic and in-organic pollutants, by a photocatalytic processes.

In order to shift the absorption band gap of TiO_2 coatings, deposited usually with anatase crystalline structure by standard magnetron sputtering deposition method in RF in visible range *(390-700 nm)*, as it was reported in many scientific works, the TiO_2 samples from this work were doped with metal *(TiO_2: Ag and TiO_2: Cu)* and non-metal *(TiO_2: C)* chemical elements using 3 supplementary magnetrons equipped with targets from Ag, Cu and C *(graphite)* and supplied with DC voltage.

Magnetron sputtering has been used for achievement of the coatings from this work because this deposition method ensures deposition without any difficulties of TiO_2 doped with metals and nonmetals in a large doping percentage range.

For determination of the doping material *(metal and non-metal)* concentration of the samples the Rutherford backscattering spectrometry, performed at a 3 MV Tandetron^{TM} Accelerator, using 3.75MeV $^{4}He^{2+}$ ions, was used.

Taking into account, as it has been reported, that the energy band gap of a semiconductor with crystalline structure is depending *(besides the doping material concentration)* also on the particle size, in this work, the correlation between the surface topography *(roughness)* and grain size of TiO_2 *(doped and un-doped with metal and non-metal)* and the technological parameters of magnetron sputtering deposition process, was as well investigated by atomic force microscopy in tapping mode.

The AFM investigations of surface topography and the nanostructure of the coatings showed that grains are uniformly distributed on the substrates at nanometric scale having the average grain size lower than 100 nm and the RBS evaluation gave information regarding stoichiometry and thicknesses of the coatings. Coatings with higher concentration of metals showed an increasing of the roughness and grain size.

S1 P26

INVESTIGATION OF CRYSTALLINE AND MAGNETIC PROPERTIES OF NANOSTRUCTURED FERRITES, HARDENED BY EXCHANGE INTERACTIONS

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The nanocrystalline materials are single or multiphase polycrystals with grain sizes in the nanometer scale. Owing to the extremely small dimensions, the nanocrystalline materials are characterized by large volume fractions interfaces which significantly modify the physical properties as compared to bulk materials. Particularly, in the magnetic nanomaterials, composed by a phase with high magnetic anisotropy (so-call hard magnetic material) and the ferromagnetic phase with reduced magnetic anisotropy (so-call soft magnetic material), that means that in ferromagnetic nanocomposites, in which the linear size of the soft magnetic phase is at least twice of the interaction length of the hard magnetic phase, the exchange interaction length being practically equivalent to the width of the Bloch wall of this hard magnetic material, take place the hardening of the soft magnetic phase by the exchange interaction forces. Constituted from magnetically hard and soft phases that interact by magnetic exchange coupling, the magnetic nanostructured oxide systems becomes potential candidates for replacing of the classical single-phase materials. The paper presents the results of the investigations, by X-ray diffraction and magnetometry, the crystalline and magnetic properties of the two-phases nanostructured oxide systems, prepared through chemical synthesis and subsequent calcination. The values reached for the specific saturation magnetisation are 35 - 39 emu/g and for coercivities 170 – 200 kA/m. The value obtained for the ratio between specific remanent and saturation magnetisation, M_r/M_S was greater than 0.5 (M_r/M_S = 0.52 – 0.54), which proves that the two constituent phases are exchange coupled.

Keywords: exchange hardened nanocomposites, nanostructured ferrites

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S1 P27

OPTIMUM CONDITIONS FOR PRODUCING ORIENTED THIN LDH FILMS

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Keywords: thin films, pulsed laser depositon, matrix assisted pulsed laser evaporation, layered double hydroxides

In this work, we present the optimized conditions for the deposition by Pulsed Laser Deposition (PLD) and Matrix Assisted Pulsed Laser Evaporation (MAPLE) of thin films of layered double hydroxides (LDH) based on Mg-Al with the next formula: $[Mg_xAl_{1-x}(OH)_2][(CO_3)_{0.25/n}{}^{n-}\cdot mH_2O]$.

The PLD deposition parameters as number of pulses, laser wavelength, substrate temperature, radiofrequency power were varied for producing thin films of LDH. For MAPLE, different solvents and wavelength, laser fluences were also tested.

The morphological and structural characterizations performed to investigate the deposited films were: X-ray diffraction (XRD), atomic force microscopy (AFM), scanning electron microscopy (SEM), energy dispersive X-ray analysis (EDX) and Fourier Transform Infra-Red Spectroscopy (FTIR).

The possible applications of the films as protective coatings and active elements in electrochemical sensors are stressed out.

Acknoledgements:
This work was supported by Romanian National Authority for Scientific Research, CNCS – UEFISCDI, project number PN-II-RU-TE-2014-4-0976 (contract TE 270/2015) —"DESYRE".

S1 P28

STRUCTURAL BEHAVIOR OF DENTAL CERAMIC MATERIALS BASED ON YTTRIA OXIDE-STABILIZED ZIRCONIA

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A large variety of stabilizers have been used for the retention of the high-temperature polymorphs in zirconia ceramics. Among these polymorphs ZrO_2 phases, tetragonal and cubic phase were received considerable attention due to their wide applications including dental restorations, fuel cell electrolytes, catalysts, oxygen sensor, gate dielectrics. The low temperature formation of the tetragonal or cubic ZrO_2 crystalline phase was attracted substantial attention because is responsible of these extraordinary properties (mechanical, electrical, catalytic and optical properties).

ZrO_2 can retain its tetragonal crystalline phase in a wide range of temperatures by the substituting Zr^{+4} ions with additional divalent or trivalent elements using stabilizers such as Y_2O_3, MgO, CaO, Al_2O_3, SrO. Glass ceramics with ZrO_2-SiO_2 composition are of great interest, in which amorphous SiO_2 matrix can retard the tetragonal-monoclinic transformation and the grain growth of ZrO_2.

The objective of the present study is to investigate how the yttrium (III) oxide and silicon dioxide contents can influence the formation of tetrahedral zirconia crystalline phase in ceramics. The ceramic systems in the $xY_2O_3 \cdot (100\text{-}x)ZrO_2$ and $3SiO_2 \cdot xY_2O_3 \cdot (97\text{-}x)ZrO_2$ compositions where x=1, 2 and 3% Y_2O_3 were synthetized by sintering method in alumina crucibles at 1400^0C for two hours.Obtained samples were characterized by investigations of XRD, FTIR spectroscopy and EXAFS analysis. The EXAFS analysis of absorption coefficient was processed by computer codes CDXAS, XAS and IFEFFIT.

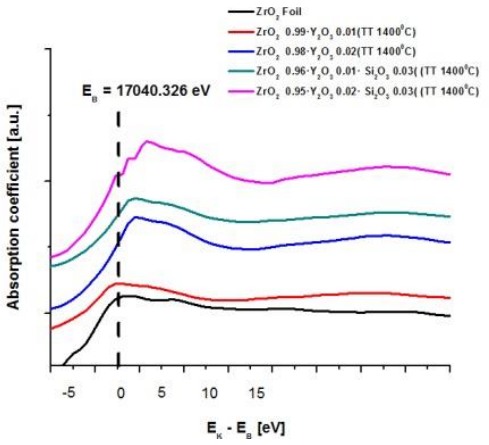

Fig. 1: Y k-edge XANES spectra of investigated samples.

Keywords: XRD, FTIR spectroscopy and EXAFS analysis
Acknowledgements: This work was supported by grants of the Romanian National Authority for Scientific Research and Innovation, CNCS/CCCDI, UEFISCDI, project number PN-III-P2-2.1-BG-2016-0077, within PNCDI III and PNCDI III, European and International Cooperation, Partnership cooperation, Contract no. 67/BM/2016.

S1 P29

IN-SITU MONITORING OF THE CURING OF EPOXY RESINS BY FTIR AND RAMAN SPECTROSCOPY

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Polymerization reactions are based on complex processes that are somewhat difficult to predict via mathematical models, especially without experimental data. A method to investigate the cure of epoxies via *in-situ* Raman spectroscopy has been developed.
The present paper describes the *in-situ* cure monitoring of a particular epoxy based resin: DGEBA Diglycidyl Ether of Bisphenol A. It is used as high-grade synthetic resins, in the electronical and aeronautical industries. A lot of experimental techniques are suitable for following the rates and extents of cure reactions in thermosets. Among them Differential Scanning Calorimetry (DSC) may be considered as one of the most interesting techniques for macrokinetics analysis of cure reactions of thermosetting systems but it is a destructive method. Our aim is to replace the use of DSC by non destructive methods FTIR and Raman spectroscopy.
Key words: Epoxy resin, process monitoring, DSC, FTIR, Raman spectroscopy.
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S1 P30

SPIN FLUCTUATIONS IN EXCHNAGE ENHANCED PARAMAGNETS

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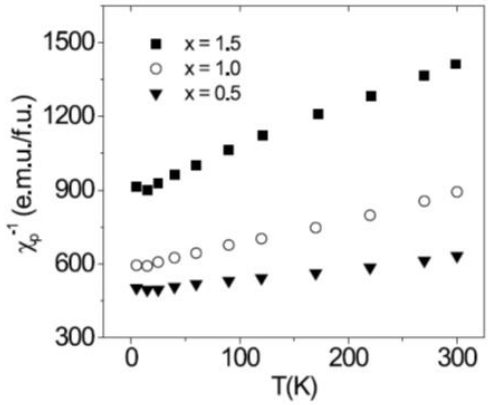
The magnetic properties of exchnage enhanced paramagnets from the $YNi_{5-x}M_x$ (M = Al, Cu), $LaNi_{5-x}M_x$ (M = Al, Cu), $YCo_{3-x}Ni_xB_2$, YCo_2B_2 and $YCo_{2-x}M_x$ (M = Ni, Si) series are analised. The magnetic susceptibilities, for end series compounds, at low temperatures ($T \leq 10$ K), follow a T^2 dependence. The magnetic susceptibility increases up to a temperature T_{max} and at $T > T^*$ a Curie-Weiss type behaviour is evidenced. The above behaviour is characteristc for systems having high Stoner exchnage enhancement factor (s = 5-10) and can be described in spin fluctuations model.



As the Co or Ni is replaced by nonmagnetic or weak magnetic elments a gradual transition from spin fluctuations to a Pauli-type paramagnetism was shown, as for example evidenced in case of $YNi_{5-x}Al_x$ compounds – Fig.1. The above behaviour is discussed in correlation with the values of the Stoner exchnage enhancement factors. The data obtained from band structrue calculations describe well the experimental value.

Keywords: paramagnetism, rare-earh compounds

S1 P31

THE INFLUENCE OF IRON IONS ON THE STRUCTURAL PROPERTIES OF TWO DIFFERENT PHOSPHATE GLASSES BY FTIR ANALYSIS

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Glasses from the systems $x(Fe_2O_3)\cdot(100\text{-}x)[P_2O_5\cdot Li_2O]$ and $x(Fe_2O_3)\cdot(100\text{-}x)[P_2O_5\cdot CaO]$ with $0 < x \leq 50$ mol % were prepared in the same conditions and characterized by FTIR spectroscopy. It was established the mode in which Fe_2O_3 influences the local structure of these glasses. The results showed for the $P_2O_5\cdot Li_2O$ glass matrix that the increasing of iron ions content indicate a gradual decreasing in the number of bridging oxygen ions and an increasing in the number of nonbridging oxygen ions [1,2]. For the $P_2O_5\cdot CaO$ glass matrix the Fe^{2+} ions in sites of distorted octahedral symmetry and clustered formations containing both Fe^{3+} and Fe^{2+} ionic species were evidenced [3]. Dipolar and superexchange interactions involving iron ions were revealed depending on the iron content of the sample.

Keywords: Structure by FTIR, Lithium phosphate glasses, Calcium phosphate glasses.

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S1 P32

STUDY OF BARRIER INHOMOGENEITIES USING CURRENT–VOLTAGE CHARACTERISTICS OF NI/4H-SIC SCHOTTKY DIODE

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In the present work,simulations of the current–voltage (I–V) characteristics of Ni/4H-SiC Schottky diodes are performed in the temperature range 175–325 K. The Gaussian distribution model have been used to analyze the observed anomalies in the (I-V) characteristics due to the barrier inhomogeneities (SBD). The analysis based on Thermionic Emission (TE) theory shows that the ideality factor n decreases while the barrier height increases φ_b with increasing temperature. The T_0 effect is validated and provides a clear evidence for the barrier inhomogeneity at interface.

Keywords: Silvaco-TCAD, Inhomogeneity, I-V characteristics, Simulation.

S1 P33

PHOTOCHEMICAL SYNTHESIS OF NOBEL METAL NANOPARTICLES FOR BIOMEDICAL USE

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Noble metals silver and gold nanoparticles have been much studied due to numerous applications in technical and life sciences. We focused on silver nanoparticle synthesis under the impact of high energy optical radiation. Silver seeds in colloidal suspension were synthesized in the first step of photochemical technology. Chemical reduction of silver nitrate with trisodium citrate as reducing agent was carried out in alkali reaction medium to obtain citrate-silver nanoparticles as seeds in aqueous suspension. In the second technological step, UV-C bactericidal source was used to irradiate the suspension and finalize the citrate-silver nanoparticles formation. The progression of the second synthesis phase for increasing UV exposure time was followed by recording the intensity of the spectral band in the visible range, due to the Surface Resonance Plasmon phenomenon specific to silver collective electrons. Transmission Electron Microscopy (TEM) analysis revealed the nanometric size of citrate-silver particles in accord with the position of the visible spectral band. Concentration of nanoparticles increasing as result of UV irradiation was estimated by considering spectral band intensity, silver density and average nanoparticle diameter provided by TEM. Biological impact was tested following the growth and development of living organisms during early ontogenetic stages.

Acknowledgements:
The work is partially funded by JINRI project 04-4-1121-2015/2017
Keywords: silver seed, ultraviolet radiation, surface resonance plasmon

S1 P34

INFLUENCE OF DEPOSITION PROCESS AND RAPID ANNEALING ON THE STRUCTURAL PROPERTIES OF OXIDE THIN FILMS

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Transparent oxide thin films (ITO) with thickness values in the range 230 – 370 nm, were grown onto glass substrates using the radio frequency magnetron sputtering (rfMS) method. After deposition, the samples were subjected to rapid thermal annealing (RTA) in air at temperatures up to 700 K. In this study, a stylus profilometer (Ambios, XP–2) was used to measure the thickness of the oxide thin films. The structural, optical and electrical properties of both as-deposited and annealed samples were investigated. A comparative analysis of the structure and properties of these oxide films was then carried out. The surface morphology of the obtained films was investigated by AFM and SEM techniques. Influences of post deposition thermal treatment on structural properties of these oxides were discussed based on XRD and XPS results. Transmittance spectra, in a double-beam configuration, were recorded in the 190 nm – 3000 nm wavelength range and, from these, optical constants were obtained for the ITO films. Optical properties of these oxide films in the near infrared (NIR) range were described by the Drude free electron model. Depending on the annealing temperature, the value of the optical bandgap, E_g, of the corresponding thin films ranged between 3.5 eV and 3.7 eV. The electrical conductivity was measured using the four points method. An electrical analysis of the conduction mechanisms specific for different voltage ranges was also performed. The obtained results are discussed in correlation with the optical properties of the thin films and the role of annealed treatment in oxide thin films. These oxide layers present interesting for advanced technologies in terms of basic research and and new potential research for the next-generation of the spatial microsatellites.

This research is supported by the National Authority for Research and Innovation in the frame of Nucleus programme - contract 4N/2016.

S1 P35

AFM AND MFM STUDY OF COBALT FERRITE NANOPARTICLES DISPERSED IN STABLE SUSPENSIONS WITH DIFFERENT CAPPING AGENTS

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Magnetic nanoparticles (MNPs) are well known for their promising applications in medical diagnostics and treatment. We synthesized cobalt ferrite nanoparticles by adapted chemical route and stabilized them in aqueous suspension by using two capping ingredients: sodium oleate and citric acid. The resulted samples were designed to contain colloidal particles coated with double layer of long chain oleate ions and respectively with thin layer of citrate ions. Comparative study was carried out to evidence the suitability of such prepared colloidal suspensions for biomedical purposes with focus on the sample granularity, dispersibility and wettability. AFM and MFM were the main investigation methods while complementary contact angle was measured too. The topography of cobalt MNPs evidenced mostly dispersed particles allowing 3D detail comparative analysis. The "maps" of the magnetic domains of the particles, were also recorded at room temperature and discussed. The differences between the two types of MNP surface modification for

[1] married as Garoi

stabilization in aqueous suspensions were analyzed considering steric as well as electrostatic forces with taking into account of suspension properties.

Acknowledgements: The work is partially financially funded through the grant Romania -JINR-Dubna, No. 220/10.04.2017, position 64 and No. 219/10.04.2017 position 64.

Keywords: cobalt ferrite, granularity, wettability

S1 P36

STRUCTURAL AND MAGNETIC PROPERTIES OF CHEMICALY SYNTHESIZED $CoPt/Fe_3O_4$ HARD/SOFT EXCHANGE COUPLED MAGNETIC SYSTEMS

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The great demand for digital data storage density has encouraged the investigation of a promissing generation of nanoscale magnetic materials. Recently, there are increasing technological and fundamental research interests in the fabrication of ferromagnetic nanoparticles for ultrahigh density magnetic recording media [1].

The materials obtained from exchange coupling of hard and soft magnetic phases nanocrystallites are known as exchange coupled magnets or short name: "spring magnets" [2, 3].Understanding the concept of exchange coupling leads to a new ways of obtaining high performance hard magnetic materials.

Ferromagnetic chemically order face-centered tetragonal, $L1_0$ CoPt alloy nanoparticles shows high uniaxial magnetocrystalline anisotropy $Ku \approx 4.9 \times 10^6$ J m^{-3}[4], in the bulk phase and also its high chemical stability which make $L1_0$ CoPt phase suitable for using as hard magnetic phase in soft-hard exchange coupled systems. In order to obtain the exchange coupling between the hard and soft phases, remain a challenge to generate $L1_0$ CoPt nanoparticles with high coercivity, controllable size and narrow size distribution. We report here the fabrication of $CoPt@Fe_3O_4$ exchange coupled nanoparticles by employing polyol method. As precursors for CoPt phase was used Co acetylacetonate and Pt acetylacetonate and as reaction media is used dioctyl ether. In order to obtain a good crystallinity of phases, the as obtained CoPt nanoparticles were annealed at 700 °C in reduction atmosphere. The soft magnetic phase will be obtained by precipitation in basic media of iron salts.

The elemental composition of materials were determinate be XPS measurements, the structure and microstructure was checked by XRD and TEM analyses. The magnetic properties were investigated by VSM magnetometry methods. The coupling between the magnetic phases is investigated by Henkel δm curves.

Keyword: exchange coupled systems, polyol synthesis, $CoPt@Fe_3O_4$ magnetic nanoparticles, hard/soft exchange coupled materials.

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Acknowledgements: This work was supported by the Romanian – JINR – Dubna 2017 Projects, protocol no. 04-4-1121-2015/2017.

S1 P37

PULSED LASER DEPOSITION OF Cu_2ZnSnS_4 THIN FILMS ON Si (100) SUBSTRATES

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Copper zinc tin sulfide (CZTS) is a quaternary semiconducting compound which has received increasing interest since the late 2000s for applications in solar cells. This material has the advantages of low price, relatively low toxicity and abundance in the Earth's crust constituent elements. Cu_2ZnSnS_4 has the band gap energy of 1.4-1.5 eV and the absorption coefficient over 104 cm^{-1}. However, the presence of volatile phases such as tin chalcogenide compounds and elementary zinc substance poses an inevitable challenge for growing pure kesterite without spurious phases. The presence of spurious phases can deteriorate the performance of solar cells as reduced open circuit voltage and shorter carrier lifetime. The successful deposition of high quality CZTS films strongly depends on reliable and optimal fabrication techniques. It is known that through the use of PLD technique, even for complex materials, the stoichiometry of the target is preserved within the deposited film. Thus Cu_2ZnSnS_4-based thin films were grown on Si (100) using PLD technique in different deposition conditions. The deposition parameters were adjusted by investigating the structural characteristics by X-ray diffraction and Raman spectroscopy, while the morphology was evidenced using SEM microscopy.

Keywords: CZTS, thin films, PLD.

Acknowledgements: The authors would like to express appreciation to the National Authority for Scientific Research and Innovation – ANCSI for the financial support through Project PN16-30/02 05 (Core Prog.)

S1 P38

EFFICIENT PHOTOCATALYTIC DEGRADATION OF RhB USING Fe_3O_4-TiO_2:Gd COMPOSITES

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Titanium dioxide is an inexpensive and environmental friendly semiconductive material, and has been widely used in photocatalytic applications owing to its light-induced oxidation, chemical stability and non-toxicity [1]. In the present work, we report the experimental results obtained on photodegradation of RhB using Fe_3O_4-TiO_2:Gd composites. The morphologie and sizes of nanoparticles were obtained using transmission electron microscopy. The XRD measurement shows the specific peaks corresponding to magnetite (Fe_3O_4) and anatase (TiO_2) phases. A secondary phase of $FeTiO_3$ has been evidenced. All semples present a superparamagnetic behaviour. By increasing the Gd doping content, the saturation magnetization increase due

to the decrease of the secondary phase of $FeTiO_3$. The best photodegradation rate was obtained for a doping content of 0.5% Gd. The photocatalyst presents a good stability after four recycles and coul be easily separated from thesolution due to the present of Fe_3O_4. According to the analysis of the reaction intermediates and final products, a mechanism of photodegradation was proposed.
Refereces:
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Keywords: nanoparticles, composites

Acknowledgements: The authors from National Institute for Research and Development of Isotopic and Molecular Technologies thank for financial support to the Ministry of Research and Innovation, Core Programme, Project PN16-30/02 02.

S1 P39

THE INFLUENCE OF ZnO CONTENT ON $CuInS_2$-ZnO NANOCOMPOSITE PROPERTIES

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$CuInS_2$ (CIS) nanomaterials, have the potential to replace traditional binary Cd-contained nanomaterials owing to their low toxicity, an intrinsic direct band gap of 1.45 eV, tunable fluorescence from the visible to near infrared range and high extinction coefficient (105 cm^{-1}) [1]. Currently CIS materials are being applied in the fields such as biolabeling, light emitting diodes (LEDs), solar cells and laser induced changes [2,3]. To improve the quantum yield of CIS nanoparticles we choose to passivate their surface using a ZnO shell. In this regard $CuInS_2$ (CIS)-ZnO nanocomposite were prepared by seed-mediated growth of ZnO nanoparticles onto the preformed CIS nanoparticles. The formation of the nanocomposite structure has been evidenced by XRD, Raman, and XPS. Based on the band gap energy evaluated using UV-Vis absorption spectroscopy the energy band setup alignment was obtained. The influence of ZnO content on optical properties of CIS nanoparticles was highlighted.

Keywords: $CuInS_2$-ZnO nanocomposite, structural characterization, optical properties.
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S1 P40

GRAPHENE OXIDE DECORATED WITH Fe DOPED SnO_2 NANOPARTICLES: STRUCTURAL AND MORPHOLOGIC CHARACTERIZATION

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Metal oxides have been regarding as alternative anode materials for Li-ion batteries due to their high specific capacity. Among them, tin dioxide (SnO_2) is considered as one of the promising materials for the next-generation Li-ion batteries due to its high theoretical capacity (782 $mAhg^{-1}$), low cost, wide availability and nontoxicity [1]. By decoration of graphene sheets with SnO_2 nanostructures it is expected an improvement of the anode materials electrochemical properties because the carbon framework can provide a fast electron transfer pathway [2].

Reduced graphene oxide (rGO) decorated with Fe doped SnO_2 nanoparticles were fabricated via the electrostatic interaction between positively charged modified Fe-doped SnO_2 oxide and negatively charged graphene oxide (GO) in the presence of poly(allylamine) hydrochloride (PAH). The decoration of rGO layers with SnO_2:Fe nanoparticles was highlited by TEM microsopy. For composite sample the diffraction patterns coincide well with those of SnO_2:Fe nanoparticles. The reduction of graphene oxide was evidenced using XRD and FT-IR spectroscopy. The formation of SnO_2:Fe-PAH-graphene composites was confirmed by FT-IR, Raman and EPR spectroscopy.

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Keywords: nanoparticles, graphene oxide, composites

Acknowledgements: The authors from National Institute for Research and Development of Isotopic and Molecular Technologies thank for financial support to the Ministry of Research and Innovation, Core Programme, Project PN16-30/02 05.

S1 P41

PREPARATION, CHARACTERISATION AND APPLICATION OF PVP-SnO_2/TiO_2 COMPOSITE NANOPARTICLES

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Composite nanostructures usually exhibit enhanced properties in comparison to their corresponding single components, owing to the integration of the different physical and chemical properties of the multiple components. The enhanced performances may be attributed to the synergistic interaction or the combination of the functionalities of the individual components[1-3].

Various hybrid materials with different components and versatile structures, exhibiting enhanced performances have been designed ad fabricated. SnO_2 is one of the most popular and promising materials because of its high stability, non-toxicity, eco-friendly and low cost and also multiple applications. In recent years, inorganic nanoparticles have also been prepared by controlling their shapes and sizes through surfactants. TiO_2 is one of the most investigated photocatalytic materials, known for very interesting properties

and its versatile applications in various fields. TiO_2 mediated photocatalytic oxidation and reduction offers potentially a facile and cheap method for removing inorganic and organic pollutants from wastewaters.

The aim of this work was to prepare polyvinylpyrrolidone (PVP)-SnO_2/TiO_2 composite nanoparticles and characterize them in terms of composition(XPS), morphology (TEM/HRTEM), structure (XRD), optical(UV-VIS) and electrochemical properties (CV) and photocatalytic activity.

Composite nanoparticles were synthesized by growing TiO_2 nanoparticles on preformed PVP capped SnO_2 nanoparticles. The PVP capped SnO_2 nanoparticles were obtained by chemical precipitation and TiO_2 nanoparticles by sol-gel process.The results revealed that by adjusting the composition of components, one can control the properties and, by consequence the application areas of these composite nanoparticles.

Keywords: composite nanoparticles, tin oxide, semiconductor, chemical synthesis

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S1 P42

SOL-GEL PREPARATION OF MODIFIED ZnO MATERIALS

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Zinc oxide (ZnO) nanostructures have attracted a wide attention due to their unique properties and immense potential applications such as transparent conducting oxides, thin film transistors, transducers, varistors, photovoltaics, semiconductor diodes, gas sensors, etc. [1]. The sol-gel approach appears to be one of the most promising methods to prepare ZnO materials because of its simplicity, reproducibility, cost-effectiveness, relatively mild conditions of synthesis, low temperature of decomposition and control on the chemical composition [2].

The present study focuses on the preparation of modified ZnO materials by the sol–gel process at room temperature (25 °C) in bazic conditions (water-ethanol mixture and ammonia aqueous solution), using tetraethylorthosilicate (TEOS, as the silica particle precursor) and different co-precursors such as phenyltriethoxysilane (PhTES) and octyltriethoxysilane (OTES) as modifying agents. The molar ratio between the TEOS and co-precursor was 1:1.

Properties of the modified ZnO materials, such as size distribution, morphology, and structure were characterized through the dynamic light scattering (DLS) technique, environmental scanning electron microscopy (ESEM), Fourier transform infrared (FTIR) spectroscopy, and thermogravimetric (TGA) analysis. The DLS and ESEM analysis revealed that the modified ZnO nanoparticles have different particle diameters. All FT-IR spectra of obtained ZnO materials exhibit broad absorption bands located at ~1100 cm^{-1}, which is assigned to the Si-O-Si stretching vibrations. The TGA technique confirms the presence of silica molecules on the zinc oxide surface. These obtained ZnO materials can be used for corrosion protection of metallic structures.

Keywords: sol-gel process, Zinc oxide, morphology

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S1 P43

SURFACE HYDROPHOBIZATION BY ELECTROSTATIC DEPOSITION OF HYDROPHOBICALLY MODIFIED POLY(ACRYLATES) WITH INORGANIC FILLER

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The present study demonstrates the effect of different layered silicates on electrostatically poly(electrolyte) multilayer films. For this purpose, the anionic complexes of sodium hydrophobically modified poly(acrylates) with the alkyl chain length 18 carbon atoms (PAC_nNa) with alkyltrimethylammonium bromides (C_xTAB, x = 10, 12, 14, 18), and the cationic clays are assembled by layer-by-layer deposition on a glass substrate. Tree types of layered silicates (Cloisite Na^+, Cloisite 30B, Closite 15A), organomodified with different fatty acids, were used. Wettability, thickness and surface morphology of the obtained films were investigated. The presence of montmorillonites led to physico-chemical changes. Contact angle (CA) measurements revealed that films obtained in the presence of Closite15A are superior water repellants than those with Cloisite Na^+, Cloisite 30B. The film roughness and thickness have the same trend as wettability. Thinner and less coarse films are obtained by NaCl addition, as observed by SEM and AFM analyses.

Keywords: Hydrophobic surface; Hydrophobically modified poly(acrylate); Layer-by-layer deposition; Layered silicates

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S1 P44

HYDROGEL-ADVANCED MODIFIED CLAY NANOCOMPOSITES AS POSSIBLE VEHICLES FOR DRUG DELIVERY

AND CONTROLLED RELEASE

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Present study reffers to the synthesis of new advanced materials based on poly(methacrylic acid)-PMAA with own advanced modified clays namely Cloisite 93A ((methyl, dihydrogenatedtallow)-(Cloisite® 93A; 90meg/100g) modified with octyl (C8), ocatdecyl (C18) alkyl chains by edge covalent bonding [1]. For the synthesis, N, N'-methylenebisacrylamide (BIS) was used as cross-linker and ammonium persulfate (APS) as initiator. The nature, concentrations of reactants and the synthesis conditions were varied according with the desired properties using environmental friendly methods, without any organic solvents and surfactants [2].

The biocompatibility of the obtained nanocomposite materials was tested *in vitro* on two cell lines. The hydrogels physical-chemical properties, determined by several techniques (Fourier transforms infrared (FTIR-ATR), electron microscopy (SEM, TEM), thermo-gravimetric analysis (TGA) and water retention analyses), demonstrated that own modified clay influences the physical-chemical properties of the hydrogels.

Keywords: hydrogel, clay, nanocomposites, biocompatibility

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Acknowledgement

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S1 P45

MORPHOLOGY OF ZnO NANOSTRUCTURED MATERIALS OBTAINED THROUGH SOL-GEL PROCESS

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Zinc oxide particles were extensively used in fields as organic coatings [1], due to the non-toxic nature of ZnO and the ability to block the UV radiation. Incorporation of nanoparticles in a polymer matrix has a critical aspect - strong tendency to aggregate inherent to the inorganic fillers, which is very important when particles are added to sol–gel matrix, because they can disturb the reticulation process.

In the present work we study the influence of the addition of ZnO nanoparticles to an organic/inorganic sol–gel matrix using two different silane precursors (3-glycidoxypropyltrimethoxysilane (GPTMS) and octyltriethoxysilane (OTES). The synthesis was realized in acidic conditions (water and 2-propanol mixture) at room temperature. ZnO nanoparticles were synthesized using TEOS (tetraethylorthosilicate, as silica particles precursor) with silane precursors, having a molar ratio 1:1. Morphological features of the final particles were characterised by: Dynamic Light Scattering (DLS) technique – measuring the size and dimensional distribution of the particles; microscopy analyses (TEM, SEM - Fig.1) – investigating the ZnO nanoparticles shape and dimensions.

Keywords: morphology, sol-gel process, Zinc oxide nanoparticles

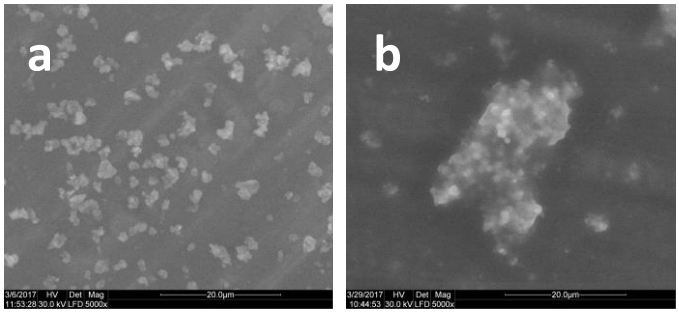

Figure 1. SEM images of ZnO nanoparticles obtained with silane precursors: a - GPTMS and b - OTES

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S1 P46

ELECTROCONDUCTIVE MAGNETORHEOLOGICAL SUSPENSIONS BASED ON CARBONYL IRON AND SILICONE OIL

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Magnetorheological suspensions (MRSs) or Bingham magnetic fluids can be prepared out of a liquid matrix, tensio-active substances and ferri-ferromagnetic micro-particles. A type of MRS was obtained by thermal decomposition of $Fe_2(CO)_9$ in a matrix consisting of mineral oil and stearic acid. In a magnetic field, the fluidity of MRSs diminishes, following the formations of chains in the fluid matrix, while for certain well-chosen values of the intensity of the magnetic field, the suspension can become electroconductive. By addition of styrene acrylate copolymer and iron oxide, MRSs with prescribed domains of electrical conductivity were obtained. It is shown that the onset of electrical conductivity in the MRSs and the electrical conductivity itself are considerably influenced by the intensity of the magnetic field.

Keywords: magneto-resistance, magnetorheological suspension, electrical conductivity, styrene acrylate copolymer.

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S1 P47

AQUEOS DISPERSION OF SILICA COMPLEX SYSTEMS OBTAINED FROM RENEWABLE MATERIALS

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The goal of this study was to synthesize aqueos dispersion of silica complex systems starting from renewable materials through sol-gel technique using soluble sodium silicate, ricinoleic acid and different coupling agents. Thus, aminopropyltriethoxysilane, phenyltriethoxysilane and glycidyloxypropyltrimethoxisilane, were used. The synthesis were realized using environmental friendly methods, without any organic solvents and surfactants.

Particle dimensions are affected by the coupling agent type and concentration, according to Dynamic Light Scattering analyses. FTIR spectra confirmed the formation of hybrid network derived from the silica precursors (sodium silicate, APTES, PTES, GPTMS) in the hybrid materials. TGA analyses showed the influence of the different chains on the thermic behavior of hybrid materials. SEM images showed different aggregation tendency of silica hybrid materials covered with stabilization complex depending on the silica precursors used in synthesis.

Keywords: silica, aqueous dispersion, ricinoleic acid

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S1 P48

INORGANIC/ORGANIC CORE-SHELL MAGNETIC MATERIALS FOR REMOVAL OF ENDOCRINE DISRUPTING PHARMACEUTICALS FROM WATER

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Generally speaking, endocrine disrupting chemicals (EDC) represent compounds that can alter the functioning of the endocrine system. From the large class of EDCs, the pharmaceuticals and personal care products (PPCP) represents one of the main concerns, due to their potential harmful effects on the wildlife and on human health, even at the low concentration at which they are usually found in water. Their presence can usually be correlate with the increase of population density and the insufficient wastewater treatments. Several studies present the widespread of such compounds in the water sources, all over the world [1-3].

For the removal of EDC, several expensive and difficult to implement strategies can be applied (such as the use of activated carbon, catalytic ozonation, etc.) but their success is limited [4]. We propose an alternative method for the removal of pharmaceutical EDCs from wastewater, by using magnetic inorganic/organic core-shell materials, based on iron oxide/natural polymeric materials. They have the advantage of facile utilization and separation from the water matrices, as well as a good removal efficiency. The synthesized materials were characterized in terms of structure (X-ray Diffraction, X-ray Fluorescence, Thermal analyses, Fourier Transform Infrared Spectroscopy), morphology (Transmission electron microscopy), magnetic properties and removal efficiency (using High-performance liquid chromatography).

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Keywords: magnetic materials; natural polymers; endocrine disrupting chemicals.

S1 P49

INTEGRATED METHODOLOGY FOR THE NON-DESTRUCTIVE CHARACTERISATION OF CULTURAL HERITAGE ARTIFACTS

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The cultural heritage artifacts in general (and metallic artifacts in particular) often need cleaning. However, application of unsuitable restoration techniques often leads to "over-cleaning" and, consequently, to irreparable aesthetic and historical value losses. To avoid such problems, a thorough characterization of the artifacts is necessary [1]. Literature data often presents either *bulk* results, referring to the entire studied material, or *micro-area* results, referring to selected points on the artifact [2, 3]. In this study, we present an integrated approach, starting from the microscopical evaluation (using optical microscopy) to the complex *bulk* **and** *micro-area* characterization of selected artifacts [4].

The nuclear analytical methods selected (**for *bulk* analyses** - Energy dispersive X-Ray Fluorescence – EDXRF Spectrometer PW4025 MiniPal 2, PANalytical, X-Ray Diffraction - Rigaku SmartLab 9kW, parallel

beam configuration; **for *micro-area* anal**yses – small spot Energy dispersive X-ray Fluorescence - Bruker Tracer S1 Titan spectrometer, *micro-area* X-Ray Diffraction - Rigaku SmartLab 9 kW, point focus configuration, Particle Induced X-Ray Emission - developed at the 3MV Tandetron from "Horia Hulubei" National Institute for Physics and Nuclear Engineering) can offer a clear image of the studied artefacts (a set of Romanian silver coins, from the end of the XIXth century, early XXth century). The samples were selected considering composition and historical aspects. From the obtained results, we can not only define the alloy composition, but also identify small corrosion spots present on the surface of the artifacts.

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Keywords: cultural heritage artifacts; nuclear techniques; analytical characterization.

S1 P50

LOW-TEMPERATURE/LARGE-AREA NANOCRYSTALLINE DIAMOND FILM DEPOSITION

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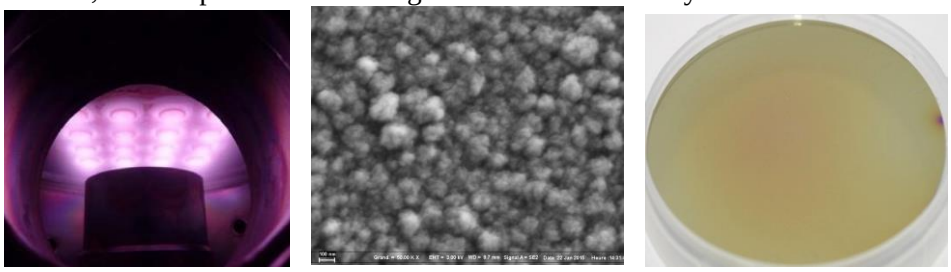
Many thermal, electrical and mechanical applications of diamond films require large area thin layers deposited on various substrates at compatible temperature, typically bellow 400 °C [1].
We have studied a distributed antenna array microwave plasma system, with 16 microwave sources arranged in a 2D matrix, which enables the growth of homogeneous 4-inch nanocrystalline diamond films (NCD) at low-pressure (0.2-0.7 mbar) and low substrate temperature (100-400 °C), by using $H_2/CH_4/CO_2$ gas chemistry [2]. Such a system allows the growth of NCD thin films on a large variety of substrates with more or less complex shapes [3]. The figure below shows together a picture of the 2D plasma matrix, a SEM micrograph of a typical NCD film, and the picture of a homogeneous 4-inch NCD layer.



In this paper, the considered low-pressure/low-temperature growth process is investigated through both plasma modelling and infrared absorption spectroscopy [4]. NCD film characterization is also carefully carried out. The effects of growth parameters, such as gas pressure, microwave power, substrate temperature and substrate position on NCD layer properties, with respect to plasma behavior, is presented and discussed.

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S1 P51

A COMPARISON BETWEEN NATURAL SOURCES OF ANTHOCYANINS AS PIGMENTS FOR DSSCs

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We report results of combined experimental and theoretical studies of anthocyanin natural dyes used as sensitizers for TiO_2 dye-sensitized solar cells (DSSCs). We compare and contrast results obtained for cyanidin and delphinidin dyes extracted from *Hibiscus Sabdariffa L.* and similar anthocyanins extracted from red cabbage. To analyze the compliance of the various dyes with the main criteria [1] that should be met by the TiO_2 sensitizer in a DSSC, we performed Density Functional Theory (DFT) calculations, which provided the optimized geometry, electronic structure and electronic spectrum of the dyes in fully protonated, as well as partially deprotonated forms, in solution. We discuss the adsorption onto the substrate, the matching of the absorption spectrum of the dye with the solar spectrum, the energy level alignment with the semiconductor and the electrolyte, and the charge transfer to the substrate. We find better energy level alignment for partially deprotonated forms of cyanidin and delphinidin. Based on this suggestion and previous results showing higher efficiency for red cabbage extracts in alkaline medium [2], we prepare solar cells using dye solutions of various pH values in order to identify the conditions for optimal performance of such devices. The recorded data for *Hibiscus* extracts referring to the photovoltaic conversion efficiency, fill factor, short-circuit current and open-circuit voltage show improved parameters.

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S1 P52

FUNCTIONAL INTERFACES IN W-TI AND W-V LAMINATES

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"W-metal laminates" are multi layered composites from alternate W and metal thin foils (~0.1 mm thickness), joined together to create components able to withstand high heat fluxes and strong irradiation in applications like that ones related to nuclear fusion reactors. On one side W has the highest melting point of all metals, good high temperature strength, high creep resistance a high thermal conductivity and a high sputtering threshold. These properties make W a first choice for armor materials in fusion energy reactors. Unfortunately bulk W can not be also used for structural applications, due especially to its high brittle- to-ductile transition temperature (DBTT). However, when cold rolled at about 400°C, thin W foils show exceptional properties in ductility, toughness and DBTT. Attempts to transfer these properties from W foils to W-based bulk materials resulted in the so-called "W-laminates" concept, where the other metal should improve the composite behaviour, especially those related to the effects of intense neutron irradiation. From this point of view, CuCrZr alloys, Cu, V and Ti metals are ideal candidates. While Cu and CuCrZr impose a lower temperature operating window for such composites, V and Ti are suited candidates for higher temperatures operation concepts. Unfortunately, W-Ti materials show a strong interdifussion of elements resulting in a catastrophic decrease of the material properties and for W-V laminates a Kirkendall effect was reported after prolonged high temperature exposure. To avoid these effects we have deposited Cu or Cr thin layers (~100 nm) on W, thus creating a functional interface between W and Ti or V foils. The resulting W-laminates produced by FAST (field assisted sintering technique) have been investigated by scaning electron microscopy and for their thermal transport properties. The present results show that the W-metal interface microstructure is improoved and, more important, the performance of these composites is considerably improvved even prolonged high temperature exposure.

Acknowledgement This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 under grand agreement No 633053, WP-MAT and WP-EDU. The views and opinions expressed herein do not necessarily reflect those of European Commission

S1 P53

HIGH TEMPERATURE THERMO-PHYSICAL PROPERTIES OF CU-BASED THERMAL BARRIER COMPOSITES.

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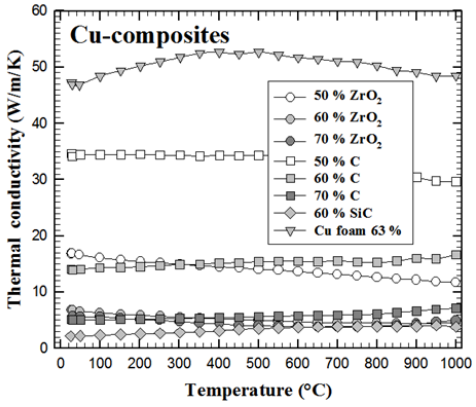
In our quest to develop thermal barrier materials for fusion related applications we have developed a spark plasma sintering based method to create Cu-ceramics composites with very high ceramic content, up to 90% volume concentration in some particular cases. In the present work we analyse the thermophysical properties of such materials in conjunction with their morphology and microstructure.



The processing technology developed allows to create Cu-ceramic composites with metallic-like electrical conductivity and thermal conductivities with low values (i.e. a few W/m/K) specific to thermal insulators.

Due to the large compositional range possible, the thermophysical properties (like thermal conductivity, specific heat, thermal expansion coefficient) can be easily tunned to designed values and due to the Cu presence in the material, the resulting thermal barriers can also be joined to other components by different brazing techniques.

Fig. Thermal conductivity of some typical Cu-based thermal barrier composites

Acknowledgement This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 under grand agreement No 633053, WP-MAT and WP-EDU. The views and opinions expressed herein do not necessarily reflect those of European Commission

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S1 P54

AUTOMATED SYSTEM USED IN THE CHARACTERIZATION OF PHOTOVOLTAIC CELLS

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The paper presents the design, fabrication and testing of an automated system used in the characterization of photovoltaic cells. The system is designed around an Arduino platform which is programmed to monitor the current and voltage of the solar cell and control the load resistor accordingly, in order to allow a USB Data Acquisition Board to measure more values, closely spaced together, in the vicinity of the maximum power point. We present the construction of each module of the system, namely the current adapter, the interface board and the variable load resistor module. We also show the code that allows an initial test followed by an algorithm that interprets the initial data and controls the load resistor in order to accommodate for any fill-factor of the cell, while keeping a high precision in the determination of the maximum power point and at the same time, keeping the total number of measurement to a minimum. Due to the high precision and sensitivity, the system is well suited for testing small area Dye-Sensitized Solar Cells. The system is proved to insure a high repeatability of the measurements and also to be time-saving when testing relatively large solar cell batches.

ABSTRACTS

S2 – Laser, Plasma and Radiation Physics and Applications

- *Laser Physics and applications*
- *Plasma Physics and applications*
- *Optoelectronics and photonics*
- *Applied and non-linear optics*
- *Ultrafast phenomena and applications*

S2 L1

FUSION PLASMA INTERACTIONS WITH MATERIALS

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In the frame of the EUROfusion Work Programe it is of great importance to study the material behaviour under fusion plasma interactions. Deuterium plasma fluxes to the first-wall of the tokamak reaction toroidal chamber of the order of $10^{-20}m^{-2}s^{-1}$ and fluences of about 2×10^{24} D m^{-2} are expected to interact with beryllium, tungsten and carbon, the materials of the JET fusion device and to be used in ITER and DEMO.

Due to plasma interaction with the walls caused by imperfect confinement as well as instabilities in the fusion plasma (disruptions, edge-localized mode (ELM's), etc.) during plasma operation sputtering of the plasma facing components (PFC) surface may occur, followed by transport in plasma and redeposition on other zones of the first wall. Interactions on divertor surface form a deposited layer, where retention of fusion fuel is possible. The deposited layer contains plasma facing wall elements as well as carbon from the CFC and as impurity.

The presence of the deposited layer can influence the properties of the inner wall as well as the thermal conductivity of the divertor materials. Also, during plasma disruptions, the PFC are subject to high heat fluxes. Therefore, it is important to expand the knowledge about high fluence interactions with deposited layers.

Studies of material behaviour, i.e. erosion & re-deposition processes including fuel inventory, are key issues of the research. A large number of special PFCs (variety of marker tiles) and wall probes are used to monitor the local and global material migration. (See Fig.1). Detailed studies of such wall elements will be highlighted in order to define an efficient use of PFC in view of ITER and DEMO requirements.

The research focuses on laboratory examination of wall components, especially beryllium marker tiles produced at NILPRP. The methodology and plan for the retrieval of components was compatible with the technical means. A detailed procedure for sectioning and analysis of the samples retrieved from the JET wall will be also highighted.

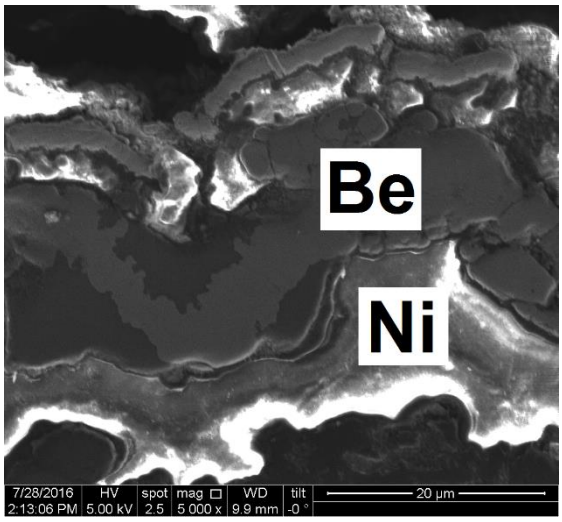

Fig.1 Typical cross-sectional SEM image

Keywords: fusion plasma interaction, marker tiles, beryllium, deuterium

Acknwledgements:

The strong contribution of the Beryllium Team of NILPRP: Corneliu Porosnicu, Ionut Jepu, Oana Pompilian, Bogdan Butoi, Paul Dinca, Valer Zaroschi as well as the financial support of the EUROfusion WP-JET2 Programe is greately acknowledged.

S2 L2

TVA OBTAINED CU/AG THIN FILMS WITH ANTIMICROBIAL PROPRIETIES FOR USE IN SMART VENTILATION SYSTEMS

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While air conditioning systems have become an ordinary item found in almost all homes and work spaces, more health problems have found their sources in the air filtration systems of these devices. Having a steady flow of air and moisture, these filters are an ideal place where bacteria like Staphylococcus aureus (S. aureus) can prosper. These bacteria are the most common source of infection that causes skin and soft tissue infections such as abscesses (boils), furuncles, and cellulitis. In some extreme cases, S. aureus can cause serious infections like bloodstream infections, pneumonia, bone and joint infections.

This work is focused on designing a smart, eco-friendly ventilation system that ensures clean, decontaminated air, while lowering the energy consumptions of buildings. Small, solar powered tubes, filled with electronics, placed in key points on glass facades ensure air circulation by convection. Issues have risen in how to trap incoming bacteria from outside and passively clean the air and kill the bacteria trapped in the tubes.

Thermionic Vacuum Arc (TVA) method was used in coating 1x1mm and 0.5x0.5mm grids with Cu, Ag and Cu/Ag layers in order to determine the best way to approach the problem.

SEM and AFM measurements were performed on the deposited thin films to determine the morphological proprieties while XRD measurements show the crystalline growth of them. Different deposition parameters can influence the topology of the film as well as the grain size that can have a major impact on the antibacterial proprieties.

We tested the deposited grids in a controlled system that ensured a steady flow of S. aureus contaminated air passing throw them in order to determine the efficiency in retaining and killing the bacteria. More tests have been done in order to determine the improvement of air quality, with very promising results.

Keywords: antibacterial thin films, Staphylococcus aureus, Cu/Ag thin films

Acknowledgements

This work was supported by a grant of the Romanian National Authority for Scientific Research, CNDI–UEFISCDI; project number 80/2014, PN-II-PT-PCCA-2013-4-2165

S2 L3

EXPERIMENTAL AND THEORETICAL INVESTIGATIONS ON THE DYNAMICS OF TRANSIENT PLASMA PLUMES GENERATED BY LASER ABLATION IN VARIOUS TEMPORAL REGIMES

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Experimental investigations were performed on laser produced plasma generated by nanosecond, picosecond and femtosecond laser ablation on selected metallic targets (Mn, Ni, Cu, Zn, Ti and Al). The aim

of this work was to investigate the effect of the target physical properties (electrical and thermal conductivities, melting, boiling points etc.) on the plasma plumes dynamics. The experiments were performed in similar conditions of laser fluence (~10 J/cm^2) background pressure (~10^{-5} Torr) and probe-target axial distances (1 - 40 mm) for all the investigated targets. Time-resolved optical investigations were focused on recording snapshots of the laser-produced plasmas at different time delays with respect to the ablation laser pulse, in order to investigate the structure of the plasma plumes and their global dynamics. The electrical investigations were performed by means of a Langmuir probe. By sampling the ionic and electronic temporal traces and reconstructing the *I-V* characteristics at different moments during plasma expansion, we were able to determine the temporal evolution of various plasma parameters which present different behaviors for the plasmas produced in ns, ps and fs regimes. In order to obtain information about the dynamics of the ejected ions, the ionic current is discussed in terms of a shifted Maxwell-Boltzmann distribution function, offering the possibility to determine parameters such as the drift velocity and the ion average temperature. Some plasma parameters were found to be dependent on the target physical properties. In particular, a strong connection was found between the electrical conductivities of the targets and the electronic temperature [1].

The theoretical investigations were conducted in the frame of our fractal hydrodynamic model for laser ablation plasma dynamics [2]. A compact version has been recently developed for the study of the spatial and temporal evolution of some plasma dynamic variables (T_e, n_i, $v_{thermal}$, λ_{Debye}). This version of our model was obtained by using normalized variables of the particle density, of the velocities, of the current density etc., and by selecting suitable scale resolutions. The influence of external factors on the ablation plasma dynamics is also considered by introducing the fractality degree as a global parameter. For the first time, clear relations are proposed between fractal model variables and some plasma parameters [3]. The predictions of the model are compared with experimental data obtained by using a Langmuir probe immersed in a laser-produced Aluminum plasma.

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S2 L4

CARBON BASED MATERIALS SYNTHESIZED BY MICROWAVE PLASMA ENHANCED CHEMICAL VAPOR DEPOSITION

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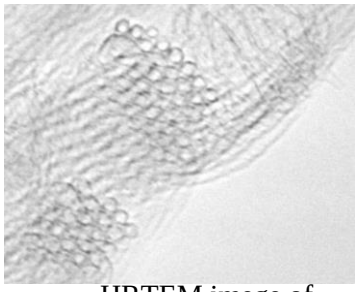
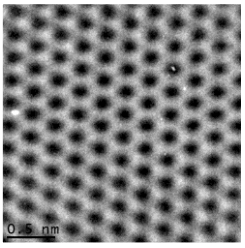
Due to evolution of nano-technological applications, the demand of 1D-, 2D- and 3D-carbon-based materials are constantly increasing. Indeed, these materials have excellent mechanical, thermal and etectrical properties and can be used for a large range of applications starting from cutting tools, electronic devices to medical applications [1, 2, 3]. Carbon materials can be synthetized in sp^2 and/or sp^3 forms and basically,.Plasma Assisted Chemical Vapour Deposition (PACVD) in a resonant cavity is one of the most versatile techniques to obtain them [4].

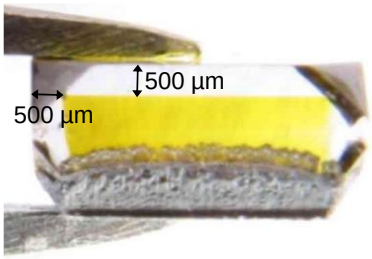
In this paper we will discuss about the principles and main advantages of this technology for the synthesis of graphene, nanotubes and diamond. In particular, we will discuss about plasma composition and how the corresponding chemistry allows us controlling the growth of carbon atoms as graphene, nanotubes and diamond. The key role played by the substrate will be discussed as well.



HRTEM imege of nanotubes



HRTEM imege of graphene



Optical image of CVD diamond layer growt on HPHT diamond substrate

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S2 L5

SYNTHESIS OF NANOMATERIALS: MODELING, SIMULATION AND SCALE-UP

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We present different modeling approaches for microwave plasma enhanced chemical vapor deposition (PECVD) of graphene and scale-up of the polyol process for cobalt-nickel nanowires or zinc oxide nanorods synthesis.

Efforts to obtain high-quality graphene film over a large area have been hampered by the lack of quantitative understanding of the gas phase chemistry as well as the nucleation and growth mechanisms at the scale and quality required for applications. In order to investigate the effect of the process parameters on the graphene growth, graphene were grown by PECVD of a mixture of methane and hydrogen over different catalysts (Co, Ni and Cu). Using a thermochemical mathematical model, we calculate the local concentration of carbon precursors on the surface resulting from the reactions taking place inside the plasma. The model includes species and energy equations for analyzing specific conditions for graphene growth in a microwave plasma reactor by extending classical chemistry formulation to non-equilibrium plasma reactors that include gas-phase reactions, surface-recombination and detailed power deposition with inelastic and elastic collision losses. To understand the effect of the macroscopic process parameters on graphene growth, a two dimension model with reduced kinetics has been also developed and implemented in the commercial computational fluid dynamics (CFD) software ANSYS Fluent. Simulations were performed to determine the gas phase fields for temperature and species concentration as well as the surface-species coverage. A model representing PECVD graphene growth on cobalt thin films by dissolution-precipitation mechanism will be presented. Our results indicates that substrate temperature as well as hydrocarbon injection time affects spatially and time resolved diffusion of carbon in bulk cobalt thereby controlling graphene nucleation and growth.

In other hand, bimetallic one-dimensional cobalt-nickel magnetic nanowires or zinc oxide nanoparticles were synthesized using the polyol process. The process was scaled-up to 4.5 liters reactor capacity to produce macroscopic quantities of magnetic nanowires. Scale-up strategy was built by empirical improvement of mixing reagents using either axial or radial mixing configurations in an agitated tank. During the synthesis,

two important local parameters appear to play an important role on the morphology of the nanowires, the Reynolds number and the energy dissipation. To access them, flow patterns developed in small and pilot scales were predicted and compared using three dimensions turbulent Computational Fluid Dynamics simulations.

S2 L6

CARBIDE PROTECTIVE COATINGS FOR SEVERE ENVIRONMENTS

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Latest research of TiSi based carbide [1] or carbonitride coatings [2] have demonstrated that both systems are promising candidates for a variety of industrial applications due to their high hardness, low friction, enhanced wear-corrosion resistance and high thermal stability.

The present paper amis to study the effects of Zr or Cr additions into TiSiC base coating system. The prepared coatings are envisaged to be used for the protection of systems/parts working under server wear and corrosion conditions. The coatings were prepared by cathodic vacuum arc method in methane atmosphere on different substrates (Si, 316L, C45). The corrosion and wear resistance of the coatings in 0.9 % NaCl solution was assessed for the TiSiC-Cr and TiSiC-Zr coatings, as well as for the reference TiSiC coating. Additional coatings investigations concerning the elemental and phase composition, chemical bonds, morphology, residual stress, hardness, and adhesion were also carried out.

All the coatings exhibited nanocomposite structures, consisting of a mixture of crystalline face-centered cubic (FCC) carbide solid solutions, with a preferential (220) texture, and amorphous carbon phases. The coatings showed compact, homogeneous and featureless cross-sectional microstructures. Cr and Zr incorporation in TiSiC resulted in lattice distortion and grain refinement. Alloying TiSiC led to a reduction of stress in the films, from -3.12 GPa (TiSiC) to -2.37 GPa (TiSiC-Cr) and -2.58 GPa (TiSiC-Zr), and to film hardness changes (TiSiC: 35.2 GPa; TiSiC-Zr: 42.1 GPa; TiSiC-Cr: 31.4 GPa). When compared to the uncoated 316L stainless steel, all the coatings exhibit better corrosion resistance in NaCl solution. For the uncoated specimen, the coefficient of friction remained practically constant during the tribological test (~ 0.3). The friction coefficient measured on the coated samples presented an unstable behaviour, presumably due to the formation and destruction of passive surface layers. The addition of both Cr and Zr to TiSiC coating led to a better friction behaviour. TiSiC-Zr coating performed the best to the corrosive attack, while TiSiC-Cr demonstrated the highest wear resistance. Combined effects of corrosive, adhesive and oxidative processes were found to mainly contribute to coating wear in corrosive environment.

Keywords: carbide coatings, cathodic arc, wear-corrosion resistance, friction coefficient.

Acknowledgements: Work supported under the projects PN 16.40.01.01, PN 16.40.01.02 (Ministry of Science and Innovation) and PN-III-P2-2.1-PED-2016-1580 (CNCS –UEFISCDI).

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S2 L7

MECHANICAL PROPERTIES AND THERMAL STABILITY OF BORON CARBIDE BASED COATINGS

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Recently, in modern material research, there is an increased interest in developing novel nanolaminate coatings. The boron and carbon based nanolaminates with X_2BC structure (i.e. X=Mo, Ta, W) [1] promise unique chemical, physical, electrical, and mechanical properties that combine the best attributes of metals and ceramics such as high temperature wear, corrosion resistance, and toughness. In this paper we report on dependence of mechanical properties and thermal stability of X-B-C coatings.
X-B-C nanostructured coatings were prepared on several different substrates (single crystalline silicon, steel, WC-Co hard-metal) using magnetron sputtering. The prepared coatings were annealed in the resistively heated laboratory furnace at several different temperatures in temperature range from 500°C to 1000 °C. The furnace chamber was evacuated to the base pressure of about 10^{-5} Pa. The details of microstructure of deposited thin layer as well as elements redistribution and changes in phase constitution caused by annealing were studied by several experimental techniques, namely scanning electron microscopy (SEM), transmission electron microscopy (TEM), X-ray diffraction and glow discharge optical emission spectroscopy (GDOES). The dependence of the X-B-C coating mechanical properties such the hardness, elastic modulus and fracture toughness on deposition conditions and the annealing temperature was studied using indentation and scratch tests at nano- as well as microlevel. In Fig. 1 an example of TEM study results is shown for MoBC coating deposited on WC-Co hard-metal substrate. This research has been supported by projects of The Czech Science Foundation (15-17875S).

Fig1. SEM image of thin lamella taken from the region of large indent (a) in MoBC film (annealed at 1000°C) shows the cross section through protective Pt layer, deposited layer and WC-Co substrate. A strong effect of Co diffusion was detected resulting in the formation of darker interlayer at coating/substrate interface see TEM images (b, c)

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S2 L8

THE AC PROBES FOR DIAGNOSTICS OF PROCESSING PLASMAS

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Plasma-assisted materials processing has been widely applied to microchip production technology, surface modification, and fabrication of innovative thin films. In order to understand and control the reactive plasmas the knowledge of basic plasma parameters is required, especially of the electron density. The Langmuir probe becomes unusable when the process under investigation creates an electrically non-conducting

film on the probe surface. Hence a range of AC probe method has been developed to overcome this problem. The presentation gives an overview of AC probes that are suitable for diagnostic of processing plasmas. Among others the principles of a plasma impedance probe, a plasma oscillation probe, a hairpin probe, a multipole resonance probe and a curling probe will be given.

The above AC probe methods determine the electron density from the electron plasma frequency and require therefore the microwave instrumentation. On the contrary the so-called floating harmonic probe technique [i,ii] uses harmonic AC signal of rather low frequency in the kHz range that is applied to the conventional Langmuir probe over a large capacitor; the Langmuir probe remains hence floating. From the curvature of the probe characterictic - in the vicinity of the floating potential - that is characterized by the harmonic distortion of the probe current the electron temperature T_e (in volts) can be obtained by using the expression $\frac{i_{1\omega}}{i_{2\omega}} = \frac{I_1(V_0/T_e)}{I_2(V_0/T_e)}$ where V_0 is the amplitude of the applied voltage, $i_{k\omega}$ the k-th harmonic component of the probe current and the $I_k(x)$ the k-th order of the modified Bessel function. The ion density (assuming the constant ion current) is obtained from expression $n_i = \frac{|i_{1\omega}|}{2(0.61eu_BA)} \frac{I_0(V_0/T_e)}{I_1(V_0/T_e)}$ where the u_B is the Bohm velocity given by $u_B = \sqrt{\frac{k_B T_e}{m_i}}$ [i]. In [ii] the expression for T_e was refined by using measurements of $i_{k\omega}$ at two applied AC voltages with different amplitudes V_1 and V_2 that generated first harmonics $i_{1\omega,1}$ and $i_{1\omega,2}$: $\frac{i_{1\omega,1}}{i_{1\omega,2}} = \frac{I_0(V_2(\cos\varphi_2)/T_e)I_1(V_1(\cos\varphi_1)/T_e)}{I_0(V_1(\cos\varphi_1)/T_e)I_1(V_2(\cos\varphi_2)/T_e)}$ (φ_i is the phase of $i_{1\omega,i}$ with respect to V_i) from which the T_e can be obtained numerically. In [iii] the method has been further modified by aplying two AC signals with different frequencies and the authors claim to be able to determine the electron energy probability function.

We attemped to compare the plasma parameters estimated from the AC harmonic floating probe method with the conventional Langmuir probe measurements in an argon DC plasma jet discharge and present the first experimental results.

The partial financial support by the Czech Science Foundation, grant 15-00863S, is gratefully acknowledged.

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S2 L9

STUDIES ON THE BINARY FILMS BASED ON TITANIUM BY THERMIONIC VACUUM ARC (TVA) METHOD

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Titanium based nanocomposites owing to their remarcable properties of the coating surfaces such as wear resistance, roughness, low friction coefficients have been synthetized and investigated in different combination and forms, such as multi-component composites.

The present work intends to provide a new approach in plasma technology design by implementing laser beams for producing advanced materials. The main objective is to make the innovation by implementing the Laser-beam in the Thermionic Vacuum Arc plasma, applying the new technology: Laser induced Thermionic Vacuum Arc (LTVA) on Titanium based nanostructures. This new concept will use at maximum the offered performances by TVA technology and by Laser-beam effect**.**

For this reason, plasma/surface interactions and growth mechanisms have to be taken into account for the definition, evaluation and comparison of the different types of coating equipment and achievable coating

results. The challenge of this work is to find the best combination for coating the mechanical parts of components by suitable complex nanocomposites and by using innovative technology.

Binary thin films as well as single thin films were deposited using Thermionic Vacuum Arc (TVA) technology. The thin films were characterized using scanning electron microscope (SEM, Zeiss EVO 50 SEM) accompanied with energy dispersive spectrometer and transmission electron microscope (TEM, Phillips CM 120 ST, 100 kV) and AFM. The film is composed of nanoparticles very smoothly distributed of 15-30 nanometer size embedded in amorphous matrix film, and by AFM analysis in AAC mode (acoustic AC mode, „tapping"). Roughness analysis using ISO standardization methods of TiCr reveals 1.11 nm Sa roughness.

Keywords: titanium, multi-components, TVA.

S2 L10

STRUCTURAL AND OPTICAL STUDY OF $Ti_xSi_{(1-x)}O_2$ FILMS PREPARED BY PLASMA ENHANCED CVD

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The mixed TiO_2-SiO_2 oxides have attracted considerable attention in the area of photocatalysis because they are more active than pure TiO_2. There are also multiple possible optical application for such coatings, with demonstrated use in waveguides, laser mirrors and rugate filters. They are also considered as an alternative dielectric for high-k applications.

Thin $Ti_xSi_{(1-x)}O_2$ films were deposited on Si substrate by plasma enhanced CVD (PECVD) in a low pressure high density plasma reactor described in detail elsewhere [1]. The apparatus consists of an inductively coupled plasma source (13.56 MHz) and a diffusion chamber mounted below the source. The deposition worked in the mixture of oxygen, hexamethyldisiloxane (HMDSO) vapours ($C_6H_{18}OSi_2$) used as the silicon precursor, and titanium isopropoxide vapours (TTIP) vapors ($Ti(OC_3H_7)_4$) used as the titanium precursor. The film composition x was varied by changing the flow rate of HMDSO while keeping the flow rate of TTIP and O_2 constant. The substrate holder was at the floating potential.

We used the density functional theory (DFT) to predict optical properties of amorphous $Ti_xSi_{(1-x)}O_2$ solid solutions. Details are described by Ondračka et al. [2]. The calculated band gaps evaluated using the Tauc-like fitting approach were 8.53 eV for SiO_2, quickly decreasing to 4.0 eV at x = 0.19, 3.52 eV at x = 0.34 and 3.24 eV at x = 1.0. Ellipsometry and spectrophotometry of experimental samples yielded a compositional trend for the experimental optical band gap comparable with our predictions. We have obtained a good agreement between calculated and measured imaginary part of the dielectric function, especially for the TiO_2 rich compositions. The chemical bonding in the films was investigated by X-ray photoelectron spectroscopy (XPS). We develop a quantitative approach to the determination of phase separation in mixed TiO_2-SiO_2 films using fitting of XPS data. XPS spectra of $Ti_xSi_{(1-x)}O_2$ material were modelled from first principles using DFT in order to some assumptions and constraints used in the fitting procedure.

Acknowledgement

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S2 O1

LASER SURFACE HARDENING OF AISI 410 STAINLESS STEEL BY USING HIGH POWER DIODE LASER

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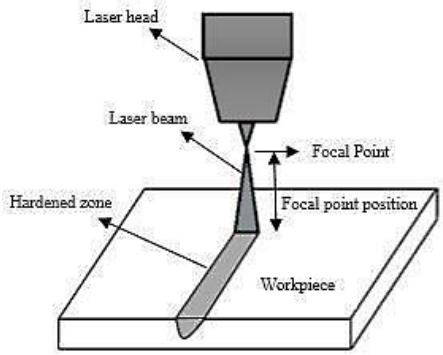
Laser surface hardening is a promising technology used for surface modification to improve the tribological materials properties. This paper surveys the capability of laser surface hardening of AISI 410 martensitic stainless steel by using continues high power diode laser with a maximum power of 1600 W. Laser power, scanning speed and focal point position were considered as variable parameters in this research. Experiments carried out by varying laser power, scanning speed and focal point position from 1200W to 1600W, 4mm/s to 7mm/s and 65mm to 75mm, respectively. The influences of process parameters on depth and width of hardened layer and microhardness distribution in laser treated areas (depth and width), were investigated. Microstructure of the laser hardened zone was studied and analysed.



Schematic of the laser surface hardening process

Results show that by increasing laser power and decreasing scanning speed, higher hardness and depth achieved. Results also reveal that width of hardened layer increases by increasing in focal plane position and reduction the laser power. Maximum thickness of hardened layer of 1.5 mm in depth and maximum surface hardness of 572 HV0.3 is obtained. Schematic of the laser surface hardening process is shown in the following Figure.

Keywords: Laser Surface Hardening, AISI 410, High Power Diode Laser, Microhardness**.**

S2 O2

EFFECTS OF LASER RADIATION FIELD ON ENERGIES OF HYRDOGEN ATOM IN DEBYE PLASMA MODELED BY HULTHEN POTENTIAL

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In this study, for the first time, to investigate effects of the laser field on hydrogen atom embedded in Debye plasma, the Schrödinger equation with Hulthen potential is numerically solved within the Ehlotzky approximation using the asymptotic iteration method. Use of the Hulthen potential to determine the screening effects on hydrogen atom embedded in Debye plasma would be useful for modeling Debye plasma in investigations of the atomic structure and collisions in the plasma physics field. The interaction potential formed by applying laser field is called as laser-dressed potential. The plasma screening effects under the influence of laser field as well as confinement effects of laser field on hydrogen atom in Debye plasma are investigated by solving the Schrödinger equation with the laser-dressed Hulthen potential. It is resulted that since applying a monochromatic laser field on hydrogen atom embedded in Debye plasma leads to shift in the profile of the total interaction potential, this shift changes localizations of energy states of hydrogen atom embedded in Debye plasma, which can be functional for experimental applications.

Keywords: Hulthen potential, laser field, Debye plasma, hydrogen atom.

S2 O3

LINEAR AND NONLINEAR FIT IN DLS TIME SERIES PROCESSING

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Keywords: Dynamic Light Scattering (DLS), Time series

If a coherent light beam is incident on a fluid containing suspended particles, each particle scatters light by an elastic interaction. The scattered wavelets are coherent, as well, therefore they interfere in the far field. The aspect of the far interference field is of maxima and minima randomly distributed. The scattering centers undergo a complex motion, as an overlapping of the Brownian motion with the sedimentation motion, the scattered light presents time fluctuations and the far field interference has the typical aspect of boiling speckles. If a small detector is placed in the interference field and the electric signal proportional to the light intensity is recorded, a DLS time series is obtained.

One known procedure of assessing the diameter of the particles in suspension, Dynamic Light Scattering (DLS), consists of several steps. The first step produces the frequency spectrum of the power time series, also called the power spectrum density. The second step consists of removing the noise from the spectrum, which means removing the 50 Hz line and the harmonics, which is produced by the power grid and induced in the connecting cables.

The power spectrum density of a DLS time series can conveniently be described by the functional form of the Lorentzian function S(f), and finding the a_0 and a_1 parameters by a least square fit is the third step.

$$S(f) = a_0 \cdot \frac{a_1}{(2\pi f)^2 + a_1^2}$$

The diameter of the SCs can be assessed as the double of the radius R, which is related to the parameter a_1.

Instead of performing a nonlinear fit, linearizing S(f) and doing a linear fit seems appealing and simple, because 1/S(f) can be seen a linear function of f^2:

$$\frac{1}{S(f)} = \frac{4\pi^2}{a_0 a_1} \cdot f^2 + \frac{a_1}{a_0}$$

During the nonlinear fit, the turnover point in the log-log plot, closely related to the a_1 parameter, hence to the radius R, is found. In this fit the data points in the small frequency range of the power spectrum have the biggest weight, having the biggest values, while the big frequencies range, with the smallest values, has the smallest weight. The nonlinear fit on 1/S(f) though has the biggest weight on the big frequency range, which presents large fluctuations, making the results of the linear fit tremendously imprecise.

S2 O4

DCMS AND HIPIMS DEPOSITION OF W AND WN THIN FILMS FOR DEUTERIUM DESORBTION STUDY

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Already in use thermonuclear reactors (JET) and future machines (ITER and DEMO) need a good understanding of PFC and reactor wall processes. Nuclear fuel retention and desorption in and from walls contributes for maximized efficiency in power generation and minimum fuel loss. This work focuses on

problems that occur from the world's tritium stock regulation as well as the search for a suitable seeding gas in cooling down the divertor.

By the use of two methods, Direct Current Sputtering (DCMS) and multipulse-High Power Impulse Magnetron Sputtering (m-HiPIMS), we deposited thin tungsten films in Ar-D and Ar-D-N reactive atmospheres on 12 x 15 mm substrates. Three Mass Flow Controllers (MFC) ensured gas ratio mixtures at 1:1 Ar-D and 1:2:1 for Ar-D-N.

The thin films obtained were analyzed by X-Ray Diffraction method (XRD) in order to determine the structural proprieties and observe the crystalline growth of each type of deposition. Also Thermal Desorption Spectroscopy method (TDS) to determine the retention mechanisms of deuterium. TDS empirical measurements show how much the Ar seeding modify the deuterium desorption temperatures.

Future methods of degassing the reactors need to be designed in ways that take into account modifications of desorption peaks, depending on the cooling gas.

Keywords: thin film deposition, fuel retention, deuterium desorption,

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S2 O5

THE INFLUENCE OF AR/D RATIO ON D RETENTION IN BERYLLIUM THIN FILMS OBTAINED BY DIRECT CURRENT MAGNETRON SPUTTERING METHOD

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Tritium removal is a top priority for International Thermonuclear Experimental Reactor (ITER). Regular bake-out procedures have the purpose to keep the tritium limit under the imposed limits. In an ITER all-metal design 93% of the reactor chamber will be composed of beryllium (Be) tiles distributed in the first wall and plasma limiters and the rest of 7% of tungsten tiles will form the divertor area. Since implantation with nuclear fuel ions will penetrate only 300 nm in Be it is expected that codeposition will play a major role in nuclear fuel retention. Due to the fact that Be tiles present a large surface in contact with the edge plasma and the sputtering yield for light hydrogen ions is larger in comaparison to tugsten, retention, Be codeposition will dominate the inventory accumulation. It is expected that a Be codeposited layer 400 nm thick can develop after 400 s ITER shot. Our study addresses a fundamental issue related to D inventory in Be codeposits. D doped Be 500 nm samples were obtained by reactive direct current magnetron sputtering process in a Argon (Ar) and D atmosphere. Six types of coatings were performed at a constant deposition rate by varying the Ar:D ratio. Four types of substrate: graphite, molybdenum, silicon and stainless steel were used. SEM measurements were performed on these coating and the results show no major surface morphology changes as a function of Ar/D ratio. RBS measurements results highlights an oxygen contamination at the top and layer-substrate boundary. Thermal desorption spectroscopy was used to assess the D inventory in respect to Ar/D ratio and as well to understand the influence of the substrate upon the total D inventory.

S2 O6

NANO EFECTS OF ION IMPLANTATION ON HARD COATINGS

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In this paper, we present the results of a study of TiN thin films which are deposited by a Physical Vapour Deposition (PVD) and Ion Beam Assisted Deposition (IBAD). In the present investigation the

subsequent ion implantation was provided with N2+ ions. The ion implantation was applied to enhance the mechanical properties of surface. A duplex surface treatment involves the sequential application of two surface technologies to produce a surface composition with combined properties. A typical duplex process involves plasma nitriding and the coating treatment of materials. The duplex coating method can improve further of the tribological properties and load-bearing capacity of materials beyond metals. The synthesis of the TiN film by IBAD has been performed by irradiation of Ar ions. Ion implantation has the capabilities of producing new compositions and structures unattainable by conventional means. Implantation may result in changes in the surface properties of a material, including hardness, wear, coefficient of friction and other properties.The nitrogen to metal ratio, EDX, table 1, is stoichiometries for IBAD technology and something smaller from PVD. The nanohardness values and microhardness are shown in table 2.

TABLE 1. ATOMIC RATIO N/TI IN COATING

	Coating	Ratio N/Ti (atomic)
1	IBAD	1.00
2	PVD	0.98
3	PVD/III	0.89

TABLE 2. SURFACE MICROHARDNESS (HV0.03) AND NANOHARDNESS (LOAD-10MN).

Unit	pn/IBAD	PVD	pn/PVD/II	Fused Silica
Vickers	2007	3028	3927	943
GPa	21.6	32.6	42.6	10,1

The thin film deposition process exerts a number of effects such as crystallographic orientation, morphology, topography, densification of the films. The evolution of the microstructure from porous and columnar grains to densel packed grains is accompanied by changes in mechanical and physical properties. A variety of analytic techniques were used for characterization, such as scratch test, calo test, Scanning electron microscopy (SEM), Atomic Force Microscope (AFM), X-ray diffraction (XRD) and Energy Dispersive X-ray analysis (EDAX).The optimization procedure for coated parts could be more effective, knowing more about the fundamental physical and mechanical properties of a coating. In this research are present the results of a study of the relationship between the process, composition, microstructure and nanohardness of duplex TiN coatings and modified with ion implantation.

Keywords— steel, coating, super hard, ion implantation, nanohardness

Acknowledgments: The authors would like to thank to The Provincial Secretariat for Higher Education and Scientific Research of Vojvodina, which supported this work by grant.

S2 P1

BIOFUNCTIONAL PLCL BASED-COATING OBTAINED BY MATRIX ASSISTED PULSED LASER EVAPORATION

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An important aspect in the field of biomedical research and tissue engineering is given by the biological reactions which occur at proteins and cell-surface interfaces. Poly(lactide-co-caprolactone)-blockpoly(ethyleneglycol)-block-poly(lactide-co-caprolactone) PLCL-PEG-PLCL co-polymers are studied extensively for their applicability in drug delivery and like ligament-bone interface applications. In this work, a parametric study on the optimization of the synthetic biodegradable PLCL-PEG-PLCL co-polymer thin films by using matrix assisted pulsed laser evaporation (MAPLE) is presented. The evaporation process of the copolymer was carried out using an Nd:YAG pulsed laser, operating at different fluences (0.3–0.9 J/cm2) with a wavelength of 266 nm and a repetition rate of 10 Hz. The main functional groups in the MAPLE-deposited thin films were determined by Fourier transform infrared spectroscopy. The results of the Fourier

transform infrared spectroscopy revealed the similarity between the molecular structures of the transferred material and of the initial material. The morphological characteristics of the samples were analyzed by characterization techniques such as Atomic force microscopy (AFM) and Scanning Electron Microscopy (SEM). The ability to control the morphology and chemistry of the deposited material through MAPLE technique is an important step in creating functional biointerfaces.

Acknowledgments: This work was supported by Romanian National Authority for Scientific Research (CNCS – UEFISCDI), under the projects PNII- PTPCCA-2013-4-199, PN-II-RU-TE-2014-4-2434 and PN09-39)

S2 P2

STUDY OF DOPING CONCENTRATION EFFECT ON NONLINEAR AND DISPERSION CHARACTERISTICS OF PHOTONIC CRYSTAL FIBER (PCF)

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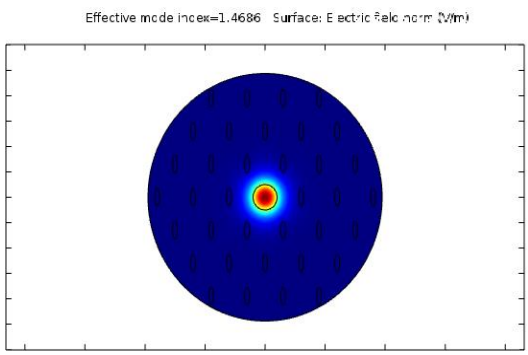
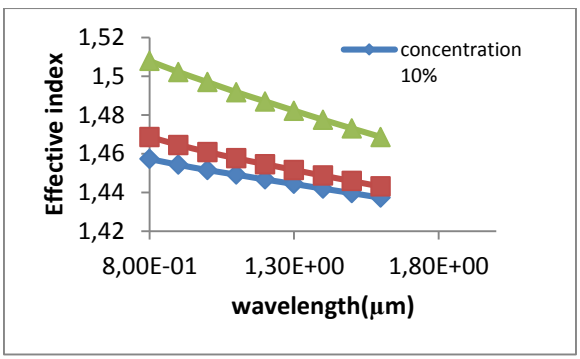
The photonic crystal fiber (PCF), have emerged due to the fact that conventional fibres can not provide certain properties [1], such as anomalous dispersion at short wavelengths [2], enhanced nonlinearity [3],and endless single mode operation [4]. In this work, we have modeled a solid-core photoniccrystal fiber (PCF) by using Comsol Multiphysics based in the finite element method (FEM). The suggested design has a central hole with elliptical air holes in the cladding arranged in a hexagonal array with constant pitch in silica. The material of core region is GeO2 doped SiO2 wich represent the high index part[5].The important optical properties like dispersion,effective area and nonlinear coefficient has been studies. Each characteristic has been investigated under different doping concentration within range of wavelength 800-1600 [nm].The intensity and the shape of output light in two dimension is shown in figure (1).

Results show that the maximum of n_{eff}=1.5079 was observed at 800 [nm] and 50% of doping concentration in photonic crystal fiber (PCF) with elliptical air holes, and the minimum of n_{eff}=1.4686 was observed at 1600 [nm] and 10% of doping concentration.The values of neff are useful for studing the characteristics of (PCF) (fig.2).





Fig(1) field distribution of proposed (PCF) structure. *Fig(2) Effective index vs. Wavelength (λ)*

Keywords: photonic crystal fiber, dispersion, finite element method.

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S2 P3

MULTIFUNCTIONALITY OF LEAD-FREE PIEZOELECTRIC $(Ba_{1-x}Ca_x)(Zr_yTi_{1-y})O_3$ THIN FILM OBTAINED BY LASER TECHNIQUES

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The environmental friendly oxide materials such as (Ba1−xCax)(ZryTi1−y)O3 (BCZT) are key materials in latest research due to their high dielectric constant and strong piezoelectric response. The phase diagram of BCZT system exhibit a morphotropic phase boundary (MPB) point around x/y = 0.15/0.10, where the rhombohedral - tetragonal phases coexist. At MPB point the dielectric and piezoelectric properties are maximized (i.e d33 reaches values of 500-600 pC/N). In this work we present the BCZT thin films with tailored properties for different functionalities needed in electronics and biotechnology. Using Pulsed Laser Deposition (PLD) technique, the role of epitaxial strain and fine stoichiometric changes induced into the BCZT nanostructured thin films during growth on the enhancement of electrical and piezoelectric properties is revealed. The thin films structural features and induced microstrain due to the lattice misfit between the pseudocubic lattice parameter of BCTZ and the used substrates were studied by X-ray diffraction (XRD) and high resolution transmission electron microscopy (HR-TEM). The dielectric properties (relative permittivity of about 2200 and tangent loss ~ 1-1.5% at frequency of 10 KHz) have been obtained by dielectric spectroscopy. The local piezoelectric properties (d33~280 pm/V), polarization dynamics and switching characteristics of the samples were investigated by piezoresponse force microscopy technique (PFM). Moreover, the applicability of piezoelectric active layers of BCZT thin films deposited by Matrix-Assisted Pulsed Laser Evaporation (MAPLE) in biotechnology has been demonstrated. The mechanisms by which BCZT-based biofilms facilitate cellular adhesion were investigated. The roles of human epithelial embryonic kidney HEK 293 cells and human malignant melanoma A 375 cells adhesion to BCZT thin films were studied using various bio-assays. The hMSC are of great interest as progenitors of bone cells, especially in regenerative medicine.

S2 P4

CHARACTERIZATION OF THE ADVANCED TANTALUM OXIDE COATINGS DEPOSITED BY TVA METHOD FOR INDUSTRIAL APPLICATIONS

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The aim of this paper is to report on the results of the wettability, thickness, refractive index and the morphology of the nanostructured Tantalum oxide (Ta_2O_5) films deposited by using the Thermionic Vacuum Arc (TVA) method. The morphology and the structure of the thin films surface were examined using a Philips

CM 120 ST (120 kV) TEM provided with HR-TEM facility capable of obtaining a resolution of 1.4 Å and a magnification of 1.2 M.

Wettability of the surface was calculated by the contact angle method. The measurement were performed by establishing the tangent angle of a sessile liquid drop on a solid surface, defined by the mechanical equilibrium of the drop under the action of three interfacial tension solid-vapour, solid-liquid and liquid – vapour, by meaning of the performed analysis software See System. The surface free energy (SFE) of the Ta_2O_5 thin films indicating a hydrophilic character. Also, the thickness and refractive index of the thin films was measured by Filmetrics F20 Model Thin Film Analysis. This device uses the spectral reflectance measurements as optical technique.

All of these results were developed taking into account the Ta_2O_5 are difficult to be processed. However, Ta_2O_5 films find applications in many fields such as: dielectric for storage capacitors; gate insulators in metal-oxide-semiconductor devices; optical coatings, anti-reflection coatings and coatings for hot mirrors. Films of Ta2O5 are also used in various medical applications due to bio- and chemically inert, being presented as prospective biomaterials in prosthesis, coronary stents or dental implants.

Thermionic Vacuum Arc can be ignited in vacuum between a heated cathode surrounded by an electron focusing Wehnelt cylinder and an anode (tungsten crucible) containing the material to be deposited (Ta_2O_5). The Thermionic Vacuum Arc (TVA) method is a new discharge type in pure metal vapour plasma, which can become one of the most suitable technology to significantly improve the quality of the surfaces covered with different materials. Two types of substrates were used in this work: silicon wafer and glass. The high value of refractive index ($n \approx 2$) as well as other properties like uniformity, low roughness and smoothness suggest that Ta_2O_5 thin films deposited by TVA technology could be considered as valuable advanced coatings materials for optical applications. Tantalum oxide thin coatings have rapidly evolved into an important field of research/development with the promise of creating a new generation of advanced micro devices for industrial applications.

Keywords: Ta_2O_5 thin films, Thermionic Vacuum Arc (TVA), free surface energy, refractive index, TEM

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S2 P5

CARBON DOPED FILMS OBTAINED BY THERMIONIC VACUUM ARC METHOD

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The synthesis of Ag, Mg and Si nanocrystalline, embedded in hydrogen-free amorphous *carbon* (a-C) matrix, deposited by a high vacuum and free buffer gas technique, were investigated. The films with compact structure and extremely smooth surface were prepared using the Thermionic Vacuum Arc (TVA) method in one electron gun configuration, on glass and silicon substrates.

The surface morphology and wettability of the obtained multifunctional thin films were investigated using: Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM) and Free Surface Energy (FSE) by See System.

The results from TEM measurements shows how the Ag, Mg and Si interacted with carbon and the influence this materials have on the thin film structure formation and the grain size distribution. From the SEM results we can make a very precise comparative study, regarding the quantity of the elements that morphed into carbides nanostructures. Also the FSE results prove how different material in combination with carbon can make changes to the surface properties

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S2 P6

ANALYSIS OF EMISSION SPECTRA FROM PLASMA ENHANCED CHEMICAL VAPOR DEPOSITION IN PRODUCTION OF GRAPHENE

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Graphene synthesis by chemical vapor deposition has been hampered by the lack of quantitative understanding of the gas phase chemistry as well as the growth mechanism at the scale and quality required for applications. In this work, we investigate methodologies for *in situ* measurement of atomic hydrogen concentration as well as rotational and excitation temperatures during Plasma Enhanced Chemical Vapor Deposition (PECVD) of Graphene over cobalt or copper catalysts. The plasma emits radiations from hydrogen atomic and molecular lines and from C_2 Swan band. The aim of the study is to obtain estimates of the plasma temperatures, and species densities at various locations in the plasma in order to determine what factors lead to the formation of defect free and few layers graphene. Since atomic hydrogen is one of the most reactive species in the plasma, its relative concentration is critical for graphene growth. Hence, the experiments were first conducted in pure hydrogen by measurements of spectra for various combinations of microwave power (300-400 W), pressure (10 -25 mbar) and substrate temperature (700-900°C). The light from the PECVD system was analyzed by optical emission spectroscopy (OES) using a spectrometer with 0.5 meter focal length and a 1800 gr/mm grating (Acton SP-2500i) on which an intensified Charged Coupled Device camera was mounted (Princeton Instruments PIMAX 2). Several spectral regions including H_2 Fulcher band and atomic lines $H_\square$ and $H_\square$ were acquired for different plasma conditions. From the analysis of spectral features from the Q-branch of the H_2 Fulcher band, we determine rotational temperature. Using argon as actinometer, we succeed also to estimate H-atom mole fractions. When the methane is added to the discharge as carbon feedstock, several dozens of species are formed in C-H system including C_2 molecules. An estimate of the rotational temperature of C_2 molecules was determined from fits of calculated spectra to measured spectra for the C_2 Swan band. Good agreement was found between the experimental results and modeling results, calculated with (0D) and (1D) codes for a wide range of powers and pressures. Experimental optimal growth conditions of graphene correspond to the maximum H-atom concentration in the plasma.

S2 P7

NONLINEAR OSCILLATIONS OF DUST ROD PARTICLES TRAPPED IN THE SHEATH OF LOW DENSITY PLASMA

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The interest for dynamics of asymmetric particles, cylindrical or microrods [1-5] has grown and is justified since in many cases the dust particles have different shapes (astrophysical enviroment, plasma reactor). In this paper, we present an experimental investigation of dust dynamics in complex plasma with cylindrical particles, to introduce the nonlinear behavior of oscillating systems in the dusty plasma laboratory.

An experimental analysis of nonlinear oscillations of one single dust particle, respectively small assemblies of two and three dust cylindrical particles levitated in the sheath of a capacitive rf plasma, above the driven electrode is made. The problem is analyzed starting with single rod particle effects, where levitation, confinement in plasma traps, charging [5], and oscillations are involved. Self-excited horizontal and vertical oscillations are discussed [6]. Then the interaction force between the particles is explored in two particle systems.

Particular attention is paid to the case of three particles, where a rotational motion in the absence of any external magnetic field is observed.

The chosen approach consists of determination of particles kinetics from visual observations using a high speed camera.

Dust-dust interaction and the attracting ion wakes [6,7] are proposed as possible mechanisms for inducing the observed dust oscillations. Dust particles levitation displacement across a wide range of rf voltage is measured.

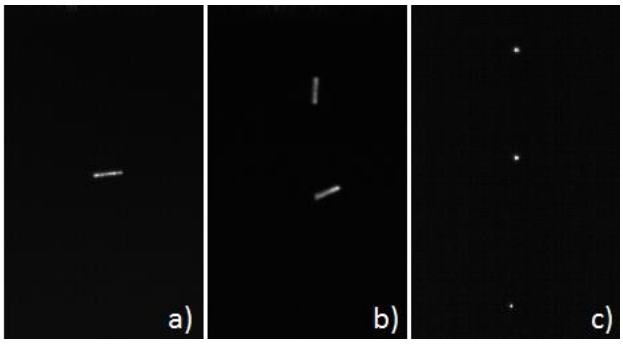

Figure: a) one single dust particle, b)two and c) three dust cylindrical particles levitated in the sheath of a capacitive rf plasma

Keywords: oscillations, cylindrical particles, wake potential, dusty plasma;

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S2 P8

CRACKS AND NANODROPLETS PRODUCED ON TUNGSTEN SURFACE BY DENSE PLASMA JETS

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Tungsten is currently the leading candidate material for building the divertor components of tokamaks due to its high melting point, low tritium retention, low sputtering yield for tritium nuclei, and high thermal conductivity [1]. Small samples of 12.5 mm in diameter made from pure tungsten were exposed to a dense plasma jet produced by a coaxial plasma gun operated at 2 kJ [2]. The surface of the samples was analyzed using a scanning electron microscope (SEM) before and after applying consecutive plasma shots. Cracks and pits were produced in the surface due to surface tensions during plasma heating. Nanodroplets of a few tens of nanometers in size could be observed on the samples surface, most likely formed after condensation of the surface vapors, as shown in Fig. 1. Four types of samples were prepared by spark plasma sintering from powders with the average particle size ranging from 70 nanometers up to 80 microns [3]. The plasma power load to the sample surface was estimated to be ~4.7 MJ $m^{-2}s^{-1/2}$ per shot. A triple Langmuir probe was used to measure the plasma temperature and density, with peak values 17 eV and 1.6×10^{22} m^{-3}, respectively.

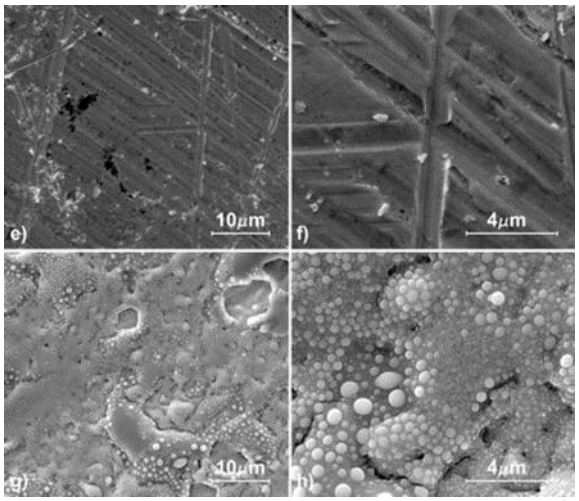

Fig. 1 Images of one sample surface in a) and b): before exposure to plasma; c) and d): after exposure to 10 plasma jet shots.

Acknowledgements: This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 under grand agreement No 633053 and from the Romanian National Education Ministery under contract 1EU8/2014.
Keywords: tungsten, plasma jet, nanodroplets, fusion

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S2 P9

CuCoFe THIN FILMS WITH MAGNETORESISTIVE PROPERTIES

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CuCoFe thin films were deposited by Thermionic Vacuum Arc(TVA) method on glass and Si substrate. The deposition was a multilayer one, each layer having a thickness of 10 nm. The first layer was of Cu, then one layer of Co, one of Cu and last one of Fe; this order repeated itself until film reached the thickness of 160 nm (16 layers). After the deposition, the samples were thermally treated for an hour at the temperature of 400ºC. With the help of X-ray diffraction, it was emphasized the existence of the intermetallic compound $Fe_{0,28}Co_{0,72}$ with a cubic network with centered volume, the network parameter **a = 8.747 Å,** with the main maximum at angle $\mathbf{2\Theta = 43.88^0}$ coresponding to the interplanar distance **d = 2.06 Å**, of the family of planes of Miller indices(411). The presence of this compound can be explained by the intensification of the diffusion phenomenon together with the increase of temperature. The galvanomagnetic measurements reveal the presence of a gigant magnetoresistance effect of these structures.
Keywords: Thermoionic Vacuum Arc, X-ray diffraction, gigant magnetoresistance.

S2 P10

MATRIX ASSISTED PULSED LASER EVAPORATION OF TiO_2 FOR DYE SENSITIZED SOLAR CELLS

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Thin films obtained using the Matrix Assisted Pulsed Laser Evaporation (MAPLE) of titanium dioxide (TiO_2) grown on soda lime glass covered with a conductive layer of fluorine-doped tin oxide (FTO) was investigated. Different set ups for MAPLE installation was used. It was found that the properties of such transparent conductive oxide TiO_2/FTO electrodes depend on this parameter. The TiO_2 films exhibited a good optical transmittance in the visible range. In addition, the films were homogenous, smooth, adherent, and without cracks or any other extended defects, being suitable for opto-electronic device applications, such as dye sensitized solar cells (DSSCs).

Keywords: TiO2 thin films, MAPLE, DSSCs.

S2 P11

ON THE OPTIMIZATION OF THE QUALITY OF ELECTRON DIFFRACTION IMAGE IN CHARACTERIZATION OF THIN FILMS USING THE PRECESSION SYSTEM

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Nanostructured materials are accurately investigated using TEM (Transmission Electron Microscopy), but compromise must be made when information are acquired using electron diffraction technique. Due to instrument geometries, the errors in electron diffraction data are larger compared to X-Ray diffraction, making the analysis difficult.

The advantage of using electron diffraction is the small area taken into study, up to a few square nanometers, but sample can be complex and can affects the results. For amorphous samples, we cannot separate useful data because of the additional quantity given by scattering on amorphous carbon or formvar film substrate. Crystalline structure analysis can be done in two steps: first, crystallographic information and cell parameters determination and second, refinement of the unit cell, including atom position.

To improve the quality of electron diffraction analysis we use precession technique: First of all, the electron beam is deflected and rotated using the condenser lens. Frequency of rotation is a controllable parameter using electronic equipment. After the beam interaction with the material studied, it is recollimated by means of DeScan lens. We applied Cohen method with a model implemented by Nielson-Riley adapted for electron diffraction by simple trigonometric approximation valid in electron diffraction case ($\sin\Theta = O$, $\cos\Theta = 1$).

We compared the electron diffraction results in the case of precession method with the conventional electron diffraction method for different thin films, based on software, wich coordinate the precession system with an original hardware system.

Keywords: Tem, Electron Diffraction, Precession, Thin Films

S2 P12

TUNING MICROSTRUCTURE AND ELECTRICAL PROPERTIES OF COMPLEX SUBSTITUTED PZT THIN FILMS DEPOSITED BY PULSED LASER DEPOSITION

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Ceramic samples of (Pb1-x Srx)(Zr0.52-ySby)(T0.48-zMnz)O3, with different lead contents, prepared by solid-state reaction technique, was used to obtain thin films on silicon substrate. The variation of the chemical composition and electrical properties of PZT thin films as a function of oxygen pressure and laser fluence during pulsed laser deposition is used to tune the properties. Scanning electron microscopy (SEM) was used to evidence the microstructural properties of the films. X-ray diffraction (XRD) and electrical measurements was performed. The permittivity and the dielectric loss were measured in a frequency range of 100-106 Hz. Dielectric properties depend on the phase content. The dielectric losses are less than 3% in a frequency range of 100-104 Hz.

Keywords: thin films PZT, ceramics, dielectric, piezoelectric

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S2 P13

CHARACTERIZATION AND THE ANTIBACTERIAL PROPERTIES OF THIN FILMS AND THE CU/AG OBTAINED BY THERMIONIC VACUUM ARC METHOD

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Bacteria, viruses and fungi are found in human habitat and some of these micro-organisms are generating pathogenic strains. Thus, the growth of pathogenic micro-organism on surfaces with which we interact in our everyday life is going to be a threat to human life. People from around the world, like doctors or scientists, are struggling to annihilate them, but the major problem is that they develop fast. The ability of bacteria to grow on different surfaces is causing huge concern in hospitals and food industries due to the increased risk of bacterial infection.

It was discovered that some metals, for example silver or copper, show some antibacterial properties and they have been used for centuries in different purposes both clinical and non-clinical because of their ability to limit the development of a wide range of micro-organisms.

In this study, we saw the effects of interaction between two bacteria, E.coli and S.aureus and our coated surfaces with silver, copper and both of them simultaneously. The surfaces were coated by Thermionic Vacuum Arc method. The samples` morphological and structural properties were investigated. XRD, RBS ,SEM and tribology measurements revealed the textured nature of the samples and also its high roughness.

Keywords: antibacterial thin films, Staphylococcus aureus, Cu/Ag thin films

Acknowledgements: This work was supported by a grant of the Romanian National Authority for Scientific Research, CNDI– UEFISCDI; project number 80/2014, PN-II-PT-PCCA-2013-4-2165

S2 P14

POST-MORTEM ANALYSES OF SELECTED SAMPLES CUT FROM TILES EXPOSED TO JET PLASMA

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Marker Be tiles, consisting on Be bulk tiles, 2 μm Ni film and 10 μm Be film were prepared at NILPRP and installed into the first wall of the Joint European Torous (JET) reactor. After 2 years of operation, the the marker Be tiles were removed from JET by remote handling during the 2015 shutdown and were disassembled in the BeHF (beryllium handling facility) at JET and were sent in Romania for sectioning in small samples. The operation was performed in the Beryllium Coating Laboratory in dry conditions. The sample temperature during the sectionioning operation did not exceed 70ºC. For temperature monitoring in real time a FLIR thermovision camera (+/- 1 ºC ; 20-900 ºC) was used. In the same way, W lamellae from Tile 5 retrieved from JET divertor were sectioned with a milling machine using special cutting discs containing more than 21% diamond powder embedded in a copper alloy.

The obtained samples were characterized in order to highlight the influence of the fusion plasma on beryllium marker tiles and W lamellae

The TDS analyses were performed at a heating rate of 10 K/min with a maximum temperature of 1323 K. The samples (5x5 mm) were placed in nickel holders in order to reduce the beryllium contamination of the measurement chamber due to material evaporation at high temperatures. The main desorption of deuterium occurred between 600K-1000 K reaching its maximum in most cases around the temperature of 800 K. These high temperatures of release for deuterium indicate that all samples have traps with high binding energy. These defects were produced most likely due to irradiation damage. In some cases a release of D was observed after 1200 K. This might be associated with defects into the bulk structure. The lack of low temperature peaks (below 625K) proves that the deuterium removal procedure (heating the chamber walls) is quite efficient preventing deuterium trapping and accumulation in low energy binding states. By integrating the desorption spectra the total amount of deuterium retained in Be samples was obtained. These values are in the range of $(4.6\text{-}15.9)\cdot 10^{17}$ D/cm^2.

A number of twenty one Be samples were analysed by XRD. The spectra emphasized the formation of beryllide compounds such as BeNi and Be_2Cr. In addition, formation of oxides such as BeO, CrO and Fe_3O_4 was also detected on particular samples.

Keywords: fusion plasma interaction, marker tiles, beryllium, deuterium

Acknwledgements: The financial support of the EUROfusion WP-JET2 Programe is greately acknowledged.

ABSTRACTS

S3 – Nuclear and sub-Nuclear Physics and Applications

- *Nuclear and subnuclear sciences and Engineering*
- *Advanced detection systems*
- *Accelerated particle beams*
- *Nuclear Techniques and applications*
- *Nuclear Safety and Radiation Protection*

S3 L1

THERMODYNAMIC PROPERTIES OF LIQUID ^{3}He CONFINED IN A SINGLE WALL CARBON NANOTUBE

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A variational approach has been done to determine the behavior of fluid ^{3}He confined in a single-walled carbon nanotube at finite temperature (1-4 K). Both interactions of ^{3}He -^{3}He and ^{3}He-C have been employed by Lennard-Jones and Stan-Cole potentials, respectively. We have calculated the energy of system by the lowest order variational method based on the cluster expansion of energy. Thermodynamic properties such as entropy, free energy, equation of state, compressibility and specific heat have been computed. These calculations have been done for density range 0.1 - 1.0 nm^{-1} and three different carbon nanotube radii R=0.3, 0.48 and 0.8 nm. The equation of state diagram shows a liquid-gas second order phase transition for this system. The relevant critical exponents have been checked the by Griffiths and Rushbrooke inequalities. The remarkable point is the low density and pressure (order of 0.1 nm^{-1} and 0.1 K.nm^{-3}) of this transition point.

S3 L2

STRUCTURAL AND COMPOSITIONAL SPECIFICATIONS ON BIOGENIC FERRIHYDRITE NANOPARTICLES PRODUCTION

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A new perspective aspect in nanoscience development is the use of microorganisms for the production of inorganic nanomaterials. The development of methods for the synthesis of nanoparticles with well-defined dimensions, shape and composition is a task and an important field of research nowadays [1-7].

In the present paper, new results of bacterial ferrihydrite nanoparticles investigation by means of SANS, X-ray and PIXE methods are presented.

The bacteria used in the research were extracted from the lake Borovoe, Krasnoyarsk Region. The obtained particles were investigated by small angle neutron scattering at the YuMO spectrometer in function at IBR-2 (Dubna) reactor, X-ray at the Kurchatov Synchrotron Radiation Source (KI, Moscow) and diffractometer Empyrean (of firm PANalitical) in function at LNPh-JINR, and proton particle induced X-ray emission (PIXE) method at the 3MeV Tandetron from IFIN-HH, Bucharest-Magurele.

Support by JINR-Romania Cooperation Programme Projects for 2016-2017 years and Grants of Romanian Governmental Representative to JINR is acknowledged. S.S. acknowledge the research project № 17-43-240527 funded by Russian Foundation for Basic Research, Government of Krasnoyarsk Territory, Krasnoyarsk Region Science and Technology Support Fund.

Keywords: *bacterial ferrihydrite nanoparticles, SANS, XRD, PIXE*

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S3 L3

MULTIPLE SHAPES AT ZERO SPIN IN THE NEUTRON-RICH NUCLEUS ^{66}NI

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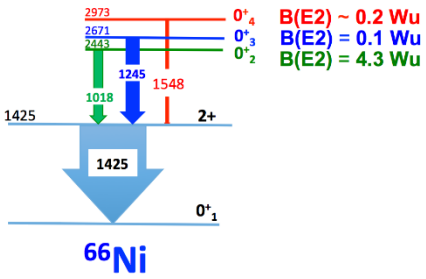
The lifetimes of the first three excited 0^+ states of ^{66}Ni were measured[1] with the ROSPHERE array[2] by employing the (^{18}O,^{16}O) two-neutron transfer reaction below the Coulomb barrier and the plunger technique. While the decay of the first excited 0^+ to the first 2^+ state proceeds with a strength of 4.3(5) W.u., the second and the third excited 0^+ states decay with a substantial hindrance via electric quadrupole, namely 0.09(1) and 0.21(7) W.u. This finding agrees well with the predictions of the Monte Carlo Shell Model, where the three excited 0^+ states are assigned to oblate-deformed, spherical and prolate-deformed shapes. Of special interest is the hindrance observed for the decay of the third excited 0^+ state, which suggest the existence of a sizeable potential barrier between the prolate and the spherical minima in the potential energy surface. This result makes ^{66}Ni a unique example of a light even-even system in which a 0^+ state from a well deformed secondary minimum does not mix with the spherical ground state. Such effect has been observed until now only for the shape isomers in the actinide region.



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Keywords: nuclear structure, ROSPHERE array, nuclear shape isomers

S3 L4

MEDICAL APPLICATIONS OF BETA AND ALPHA EMITTERS RADIONUCLIDES – ADVANTAGES AND LIMITATIONS OF SYSTEMIC RADIOTHERAPY

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Keywords: systemic radiotherapy, radioisotopes, nuclear medicine

Nuclear medicine uses unstable isotopes into pharmaceutical formulations in clinical practice both for diagnostic and therapeutic porposes. They are also used for basic medical research, as tracers, to understand metabolic pathways in humans, in pharmacokinetic or internal dosimetry studies.

The presentation is a general review on radionuclide therapy in oncology, highlighting some of the new tendencies in this field. Approximately 3800 radiation emitting isotopes can be produced artificially through neutron activation in a nuclear reactor, or nuclear reaction in a cyclotron or linear accelerator but, at present, there are 200 radioisotopes investigated for potential medical applications and only less than 50 are used clinically on a regular basis. Over 10,000 hospitals worldwide use radioisotopes in medicine, and about 90% of the procedures are for diagnosis. In developed countries (26% of world population) the frequency of diagnostic nuclear medicine is 1.9% per year. In the USA there are over 20 million nuclear medicine procedures per year among 311 million people, and in Europe about 10 million among 500 million people. Australia is the top country that uses nuclear medicine for therapeutic purposes (it is estimated that half the current population will be exposed to nuclear radiation for different diseases therapy).

In systemic radiotherapy, the molecular probes deliver *in situ* high distructive capacity of beta and alpha emitting radionuclides, based on the high specific biochemical processes; it has been proven effective for the treatment of certain commonly occurring forms of cancer, and to eradicate disseminated tumor cells and small metastases. At least eleven beta-emitting radionuclides (^{177}Lu, ^{166}Ho, $^{186/188}$Re, ^{67}Cu, ^{149}Pm, ^{199}Au, ^{77}Br, ^{105}Rh, ^{90}Y and ^{131}I) and four alpha-emitting radionuclides (^{213}Bi, ^{223}Ra, ^{225}Ac and ^{211}At) are involved in current preclinical and clinical research. However, a shortage of radionuclides for research and clinical trials continues to impede the full implementation of targeted radiopharmaceutical therapeutics. Of the radionuclides mentioned above, only two (^{90}Y and ^{131}I) are readily available in a form suitable for use in clinical trials. There is an immediate and acute need for alpha-emitting therapeutic radionuclides, which have higher linear energy transfer (LET), around 100 keV/μm, and shorter range of action, resulting in far more selective and localized cytotoxicity. Besides alpha-emitters, additional beta-emitters are needed to enhance theragnostics (compounds that contain an isotope or isotopes that enable both imaging and therapy) for improved determination of the radiation dose.

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S3 L5

NEUTRON PLANAR WAVEGUIDES

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Neutron planar waveguide is a tri-layer film which transforms the conventional neutron beam of the width of 0.1-10 mm into the narrow microbeam of the width of 0.1-10 μm. We review the principles, properties and applications of the planar waveguides for the investigations of magnetic nanostructures.

The unpolarized neutron microbeam was demonstrated in [1] and the polarized microbeam in [2]. Inside the middle layer, the neutron wave is resonantly enhanced, propagates along the interfaces like in a channel and goes out from the edge as a neutron microbeam. During this channeling process, the neutron wave is exponentially decayed on the distance of several millimeters termed as neutron channeling length. The theory of neutron channeling in planar waveguides was developed in [3]. Experimentally channeling length was measured in [4,5].

We proposed the method of polarized neutron channeling for the direct determination of low magnetization value of weakly magnetic films. In [6] the magnetization value about 10 G was measured in the film $TbCo_5$. Such weakly magnetic film containing rare-earth elements are widely used for the development of new methods of magnetic recording and switching.

In [7] we demonstrated the method of neutron sonde microscopy. The polarized neutron microbeam of 2.6 μm width was used for scan the amorphous magnetic wire of 190 μm width. Larmor precession at transmission was used. The feasibility of experiments with polarized neutron microbeam was proved.

Keywords: planar waveguide, neutron microbeam, channeling, magnetic nanostructures
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S3 L6

AN INTRODUCTION ON NOVEL METHOD TO ELIMINATE THE PHOTON CONTAMINATION DURING ELECTRON BEAM CANCER THERAPY USING MAGNETIC FIELD

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Electron beams are employed in radiotherapy mega electron volt of skin, head and neck cancers. The electrons are produced by linear accelerators. There are some advantages are associated with electron therapy. These are including the uniform distribution in target tissues and rapid dose reduction in behind regions following treatment. Electrons are deflected in the magnetic field by Lorantz force. Therefore, the magnetic field can be employed to change dose distribution in the target tissues. **Methods** This study is aimed to develop a miniapplicator with easy installation on linear accelerator. Such instrument can be considered to change the path of electrons by applying a magnetic field without any change in contaminated photon path. Addionally, this model is capable to simulate and predict the path of electron in the magnetic field by means of finite element method. A mini-applicator equipped with two neodymium permanent magnets was designed that enables tuning the distance between magnets. This device was placed in a standard applicator of Varian 2100 CD linear accelerator. The mini-applicator was simulated in CST Studio finite element software. Deflection angle and displacement of the electron beam was calculated after passing through the magnetic field. By determining a 2 to 5cm distance between two poles, various intensities of transverse magnetic field was created. The accelerator head was turned so that the deflected electrons became vertical to the water surface. To measure the displacement of the electron beam, EBT2 GafChromic films were employed. After being exposed, the films were scanned using HP G3010 reflection scanner and their optical density was extracted using programming in MATLAB environment. Displacement of the electron beam was compared with results of simulation after applying the magnetic field. **Results:** Simulation results of the magnetic field showed good agreement with measured values. Maximum deflection angle for a 12 MeV beam was 32.9° and minimum

deflection for 15 MeV was 12.1°. Measurement with the film showed precision of simulation in predicting the amount of displacement in the electron beam. **Conclusion** A magnetic mini-applicator was made and simulated using finite element method. Deflection angle and displacement of electron beam were calculated. With the method used in this study, a good prediction of the path of high-energy electrons was made before they entered the body.

Keywords: Linear accelerator; Electron beam; Magnetic field; NdFeb, Particle tracking simulation

S3 L7

ULTRACOLD NEUTRONS (UCN) AND INVESTIGATION OF UCNs INELASTIC SCATTERING WITH SMALL ENERGY TRANSFER AT SURFACE OF SOLIDS AND LIQUIDS

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Keywords: ultracold neutrons, inelastic scattering

Ultracold neutrons are neutrons that could be stored in material or magnetic traps. It was discovered in Frank Laboratory of Neutron Physics of Joint Institute for Nuclear Research (Dubna) at 1968 [1]. UCN is unique instrument for quantum mechanics study and fundamental physics. More precise experimental results were obtained for the neutron lifetime and the neutron electric dipole moment with ultracold neutrons [2, 3]. The study of possible systemic effects in these precision experiments requires a clear understanding of the physical processes at the neutron reflection from a surface. Some of the processes can lead to losses of neutrons from the traps. At the same time, experimentally measured losses are strongly exceed the theoretically predicted values for trap walls with small capture at low temperature [4]. The search for a source of additional losses led to the observation of a new (unpredictable) phenomenon. It is inelastic neutron scattering with a small energy transfer (about initial neutron energy). It was cold "small heating" of UCN [5].

The results of investigation of UCN "small heating" at solids and liquids will be presented in the talk. The set of experimental results allow to conclude that reason of UCN "small heating" at solids is neutron scattering by nanoparticles. This particles move permanently along the surfaces due to its thermal energy. At liquids, the phenomenon can be explained by neutron scattering at nanodroplets flying over the surface or viscoelastic capillary waves [6-8].

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S3 L8

MONODISPERSE PEROVSKITE NANOCRYSTALS FOR APPLICATIONS IN ENERGY STORAGE AND FLEXIBLE ELECTRONICS

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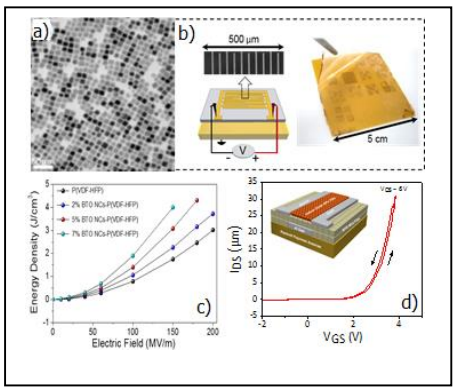
Titanium-based perovskite oxides have attracted a considerable attention in the past decade due to their unique physical and chemical properties which can be used in cutting-edge applications such as data storage, water splitting, energy conversion and storage[3], solid oxide fuel cells, multiferroics, spintronics and photovoltaics. In this work we report on the rational synthesis of deagglomerated and nearly monodisperse titanium-containing perovskite colloidal nanocrystals with controlled chemical composition and morphology. By using $BaTiO_3$, an archetypal ferroelectric titanium-containing perovskite, as a model system, we demonstrate that the size and shape of the nanocrystals can be varied from spheroidal to cubic upon tuning the various parameters, such as the polarity of the solvent, concentration of the precursors and the reaction temperature, respectively.[1] Neutron diffraction measurements revealed the existence of a tetragonal distortion in nanocubes as small as 5 nm whereas the surface composition of the nanocrystals can be tuned via simple ligand-exchange and/or chemical reactions, thereby rendering the as-prepared, hydrophobic, nanoparticles hydrophilic. Additionally, highly uniform ferroelectric nanocubes can be assembled into complex hierarchical 2D and 3D structures such as monolayers, superlattice assemblies and superparticles, which can be interesting systems for the study of the collective properties of ferroelectric nanocrystals. Monodisperse, surface-functionalized ferroelectric 15 nm $BaTiO_3$ nanoparticles have been selectively incorporated with a high packing density into poly(vinylidene fluoride-co-hexafluoropropene) (P(VDF-HFP)) leading to the formation of biphasic $BaTiO_3$-P(VDF-HFP) nanocomposite films.The composite containing 7% $BaTiO_3$ nanocrystals displays a high permittivity (ε=21) and a relatively high energy density (E=4.01 J/cm^3) at 150 kV/m, which is 132% higher than that of the neat polymer and also exceeds the values reported in the literature for polymer-ceramic nanocomposites containing a similar amount of nanoparticle fillers.[2] Moreover, dielectric films based on 15 nm $BaTiO_3$ cuboidal nanocrystals have been used to design the gate dielectric layer in transparent field effect transistors (FET) by using 8 nm In_2O_3 nanocrystals as the semiconductor layer. Due to the increased dielectric constant of the gate dielectric layer (□=220), bottom gate thin film transistors have exhibited an excellent electrical performance compared to other nanoparticle-based field-effect transistors. Specifically, the on/off ratio was 104, whereas the threshold voltage was 2.9 V and the charge mobility has a value of17.4 $cm^2 \cdot V^{-1} \cdot s^{-1}$ at an operating voltage of 4 V with a low interfacial trapped state density, making these FETs suitable for implementation in various applications in electronics.



S3 O1

HIGH GRADE DECONTAMINATION OF Ni TARGETS FOR SUB-BARRIER TRANSFER REACTIONS

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Sub-barrier neutron transfer reactions with ^{18}O or ^{13}C have a high spectroscopic potential which has been recently proven in several successful experiments with the RoSPHERE array in Bucharest. However,

special care must be provided in this kind of experiments in order to avoid contamination of gamma spectra: if chemical contaminants such as Oxygen are present in the target, the reaction cross-section on these contaminants is much higher than in the case of the reaction of interest.
This work concerns the 2 neutron transfer reaction of ^{18}O beam on a ^{64}Ni target at sub-barrier energies. For this experiment were prepared thin (~1mg/ cm2) and thick (~5mg/ cm2) metallic layers of ^{64}Ni with high-purity (99.53% certified enrichment) and with good thickness uniformity on the defined surface. The preparation process started from the metallic powder and followed a series of steps (pressing, heating with an electron-gun and finally rolled), until the required thickness and uniformity were achieved. During the target preparation process, due to the known chemical activity of the Ni powder with the air components, atomic layers of Oxygen are incorporated and also formed on the target surface.
For the experimental energy range, the ^{18}O beam induced nuclear reactions on the ^{16}O at the target surface. This is a major drawback, since gamma rays coming from the reactions on ^{16}O bring a significant contribution in the gamma energy spectrum. In order to overcome it, a thermal treatment with a hydrogen oven was applied. The performances of the targets after the thermal treatment showed an important reduction of the Oxygen contamination.

Keywords: thermal treatment, sub-barrier transfer reactions

S3 O2

COMPLETE ANGULAR DISTRIBUTION MEASUREMENTS FOR THE STUDY OF ^{156}Gd

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The structure of ^{156}Gd was investigated with the (p,t) transfer reaction at an incident energy of 23 MeV using the Q3D spectrometer [1]. The results were obtained by measuring angular distributions and comparing them with the calculations made using Distorted Wave Born Approximation (DWBA). For a correct information about the excitation energies in ^{156}Gd we used $^{154}Gd(p,t)^{152}Gd$ and $^{126}Te(p,t)^{124}Te$ calibration reactions measured in the same magnetic settings. Emphasis was put on determining the 0^+ excited states, which are some of the most important excitations in the rare-earth region [2, 3]. The structure of these states are complex and theoretical models have difficulties describing them. In particular, for ^{156}Gd, our results are close to the predictions given by the Interacting Boson Model (IBM) [4] and suggest an increased contribution of the octupole degrees of freedom.

Keywords: rare-earth region, Q3D spectrometer, (p,t) transfer reaction, 0^+ excited states

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S3 O3

CBM-TOF INNER WALL DESIGN FOR SIS100

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Triggerless mode operation of the CBM experiment requires a negligible noise or spurious signals from detectors and front-end electronics. Therefore, a close to perfect impedance matching between the detector and the electronics is mandatory. A new MSRPC (Multi-Strip Resistive Plate Counter) with the possibility to tune the characteristic impedance of the signal transmission line to the one of the FEE channel was designed, built and successful tested in our group.

Based on the obtained performance which fulfill all the requirements of the CBM-TOF subsystem, the design of the CBM-TOF inner wall zone was updated. In the current design of the CBM experiment at SIS100 the TOF wall will be positioned at 8 m distance from the target. The CBM-TOF inner wall modular structures based on 12 modules of 4 types is described in detail. Module design, module integration and counter integration inside each module will be comprehensively discussed. A self-sustained mechanical support will be designed such to be easily integrated in the overall structure of the CBM-TOF wall.
Keywords: FAIR, CBM-TOF, Resistive Plate Counter

S3 O4

LIFETIME MEASUREMENT OF THE FIRST 1^- STATE IN ^{50}MN THROUGH THE IN-BEAM FEST TECHNIQUE

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We report a lifetime measurement of the T=0, $J^\pi=1^-$ state at E_x=1727 keV in the self-conjugate odd-odd ^{50}Mn nucleus. A prolate deformation of the nucleus explains the existence of a 1^- state at such a low excitation energy and the state can most likely be associated to the ([312]5/2$^-$ × [202]3/2$^+$) nucleon configuration, based on the Nilsson model. A previous study[1] suggests that the allowed decay of the T=0, $J^\pi=1^-$ state might be slower than expected, close to that of a forbidden ΔT=0 E1 transition, thus spiking our interest.

Excited states were populated through the ^{50}Cr(p,nγ)^{50}Mn fusion-evaporation reaction by impinging a 15 MeV proton beam on a thick ^{50}Cr target at the 9 MV Tandem Accelerator in IFIN-HH. The gamma rays were detected with the ROSPHERE spectrometer used in a mixed configuration of 14 Compton-suppressed HPGe detectors and 11 LaBr3(Ce) detectors. The lifetime was measured using the in-beam Fast Electronic Scintillation Timing (FEST) technique.

The reduced transition probability B(E1) values of the two de-exciting 1727-keV ($1^-\rightarrow0^+$) and 927-keV ($1^-\rightarrow2^+$) transitions were extracted from the measured lifetime. Experimental results point to a significant E1 hindrance and the theoretical approach is in an ongoing process.

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This work was partially supported from support grant PN-II-TE-2014-230.

S3 O5

40 YEARS OF ARCHAEOMETRY AT HORIA HULUBEI NATIONAL INSTITUTE FOR NUCLEAR PHYSICS AND ENGINEERING

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A brief history of archaeometrical research at NIPNE-HH is presented.

During the summer of 1979 begins a new page in the history of Romanian archaeometry, in the moment was started the first major investigation using modern analytical tools. It regarded the 13th century Byzantine gold coins from the Uzun Bair hoard, one of the largest in Europe. Some of the results of these analyses of highly historical importance were published by V. Zoran, L. Trache, E. Oberländer-Târnoveanu, A. Berinde and P. T. Frangopol, 'The X-Ray Fluorescence Analysis of a Gold Byzantine Coin Hoard from the Thirteenth Century', in *First Romanian Conference on the Applications of the Physics Methods in Archaeology, Cluj-Napoca, 5th-6th November 1987*, ed. P. T. Frangopol and V. V. Morariu, Bucureşti, vol. 1, 1988, 147-164. One could also mention the publications of important studies on the composition of the early Wallachian coinage (1365-1418) made by C. Beşliu, V. Cojocaru, C. Ştirbu et al., „Méthodes nucléaires utilisées pour établier la composition de l'alliage de quelques monnaies de Valachie (XIVe-XVe siècles)', *Cercetări Numismatice*, 4 (1982) 41-56. For this period we must outline the importance of the first two volumes dedicated to archaeometry in Romania edited by P.T. Frangopol and V.V. Morariu.

After 1990, in the frame of archaeometrical research using nuclear and atomic analytical methods as Ion Beam Analysis (IBA) and X-Ray Fluorescence (XRF) two directions were be developed: archaeometallurgy and archaeological geology. In archaeometallurgy, the composition of ancient artifacts – mainly gold, silver and copper-bronze – is studied, from elemental analysis to layers structure techniques as gilding and silvering. These aspects are essential for authentication – provenance studies on valuable Cultural Heritage items – jewelry, coins, adornments, toreutics, weapons, other museum objects. We can mention: V. Cojocaru, B. Constantinescu et al., 'EDXRF and PAA analyses of Dacian gold coins of 'Koson' type', *Journal of Radioanalytical and Nuclear Chemistry*, 246.1 (2000) and Roxana Bugoi, B. Constantinescu, et al., 'Archaeometrical studies of Greek and Roman silver coins', *Journal of Radioanalytical and Nuclear Chemistry*, 242.3 (1999).

For archaeological geology the goal is to characterize minerals sources (mines, placers, geological deposits) for metals, gemstones, obsidian, inorganic pigments and to compare them with the similar materials used in artifacts – gold, silver, copper, lead, obsidian, garnets, rubies, ceramics pigments in order to obtain provenance information – ancient workshops, technologies, long-range trade routes, historical commercial and military aspects. We can mention the authentication of the famous Dacian gold spiraled bracelets found in Sarmizegetusa and recuperated by Romanian authorities from France, USA, Great Britain, Germany. Studies on painted art objects – pictures, icons, wood sculptures, manuscripts, etc – were also started for authentication-provenance conclusions.

Keywords: archaeometallurgy, XRF, PIXE, coins

S3 O6

IN-BEAM FEST MEASUREMENTS USING THE ROSPHERE SPECTROMETER: THE CASE OF ^{206}PO

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We are reporting lifetime measurements for the 2^+, 4^+ and 6^+ states in the ^{206}Po nucleus through the in-beam Fast Electronic Scintillation Timing (FEST) method. The measurements are part of an effort to evaluate the validity of the seniority scheme around the A≈200 mass region of Po nuclei and to provide important experimental input needed to tune theoretical models.

The experiment was performed at IFIN-HH using a ^{13}C beam which was impinged on a ^{197}Au target to produce ^{206}At through fusion-evaporation reaction. The beta decay of ^{206}At into ^{206}Po provided us with clean spectra which simplified the extraction of the lifetimes.

The gamma rays were detected using the ROSPHERE detector array. ROSPHERE is a symmetric 4π γ-ray spectrometer which was used in a mixed configuration of 14 HPGe detectors and 11 $LaBr_3$ detectors for lifetime measurements employing the FEST method.

Our results are compared with several theoretical models and with the complementary experimental data and indicate that the structure of ^{206}Po lies between two benchmarks of nuclear structure: the seniority regime and the collective behaviour.

S3 O7

TEST BENCH DESIGN FOR EVALUATING THE PERFORMANCE OF MULTI-ANODE PHOTOMULTIPLIER TUBES

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The work is done in context of the LHCb Upgrade Program [1]. The Ring Imaging Cherenkov (RICH) sub-detectors will be redesigned to work with multi-anode photomultiplier tubes (MaPMTs) [2], and we propose a solution which will allow us to test MaPMTs in concordance with the LHCb requirements and the alternatives from other LHCb testing labs.The proposed test bench includes a dark box with a 0.25 m^3 volume, where all the electronics and signal processing devices are placed along with the MaPMT sensors. These are isolated in to a small black alummium box to further reduce the photon background. Tests are being carried out like: signal amplification, gain uniformity, dark current measurements with counting, charge measurements, crosstalk measurements and single photon response tests. The data aquisition system (DAQ) embeds an Application Specific Integrated Circuit (ASIC) specially designed for this type of photo-detectors by the Omega MICRO collaboration [3]. These ASICs are ideal to test the quality of MaPMTs within LHCb requirements, and the integrated circuits have the following important perfomances: low power consumption, could reach 100 % trigger efficiency above 1/3 photoelectron and 10 ns double pulse resolution [4]. The entire DAQ system will be controlled using customized Graphical User Interface (GUI) installed on a PC placed outside the dark box.

Keywords: Cherenkov radiation, ASIC, MaPMT, DAQ.
Acknowledgements
The work of V. M. PLACINTA and L. N. COJOCARIU, and the cost of all materials and laboratory tools used for building the test bench were supported by Ministry of National Education (MEN) and the Institute of Atomic Physics Bucharest (IFA) through grants 7/16.03.2016 and 3/3.01.2012, and national project "NUCLEU" number PN 16 42 01 03.
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S3 O8

TOTAL EFFECTIVE DOSE EQUIVALENT ASSESSMENT USING RESRAD CODE FOR THE DISMANTLING OPERATIONS OF THE ALUMINIUM VESSEL OF THE IFIN-HH VVR-S REACTOR FROM MAGURELE, ROMANIA

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The Horia Hubulei - National Institute of Physics and Nuclear Engineering (IFIN-HH) VVR-S nuclear research reactor operated from 1957 to 1997 at a nominal thermal power of 2 MW, using low-enriched nuclear fuel (10%) type EK-10 and highly enriched fuel (36%) type S-36. It served as the basis for experimental research and radioisotope production. On average, the installation functioned 5 days per week at full or variable power. The total thermal energy produced until 1997 was 9.59 GWd. Reactor decommissioning activities started in 2010. Various activities related to the dismantling of the reactor block were carried out between 2015 and 2016. To avoid high levels of exposure and the associated risk of these activities, an evaluation of the total effective dose equivalent (TEDE) was performed using RESRAD (RESidual RADioactive) code package. This is a computer model designed to estimate radiation doses and risks developed by Argonne National Laboratory. Our principal scope was to ensure the radioprotection safety for the professional worker that is performing the dismantling works. The aluminium vessels were cut and sent to be stored intermediary. The most important part of the work, because of the higher dose rate expected, consisted of dealing with the central part of the aluminium vessels around reactor core. Here the dose rate varies between 400 μSv/h and 35 mSv/h. We also detected a high peak of 140 mSv/h localized in an area close to the thermal column. The spot is situated inside the aluminium vessel on the horizontal channel perpendicularly to the thermal column. Moreover, samples were taken from the aluminium vessel for spectrometric analyses in order to determine the involved radionuclides. The most important radionuclides were determined to be: ^{60}Co, ^{137}Cs, ^{152}Eu and ^{154}Eu. We needed these calculated data to make safety consideration on the operational phase of the dismantling, to avoid the over exposure situation, to make shield calculation and to determine the maximum time allowed for the worker to operate the cutting equipment.
Keywords: decommissioning, computer model, total effective dose equivalent, aluminium vessels
PACS: 28.41.Ak Nuclear power: theory, and simulation.

S3 O9

ASSESSMENT OF RADIOISOTOPES PRODUCTION FOR MEDICAL APPLICATIONS AT ELI-NP

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Abstract. It is well known that the radioisotope production has a big importance in medical diagnostic imaging or therapy. Currently, the routes for radioisotopes production are: accelerated beams or nuclear reactors. The role of radioisotopes is to precisely localize the pathological process or treat the illness by selectively targeting the site using a bioactive molecule as carrier. The increasing demand for medical radioisotopes requires more production facilities, along with the investigation of new ways of production and the application of the new radioisotopes in both diagnosis and therapy. A new alternative route for radioisotopes production is by photonuclear reaction using the high intensity γ beams at the Extreme Light Infrastructure — Nuclear Physics (ELI–NP) facility. The interest in using the high-intensity γ beam for radioisotopes production lies both in the possibility to obtain high specific activity radioisotopes that are not produced currently in enough quantity and also for extending the range of radioisotopes potential useful clinically.

The Gamma Beam System of ELI–NP will produce brilliant, quasi–monochromatic gamma–ray beams via Inverse Compton Scattering of short laser pulses on relativistic electron beam pulses. The gamma–ray beam at ELI–NP will be characterized by large spectral density of about 10 4 photons/s/eV, narrow bandwidth (< 0.5%) and tunable energy from 200 keV up to about 20 MeV. The results of case simulations of the photonuclear reaction to produce radioisotopes of medical interest will be presented and discussed compared with the current routes and characteristics.

Keywords: medical radioisotope, photonuclear reaction, gamma beam facility, radioisotope production.

S3 O10

STUDY OF STRANGE AND BEAUTY PARTICLES PRODUCTION IN PP INTERACTIONS AT SQRT(S)=13 TEV USING PYTHIA

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Keywords: pp collisions, Hard QCD, strangeness, beauty

Given the difficulties to compute production amplitudes for QCD interactions at low energies, interactions which take place at the partonic level especially during the hadronization process following a pp collision at LHC, we rely on phenomenological models to estimate the production of hadrons. One such model is the Lund String Model which describes the hadronization process from the view-point of an oscillating string that connects the partons [1]. This model is used by the PYTHIA generator for the hadronization process. The strong interactions described by QCD can be split according to the energy scale into soft-QCD and hard-QCD processes. Soft-QCD processes take place at low energy scales (low momentum transfer) and are described by non-perturbative QCD (e.g. elastic scattering, diffraction etc.). Hard-QCD processes take place at larger energy scales (large momentum transfer) and can be described using perturbative QCD (e.g. gg→bbbar) [2][3][4][5]. In this work, we have used data generated with PYTHIA for pp collisions at sqrt(s)=13 TeV to compare the

kinematical behaviour of strange and beauty particles before and after the hadronization process and also at different energy scales of the hard process (the interaction between the most energetic partons in the event [3]). The study focuses on the understanding of the transition between soft and hard-QCD and also on the structure of events at large energy scales of the hard process (large minimum transverse momentum of the outgoing hard process partons [3]). For further reading, please see [6].

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S3 O11

PREPARATION AND CHARACTERIZATION OF NICKEL TARGETS FOR CYCLOTRON PRODUCTION OF PET RADIOISOTOPE ^{64}Cu

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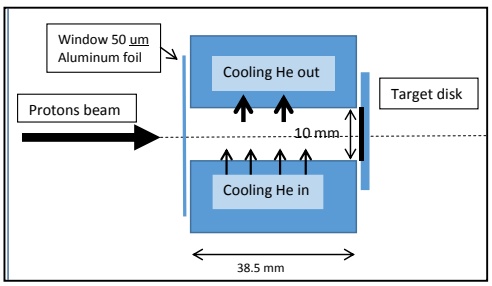
There is growing interest in the research community for new PET radioisotopes with relatively long half-lives. Cu-64 is a candidate, since it can be produced with medical cyclotrons, the translational energy of its emitted positron is moderate (0.65MeV), its half-life is quite long (12.7h) to label a range of molecular targeting agents and can be transported at long distance. In the present work is reported the cyclotron route to obtain copper-64 isotope, using the nuclear reaction ^{64}Ni(p,n)^{64}Cu. The main stage described is our technology for preparation and characterization of nickel targets.

The targets are irradiated with proton beams at our new cyclotron laboratory for radioisotope production and multi-disciplinary research, operational in IFIN-HH since 2012. The machine is a TR19 model which accelerates negative ions (H-) on a vertically arranged plane and by passing the ions through a thin pyrolytic carbon foil extract protons in the range 14-19 MeV energy and up to 300 microamps.

(a) The copper disk gold plated prepared for Ni electroplating (b) Round solid target holder (c) Setup for proton irradiation



Circular copper disks with 24 mm diameter, have been gold plated and in the central region on a 10 mm diameter area was deposited by electroplating natNi or enrich ^{64}Ni. (Fig. 4)

Finally, the Ni target was introduced inside the Round target holder Fig. 2 and 3) and successfully irradiated with a proton beam. This proton beam must be reduced by the degrader composed of Al foils

Keywords: Cyclotron; Solid target; Electroplating, Cu-64

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Acknowledgements: This work was supported by the Romanian Research National Programme PN 16420204 / 2016

S3 O12

DYNAMICAL EFFECTS OF THE SYMMETRY ENERGY FOR THE HEAVY-ION REACTION 124SN+64NI AT 35/45 AMeV

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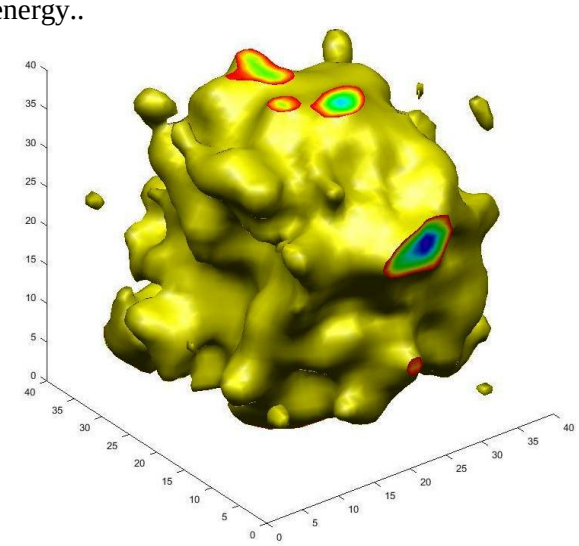
Considering a numerical approach based on an implementation of the Boltzmann-Nordheim-Vlasov equation which includes two body collisional effects, we have analyzed the kinematics and the isospin dynamics for the heavy-ion reaction 124Sn+64Ni at 35AMeV and 45AMeV, for impact parameters corresponding to multi-fragmentation and neck-fragmentation events. Analyzing the kinematical properties of the corresponding events where one or two intermediate mass fragments are generated, we have obtained results which can add different further constraints on the parametrization with density of the symmetry energy..



Acknowledgements: the authors M. Marciu, V. Baran, and R. Zus acknowledge financial support from the project 29 ELI RO, financed by the Institute of Atomic Physics

Fig 1. The density distribution evolution coresponding to the expansion of the nuclear matter in a heavy-ion reaction 124Sn+64Ni at 45 AMeV, impact parameter 5fm and time 220fm/c. The 3D cubic box has the linear length of 40fm.

S3 O13

DYNAMIC INVESTIGATION BY NEUTRON AND GAMMA IMAGING OF A COFFEE MAKER

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An imaging facility (INUS) with thermal neutrons and gamma radiations supplied by a TRIGA Annular Core Pulsing Reactor (ACPR) is in use at the Institute for Nuclear Research (INR). ACPR is a nuclear research reactor operated in steady state with a maximum power of 500 KW and in pulsing mode with a peak power of 20000 MW. For investigations presented in this paper ACPR was operated in steady state mode at a power of 100 kW.

There are presented the investigations performed in the dynamic mode for a coffee maker in the process of the coffee preparation using two types of filters, a paper one and a fine plastic sieve the other, using neutrons and gamma radiations as penetrant probes on turn or together. Differences are observed and discussed concerning preparation of the coffee using the two types of filters and the possibility to put in evidence this process using the two types of penetrant radiations (Fig. 1).

The detector for radiations consists of two scintillators (6Li-ZnS scintillator that captures thermal neutrons and Lanex scintillator that captures gamma radiations and thermal neutrons) and an EM-CCD Hamamatsu C9100-02 camera that can acquire images from scintillators up to 30 frames/s for all field of view (300 mm x 300 mm).

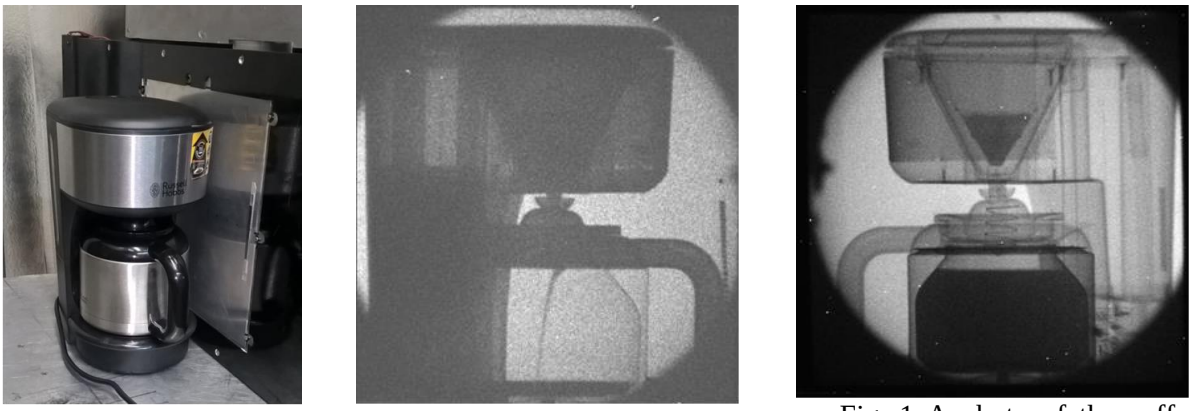

Fig. 1 A photo of the coffee maker (left), an image taken with neutrons (middle) and with neutrons and gammas (right)

Keywords: dynamic neutron and gamma imaging, coffee maker investigation

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S3 O14

ALPHA DECAY HALF LIVE CALCULATIONS OF DEFORMED HEAVY NUCLEI BY CONSIDERING DEFORMATION PARAMETERS IN FERMI GAS MODEL

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Calculations on the α-decay half-lives of deformed heavy nuclei are performed with in Fermi Gas model. The Wood Saxon potential is employed to calculate half–lives through a coulomb barrier while deformation parameters are considered as a Fermi gas model correction. The present study is restricted to even- even nuclei in the heavy mass region with N>126. The main consideration in this model, is V_0b^2=100 MeV, while, b, is the force range between two nucleons to be represented by an attractive well, and depth, -V_0. The α-decay half lives obtained are found to be in agreement with the experimental data for deformed heavy nuclei.

Keywords: Fermi gas model, deformed heavy nuclei, Wood Saxon, Alpha decay half life
Acknowledgment: The author would like to thank Dr.Ion Cooper from Sydney University and Prof.Shmuel Gurvitz from Weizmann Institute for numerous fruitful discussions on this problem.

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S3 P1

ANCIENT BRONZE AND SILVER METALLURGY STUDIES BY MICRO-PIXE

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We focused on metallurgical aspects of Dacian and Roman silver items – coins and adornments (Ist Century BC – IIIrd Century AD) and of Histria bronze monetary emissions (VIth Century BC - Ist Century AD) to obtain a general image of metallurgical procedures used by the ancient populations from Romania's territory. We used a 2.5 MeV proton beam which allowed us a better study on Ag, Sn, Sb – chemical elements with X-rays energy between 20-30 keV, 2.5 MeV protons allowing bigger X-rays production cross-sections. In the case of silver we studied the so-called "four-metals" items (Silver-Copper-Tin-Lead): Dacian tetradrachms type Radulesti-Hunedoara and a Dacian spiraled bracelet found in North-West of Transylvania. The questions were to understand if silver is alloyed with bronze or separately with copper, tin and lead and, very important, to study elemental segregations of lead, tin and copper in silver. We also investigated silver Roman denarii – Republican and late Imperial. Five less "artistic" valuable items were cut and their section analyzed by micro-PIXE as elemental maps. The segregation phenomenon is directly connected to the quality of the metallurgy, e.g. the temperature of alloying, and the preliminary hammering, homogeneous materials being obtained at higher temperatures, not always available in those times. Lead and Tin segregations in relation to Silver were put in evidence – the maps are under processing. The progress of Roman metallurgy is illustrated by the practical absence of segregation for late Imperial denarii as compared with Republican denarii.

The bronze objects were mainly arrow-heads, used as monetary signs by Greeks and local population in Dobroudja (VII-VIth Centuries BC), their main metallurgical problem to be solved by us being the important presence (few percents) of antimony and manganese in their alloys. To explain the presence of antimony as copper minerals component or as intentionally added metal to bronze, three less "good looking" arrow-heads were cut and their section analyzed to obtain elemental maps illustrating an eventual segregation of antimony with respect to copper – which was indeed observed. The explanation of manganese presence in the arrow-heads is more complicated. Up to now, the unanimous opinion was manganese can be only superficially present in ancient bronze. The possibility manganese (iron also) from the flux used for smelting copper could becomes a real bronze "bulk" component must be considered. Three arrow-heads where manganese is detected as few percents were also cut, the elemental maps indicating manganese is a bulk constituent of the bronze.

Keywords: silver, bronze, micro-PIXE, coins

S3 P2

NEUTRON DIFFRACTION STUDY OF CONCRETE STRUCTURES

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Cementitious materials are widely used as repository barriers and for encapsulation of radioactive wastes (Nicu M et al 2016). The wastes produced as result of nuclear activities are very diverse and it is need to develop special cement matrices to preserve their migration in the environment.

In time in the cementitious materials different physical and chemical phenomena occur. These phenomena affect the structure of the material and the mechanical resistance. The developed cementitious materials used for the encapsulation of radioactive waste must resist 300 years, so the monitoring in time of the developed materials structure is very important item.

We measured time-of-flight spectrum for each spatial direction on the 5x5 degree grid on the stereographic projection at the diffractometer SKAT (Ullemeyer K et al 1998, Keppler R et al 2014). It is interesting that concrete microstructure is different for the different constituent of the specific concrete.

Concrete is obtained from crystalline that exhibits anisotropic behavior. We fulfilled neutron texture measurements. It were investigated a set of samples with different chemical content. Samples with the one year aging were measured. We observed grows of the diffraction peaks which confirms the crystallization processes intensification. Our aim is to trace the possible changes of the studying samples with several years aging. Besides samples with 56% content of silicon oxide were measured to obtain pole figures. Corresponding pole figures exhibit very low degree of anisotropy.

The JINR – Romania scientific cooperation program 2016 -2017 are acknowledged.

Nicu M et al 2016 Effect of magnesium oxide particle size and the filler content on magnesium potassium phosphate cement properties *Romanian Journal of Physics* **61**(3-4) 543-552

Ullemeyer K et al 1998 The SKAT texture diffractometer at the pulsed reactor IBR-2 at Dubna: experimental layout and first measurements *Nuclear Instruments and Methods in Physics Research A* **412-1** 80

Keppler R et al 2014 Potential of full pattern fit methods for the texture analysis of geological materials: implications from texture measurements at the recently upgraded neutron time-of-flight diffractometer SKAT *Journal of Applied Crystallography* **47** 1520

S3 P3

RADIOCARBON DATING
APPLICATIONS OF ACCELERATOR MASS SPECTROMETRY

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This paper gives an overview of the radiocarbon dating method, the origin of ^{14}C, the global carbon cycle and the Accelerator Mass Spectrometry at the 1 MV Tandetron.

The isotope with mass 14 known as radiocarbon is one of the unstable isotopes of carbon with widespread applications in the scientific world. The use of ^{14}C as a „clock" for estimating the age of various historical and pre-historical samples is one of its most important applications.

Towards the development of a National Dating Program in Romania, the ^{14}C dating laboratory was commissioned in 2012 at IFIN-HH Bucharest. The particle accelerator in conjunction with ion sources, large

magnets, and detectors was commissioned to measure C, Be, I and Al isotopic ratios up to a sensitivity of 10^{-15}.

Figure 1: Accelerator Mass Spectrometry at the 1 MV Tandetron

Performing analysis at such a sensitivity opens the possibility for applications in various domains such as: carbon dating of artefacts, material research, geology, determination of erosion rates, detection of existing nuclear pollution, forensic science and nuclear activity surveillance, diagnose of fusion experiments, astrophysics and oceanography, biomedical, pharmacological applications and others.

Sampling, sample preparation and measurement of the ^{14}C content are important steps in obtaining reliable radiocarbon ages. In the ^{14}C AMS technique, the element of interest (sample carbon) is chemically separated from the original sample, converted to graphite, pressed into a cathode (sample target holder) where it forms a solid graphite plug or layer and then is placed into a sputter ion source of a Tandem type accelerator. Calibration of radiocarbon ages is the final step in establishing the calendaristic age.

In conclusion any material which has carbon into its composition can be dated or ^{14}C concentration determined as an isotopic ratio 14C/12C.

Keywords: Accelerator Mass Spectrometry, radiocarbon, dating.

S3 P4

MANAGEMENT OF MATERIALS THAT ARISE FROM DECOMMISSIONING THE VESSELS OF THE VVR-S REACTOR

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The VVR-S nuclear reactor from Magurele had a maximum thermal power of 2 MW that used distilled water as moderator, coolant and reflector. After 40 years as successful operation, the reactor was stopped in 1997. In 2010 was started the decommissioning project. The VVR-S reactor is the first nuclear installation in decommissioning from Romania. Important quantities of materials are being generated during the decommissioning program. All these materials can leave the nuclear site by recycling (free release) or final/intermediate storage (radioactive wastes management).

The VVR-S reactor contains three aluminium vessels: (i) the central vessel which is designed to contain the nuclear fuel from the active area; (ii) the median vessel which separates the primary cooling circuit from the secondary cooling circuit; (iii) external vessel that contain the other vessels. The reactor vessels are the most activate part of the reactor block.

The working methodology for the reactor components decommissioning contain the dismantling, sorting, radiological characterization, free release and radioactive waste management. For each component dismantling a working procedure is established to give the details of the work to be done, and analysis of safety aspects are being considered (conventional and radiological). The materials sorting step is based on primary radiological characterization. The materials that meet the threshold primary radiological characterization are transferred to the Radiological Characterization Laboratory for final radiological characterization. The aluminium alloy reactor vessel parts with high activity are segmented and inserted in 220 l drums. The drums with radioactive waste are being radiologically characterized prior to intermediate storage.

The aim of this paper is to present the management of waste (radioactive or nonradioactive) that arise from the decommissioning of the VVR-S reactor vessels.

Keywords: decommissioning, free release, nuclear reactor.

S3 P5

XRD STUDIES AND MECHANICAL BEHAVIOUR OF CEMENT EMBEDDING MATRICES CONTAINING NICKEL FERROCYANIDE SORBENTS

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Radioactive wastes are generated in a variety of physical and chemical forms, including gases, liquids and solids. The immobilization of radioactive waste in Portland cement matrix is the most used method, applied in the world by the countries developing nuclear energy programs. To respect waste acceptance criteria for disposal, the matrix must be stable in time from chemical, physical, mechanical and geometric point of view. This paper gives information about the influence of ferrocyanide sorbents used at the liquid radioactive waste treatment for removal of cesium on the mortar structures. The experimental data obtained on samples prepared with ferrocyanide and cement, offer structural information regarding the interaction between the different ratio of ferrocyanide with the major components of the cement matrix.

Keywords: X-ray diffraction, Physical Mechanical tests, Radioactive waste, Conditioning matrix.

S3 P6

THE EVALUATION OF THE GROSS ALPHA AND THE GROSS BETA ACTIVITIES FROM FOODSTUFF

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The consumption of water and foodstuffs represents one of the most important pathways for ingestion of natural radionuclides. The radionuclides from the natural decay series (^{238}U, ^{232}Th, ^{235}U) and also ^{40}K radionuclide are transferred from different natural sources to foodstuffs.

This study was carried out in order to evaluate the gross alpha and the gross beta activities from the foodstuff items commonly used from Romania. The gross alpha and beta activities of the samples were measured using the low-background MPC-2000-DP counting system (Protean Instruments Corporation), with a ZnS dual phosphor detector (zinc sulphide and plastic). The samples were collected from markets in three counties from South-Eastern part of Romania: Galati, Braila, and Vrancea. Seven groups of food items were analized: vegetables, fruits, roots, baby cereals, cheese, meat and eggs.

The values for the gross alpha and the gross beta activity measured in all samples was found below 4.49±1.07 Bq kg^{-1} and 249.86±37.96 Bq kg^{-1}, respectively. In all samples the values of gross alpha activities were lower than the values of gross beta activities. The obtained data were compared with the reference values for Romania and, also, with the radioactivity levels found in similar food items in another parts of the world.

Keywords: foodstuffs, gross alpha/beta activity, Romania

S3 P7

DETERMINATION OF NATURAL RADIONUCLIDES IN MILK

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For many people, pasteurized milk is a basic foodstuff. The determination of natural radionuclides in milk is very useful for the assessment of the radiological risk.

This study was carried out in order to evaluate the annual effective dose due to the intake of natural radionuclides from milk. Therefore, the concentrations of ^{238}U, ^{232}Th, ^{210}Po, ^{210}Pb and ^{40}K were determined in milk samples. The samples were collected from markets in three counties from South-Eastern part of Romania: Galati, Braila, and Vrancea.

The concentrations of ^{238}U and ^{232}Th were determined by spectrophotometric measurements of arsenazo III-U^{4+} complex and arsenazo III-Th^{4+} complex, respectively. The self deposition onto nickel disc, followed by the measurement of the gross alpha activity was used in order to determine the concentration of ^{210}Po and ^{210}Pb. The concentration of ^{40}K was determined by gamma-spectrometry using a NaI(Tl) detector.

In all the samples, the values for the gross alpha and the gross beta activity were lower than the values 0.035±0.008 Bq L^{-1} and 41.22±6.138, respectively, whereas the maximum levels for concentration of ^{238}U, ^{232}Th, ^{210}Po, ^{210}Pb were found to be 90±13, 87±14, 41±9, 28±6 mBq L^{-1}, respectively. The highest concentration for ^{40}K in the milk samples was 27±5 Bq L^{-1}.

In this study the annual effective dose due ingestion of natural radionuclides from milk is lower than the recommended value of 0.1 mSv y^{-1}.

Keywords: ^{210}Po, ^{210}Pb, ^{238}U, ^{232}Th, ^{40}K; milk; annual effective dose.

S3 P8

A FILAMENT SUPPLY PROTECTION CIRCUIT FOR THE EMISSION TUBE OF THE RF POWER AMPLIFIER FOR CYCLOTRON APPLICATIONS

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Keywords: radiofrequency, power supply, power amplifier, cyclotron.

The power supply unit for the filament of the emission tube used inside the radiofrequency (RF) power amplifier (PA) provides both stable AC voltage and current to guarantee a steady electron beam emission and a constant temperature for the cathode of the RF vacuum tube. In a classical RF PA where only the tube filament supply voltage is monitored, if a filament discontinuity occurs, the tube supply voltages (grid, plate) are still applied and this may cause internal discharges and the vacuum tube failure.

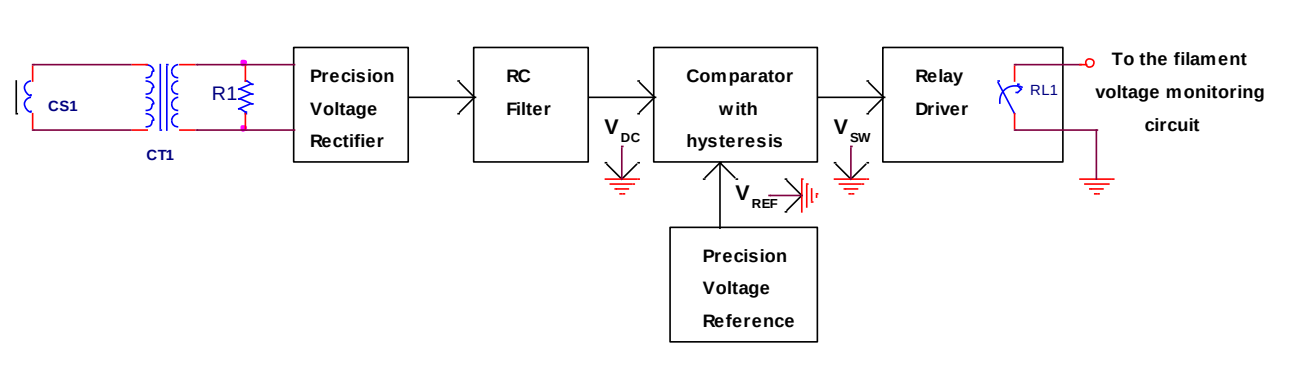

Fig.1 The proposed architecture

An analog architecture which allows the measurement of the filament current, and which it may be added to an existing voltage measurement circuit, is presented in Fig.1. The tube filament current is measured by using a current sensor (CS1). A fraction of the measured current is transformed into a voltage value by using the CT1 transformer and the R1 resistor. A precision voltage rectifier followed by an RC filter converts the AC pulses into a DC voltage (V_{DC}) proportional with the filament current of the RF tube. A comparator circuit acquires the V_{DC} from the rectifier and the V_{REF} from a precision voltage reference, and it triggers its output in the moments of time when the V_{DC} is greater than V_{REF}. A transistor driver connected to the comparator output switches a relay contact (RL1) when the filament current value exceeds this threshold.

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S3 P9

DESIGN OF A HIGH EFFICIENCY MULTI-LAYERED RADIATION SHIELDING

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With the increasing applications of cyclotrons in health care and physics research a variable energy machine was commissioning at IFIN-HH in 2012. Named TR19 and manufactured by the Canadian company Advanced Cyclotron System Inc. (ACSI) it represented the core of a new Radiopharmaceuticals Research Centre. Two years later the irradiation infrastructure was increased by adding a Secondary proton beam extension line mounted underneath the existing horizontal beam line. The beam line extension allows for a second pathway to conduct the variable energy proton beam to a High Current Solid Target Station. To avoid activation of various components due to high neutrons and gamma fluency around the solid target station a local radiation shielding was design that encloses the collimator and the solid target station. The available space is very limited (see Fig. 1) so a high efficiency radiation shielding was designed to minimize dimensions. In the present work we perform Monte Carlo simulations in order to study the neutron fluency, the energy deposition, the dose equivalent and the residual nuclei around the solid target station. For these simulations the Monte Carlo codes FLUKA/FLAIR and SRIM/TRIM were used. The facility has been tested under various experimental configurations.
The shield consists of a rectangular box that surrounds the target selector on 5 sides; the 6th side is contained by the concrete floor (see Fig. 2)
We created two configurations for the local shield. It has been found that the wall thickness can't exceed 18 cm, because inside is placed an irradiation station with her connections and for this is necessary a sufficient space. In the first set of simulations, it has been considered that the wall thickness of 18 cm is distributed in

two layers, a lead layer of 13 cm on the inside near the target and a borated polyethylene layer of 5 cm at the exterior. In the second set of simulations, it has been considered that the wall thickness of 18 cm is distributed in 18 layers of 1 cm, which are alternately placed, from inside where the first layer is a lead layer of 1 cm and ending outside with a borated polyethylene layer of 1 cm (sandwich configuration).

Fig. 1 Detailed configuration of the solid target station installed on a short beam line oriented at 26^0 to the floor

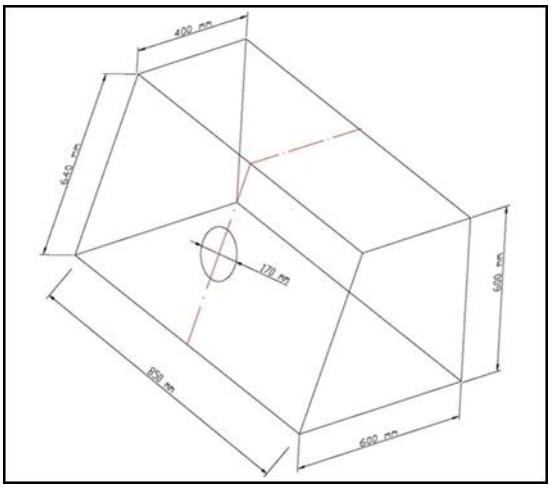
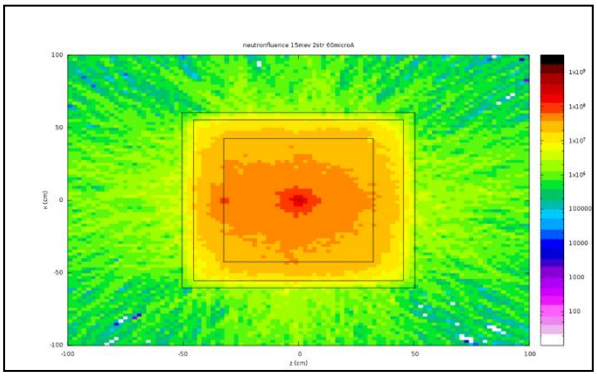
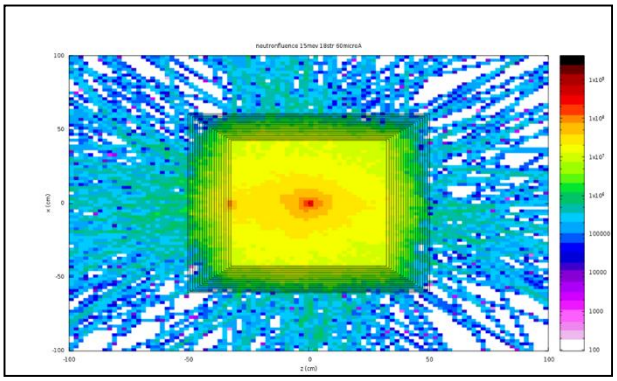


Fig. 2 3D geometry of the shield in Autocad

Using these two configurations of the local shield, we performed Monte Carlo simulations to obtain informations about the fluence of the neutrons and the photons inside the cyclotron bunker, fluencies that are obtained from reaction $^{100}Mo(p,2n)^{99m}Tc$ at different beam energies and intensities (see Fig 3 and Fig. 4)

Fig. 3 Neutrons fluence for wall with 2 layers Fig. 4 Neutrons fluence for wall with 18 layers





Keywords: Cyclotron; Radiation; Shielding; Fluka code

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S3 P10

OPTIMISED SOLUTIONS FOR SUPER-COMPACTION OF RADIOACTIVE WASTE

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The main aim of the treatment of radioactive waste by super-compaction is to minimize the volume of waste requiring subsequent storage or disposal, and to enhance the efficiency and safety of handling, storage and disposal of radioactive waste.
The super-compaction is a process used for conversion of the radioactive waste into a stable, compacted solid form as a cylindrical pellet. A characteristic of the compaction is that it reduces the volume of waste but the amount of radioactivity remains the same.
The radioactive waste treated by super-compaction is generated mainly from decommissioning of WWR research reactor which belongs to NIPNE. Some of them are secondary radioactive waste generated by own treatment activities and some are coming from different licensed institutions in the country. The radioactive waste mainly consists of contaminated scrap metal, contaminated debris, protective clothes, glass, and other contaminated materials.

In order to keep the exposure of workers as low as possible, have been investigated solutions for optimization of the super-compaction process. The content of each radioactive waste package which is subsequently transformed into a pallet is analyzed in terms of activity, dose rate and type of materials. The final disposal package which contains pallets shall meet the waste acceptance criteria for disposal. The content of each final disposal package is optimized such as the mass, dose rate at surface and total activity per package meet waste acceptance criteria. Due consideration has been done to the minimization of actions performed by workers. Based on experience of previous radioactive waste compaction campaigns performed at NIPNE DMDR Măgurele has been identified actions for optimize the super-compaction process.

The paper describes the identified solutions for optimization of super-compaction process conducted in at NIPNE DMDR Măgurele.

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S3 P11

IMPROVEMENT OF THE REGULATORY FRAMEWORK IN THE FIELD OF RADIOACTIVE WASTE AND DECOMMISSIONING

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The paper describes the work done National Commission for Nuclear Activities Control as regulatory authority of Romania in order to improve the regulatory framework in the field of radioactive waste and decommissioning of nuclear and radiological facilities.

The safety and licensing requirements on the predisposal of radioactive waste cover both radioactive waste from nuclear and radiological facilities and spent sealed radioactive sources. The responsibilities of the licensees, the integrated management system, the safety culture, and the record keeping system, reporting to CNCAN, interdependences among the steps of the predisposal management of radioactive waste and disused radioactive sources are described. The chapter on specific requirements for each step of the predisposal management covers the control of generation, characterization and classification of radioactive waste, waste acceptance criteria, collection, segregation, treatment, conditioning and storage of radioactive waste and disused radioactive sources. The chapter on requirements for the development of predisposal radioactive waste facilities details the safety requirements for siting, design, construction, commissioning, operation and permanent shut down of the facilities. The regulation introduces the concepts of safety case, safety assessment and periodic safety review, their contents being provided in the Annexes to the regulation.
The safety and licensing requirements on decommissioning cover both nuclear and radiological facilities. The end state criteria, responsibilities of the licensees, integrated management system, safety culture, record keeping system, reporting to CNCAN, are described in this regulation. The regulation defines the requirements for decommissioning strategies, planning of decommissioning activities, as well as the transition from operation to decommissioning phase and conducting of decommissioning actions. The regulation introduces the concepts of safety case and safety assessment, their contents being provided in the Annexes to the regulation. The requirements for final radiological verification are also provided. The content of the final radiological survey report as well as the final decommissioning report are provided in the Annexes to the regulation.

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S3 P12

A MEASUREMENT METHOD OF THE TARGET BEAM CURRENT BY USING A FAULTY COLLIMATOR IN CYCLOTRON APPLICATIONS

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Keywords: collimator, cyclotron, beam current measurement, fault.

Inside a target system designed for cyclotron applications, the collimators are used to guide the particle beam on the target. If the beam is not centered or focused, it exceeds the diameter of the transmission path and some charged particles collide the collimator. Thus, a residual current which is proportional with the number of the diverted particles appears in the collimator (Fig.1). To measure this current, the collimator is isolated and it is connected to a negative feedback transadmitance amplifier. The beam is considered centered for a minimum value of the residual current.

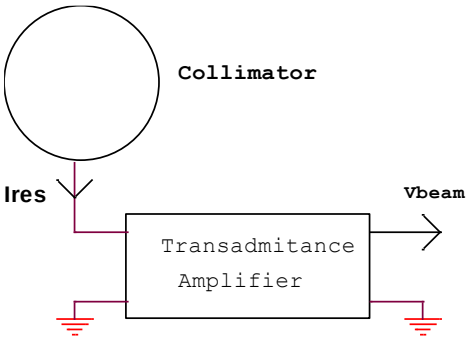

Fig.1 The residual current measurement

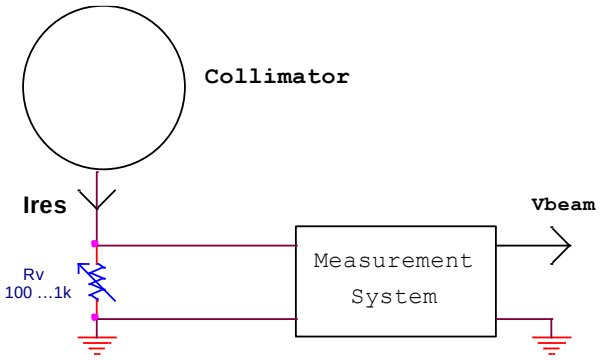

Fig.2 The proposed measurement method

Ifn the situation when the insulation resistance of the collimator is degraded to low values (100Ω÷1KΩ), the residual current is leaking to the ground and the collimator cannot be used to center the beam. Furthermore, if this happens during a session of irradiation, when the intervetion of the service team is practically compromised because of high doses of radiation due to the activation of the target, the collimator cannot be used anymore.

The proposed method (Fig.2) is considering a system where the insulation resistance of the collimator is periodically monitored, and the voltage drop on the insulation resistance (R_v) is amplified, computed and then provided at its output(V_{beam}) by the measurment system.

Acknowledgment: "The work has been funded by the Sectorial Operational Program Human Resources Development 2007-2013 of the Ministry of European Funds through the Financial Agreement POSDRU/159/1.5/S/ 134398 and by the PN 16420204/2016"

S3 P13

COMBINED NUCLEAR TECHNIQUES FOR TRACE ELEMENT ANALYSIS IN ENVIRONMENTAL AND MATERIALS SCIENCE

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Experience in applying non-destructive nuclear analytical techniques in materials science and environmental studies is reviewed. The used techniques are: instrumental neutron activation analysis (INAA), energy-dispersive X-ray fluorescence (ED-XRF), particle-induced X-ray emission (PIXE) and particle-induced gamma-ray emission (PIGE).

ED-XRF was applied at "Dunarea de Jos" University of Galati (UDJG) to investigate the elemental content of some metallurgical (special stainless steels) and environmental materials (soils, sediments) and the results for some trace elements were compared with those obtained by INAA at Frank Laboratory of Neutron Physics (FLNP) of Joint Institute of Nuclear Research (JINR) at Dubna, Russia. PIXE and PIGE ion beam techniques were applied at the 3 MV Tandetron of Horia Hulubei National Institute for Physics and Nuclear Engineering (IFIN-HH) using a 3 MeV proton beam.

The advantages and drawbacks of the employed techniques are discussed in relation with each analyzed matrix and chemical element.

Further work will be carried out in the frame of JINR Dubna-Romania bilateral projects between FNLP–JINR and UDJG, for the investigation of micro-composition of high purity materials (boron nitrides

and synthetic diamonds) and special steels, in combination with their micro-structure characterization using electron microscopy (SEM) and X-ray Diffraction (XRD).

Keywords: ED-XRF, INAA, PIXE; PIGE; environmental materials; special steels

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S3 P14

MEDICAL RADIOISOTOPE PRODUCTION AND MULTI-DISCIPLINARY RESEARCH ACTIVITIES WITH A PET CYCLOTRON

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The new cyclotron laboratory for radioisotope production and multi-disciplinary research is operational in IFIN-HH since 2012. The machine is a TR19 model manufactured by Advanced Cyclotron Systems and it is the core of the Radiopharmaceuticals Research Centre that would fulfill the urgent national need for a continuous and reliable supply of present and future radioisotopes for biomedical research and other applications. The cyclotron accelerates negative ions (H^-) on a vertically arranged plane and by passing the ions through a thin pyrolytic carbon foil extract protons in the range 14-19 MeV energy and up to 300 microamps.

Medical PET cyclotrons usually run during the night or early in the morning, for the production of radiotracers that will be used for imaging, such that the beam lines are in principle available for other purposes during the daytime. This represents an opportunity to exploit the science potential of these accelerators well beyond medical imaging applications.

To perform multidisciplinary research the IFIN-HH facility is equipped with a 6 m external beam line that transfer the protons to an experimental hall, which is always accessible for scientific activities. In this paper we present a selection of our research activities such as New radioisotopes for medical applications, Positron source based on the ^{48}V isotope dedicated to positron lifetime spectroscopy, Slow positron accelerator in line with cyclotron, Neutron activator driven by cyclotron. The extension of the irradiation capabilities in the experiment hall will be described too.

Keywords: Cyclotron; ion beam applications

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S3 P15

INVESTIGATION OF MAJOR AND MINOR ELEMENTS IN TREE LEAVES THICK TARGET SAMPLES BY PIXE, PIGE, AND RBS ANALYTICAL TECHNIQUES

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This paper presents analytical results obtained by Ion Beam Analysis (IBA) techniques at the 3 MV Tandetron of IFIN-HH on selected vegetal samples, in particular tree leaves of different species used as

biomonitors of urban air pollution in Bucharest city. Particle-Induced X-ray Emission (PIXE), Particle-Induced Gamma-ray Emission (PIGE), and Rutherford Backscattering Spectroscopy (RBS) were concomitantly applied using 3 MeV proton beam in vacuum. Thick target samples were prepared from vegetal material washed with ultrapure water, then dried at 45°C, ground in a mortar, and pressed as tablets of about 1 mm thick.The main elements investigated by PIXE were Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Cu, Zn, Se, Br, Sr, and Pb. Complementary, PIGE could determine F, Na, and Mg, while RBS was able to determine H, C, N and O major elements (percent mass fractions of N and H, and tens of percent mass fractions of O and C). In parallel to PIXE, the elements Al, P, and Cl could also be determined by PIGE, while Ca and Si by RBS, with lower uncertainties by PIXE.

Keywords: PIXE; PIGE; RBS; vegetal samples; tree leaves.

S3 P16

COMPARISON OF ION BEAM ANALYSIS (IBA) AND INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS (INAA) TECHNIQUES ON TREE LEAVES SAMPLES

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This paper presents a comparison of the analytical results obtained by Ion Beam Analysis (IBA) and Instrumental Neutron Activation Analysis (INAA) techniques on tree leaves samples collected in Romania. Particle-Induced X-ray Emission (PIXE), Particle-Induced Gamma-ray Emission (PIGE), and Rutherford Backscattering Spectroscopy (RBS) were applied at the 3 MV Tandetron of IFIN-HH using a 3 MeV proton beam. The elements determined by PIXE were Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Cu, Zn, Se, Br, Sr, and Pb, while those determined by PIGE and RBS were F, Na, and Mg, as well as H, C, N and O, respectively.

Instrumental neutron activation analysis (INAA) was applied at the Joint Institute for Nuclear Research (JINR) Dubna (Rusia) and, for selected samples, at the Horia Hulubei National Institute of Physics and Nuclear Engineering (IFIN-HH) at Magurele (Romania). Neutron irradiation was carried out at the IBR-2 reactor in Dubna to examine short and long half-life radionuclides, as well as TRIGA reactor of the Institute for Nuclear Research Pitesti, Romania, for long half-life radionuclides. A total 42 elements were determined: Al, Au, Ag, As, Ba, Br, Ca, Cd, Ce, Cl, Co, Cr, Cs, Dy, Eu, Fe, I, Hf, Hg, K, La, Lu, Mg, Mn, Mo, Na, Ni, Rb, Sb, Sm, Sc, Se, Sr, Ta, Tb, Th, Zn, Zr, Yb, U, V, and W. The elements Al, Cl, Dy, I, Mg, Mn, and V could be determined using short half-life radionuclides produced by neutron activation at Dubna.

The results obtained for a large number of elements in this study will contribute to a better understanding of urban air pollution using tree leaves biomonitors.

Keywords: PIXE; PIGE; RBS; INAA; tree leaves.

S3 P17

DETERMINATION OF RADON CONCENTRATION LEVELS IN WELL WATERS NEAR THE NORTH ANATOLIAN FAULT ZONE, IN GÖNEN / BALIKESIR, TURKEY

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There are plenty environmental sources that threaten human health, most of these are human-sources although some are due to natural sources. One of the most dangerous and toxic of these sources is the radon gas. Radon is a naturally occurring radioactive gas emitted from the crust of the Earth. It is not easily recognizable because it is tasteless, odorless and colorless and is found in varied concentrations inside soil, water and air. It is known that the adverse effect of Radon on health is due to the alpha composition coming from its radioactivity, which ionize living particles and harm the molecular structures of the live organisms. The rate of radon doses is mostly higher around fault lines.

High concentrations of radon are often used as a geophysical tool for uranium exploration, earthquake and volcanic activity predication, and fault zones confirmation. The aim of this study is to assure the suitability of this method in the study of fault zones.

In this study, we make the radon measurements using the water samples which obtained around wells in Gönen during May 2016. Gönen is a district of Balıkesir Province of Turkey, in the southern part of Marmara Sea. The town is mostly known for its therapeutic hot springs. The reason the study takes place in Gönen is because the area lies on a fault line. This earthquake active zone has produced earthquakes in magnitudes from 3.0 to 7.1 in Richter scale. The ^{222}Rn concentrations in well waters near the fault zone in Gönen and its surroundings were determined for the first time.

S3 P18

ARTWORKS CHARACTERIZATION AT IFIN-HH – AN AUTHENTICATION OPPORTUNITY FOR ROMANIAN PAINTINGS

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Cultural heritage is one of the most important factors for a nation's identity. On one hand, it represents the legacy of the people provided along their history, a thing that a community can be proud of and a reason for continuous development; on the other hand, it shows the level of civilisation and progress reached along its existence. In this respect, consolidation and preservation of cultural heritage is a mandatory task.

The aim of this work is to present recent activities and progress which IFIN-HH has made for characterization, identification of pigments for art works from museums and private collections. The study of paintings has a great importance because it may provide information regarding the techniques used by the artist, cultural and historical aspects, authentication and adequate procedures for restoration and conservation. The pigments used remain one of the most studied part of a painting, due to the information stored, suitable for interpretation.

For pigment identification we used non-destructive and non-contact complementary methods (FT-Raman molecular spectroscopic methods, Particle Induced X-Ray Emission - PIXE and X-Ray Florescence - XRF) which are the main analysis techniques accepted by the conservators' and restorers' community. The FT-Raman method identifies the pigments using spectral databases, while PIXE and XRF are capable of providing elemental analysis from the area where it was focused. The two complementary techniques, PIXE and XRF, were used in order to confirm the results obtained through Raman Spectroscopy. PIXE measurements were performed using the 3MV Tandetron installed ar IFIN-HH, while XRF measurements

were performed using a Bruker Tracer S1 Titan spectrometer. Molecular structure characterization was performed by FT-IR / Raman spectroscopy using a Bruker Vertex 70 class spectrometer.

All the paintings belong to the same author and are authenticated; also, it is confirmed that the author used the exact same pigments for over 50 years, which is the period separating the oldest and the newest painting. This can also provide precious information on the evolution of the pigments over the decades.

Cultural heritage objects degrade due to physical, chemical and biologiscal factors. Considering this, gamma irradiation treatment is an efficient way of disinfection for cultural heritage items that have sufferes biological attacks.

Before stopping painting damage caused by microorganisms, those were isolated and characterized, for establishing a decontamination dose as low as process efficiency is reasonably guaranteed.

Keywords: FT-Raman, PIXE, XRF, paiting, gamma irradiation, microbiological testing
Acknowledgements: This work was partially supported by the project cod: PN 16 42 03 02

S3 P19

ON THE STRUCTURE OF MAGNETORHEOLOGICAL ELASTOMERS

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Magnetorheological elastomers (MREs) pertain to a particular class, so called intelligent materials, because they can react to changes in their environment [1-3]. They are composed of magnetic particles, low-permeability matrices, eventually additives [4, 5]. Applying an external magnetic field a structure could form inside the material, or an existant structure may change [6, 7].

In addition, the rheological and electrical properties can be influenced by implementing a mechanical stress, in conjunction with or without a magnetic field. These properties of MREs can be used for production of capacitors [8], sensors and/or transducers of mechanical deformations and magnetic fields [4].

In the present paper the structure of several types of magnetorheological elastomers is analysed based on SANS, XRD, SEM.

Support by JINR-Romania Cooperation Programme Projects for 2016-2017 years and Grants of Romanian Governmental Representative to JINR is acknowledged.

Keywords: *magnetorheological elastomer, SANS, XRD, SEM*

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S3 P20

SIMPLE PHENOMENOLOGICAL FORMULA FOR A HALF-LIVES OF SUPERHEAVY NUCLEI

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In the last years the quantity and quality of experimental data of new super-heavy nuclei (SHN) have increased considerably. These nuclei have now become available for experimental studies with in-beam and decay spectroscopic methods, and also for detailed investigations through a variety of phenomenological and theoretical approaches [1-2]. The comparison of the behavior of measured AD properties with predictions from two theoretical approximations with and without the microscopic structure of involved nuclei provides a unique information on the clustering and reaction amplitudes [3].
Half-lives predictions are made for unknown nuclei near closed shells with Z=50, 82, 108, 120, and N=50, 126, 172 [4-5].

Key words: Super heavy nuclei (SHN); α-decay, α-clustering.

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S3 P21

INVESTIGATION OF CRYSTAL AND MAGNETIC STRUCTURES OF NANOSTRUCTURED MANGANITES AT HIGH PRESSURE BY MEANS OF NEUTRON DIFFRACTION

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Manganites of perovskite type $La_{1-x}Sr_xMnO_3$ exhibit great variety of properties depending on the doping level and particle size.

Such compounds are widely used in the manufacture of magnetic media for storing information, supersensitive magnetic field and temperature sensors. Whereas an important factor in determining the behavior of manganites is the particle size, special attention attracted the nanostructured manganites $La_{1-x}Sr_xMnO_3$, which became a promising materials for applications in biomedicine.

Apart from potential application, the complex manganites are attractive for great number of scientific research. The knowledge of relationship between magnetic and crystal structure of nanostructured manganites $La_{1-x}Sr_xMnO_3$, which can be obtained from high-pressure investigations, is very essential for understanding the nature and mechanism of physical phenomena observed in these nanostructured compounds.

Recently it has been discovered that nanostructured manganites $La_{1-x}Sr_xMnO_3$ (near $x \sim 0.33$) have a rhombohedral structure both in the corresponding bulk samples. However, the magnetic state of these compounds, in contrast to powder samples that exhibit ferromagnetic metallic state, characterized by coexistence of ferromagnetic (FM) and antiferromagnetic (AFM) phase A-type.

The crystal and magnetic structure of nanostructured manganites $La_{1-x}Sr_xMnO_3$ with doping level x= 0.28 *и* 0.37 has been studied by means of a neutron diffraction method on a new diffractometer for investigation microsamples at high pressure DN-6 of high-flux pulsed reactor IBR-2 (FLNP, JINR, Dubna) using high pressure chambers with sapphire anvils under pressure up to 5.7 GPa.

In both samples the FM ordering is formed close the room temperature and at cooling below T<270 K the ferromagnetic FM phase coexists with an A-type antiferromagnetic AFM phase. At high pressure the volume fraction of AFM phase increases while FM is gradually suppressed. The structural aspects of the magnetic phase separation and pressure effects on the studied nanostructured manganites are discussed.

Pressure dependences of unit cell parameters and volume, magnetic moments of ferromagnetic (FM) phase and antiferromagnetic (AFM) phase, Curie and Neel temperature were calculated.

ABSTRACTS

S4 – Cross-disciplinary Applications of Physics

- *Nonlinear dynamics, complex systems and applications*
- *Biological complexity and genetics, Biophysics and bioengineering*
- *Econophysics*
- *Physics of Social Systems*

S4 L1

NEUTRON QUANTITATIVE TEXTURE ANALYSIS OF THE *BIVALVIA* MOLLUSCS SHELLS

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Keywords: crystallographic texture, neutron diffraction, *Bivalvia* mollusks shells

Recently serious interests are focused on the crystallographic texture studies of biological objects. It turns out that polycrystalline physical or mechanical properties exhibit very often an anisotropy which is mainly due to the presence of preferred orientations or crystallographic texture described by an ODF (Orientation Distribution Function). Both aspects, characterizing the texture from one side and correlating it to the properties from the other side, could be essential in understanding of the polycrystalline biological materials behavior.

An important step of texture analysis is pole figures processing and orientation distribution function (ODF) reconstruction. The ODF could be reconstructed from the pole figures that are obtained from experimentally measured neutron time-of-flight diffraction spectra.

In the present work we focused on the study of the *Bivalvia* mollusks shells**.** The spectra of the shells were measured at SKAT (Ullemeyer K et al 1998, Keppler R et al 2014) spectrometer at pulsed reactor IBR-2 (Dubna, Russia). We measured *Mytilus galloprovincialis, Mytilus edulis, Mya arenaria,* and *Ostreidae edulis.* Investigated samples exhibited different phase content. *Mya arenaria* has only aragonite phase whereas *Ostreidae edulis* has only calcite phase. All *Mytilus*es possess both calcite and aragonite phases of different content. The crystallographic texture of all *Mytilus* samples demonstrated very sharp texture of the calcite phase. Other samples do not show sharp crystallographic texture.

The JINR – Romania scientific cooperation program 2016 -2017 are acknowledged.

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Keppler R et al 2014 Potential of full pattern fit methods for the texture analysis of geological materials: implications from texture measurements at the recently upgraded neutron time-of-flight diffractometer SKAT *Journal of Applied Crystallography* **47** 1520

S4 O1

THE OPTIMAL NUTRITIONAL VALUE OF LETTUCE PLANTS DURING THE GROWING STAGES

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Keywords: Vegetables, stable isotopes, elemental profile

The uptake of elements in plants is affected by the plant species, plant maturity or agricultural practices. In this light, multielemental content of *Lactuca sativa* plant was monitored in order to identify the optimal harvest period of plant, from the maximum nutritional point of view.

Lettuce plants were cultivated in greenhouse and samples collection was made every two weeks. Plant samples were irrigated with water from two different sources. The irrigation waters slightly differ in terms of elemental concentrations, the first water source was tap water (Group A) while the second one was spring

water (Group B). In this experiment, for both plant groups the same commercial soil was used. A total of 56 samples consisting in different plant tissues (roots, nervures and leaves) and soil were investigated.

The obtained experimental data were subjected to different chemometric techniques. In this study, *Lactuca sativa* plant presents similar behavior concerning the metal concentration in whole plant for both two irrigation waters. The evolution of elemental content during the eight weeks of growing was investigated by applying ANOVA separately on: macroelements (Na, Mg, K, Ca, P), essential elements (Fe, Cr, Mn, Cu, Zn,) potential toxic elements (Li, Al, V, Co, Ni, As, Cd, Ba, Pb) and technological critical elements TCE (Platinum Group Elements and Rare Earth Elements). It was observed that for all four elements groups: macro-, essential potential toxic and technological critical elements, the maximum concentration correspond preponderantly to second week of growing.

Acknowledgments

The financial support for this work was provided by the Executive Agency for Higher Education, Research, Development and Innovation (UEFISCDI),in the frame of HUMAN RESOURCES Program, Contract no: 159/01.10.2015

S4 O2

BIOPHYSICAL STUDIES OF GOLD NANOPARTICLES FUNCTIONALIZED WITH ^{68}Ga-DOTA CONJUGATED PEPTIDES AS IMPROVED TUMOUR TARGETING SYSTEM

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Nanoparticles have recently emerged as an innovative strategy for cancer diagnosis and therapy. Their functionalization with biorecognition molecules (ligands) forms targeted drug delivery systems that proved to have great potential for early detection of tumors through molecular imaging techniques.

In the present study we have evaluated the binding kinetic inside tumor cells of gold nanoparticles functionalized with ^{68}Ga radiolabeled peptides. For this purpose we used 40 nm polyethylene glycol–coated (PEG-5000) gold nanoparticles characterized through dynamic light scattering (DLS) technique, followed by further functionalization with ^{68}Ga radiolabeled somatostatin analogues. After functionalization analysis through UV-Vis spectroscopy, the radiolabeled compounds were incubated on neuroendocrine colorectal cancer cell line HT-29 and U87MG human glioblastoma cell line. *In vitro* binding kinetics assessment showed over 60% radioisotope retention inside tumor cells in the presence of AuNP. This result is attributed to AuNPs possibility to bind several peptides on their surface and further internalize by somatostatin receptors SSTR2, SSTR3 and SSTR5 mediated endocytosis.

Keywords: gold nanoparticles, ^{68}Ga, somatostatin analogues, colorectal cancer, glioblastoma.

S4 O3

ANODE INTERFACIAL MODIFICATION BY SELF-ASSEMBLED MONOLAYER IN ORGANIC SOLAR CELL

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Organic solar cells (OSCs) offer a possible candidate to conventional silicon-based solar cells due to their versatility in production methods, low-cost manufacturing, properties and applications. Indium tin oxide (ITO) is the most commonly used through the transparency in the visible region ease of patterning and high electrical conductivity in the solar cell, such as transparent conducting oxide. The energy level matching between the work function (WF) level of ITO and the highest occupied molecular orbital level (HOMO) energy level of the organic donor material plays a crucial role to enhance the performance of OSCs. Therefore, the insertion of buffer layer approach has been commonly studied by employing interfacial modification techniques such as metal oxide layers, plasma treatment, cross-linked thin film and self-assembly monolayers (SAMs). In this study, we synthesized different organic SAM molecules to modify ITO surface as shown in Figure. The effects of the SAM molecules on the device performance of the OSCs were investigated.

Keywords: SAM, organic solar cell, buffer layer

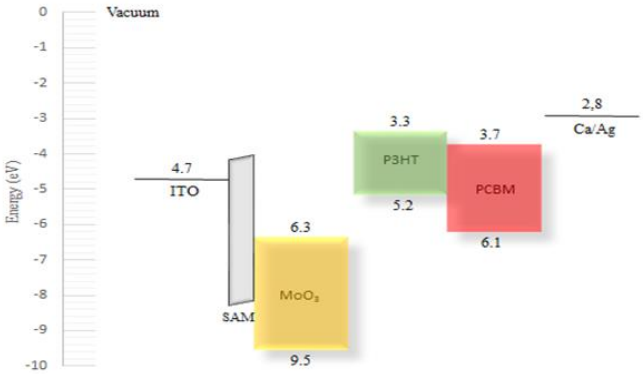

Figure. The energy diagram of the SAM modified organic solar cell

Acknowledgments: This work was supported by TUBITAK. (Project number: 113M978).

S4 P1

RECONFIGURABLE PLASMONIC METASURFACES PROVIDE GREAT FLEXIBILITY IN THE DESIGN OF PHOTONIC DEVICES

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A special interest in metasurfaces (MTS) as new kind of two-dimensional metamaterials was developed since 2011 to achieve exotic optical phenomena and components: negative refraction or reflection, polarization, plasmonics, as well as aberration-free ultrathin lenses. Based on Gartner's hype cycle the evolution of MTS is extrapolated in Fig.1 as a new research direction concerning the conception, analysis and

realization of reconfigurable, sensorial, adaptive and cognitive "skins" for sensing applications and optical communications. Various technologies are emerging to provide modulation of MTS response using mechanical, thermal, electrical or optical control. Therefore, unconventional devices without volumetric counterparts, but with reduced dimensions can be achievable to explore the connection between active MTS design, the control of surface plasmon-polariton, nonlinear MTS for broadband frequency conversion or the interaction of device building blocks (optical antennas, dielectric resonators, quantum emitters, etc.). An initiative from National Institute of Research and Development of Materials Physics (NIMP) was included in a H2020 proposal as "New type of flat optics with electrically controlled optical properties by surface structure based on low-loss plasmonic materials" in order to develop the aberration-free, ultrathin plasmonic optics with voltage-controlled properties for superlenses and polarization state analyzers.

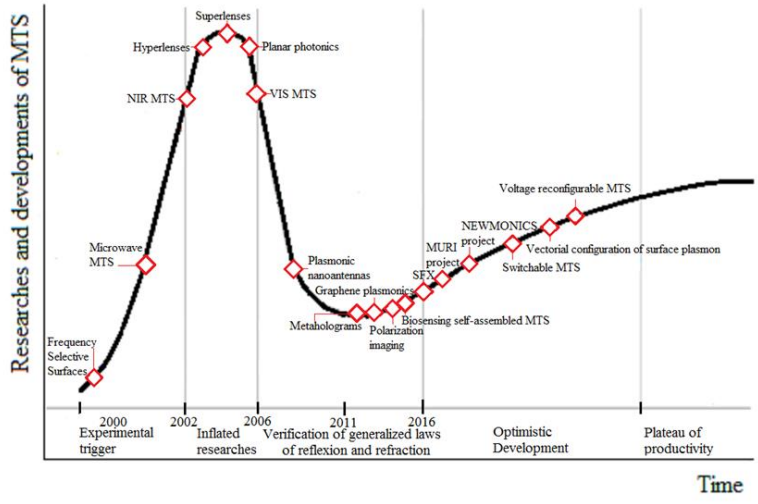

Fig.1 The evolution of MTS represented according with the general Gartner's hype cycle

S4 P2

BIOEFFECTS OF MAGNETIC NANOPARTICLES PRESENCE IN THE CULTURE SOIL OF *LAVANDULA ANGUSTIFOLIA*

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Nanotechnologies are an important part of the industrial revolution to develop new materials used in different purposes. Environmental impact of engineered nanoparticles generates an increased concern regarding possible effects on the soil, water, air, microorganisms, plants or animals. The potential toxicity of magnetic nanoparticles, with 11.45nm average size, supplying the culture soil of the lavender (*Lavandula angustifolia*) plantlets during of 190 days of development after germination, was evaluated. Diluted suspensions of colloidal magnetic nanoparticles coated with citric acid, stabilized in water, were supplied the culture soil: volume fraction ranging between 10 and 350µl/l, equivalent with magnetic nanoparticle concentrations between 19.6µg/ml and 686µg/ml. The impact of magnetic nanoparticles presence in the culture soil of lavender was recorded at the level of: seeds germination, seedlings growth, green tissue contents of photo-assimilatory pigments, photosynthesis apparent efficacy. The seeds germination was inhibited for enhanced nanoparticle concentrations supplying culture soil. Photosynthesis efficacy appeared not to be significant influenced by magnetic nanoparticles presence in the culture medium. The chlorophyll a and chlorophyll b levels were found decreased with up to 30% for higher concentration of magnetic nanoparticles solution added daily to the culture soil of lavender plantlets. Lavender is a plant of medical interest, thus a negative influence of the nanoparticles presence in the soil during plant development, could affect its active principles.

Keywords: magnetic nanoparticles; assimilatory pigments; photosynthesis efficacy; lavender

S4 P3

50HZ SINUSOIDAL MAGNETIC FIELD EFFECTS ON WATER PROPERTIES

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Water is the most common and important material present in nature. The growth and development of all living organisms need of water. Thus we may say that without water there is no life in the entire world. The changes in properties of water under the action of a low frequency magnetic field are an interesting and important question, which has not been solved yet. Many experiments show that the water exposed to a magnetic field may be magnetized, even though the magnetized effect is low. In this work, we study the impact of 50Hz sinusoidal magnetic field on water properties. For the magnetic treatment 120ml containers with distilled water were exposed one by one to a homogenous 50Hz sinusoidal magnetic field with magnetic induction between 1 and 5mT for different exposure durations between 5 and 240s, in the central place of Helmholtz coils system. Magnetic exposure and all measurements were carried out in the same temperature (295K). The magnetic treatment of water was used to examine the effects on the density, surface tension, viscosity, pH, oxygen concentrations and electrical conductivity, compared with the control sample. After magnetically exposure, all parameters analysed were changed, shown that 50Hz magnetic field presence influences the properties of water for different magnetic induction values as well as different durations of exposure. Experimental results show that the viscosity and the surface tension were increased when the water sample was exposed to the magnetic field. Increasing of these physico-chemical properties means an increasing of molecular interactions.

Keywords: water, physico-chemical properties, extremely low frequency magnetic field

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S4 P4

BIO-ACTIVITY OF ORGANIC/INORGANIC PHYTO-GENERATED COMPOSITES IN BIO-INSPIRED SYSTEMS

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Green nanotechnology gained a huge interest in scientific world, in the last years. Recently, the plants have been greatly used as raw material for preparation of many nanomaterials because of their low cost and high abundance in nature.

The present study aimed to design in a "green" approach, novel organic/inorganic biocomposites with interesting bio-activity. Silver-copper composites were phyto-generated from *Citrus* peel extract. Bio-inspired lipid bilayers with and without chlorophyll *a* were prepared through lipid film hydration method, and further used to develop two hybrid systems containing these metallic structures. The obtained biocomposites presented good physical stability (zeta potential values ranging from -30 to -35.1 mV), and their morphology was analyzed by AFM. They showed high antioxidant activity (*in vitro* tested through chemiluminescence method),

and exhibited *in vitro* antiproliferative effect on human colorectal cancer cells (Caco-2 ATCC HTB-37), and also good antimicrobial activity against *Escherichia coli*. These results are promising, the obtained biocomposites could be used in many bio-applications.

Keywords: Silver-copper biocomposites, bio-inspired lipid membranes, chlorophyll *a*, bio-activity

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S4 P5

INTERACTIONS OF HUMAN SERUM ALBUMIN WITH FOLIC ACID

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The binding of folic acid (FA) with human serum albumin (HSA), at pH 7.4, in HEPES buffer was studied. FTIR, steady state and time resolved fluorescence were used to analyse the binding mechanism.

The mechanism of the quencing of HSA in the presence of folic acid was characterised, monitoring the decay of the fluorescence emission signal of HSA in the presence increasing concentration of folic acid, using the Stern-Volmer ecuation. The bimolecular constant was determined and the mechanism of the binding was found to be static. This result was confirmed by the fluorescence lifetime measurements for HSA in complex with folic acid. The energy transfer efficiency between the donor, HSA, and the acceptor, folic acid ,was calculated and the distance between the donor and the acceptor was determined. We found that the the quencing mechanism of folic acid - HSA complex is a combination of static and nonradiative energy transfer.

The adsorbtion of HSA and HSA-FA complex on gold substrate in increasing concentrations of FA was studied by cyclic voltammetry and electrochemical impedance spectroscopy. Changes in redox current and corresponding parameters of equivalent electric circuit at gold-solution interface were used to evidentiate and interpret the biomolecular interaction.

The affinity binding constant and the thermodynamic parameters of HSA interaction with folic acid were evaluated. The values of these parameters put in evidence a moderate exothermic binding process, driving by both enthalpically and entropically contributions.

Key words: binding mechanism, affinity constant, thermodynamic parameters,

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S4 P6

PHYSICOCHEMICAL AND MORPHOLOGICAL ANALYSIS OF BIOHYBRIDS BASED ON CHITOSAN AND HERBAL EXTRACTS

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Chitosan, a very versatile biopolymer, gained a large spectrum of biomedical applications such as: tissue engineering, wound healing, burn treatment, artificial skin, ophthalmology (contact lenses), carrier for drug delivering systems, to name few. The main characteristics that make it an ideal carrier system are its biodegradability, biocompatibility, availability, safety, cationic charge and antimicrobial potential. The chitosan reactivity is extremely versatile due to amino- functional groups, induced by the degree of deacetylation. Our research focused on preparing samples with different concentrations of chitosan (from 1% to 5%) in solution of acetic acid (3.5 v/v%), and characterized from point of view, physical properties: viscosity, molecular weight, density as well as the degree of deacetylation, by potentiometric titration. The biohybrids are designed by ultrasonic activation and self-assembling of the *Cyperus rotundus* L. extract (Soxhlet method) with chitosan. Characterizations:micro-nanoscopic (SEM-AFM), physico-chemical (QSAR-properties) and the antioxidant capacity of *Cyperus rotundus* L. extract. The antioxidant properties are measured by ABTS and CL(chemiluminescence) method and correlated with 3D Structure Atomic Force Microscopy (AFM) topography. In addition FT-IR spectroscopy showed a specific interaction between hydroxyl groups of polyphenols from *Cyperus rotundus* L. extract with amide I groups from chitosan leading to new potential applications in biomedical area of the biohybrids made of biopolymer and herbal extracts.

Acknowledgements: This work was supported by the Ministry of Science and Technology in Baghdad and by the Romanian National Authority for Scientific Research, Project Project PN II PCCA No 210/2014 and PN16270303.

S4 P7

HAND GESTURE MONITORING USING LOW-COST OPEN-SOURCE MICROCONTROLLERS COUPLED WITH FORCE SENSITIVE RESISTORS AND ELECTROMYOGRAPHY SENSORS

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In the last several years, the increased use of wearable devices has generated interest in novel gesture input techniques for mobile interactions [1-3]. Of particular importance is integrating various biomedical-based sensors into devices that are already ergonomically acceptable to consummers. However, current techniques can be impractical due to signal interference, requirement for additional sensors mounted independently of the wearable, and inability to sense different types of gestures.

In this study we consider a low-cost open-source environment, where users interact with several computing devices and platforms. Thus, the concrete usage of any tool requires a specific configuration process in order to meet the end user's needs. The aim is to compare the effectiveness of hand gesture recognition using EMG electrodes when using sensors located on the forearm in comparison to force-sensitive resistor (FSR) array located over the fingers of the hand. Our interest is in how the relocation of sensors would affect

the classification rates of finger gestures. These sensors (EMG and FSR) are connected, through circuit boards, to an Arduino Uno. The Arduino is programmed to read analogue data from the sensors, which are then sent to the computer via serial communication for data collection and processing. We used Python enviroment in order to acquire these signals and process them.

Our study confirmed that by including EMG along the FSR sensors the classification rate for different kinds of gesture (including all fingers and wrist) increased, providing a better understanding of the complex hand dynamics. These findings can be used in machine learning systems for developing versatile hand prosthesis or in rehabilitation.

Keywords: hand gestures; biomedical-based sensors; EMG; force sensitive resistors;

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S4 P8

BIO-NANOMETALS IN MEDICAL APPLICATIONS

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Nowadays, recent advances in nanotechnology have been applied in the biomedical field. Nanomedicine uses metallic nanoparticles as photo-thermal agents (gold nanoparticles) or as drug delivery systems, antimicrobial agents, cancer diagnostic applications, or in tissue regeneration. In the last years, bio-generated nano-metals incorporated in biocomposites were the most used in medical applications due to their biocompatibility, low toxicity and high bioactivity.

Our work presents the bio-performances of some biohybrid systems (based on silver nanoparticles phyto-synthesized using various plants), which were characterized by modern biophysical methods: absorption and emission spectroscopy, AFM analysis, antimicrobial investigation, cytotoxicity and hemocompatibility testing. Their antioxidant properties were checked by chemiluminescence method, the antioxidant activity ranging from 85% to 99.5%. Zeta potential measurements revealed good physical stability of the designed biohybrids (-30.1 ÷ -34.2 mV). *Mentha piperita*-AgNPs based samples exhibited the best biocidal effect against *Staphylococcus aureus*. The biocomposites containing curcumin showed significant *in vitro* cytotoxicity against HT-29 cancer cells.

The use of bio-nanometals as building blocks to design novel and interesting bioplatforms for medical applications still remains a challenge.

Keywords: Metallic nanoparticles, antimicrobial activity, antioxidant properties, cancer

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S4 P9

DYNAMIC LIGHT SCATTERING TIME SERIES GENERATION USING HARMONIC FUNCTIONS

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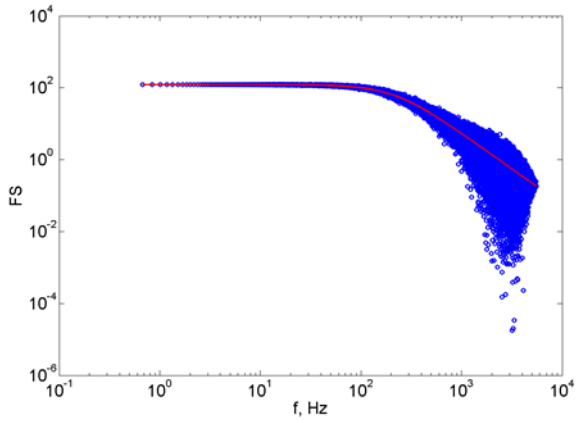
Keywords: Dynamic Light Scattering (DLS), Time series

If a coherent light beam is incident on a fluid containing suspended particles, each particle scatters light by an elastic interaction. The scattered wavelets are coherent, as well, therefore they interfere in the far field. The aspect of the far interference field is of maxima and minima randomly distributed. The scattering centers undergo a complex motion, as an overlapping of the Brownian motion with the sedimentation motion, the scattered light presents time fluctuations and the far field interference has the typical aspect of boiling speckles. If a small detector is placed in the interference field and the electric signal proportional to the light intensity is recorded, a DLS time series is obtained.



An algorithm and a code to generate realistic time series in a simple manner can be useful in improving the DLS procedure. Finding a simple algorithm that uses a deterministic procedure to produce a time series generated by a stochastic system is a challenging task. Such a simple algorithm uses a sum of harmonic functions with random phases and amplitudes computed in such a manner to provide the power spectrum expected by the real system. The correctness of the simulated time series was verified by using a least square fitting procedure, previously described.

The figure presents the frequency spectrum generated computed for such a simulated time series (dots) and the computed frequency spectrum (continuous line) and the match is quite good. The algorithm is presented in detail in the extended paper.

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S4 P10

KINETIC OF ORGANOSULFUR COMPAUNDS INTERACTION WITH UNILAMELLAR PHOSPHOLIPID VESICLES

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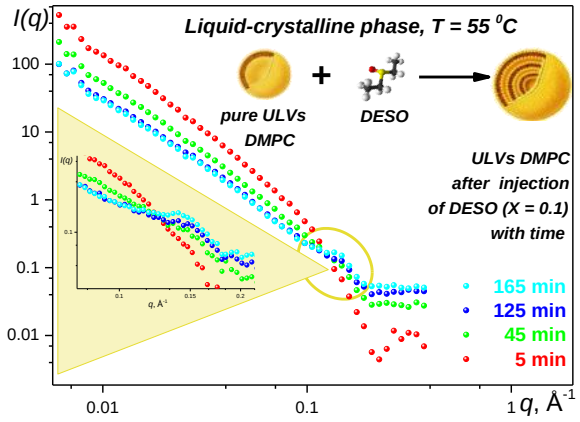
The main goal of cryobiology is the preservation of living cells. Dimethyl sulfoxide (DMSO) is more popular among the cryoprotectants. DMSO replace water molecules associated with cellular elements, and affect the structure of water. Thus, DMSO reduces the likelihood of the formation of ice crystals which can

damage the cells. Along with DMSO another one organosulfur compaund – diethyl sulfoxide (DESO) can be used as a cryoprotectant. DESO shows strong interaction with water, even stronger than that of DMSO [1]. The investigation of the ability of DESO to act as an effective cryoprotectant on *E. coli* survival confirms that DESO, more than DMSO, is able to penetrate living tissues without causing significant damage [2].

The present work devoted to structural investigation of the unilamellar vesicles (ULVs) 1,2-dimyristoyl-*sn*-glycero-3-phosphocholine (DMPC) using small angle neutron scattering (SANS). The experiments were performed at YuMO time-of-flight spectrometer at the IBR-2 pulsed reactor (Dubna, Moscow region, Russia). It was shown that the structure of the ULVs DMPC disolved in water is changes after injection of the sulfoxides with small mole fraction ($X = 0.1$ or $X = 0.2$). The formation of the multilamellar vesicles (MLVs) was observed in case of the both sulfoxides in liquid-crystalline phase with time. However, the effect is more pronounced in the presence of DESO. Beside, it was found that the structure of the vesicles is completely restored after freezing-heating at $X_{DESO} = 0.1$.

Additionally the structural parameters obtained from SANS were compared with Molecular-dynamic simulation.



Structural changes of ULVs DMPC (1wt%) (left) and depence of bilayer thickness (right) on time according to SANS data

t(min) / X_{DESO}	0.0	0.1	0.2
0	36.3(1)		
5		36.1(1)	36.2(1)
45	36.3(1)	27.2(2)	21.1(1)
125		27.6(3)	
165	36.3(1)	27.6(1)	

Keywords: Unilamellar vesicles, Sulfoxides, SANS

Acknowledgements: This research was supported by the JINR-UAIC Scientific Projects № 218_9 and № 219_36 from 10.04.2017

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S4 P11

ICP-MS and AAS METHODS APPLIED ON THE SEWAGE SLUDGES FROM DAMBOVITA COUNTY

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Currently, an important issue, both for agriculture and population is the waste management and their integration into productive agricultural use. Reintroduction in the natural circuit of the sewage sludges is an

urgent priority. This paper presents the concentration of heavy metals (Cd, Cr, Cu, Fe, Mn, Pb and Zn) through Atomic Absorption Spectrometry (AAS) and Inductively Coupled Plasma Mass Spectrometry (ICP-MS) of some cereals (maize, wheat and oats). These grains were grown with different concentrations of mud/soil (0/100, 25/75, 50/50,75/25 100/0) and we aimed to observe the potential impact that it may have on the environment. The analyzes were performed on different stages of grain growth.

Keywords: heavy metals, sewage sludge, AAS, ICP-MS

S4 P12

MOLECULAR INTERACTION BETWEEN DRUGS WITH ANTIMICROBIAL ACTIVITY AND MACROMOLECULAR RECEPTORS

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Antibiotics have improved public health but very success of these drugs has often resulted in an inappropriate and irrational use of antimicrobial drugs. Increasing the number of pathogens resistant to different classes of antibiotics and infectious diseases led to the need to develop a new approach to antimicrobial therapy. With the view to counteract the increasing prevalence of this phenomenon, a large number of research studies have been focused on the development of new molecules with antibacterial and/or fungicidal properties. New quaternary ammonium compounds, having at the basis the 2-aryl-thiazole system diversely substituted at the 2, 4, and 5 positions, have been synthesized. The main goal of our contribution is to provide a complete thermodynamic profile of the binding, in liquid and solid state, of drugs with antimicrobial activity to macromolecular receptors by ITC calorimetry, 1H NMR and XRPD methods.

Acknowlegements. Financial support from the National Authority for Scientific Research and Innovation – ANCSI, Core Programme, Project PN16-300203 is gratefully acknowledged.

S4 P13

QUANTITATIVE ANALYSIS OF ZIDOVUDINE – HSA INTERACTION BASED ON ITC CALORIMETRY, FLUORESCENCE AND NMR SPECTROSCOPY

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A quantitative analysis of the interaction between zidovudine (AZT) and human serum albumin (HSA) was achieved using Isothermal titration calorimetry (ITC) in combination with fluorescence spectroscopy and 1H NMR spin-lattice selective relaxation. ITC directly measure the heat during a biomolecular binding event and gave us thermodynamic parameters and the characteristic association constant. By fluorescence quenching, the binding parameters of AZT-HSA interaction was determined and location to binding site I of HSA was confirmed. Via T1 NMR selective relaxation time measurements the drug-protein binding extent was evaluated as dissociation constants KD and affinity index. The involvement of azido moiety of zidovudine in molecular complex formation was put in evidence. All three methods indicated a very weak binding interaction. The thermodynamic signature indicates that at least hydrophobic and electrostatic type interactions played a main role in the binding process.

Acknowlegements. Financial support from the National Authority for Scientific Research and Innovation – ANCSI, Core Programme, Project PN16-300203 is gratefully acknowledged.

S4 P14

TIME-DEPENDENT ORGAN RESPONSE TO SPIONS IN RATS

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SuperParamagnetic Iron Oxide Nanoparticles (SPIONs) effects on tissues have been studied but their actions are not truly understood. We analysed 50 nm SPIONs (Fig. 1) effects on rat organs, blood serum and urine at 6, 12 and 24 hours after administration. SPIONs were obtained by the oil mini-emulsion method and clusters were coated with polyethylene glycol (PEG). Rats were injected intraperitoneally or intravenously with SPIONs, and organs were analyzed by histological methods and transmission electron microscopy. Blood serum and urine were analyzed by spectrophotometry. Our results indicated that SPIONs spread throughout all of the studied organs already at 6 hours' post administration. SPIONs were found to affect mostly the lungs at 24 hours' time point.

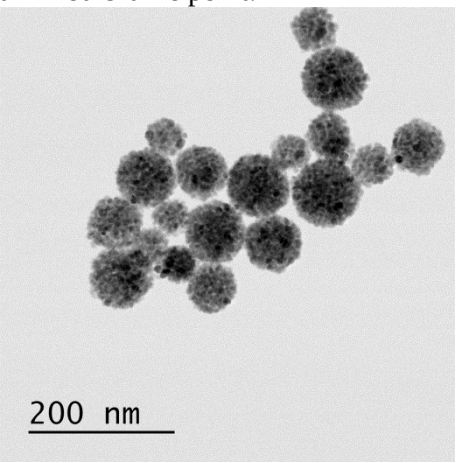

Fig. 1. 50 nm polyethylene glycol covered superparapagnetic iron oxide nanoparticles (SPIONs)

Keywords: SPIONs, lungs, rat

Acknowledgements: This work was financed from PN-II-RU-TE 2014 -4-0608 grant awarded by the Romanian Government to LBT

S4 P15

SPECTROSCOPIC STUDY OF MEMBRANE FLUIDITY MODIFICATIONS INDUCED BY DIFFERENT DECONTAMINATION TREATMENTS ON *ESCHERICHIA COLI*

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In this study, we use fluorescence spectroscopy to investigate the fluidity changes in Escherichia coli external membrane as a response to different disinfectants treatments, used at sub-MIC's levels (minimal inhibitory concentrations). Those disinfectants are very used in hospitals, pharmaceutical and food industry, and even at home, as an effective method to prevent the spreading of microorganisms [1-3]; they are: *ethanol, isopropanol, sodium hypochlorite* and *bis(aminopropyl)laurylamine(N-(3-aminopropyl)-N-dodecyl-1,3-propanediamine)* – commercial name *ISORAPID.*

As fluorescent probe, we use Laurdan (6-Dodecanoyl-2-Dimethylaminonaphthalene), a fluorophore sensitive to environment polarity. Laurdan is intensively used as a tool for describing biological membranes fluidity [4-6].

The fluorescence spectra were analyzed using a deconvolution procedure developed earlier [7]. We found that each kind of treatment induce at outer membrane level different changes in fluidity, due to different mechanism of action.

We can conclude, from this study, that outer membrane plays a significant role in bacterial resistance, when decontamination agents are used in an inappropriate manner, at concentrations below MIC. The resistance of bacteria could increase after these treatments.

Keywords: disinfectants, *E.coli*, membrane fluidity, fluorescence spectroscopy.

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S4 P16

MODELS APPLIED TO STEADY STATE AND TIME RESOLVED FLUORESCENCE DATA ANALYSIS TO OBTAIN WATER-TO-LIPID PARTITION FREE ENERGY. AN EXPERIMENTAL APPROACH

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Antimicrobial peptides (AMP's) have been shown, in recent years, to be a method of fighting against infections caused by microorganisms (bacteria, fungi, viruses). This method of treatment was chosen as an alternative to antibiotics, due to the fact that microorganisms gained increased resistance to the latter [1]. AMP's are a particular class of peptides which are part of the host innate defense mechanisms of many organisms [2, 3].

In order to obtain the maximum effect of these treatments, it is necessary to study the interaction mechanisms between these AMP's and the pathogens against which they fight. Because the cell membrane confers individuality for both eukaryotic and prokaryotic cells, behaving as a selective barrier to ions and molecules, it is important to study the interaction mechanisms between this one and AMP's.

Before in-vitro studies required to establish the activity of AMP's in relation to mammalian and bacterial cells, and also in parallel with these, it is necessary to establish mechanisms of interaction between the peptides and the cell membrane. This is done using cell membrane models - liposomes, with various compositions

(neutral lipids for mammalian membranes and negatively charged lipids for bacterial membranes). The most widely used liposomes are large unilamellar vesicles - LUV's.

In this study we focused on the water-to-lipid partition free energy for three AMP's in relation with neutral DOPC and negatively charged DOPC-DPPG (85:15 mol) LUV's. The AMP's used are, as follow: **Melittin**, a 26 amino acids peptide, the principal component of apitoxin (bee venom), **Cecropin P1** an antibacterial peptide from *Ascaris suum*, a parasitic nematode that resides in the pig intestine and **Indolicidin**, a 13 amino acids tryptophan-rich cationic peptide, isolated from bovine neutrophils.

The aim of this study was to determine the water-to-lipid partition free energy and to choose a suitable model for analisis [4-7] of both steady state and time resolved flurescence measurements data, in correlation with mecanism of interaction between the AMP's and LUV's.

We can conclude, from this study, that steady state and time resolved fluorescence techniques can be used to obtain the water-to-lipid partition free energy, but different models for data analisis must be applied, in agreement with the mechanism of interaction between the AMP's and LUV's.

Keywords: AMP, LUV, partition free energy, steady state and time resolved fluorescence.

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ABSTRACTS

S5 – Engineering and Industrial Physics

- *Physics of energy transfer, conversion and storage*
- *Environmental Physics*
- *Sensors and Device Physics*
- *Micro- and Nanoelectronics*
- *Microelectromechanical systems*
- *Instrumentation and Metrology*
- *Imagining, Microscopy and Spectroscopy and their applications*
- *Instrumentation, processing, fabrication and measurement technologies*
- *Applications of fluid mechanics and microfluidics*

S5 L1

CHARACTERIZATION OF METAL NANOPARTICLES IN WATER WITH QUARTZ CRYSTAL MICROBALANCE

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In this paper we study and develop a simple method to characterize metal nanoparticles in liquid media using Quartz Crystal Microbalances (QCM). Considering the fact that nanoparticles are difficult to investigate under normal conditions, we choose to use a Quartz Crystal Microbalance in order to remove the liquid and retain only the nanoparticles on the sensor surface for the further investigations. The rates of mass change versus time plots are useful indicators of particle behavior during deposition on surfaces. Metal nanoparticles interactions with solid surfaces are of interest to learn about nanoparticle surface affinity, e.g. for filtering/removal of nanoparticles from water or air, for collecting samples for later characterization, or for preventing nanoparticle induced fouling. For experiments we used five types of metal nanoparticles in ultra-pure water: Ag, Au, Pd, Ti and Fe. The nanoparticles have the size of between 70 nm and 80 nm, and the concentration was about 20 mg/l. After deposition nanoparticles on sensors we have been analyzed surfaces of sensors by Atomic Force Microscopy - AFM (Ntegra Prima by NT-MDT), Scanning Electron Microscopy-SEM (SU-70 by Hitachi) and Energy Dispersive X-Ray Spectrometer (UltraDry EDS) for characterization of clusters and isolated nanoparticles. Nanoparticles were adsorbed uniformly over the entire sensor, but from place to place were formed clusters. Depending on the adsorbed element and the size of the nanoparticles, the formed clusters have different shapes. These shapes were investigated in order to determinate the mean size of nanoparticles. Obtained AFM images were processed with Nova Px software. The purity of metal nano colloids is 99.99% of metal. The metal nanoparticles in the water are electrostatically stabilized. The mean zeta potentials are between -53 mV and - 65 mV.
***Keywords*:** Quartz Crystal Microbalance, Newtonian liquids, solid/fluid interfaces

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S5 L2

COMPLEX ARRAYS OF NANOWIRES & NANOTUBES. FROM NANOFABRICATION TOWARD NEXT GENERATION DEVICES

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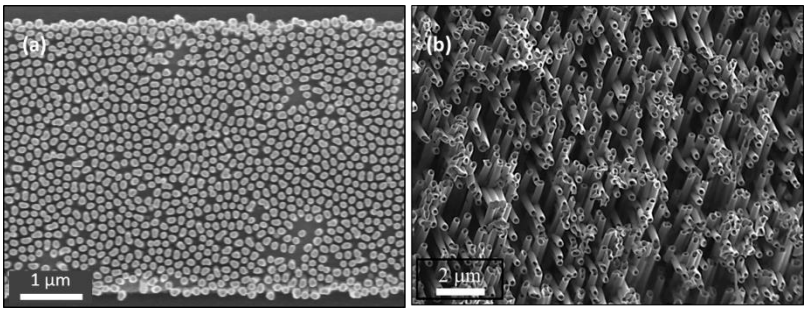
The dense arrays of nanowires or nanotubes are expected to play an important role in the development of the next generation of nanostructured devices, as their high surface-to-volume ratio could be beneficial for a wide range of applications. However, the use of such one-dimensional nanostructures as functional building blocks within electronic devices requires specially tailored nanoarchitectures with well-defined patterns, positions and pitches.

In this context, several cost-effective pathways of preparing large and dense arrays of nanowires or nanotubes, with easily tunable geometrical dimensions and spatial arrangement are discussed. The described fabrication approaches mostly rely on the template-assisted electrochemistry, additionally coupled with advanced patterning protocols. The methods are extremely versatile and allow the design of a wide range of elongated nanostructures, including metallic, polymeric and hybrid core/shell nanowires or nanotubes, with great applicability in various fields, such as sensing and biosensing, energy storage and harvesting, or magnetic recording, only to mention a few. Subsequently, several such device-oriented applications are presented in details.



(a) Nanowire-templated interdigitated microelectrodes for highly-sensitive pH detection; (b) 3D interconnected Polypyrrole nanotubes for highly-sensitive chemiresistive gasseous ammonia sensing.

Keywords: alumina & polycarbonate templates; optical and e-beam lithography; capacitive and chemiresistive sensing; electrodes for micro-batteries.

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S5 L3

ELECTRICAL INSULATORS AND ENVIRONMENTAL SAMPLES ANALYZED BY COMPLEMENTARY ANALYTICAL TECHNIQUES

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The metal impurities in insulators of electrical rotating machines and heavy metals in environmental samples, were analysed by complementary spectrometric techniques of high sensitivity and precision : Inductively Coupled Plasma Mass Spectrometry (ICP-MS), Atomic Absorption Spectrometry (AAS) and Energy Dispersive X-Ray Fluorescence (EDXRF). For elemental analyses of insulators samples we applied the Inductively Coupled Plasma Mass Spectrometry - ICP-MS technique. The concentrations (in the range of ppb) of Al, Mn, Fe, Ni, Co, Cu, Zn, Cr, Cd and Pb in insulation of cables were determined. These transferred metals from cables in insulation, during operation of the rotating electrical machine, causes degradation of insulation, affect its insulating properties and can lead to undesired electrochemical processes under the electrical stress factor. Diagrams of the transferred metal concentrations are given. In the same period of time we analysed heavy metals in moss samples used as bioindicators of environmental pollutions. For experiments we applied by complementarity AAS, ICP-MS and EDXRF spectrometries techniques, respectively. We determined the concentrations of Cr, Fe, Mn, Ni and Zn from the mosses samples. The mosses samples, as bioindicators, were used in the study of heavy metals from atmospheric deposition in Dambovita County

Romania. The concentration of Fe from the same samples was determined using all these methods and we obtained a very good agreement, in statistical limits. This demonstrate the capability of these analytical methods, of high precision and sensitivity, wich can be applied on a large spectrum of samples, insulator of electrical rotating machine and environmental.

Key words: insulator, methods, electrical rotating machines, environmental.

Acknowledgments: The research leading to these results has received funding from PN II 2013 (Partnership Programme) under the project PN-II-PT-PCCA-2013-4-0792 "High performance polymeric insulations for electrical rotation machines. Technology and modeling approaches", contract no. 262.

S5 L4

PHOTOELECTRON SPECTROMICROSCOPY OF FERROELECTRICS

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Ferroelectric thin layers are intensely studied nowadays, owing to their possible applications in non-volatile memories, pyroelectricity, catalysis and photocatalysis [1]. Thin films exhibit single domain states, due to a 'self-doping' phenomenon, which supposes the creation of oxygen vacancies during the film synthesis, providing electrons for the compensation of the depolarization field [2]. The achievement of high quality single crystal layers with defined polarization allowed one to validate photoelectron spectroscopy as a tool to detect band bending at surfaces and hence the polarization state without any mechanical interaction with the surface [3–5]. One step further was achieved during the last years, by using photoelectron spectromicroscopy performed at synchrotron radiation beamlines with 'binding energy contrast' [6] in order to detect simultaneously spatial and spectroscopic features occurring on ferroelectric surfaces. Time-dependent phenomena were also recorded [7] (Fig. 1), pointing on dynamic screening of the depolarization field on well-defined areas. This talk will review all these new aspects in the surface physics of ferroelectrics.

Keywords: ferroelectrics, photoelectron spectroscopy, spectro-microscopy

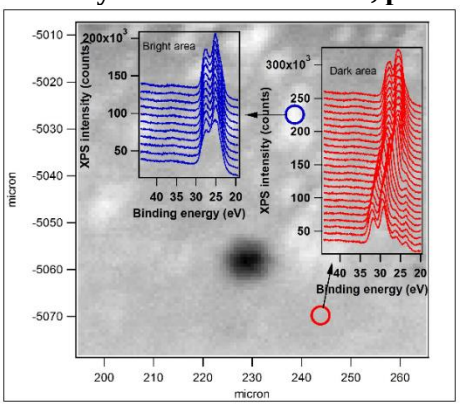

Figure 1. Pb 5d spectro-microscopic data for a 70 × 70 μm^2 area on a 150 nm $PbZr_{0.2}Ti_{0.8}O_3$ film grown on $La_{0.5}Sr_{0.5}MnO_3$ / $SrTiO_3$(001). The map represents total photoemitted intensity from each point between 20 and 24 eV binding energy, with a spatial resolution of 1 μm. In each point a complete photoemission spectrum is recorded. The temporal evolution in two selected points is represented in the graphs superposed: red and green curves, corresponding to circles designated by similar colors (unpublished).

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S5 L5

ATOMISTIC SIMULATIONS OF THE DYNAMICS AND THERMODYNAMICS OF DENDRIMER-DNA AND DENDRIMER-NANOPORE INTERACTIONS

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Three aspects concerning the interaction of PAMAM dendrimers with biological molecules will be discussed. First, I will describe molecular dynamics simulations of dendrimers of various generations confined inside proteinaceous membrane pores. The study explains single-molecule nanopore measurements [1] and establishes an atomistic model of pore dendrimer interactions. Electrophoretic migration of polycationic PAMAM dendrimers into confined space is not dictated by the diameter of the dendrimer, but by their generation-dependent flexibility. Differences in dendrimer flexibility also rationalize the apparent anomaly that experimental nanopore current read-outs depend in nonlinear fashion on dendrimer size. These findings can improve analyses of biophysical experiments, and the rational design of functional materials (e.g., nanoporous filtration devices and nanoscale drug carriers that pass biological pores).

Second, I will present a computational study of the interaction of DNA with dendrimers, featuring simulations at the atomic level to map out the free energy profile of the DNA-dendrimer interactions and to build a mesoscopic model that reproduces single-molecule force-extension curves obtained using optical tweezers [2].

Lastly, I will discuss an often overlooked factor involving the role of solvent in dendrimer interactions. We present evidence from molecular dynamics simulations that the hydrogen bonding network in ordered waters between a strand of DNA and a highly charged dendrimer contributes significantly to the free energy by extending the interaction well beyond the electrostatic range of the molecules. Our results are in good agreement with experiments on the role of solvent in DNA condensation by multivalent cations [3]. We also make connections to mean field theories for hydration forces that go beyond DLVO theory. The water-bridging effect explains the kinetic rates of several biomolecular interactions that are too fast to be due to pure diffusion, and has implications for the design of novel means to deliver genetic material into cells.

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Acknowledgements: This work was supported by the National Science Foundation and the National Institutes of Health.

S5 O1

SEISMICITY OF ITALY

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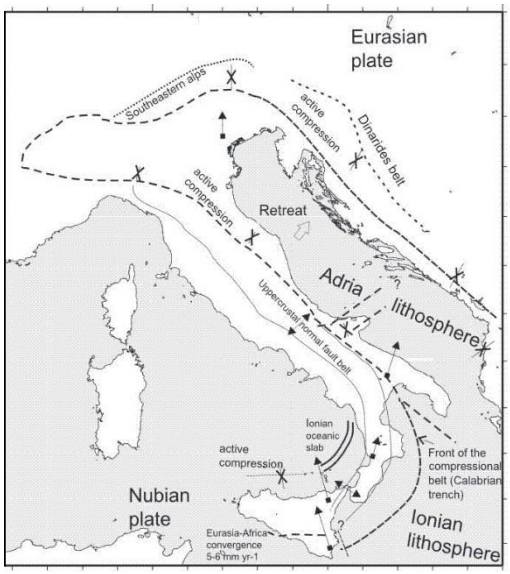
The tectonics of Italy is a result of the collisions between Nubia and Euro-Asia plates. This tectonics is accompanied by different smaller tectonic units as results during subduction of the Nubia under Euro-Asia and during the collision of the Alpine and Apennine orogenic belts.



Tectonic map of Italy. Arrows are directions GPS measurements. After Chiarabba, 2004.

In Italy and surrounding areas we can recognize different stages of the Wilson-Reading cycle. In south, the Calabrian arc, define the Benioff plane with 70^0 NW dipping of the subduction of Nubian plate under the Euro-Asia plate. In the East we distinguished the thrust of the Southern Apennines over the Adria plate, and the subduction of the Adria (continental)-Ionian (oceanic) lithosphere which is acting in central and northern Apennines. The southern limit of the Adria from Nubia is Gargano-Dubrovnik fault. West of Calabria compressional structures (Calabrian trench) the Thyrenian Sea is opening, pushing the southern Italy to the Greece and taking place the subduction process of Ionian lithosphere. The limit between Ionian lithosphere and Nubian lithosphere is marked Malta escarpment (a hidden fault). North of Sicily, due to subduction of Nubia under Sicily, is highlight a compressional zone, probably a future subduction zone, but this time, a subduction in which Euro-Asia plate is subducted under the Nubian plate. In southern part of Sicily is situated an extensional structure with a very important role in subduction process(Biela, 2011).

In central Apennines, west of compresional zone between Adria and Apennines, is located an upper crustal normal fault belt, which it is responsible for seismic sequences from 2009(Aquila) and 2016 (Amatrice).

Acknowledgements for:

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S5 O2

INFRARED SATELLITE IMAGERY FOR SHORT TERM SEISMIC PRECURSORS ASSOCIATED WITH SOME EARTHQUAKES RECORDED IN VRANCEA ZONE

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Short-term earthquake prediction (timescale of hours, days and weeks) is of essential importance to mitigate strong seismic events disasters. During last decade, due to fast progress of thermal infrared (TIR) technology, all weather, high-resolution and high-dynamic range of new developed sensors, a large time-series data base is available for seismic anomalies monitoring in relation with earthquakes. As received satellite infrared information is influenced by many types of factors, the main problem for seismic anomalies recognition is to extract useful information associated with tectonic activities and to eliminate the effects of non-tectonic factors. Pre-earthquake spatio-temporal developed thermal anomalies are controlled by various factors like as earthquake moment magnitude and its focal depth, geological setting, topography and land covers. In this paper, changes before and after the Vrancea earthquakes in the land and atmospheric parameters have been investigated on the basis of time-series geospatial and field data analysis. The detected changes show a complementary behavior in terms of the various geophysical parameters, further showing strong evidence of coupling between lithosphere-land surface-atmosphere-ionosphere associated with the Vrancea's

earthquakes. Have been selected the atmospheric earthquake presignals detectable from space: surface latent heat flux (SLHF), and air (AT) surface temperature anomalies, provided by time-series satellite NOAA AVHRR and in-situ monitoring data. For some analyzed earthquakes, starting with ten days up to one week prior to a moderate or strong earthquake a transient thermal infrared rise appeared in SLHF (tens of W/m^2) and AT (2-10C°) values higher than the normal, function of the magnitude and focal depth, which disappeared after the main shock. The joint analysis of geospatial, geophysical, and geological information is revealing new insights for Vrancea zone seismicity understanding in Romania.

Keywords : Seismic anomalies, geophysical parameters, Vrancea active zone, Romania.

Acknowledgements

This work was supported by Romanian National Authority for Scientific Research by grant CNDI–UEFISCDI, project number PN-II-PT-PCCA- 86/2014 VRAGEO and Program NUCLEU Contract 5N/09.03.2016, under 16 40.01.01 and 16 40.01.02 research theme.

S5 O3

QUANTITATIVE DETERMINATION OF RETAINED AUSTENITE IN STEELS BY NEUTRON DIFFRACTION

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Retained austenite (RA) is a dispersed phase inherent in high-strength steels since stabilization of high-temperature □□phase (austenite) by alloying elements in order to get a strong overcooling in quenching and, hence, to make the final martensitic structure, inevitably results in saving some quantity of the stabilized □□phase. RA can be desirable, as in TRIP steels where it enhances ductility, or harmful otherwise because of the eventual carbide precipitation transforming the RA islands into brittle zones, a kind of crack origins. In both cases, however, reliable evaluation of the RA volume fraction, particularly when the latter is small (<2%), is a challenging problem of utmost practical significance. Specifically, RA detectability limits in terms of volume fraction are not less than 2% and 1%, respectively, for the X-ray (XRD) and neutron diffraction (ND) techniques. A scientific value of this problem is high as well because reliable data on RA amount are indispensable in verification of models for □-□ transformations in steels.

Existing procedures [1,2] to determine quantitatively retained austenite in steels by the neutron diffraction have serious drawbacks as follows. First, there are no direct ways to verify results accuracy; second, the measurements are highly affected by a crystallographic texture. The new technique to determine the retained austenite in high strength steels using the neutron diffraction method is proposed. Measurements of neutron diffraction spectra were carried out at the texture diffractometer SKAT (JINR Dubna, Russian Federation) in order to eliminate the influence of a texture on the result. Measurements of calibration samples with specified content of the austenite were fulfilled. On the basis of these measurements the calibration lines were computed. These lines to be used for retained austenite content determination in medium-carbon steels samples (0.3 to 0.4%) with a yield strength of 1500 MPa and 1700 MPa, subjected to different annealing (150 to 400C°) after quenching.

The JINR – CRISM "Prometey" agreement No. 400-897/615- 2016 are acknowledged.

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S5 O4

MULTISCALE MECHANICAL MODELING OF EPOXY-GRAPHITE NANOPLATELET COMPOSITES USING ASYMPTOTIC HOMOGENIZATION METHOD

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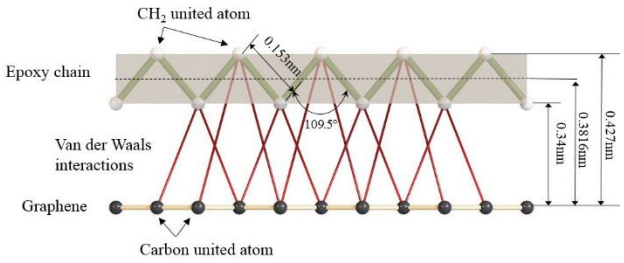
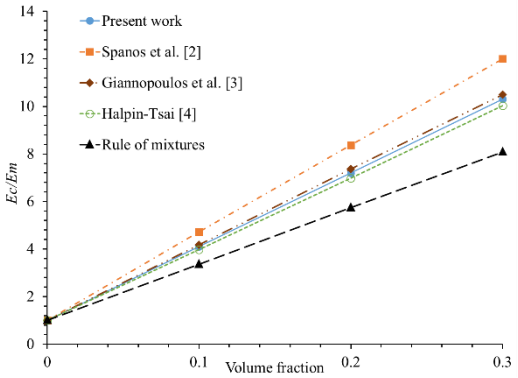
Graphite nanoplatelet (GNP) which is graphitic nanofiller made up of stacked two-dimensional graphene sheets presents special properties. A review of the literature reveals that incorporating these nanomaterials into a polymer matrix effectively improves their properties. This paper is the connection between nanostructures and the continuum mechanics which grafting the asymptotic homogenization approach onto the epoxy-graphite nanoplatelets composite problem during the multiscale technique. In the present model, the epoxy matrix and GNP are represented as a continuum and atomistic phases, respectively. It is assumed that interphase region is a continuum medium with specific thickness while its mechanical properties are derived from bonding between the basic composite components. The surrounding matrix could be assumed as a polymer with isotropic properties or a composite with orthotropic properties. To evaluate the effect of the GNP volume fraction the thickness of the polymer is variable. Here, for modeling critical part which is the interface between epoxy and the GNP, epoxy is assumed as discrete molecular chains. We assume a thickness of 0.3816 nm for GNP/epoxy interface (see figure). The boundary value problem [1] is solved and constitutive equations for equivalent anisotropic homogeneous shell are derived to define their effective stiffness coefficients. In order to validate the present model, the normalized Young's modulus *Ec*/*Em* (i.e., the ratio of composite modulus to matrix modulus) is compared with that obtained by other investigators [2-4] (see figure). It is seen that the present results have decent agreements. Thus, the analytical asymptotic homogenization is a useful method for modeling nanostructures instead of using heavy computational modeling or difficult experiments.





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S5 O5

MICROBIAL FUEL CELLS INOCULANTS: SPECIALIZED OLIGOCULTURES VS. BIODIVERSE MICROBIOTA

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[2]Polytechnic University of Bucharest, Power Engineering Faculty, Hydraulic Machines and Environmental Engineering Department, Bucharest, Romania

Research on Microbial Fuel Cells (MFCs) has mainly targeted wastewater processing, focusing on upscaling and integration of MFC units into the existing water-treatment infrastructure. To examine more versatile uses of this technology, we investigate the potential of monochamber MFCs to remove high nitrate concentrations from wastewaters with simultaneous energy production. Our experimental setup employed anolytes consisting of synthetic wastewater with high organic and nitrate loads. MFC systems were inoculated with microbial cultures collected from: i) the active sludge of a wastewater treatment facility, and ii) the silt of a river basin that regularly accepts heavy loads of nitrates from the local agriculture. The systems were characterized according to their capacity for simultaneous organic matter and nitrate removal, as well as current and power density production. Apart from demonstrating that MFC technology is applicable in nitrate removal, our research highlights the efficiency presented by biodiverse freshwater microbiota over that by specialized oligocultures (i.e. active sludge) in energy production.
Keywords: microbial fuel cells, nitrate removal, energy production, wastewater treatment

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S5 O6

NATURAL NANOARCHITECTURE OF BLUE CRAB (*Callinectes sapidus* Rathbun, 1896) CLAW STUDIED BY RAMAN SPECTROSCOPY AND SCANNING ELECTRON MICROSCOPY

Fran NEKVAPIL[1,2], Sanja TOMŠIĆ[1], Branko GLAMUZINA[1], Lucian BARBU-TUDORAN[3,4], Ioana BREZESTEAN[2], Simona CINTĂ PINZARU[2]*

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Four laser lines were employed to non-destructively characterize the Raman scattering signal of the complex exoskeleton of the blue crab (*Callinectes sapidus*) claw. Four distinct compounds could be identified and localized within the complex nanoarchitecture. The astaxanthin (AXT), biogenic magnesian calcite and astaxanthin-crustacyanin complex (ACC) were unambiguously differentiated for the first time in the complex exoskeleton. Chitin trace was detectable using the near infrared line. Complementary information from SEM EDX analysis combined with micro Raman data and images allowed to provide for the first time a complete structural characterization and to critically address a recent study[1] of the blue crab shell employing 488 nm laser, claiming the carotenoid chromophore only responsible for the various colors, and the presence of Sr and Br in the calcite skeleton. The 532 nm laser line, which is near-resonant for AXT, is not resonant for the ACC, but the 632 nm line falls within the full resonance of the latter. The 830 nm laser line showed prominent Raman peaks of magnesian calcite and not calcite and vaterite as previously claimed[1], and trace of chitin (Fig. 1). The target area was also examined using scanning electron microscope to study the natural nanoarchitecture (Fig. 1). This study highlights the importance of informed choice of laser line for drawing correct conclusions on the complex natural biocomposites.

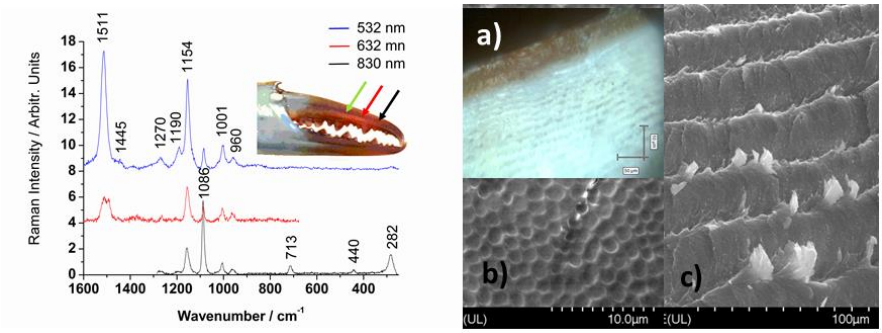

Fig. 1. Representative Raman spectra of the outer red surface of the blue crab claw, excited with 532, 632 or 830 nm laser line as indicated, revealing the astaxanthin, alpha- ACC and magnesian calcite, respectively with trace chitin ; (a) Cross section, microscopy view, b) and c) SEM images from the outermost, red surface and the nanoarchitecture of the layers.

Keywords: blue crab, natural photonic crystal, Raman spectroscopy, SEM
Reference:
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S5 O7

ADVANCED SITE MONITORING AND SOURCE CHARACTERIZATION IN AREAS WITH COMPLEX SEISMICITY - GALATI AREA STUDY

Dragos TATARU[1], Natalia POIATA[1], Bogdan GRECU[1], Eduard NASTASE[1]

[1]*National Institute for Earth Physics*

Starting from 2012 advanced seismic monitoring has been carried in the area of Galati in southeast Romania. The region of Galati is typically characterized by small to moderate earthquakes, however, in 2013, an earthquake swarm comprised of three months of seismic activity occurred in the area. Between September 23rd and November 5th 2013, 937 earthquakes with magnitudes of 0.2 - 4.0 have been reported. The intensity of events was high enough to be felt by the local people, leading to panic in the area. The proximity of active oil fields also rose the question of possible induced or triggered events.

Mobile seismic and GPS/GNSS stations have been deployed immediately after the sequence has started and run continuously, delivering real-time measurements till the present. Additionally, active seismic measurements were performed in order to characterize the shallow velocity structure at specific sites.

We attempted to provide a better understanding of the underlying seismic processes in the area by designing and implementing an advanced monitoring system that makes use of a newly-available array-based detection and location scheme. The resulted seismic catalog have been compared with the outputs of routine location methods based classical algorithms.

We also explore how the resolution of this seismic catalogue can be improved by an additional temporary deployment of seismic stations in the area, and evaluate which station configuration would provide an optimal coverage. Another aspect investigated in this study addresses the issue of how the uncertainties of the velocity models, due to the poor knowledge of the underground structure, are affecting the quality of earthquakes' catalogue locations. In the final part we discuss the potential of combining together all of the above aspects into an optimized, efficient scheme for monitoring the seismic activities in the areas with low and complex seismicity.

Keywords: earthquakes, monitoring, seismic velocity

Acknowledgements: This work was done in the framework of project PN 16 35 03 02 /2016 supported by the Romanian Ministry of Education and Scientific Research.

S5 O8

TESTING AND DEVELOPMENT OF HIGH-RATE GPS WAVEFORMS STUDY OVER 2016 VRANCEA SEISMIC EVENTS

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Since GPS/GNSS technology was first successfully demonstrated to estimate baseline components at the cm level of accuracy, it has been routinely used to precisely measure crustal deformation. In particular, significant advances in GPS hardware and data processing have enabled GPS measurements at a very high frequency.

GPS geodesy and seismology have traditionally been considered distinct tools focused on disparate frequency bands of the deformation spectrum. GPS Geodesy is focused on long-term secular tectonic deformation and static displacements from large earthquakes, while the latter measured dynamic displacements with periods ranging from fractions of seconds to several minutes. High-rate GPS positioning has been recognized as a powerful tool in estimating epoch-wise station displacement which is particularly useful in seismology. The major advantages of using GPS receivers as seismometers are that they can measure large dynamic displacements without saturation. However, GPS is a few orders of magnitudes less sensitive than seismometers, considering that GPS can only detect movements at the noise level of a few millimeters or accelerations at the noise level of sub-centimeter per second squared.

The goal of our analysis is to provide 1 Hz position horizontal, vertical and 3D reconstructed movements in order to compare these data to displacements derived from velocities measured at nearly-collocated broadband seismic stations. The high-rate GPS data can capture the rapid co-seismic ground displacements over a range of frequencies and amplitudes that are in some sense wider than those recorded by seismic sensors. High-rate, real-time GPS networks can enhance earthquake detection and seismic risk mitigation.

Keywords: GNSS, High-rate GPS data, GPS seismology

Acknowledgements: This paper was carried out within Nucleu Program, supported by ANCSI, project no. PN 16 35 03 08, grant of the Romanian National Authority for Scientific Research and Innovation, CNCS/CCCDI-UEFISCDI, project number PN-III-P2-2.1.PED-2016-1014, within PNCDI III and PNII contract no. 86/01.07.2014.

S5 O9

FEATURE WEIGHTS IMPROVING THE AUTOMATED DETECTION OF SYNTHETIC DRUGS OF ABUSE

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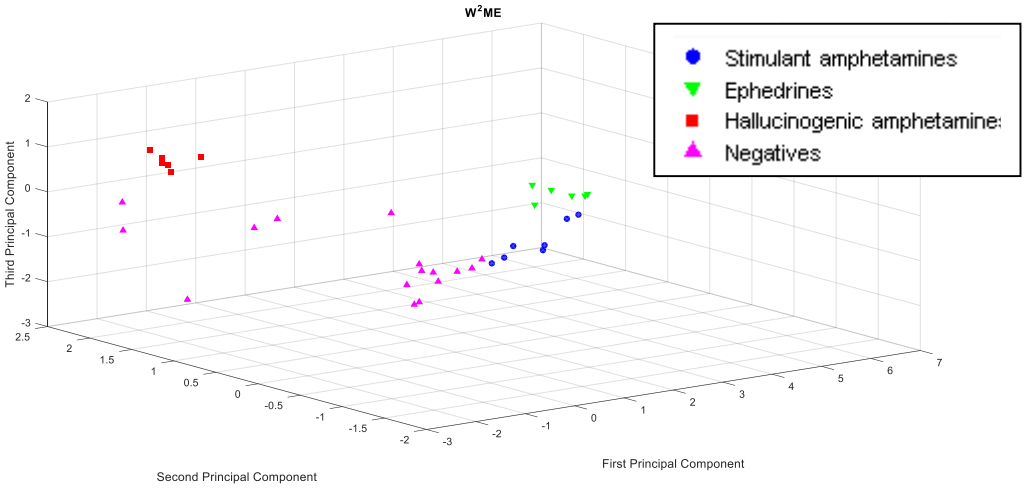
[2]Department of Chemistry, Physics and Environment, "Dunarea de Jos" University of Galati, Romania

We are presenting a comparative study regarding the effect of two feature weights, w^2_{ME} and $(w\text{-}1)^2_{ME}$, on the efficiency of an unsupervised pattern recognition application developed for the automated detection of amphetamine-like substances and of ephedrines, stimulants which are also the main precursors of the latter compounds. The application was designed to operate a new portable spectrometer, which is equipped with a quantum cascade laser (QCL) that emits between 1405 and 1150 cm^{-1} (UT8). The feature weights have been used for preprocessing the infrared absorptions that these synthetic drugs of abuse display in this narrow infrared spectral window. The automated class identity recognition is based on Principal Component Analysis (PCA). The effect of the feature weights on the classification efficiency has been assessed by comparing the

cumulated explained variance and the PCA score plots, as well as by estimating the potential overlapping of the clusters in each case.

Key words: detection, synthetic drugs of abuse



3D PCA score plot obtained with the w^2 feature weighted spectra recorded betwen 1405 and 1150 cm^{-1} for amphetamine-like substances and their main precursors (ephedrines)

S5 O10

EFFECTS OF INTERSTITIAL ATOMS (H, N, C) ON MAGNETIC PROPERTIES OF $HOFE_7CO_4TI$

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$HoFe_7Co_4Ti$ compound has been synthesized by arc melting method, followed by a heat treatment. The gas-phase interstitial modification process was carried out using fixed gas atmosphere in an autoclave. The carbide was obtained by heating powder of starting alloy mixed with ($C_{14}H_{10}$) in sealed quartz tube at 350 °C. The magnetization was measured in applied magnetic fields up to 10 T and at temperatures 5 K and RT. Also magnetization was carried out at magnetic field of 0.1 T and at temperatures ranging from 5 K to 300 K.

Fig. 1. shows that the parent sample exhibits a first order magnetization process (FOMP) at 5 K but it is completely disappeared by insertion interstitial atoms. Also the results presented in Fig. 1 show that there isn't any other significant change upon hydrogenation or carburization whereas the magnetization of the nitride compound increases dramatically. As evidenced in the Fig. 2, Also a spin-reorientation was observed at 130 K in hydride, and at 140 K in carbide sample which wasn't seen in parent and nitride alloy.

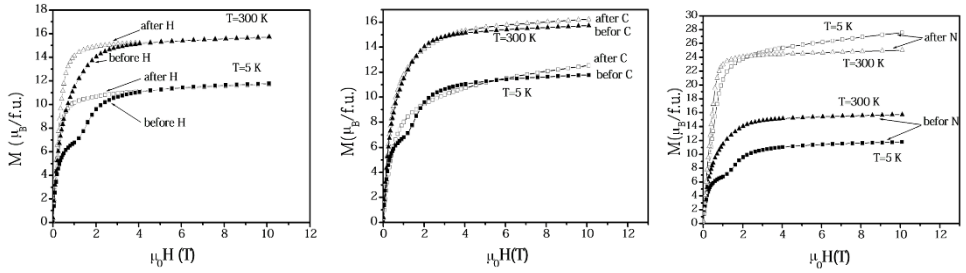

Fig. 1 Field dependence of magnetization of the $HoFe_7Co_4Ti$ compound and its interstitially at 5 and 300K

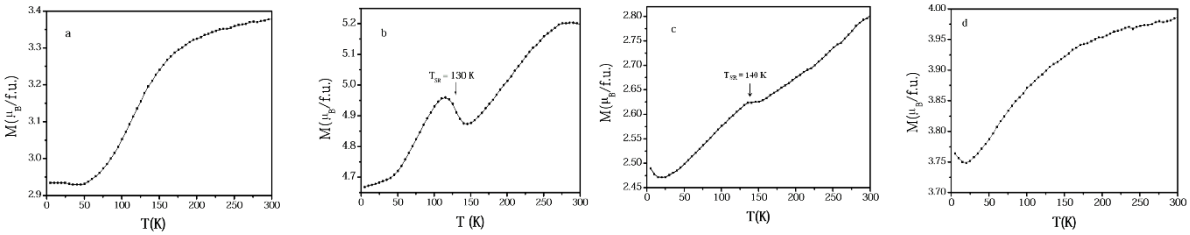

Fig. 2 Temperature dependence of the magnetization of a) $HoFe_7Co_4Ti$, and its b) hydride, c) carbide, and d) nitride

Keywords: FOMP, spin-reorientation, interstitial atoms

S5 O11

STUDY OF PHOTOCATALYTIC DEGRADATION OF METHYLENE BLUE VIA ZNO NANOPARTICLES IN THE PURIFICATION OF WATER

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The treatment of water has become a critical issue because of deterioration in water quality caused by human being. While different techniques remain impotent against certain pollutants, photocatalysis seems to be a promising technology. This method proves to be perspective and advantageous due to its high efficiency, low cost and easy utilization in different type of water purifying devices.
In this work, we study the photocatalytic activity of ZnO on model pollutants such as methylene blue. The effect of concentration and temperature of the dye were investigated. The photocatalytic efficiency was calculated from absorption spectra using UV-visible spectroscopy.

Keywords: ZnO, photocatalysis, degradation, methylene blue.

S5 O12

EARTHQUAKE MECHANISMS AND CHARACTERIZATION OF SEISMOGENIC ZONES IN THE SOUTH-EASTERN PART OF ROMANIA

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The present paper is investigating the earthquake focal mechanisms for the seismogenic zones in Romania on the basis of an updated catalogue of earthquakes for which fault plane solutions are determined (in the time interval 1998 – 2012, continuing in this way the previous catalogue published by Radulian et al., 2002 and interpreted by Bala et al., 2003). We reconsidered the available fault plane solutions and finally selected a single fault plane solution for each event in the catalogue. The earthquake mechanisms are computed using the P-wave arrival polarities. For each focal mechanism, the fault plane was chosen as the nodal plane that matched better the orientation of faults in the vicinity.

The catalogue of fault plane solutions comprises 264 intermediate-depth and 95 crustal earthquakes, covering the time interval 1998 – 2012. The crustal seismicity recorded in front of the Carpathians Arc bend is significantly lower than that recorded in the mantle. Crustal earthquakes did not exceed Mw = 4.9 in the Moesian Platform, while an earthquake of Mw = 6 was recorded in 2004, Oct.27 in the Vrancea subcrustal slab. All the available earthquakes mechanisms are examined closely from the point of view of the distribution of the main angles *strike, dip and rake*. The behavior of the mechanism solutions, characterized by B, P and T axes values is examined according to the focal mechanism classification diagram proposed by Kaverina et al., 1996. In this way the distribution of the earthquake mechanism can be viewed directly between normal, strike-slip and reverse pure mechanisms and compared with the geodynamic characteristics of each seismogenic zone.

The present catalogue will be a valuable contribution to an extended primary input data for all seismic hazard computations.

Acknowledgements
This paper was partially carried out within NUCLEU Program, supported by ANCSI and within Project "National Level of Risks Assessment" (RO-RISK).

Key words: earthquake mechanism, active fault systems, intermediate-depth and crustal earthquakes.

S5 O13

XRF THICKNESS CALIBRATION BY COMBINED MONTE CARLO MODELLING AND REFERENCE PROBES

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The X-ray fluorescence (XRF) spectroscopy represents a widely-applied method in research and industry as a tool to perform easy and quick compositional and coating thickness measurements [1].

Quantitative results for coating thickness are provided pending adequate calibrations.

Thickness calibration of XRF technique can be done by calibration probes or by a reference-free fundamental parameters approach. In this study we show that, for a specific multilayer coating of tungsten and molybdenum on the titanium substrate, a combination of Monte Carlo Modelling validated with a few reference samples gives an accurate solution for the calibration curve. By Monte Carlo simulation a realistic description of the X-ray generation and transport into the measuring configuration is obtained. Reference samples with known geometry are used for to accurately determine the correction factor between Monte Carlo results and the experimental values.

This calibration procedure was applied on the study of multi-layers of tungsten and molybdenum on tungsten substrate; which were deposited by Magnetron Sputtering. Coatings thicknesses of the reference samples were calibrated using GDOES (Glow discharge optical emission spectrometry) [2].

Due to the presence in the studied multi-layers of the same material (tungsten) as layer and substrate, the study of the substrate influence becomes important given the attenuation or amplification that could influence the acquired fluorescence spectra. The correction factors to translate from the reference samples with titanium substrate to multilayer samples with tungsten substrate were determined by Monte Carlo simulation as well. Finally, we conducted a cross-check of the coating thicknesses by SEM and determined a good agreement with the XRF results.

S5 O14

SEISMIC WARNING TIME FOR VRANCEA EARTHQUAKES IN THREE LARGE DAMS SITES SITUATED IN THE EASTERN PART OF ROMANIA

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The seismic early warning system in Romania (one of the few operating systems from the world) uses a mixed regional approach, based on the national seismic network and local sensors to obtain a fast location for recorded events and estimate the actual earthquake magnitude. The warning (alarm) time is the time difference between the issuing earthquake alert moment (T1) and the dangerous transversal seismic wave S arrival moment at the interest point (TS). The moment of the earthquake occurrence (To) is before T1. It is important to remember that warning time, as defined above, is very short, and may be of seconds or tens of seconds, depending on the location of the target alarmed. Therefore, areas near the epicenter can not receive alerts before the arrival of the seismic wave. People or institution inside the epicentral area can only receive information on the current event. It should also be noted that the precision of the quick information about the size and location of the earthquake is limited due to the estimates short time and the small number of seismic stations located in the epicentral area that might offer helpful data.

Earthquake warning systems can provide warnings related to the occurrence of an earthquake and its size and, the most performant ones also about the felt intensity and the expected time until the arrival of seismic P and S wave in a given site. These estimates are made using fast seismic waveform analysis recorded by the seismometers near the epicenter.

In order to assess the performance of the alarm system for the 3 dams studied in this paper: Poiana Uzului – Bacău County, Râpa Albastra - Vaslui County and Izvorul Muntelui –Neamț County, there have been made offline simulations on seismic recordings for estimating the actual warning time in the three locations mentioned above. There have been chosen four representative earthquakes Mw>5.0, occurred in the last years in Vrancea seismic zone, for which there are enough records. In Figure 1 is presented as example, the case of the warning time for Rapa Albastra Dam, for the crustal depth earthquake occurred in 2014/11/22, 19:34:20 UTC, latitude 45.91, longitude 27.09, Mw 5.2 and h= 47.2 km

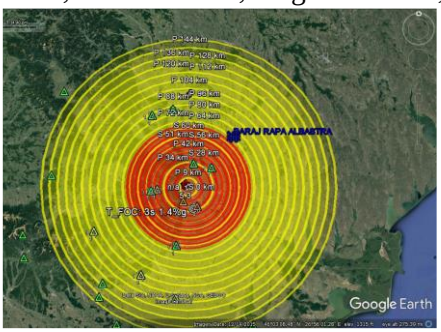

Figure 1. The first estimation of magnitude and earthquake location is 19:14:27.11, P wave arrives at 19:14:29 (less than 2 seconds after the estimation), S wave arrives at Râpa Albastra Dam at 19:14:40 (S-P=11s and warning time 12.89 s).

S5 P1

MAIN TRANSEVERSAL AND OBLIQUE ACTIVE FAULTS FROM ONSHORE AND OFFSHORE OF THE BlACK SEA COAST

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The main goal of this article is to decode the seismicity of the Eastern part of Romania and its correlations with the active tectonic (faults systems) present in the area, in order to create a specific database for seismic hazard assessment process and also describing the faults in the SHARE manner. This presentation

is a continuation of an article presented in 2015, in which we highlighted the longitudinal faults system from onshore and offshore of the Black Sea coast. This paper treat the problem of the active faults from the Eastern part of the country using DISS methodology (Basili et al., 2008) and proposes to introduce this data in the European scientific circuit, by EPOS project.

In order to define the active faults, the following elements have been taken into account:

- Geometrical parameters, such as: length, active length, width and depth of the earthquakes foci.
- Seismological parameters, such as: strike, dip, rake (slip);
- Correlation of the seismicity with the known fault system.

The studies on active tectonics have clearly shown the position of the seismic sources (connected to well define active faults) which do not result in alternatives of other model constructions.

In the studied area, we have identified three fault systems: a longitudinal, transversal and an oblique one. In this paper, we present our results regarding only the main faults of the transversal and oblique systems.

We present the transversal faults system, parallel to the Black Sea coast comprising Constanta, Razelm, Lacul Rosu and West Midia Faults and oblique faults system with a NW-SE direction of the faults, such as Nistru, Odessa and West Crimea.

Acknowledgements:

The study was partly funded by the projects:

1. DARING Project no. 69/2014 supported by the Partnership in Priority Areas Program – PNII, under MEN-UEFISCDI,
2. "Nucleu" of the National Plan for Research, Development and Innovation of the Romanian Ministry of National Education, Contract no**. PN 16 35 01 12, PN 16 35 03 05, PN 16 35 01 , PN 16 35 03 01**
3. Assesment, Strategy And Risk Reduction for Tsunamis in Europe, Astarte, 603839/2013

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S5 P2

GEOTECTONIC CHARACTERISTICS OF THE HATEG BASIN

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The main target of this article is to decipher the connection between the seismicity and tectonic of the Hateg Basin. The Hateg Basin (depression) is located between Retezat Mountains to south, Sebes Mountains to the east, Poiana Rusca Mountains to the west and to the north by Strei basin through a threshold, located nearby Hateg city. The Hateg Basin, is a basin that was formed in Paleogene and worked as a bay of the Transylvanian Depression. Sedimentary deposits belong to the interval Paleogene - Miocene and ends with Badeniano-Sarmatian deposits, but not as a continuous sedimentary suite, showing major stratigraphic hiatus in the Eomiocen. Consequently there are two cycles of sedimentation: Paleocene-Eomiocen first and second Meso-Neomiocen. The basement consists of Sebes-Lotru crystalline schists series. (Mutihac V., et al., 2007). The Hateg-Streiu system is characterized by ruptural tectonic, superimposed to a monoclinic structure, in which the terms are succeeded from the oldest to the newest. This ruptural tectonic is defined by a subhercinic age or later. Also the basin is affected by Alpine tectonics through ruptural disjunctive dislocations and subordonate by the plicative dislocations affecting both the pre-Mesozoic basement and Mesozoic-Tertiary sedimentary deposits.

Plicative structural elements are poorly represented in the Hateg-Strei system, both mesozoic formations and the tertiary deposits having convergence failures to the center of the basin, on a NE-SW direction with dipping to the south-east.

The transversal ruptural (disjunctive) elements from Poiana Rusca Mountains area are related to the formation of the Hateg-Strei system, their scale being in the tens of meters.
Oblique fractures belong to the two systems oriented, the first to the NE-SW and the second to the NW-SE. The NE-SW fault system, are the main faults in the area and are more important than the faults of the second system(NW-SE), affecting both the region surrounding basin and the basement of the basin.
Through out such system of fractures oriented NE-SW, the basin formed by dipping some of the basement blocks with fault plane inclination(dipping) to the south east.
From seismological point of view the Hateg Basin is characterized by the presence of seismic sequences, with maximum magnitude lower then 5 (M_L). The epicentral distribution and fault plane solutions confirm the tectonics of the basin.

Acknowledgements: The study was partly funded by the projects: This paper was partially carried out within Nucleu Program, supported by ANCSI, projects no. PN 16 35 01 12, PN 16 35 03 05, PN 16 35 01 08, PN 16 35 01 05

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S5 P3

THE USE OF SEM MICROSCOPY IN THE DETECTION OF CARBON ATOMS SPATIAL FORMATIONS TYPE FULLERENES WHEN A GRAPHITE FILMS ARE OBTAININED BY ELECTRIC DISCHARGE IMPULSE METHOD

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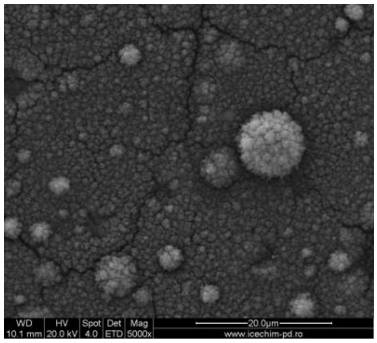
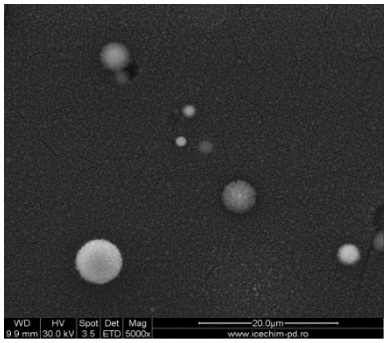
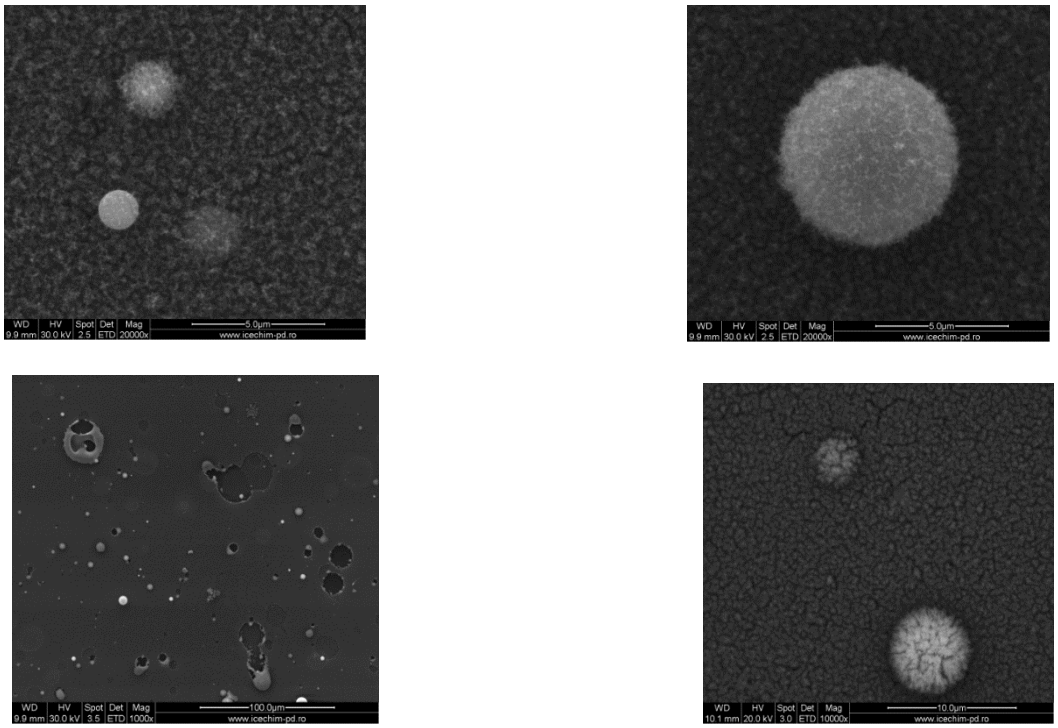
Key words: SEM Microscopy, Fullerenes, graphite pellicle

The analysis of processed surface morphology under pulsed electrical discharges using pyrolytic graphite electrode tool, showed that physico-chemical changes were not exceed micrometer depth. Besides the main component of processed material - ie pyrolytic graphite the analyzes attest a significant amount of atomic carbon. After analysis thermogravimetric carried out for graphite pellicle, have been found an interesting phenomenon of mass addition, in the conditions in which analyzes were performed under an inert atmosphere of nitrogene N_2, in order to avoid oxidation process which inevitably brings in system excess of mass . This phenomenon has determined the next set of analyzes of SEM Microscopy, to visualize the structure for graphite pellicle obtained, and also to identify the structural elements that have led to the occurrence of the mass addition phenomenon.**The SEM image for layed graphite on electrical discharges in pulse procedure EDI revealed a number of regular globular formations fullerenes type composed of carbon atoms arranged in spatial structures consisting of 60-80 carbon atoms**







The SEM Images of graphite pellicle that reveal the spatial formations composed of carbon atoms fullerenes types

S5 P4

SPATIO-TEMPORAL ANALYSIS OF URBAN CLIMATE -VEGETATION LAND COVER INTERACTION IN BUCHAREST CITY FROM REMOTE SENSING DATA

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[2] University Transylvania of Brasov, Forestry Faculty.

In frame of predicted increasing extreme climate events and global warming, urban climate is an important issue in scientific research. This paper investigated the influences of urban growth and green land cover on metropolitan climate of Bucahrest in Romania. Remote sensing data from Landsat ETM+ and time series MODIS Terra/Aqua sensors as well as in-situ meteorological data have been used to assess urban land cover– temperature interactions over period between 2000 and 2016 years. Vegetation abundances and percent impervious surfaces were derived by means of linear spectral mixture model, and a method for effectively enhancing impervious surface has been developed to accurately examine the urban growth. The air (Ta) and land surface temperature (Ts), key parameters for urban climate characteristics analysis, were analyzed in relation with the Normalized Difference Vegetation Index (NDVI) at city level. Based on these parameters, the urban growth, Urban Heat Island (UHI) effect and the relationships of Ts to other biogeophysical parameters have been analyzed. Results indicated that the metropolitan area ratio of impervious surface in Bucharest increased significantly during investigated period, the intensity of urban heat island and heat wave events being most significant. The correlation analyses revealed that, at the pixel-scale, Ta and Ts possessed a strong positive correlation with percent impervious surfaces and negative correlation with vegetation abundances at the regional scale, respectively. This analysis provided an integrated research scheme and the findings can be very useful for urban ecosystem modeling. Was also analyzed UHI phenomenon during extreme heat waves events. Satellite data analysis stressed a clear land surface temperature contrast between the central, median and peripheral zones of Bucharest city.The analysis show that different urban/periurban

zones and landscapes bring diurnally and seasonally different contributions to the local and regional thermal environment. Urban land cover was the most important contributor to increases in regional Ts. Vegetation had a clear cooling effect as the normalized vegetation difference index (NDVI) increased during summer periods. This study attempts to provide environmental awareness to urban planners suggesting that future changes in urban land cover could substantially affect climate by altering biophysical land–atmosphere interactions.

Keywords: urban climate Bucharest, time-series MODIS Terra/Aqua satellite data, biogeophysical parameters.

This work was supported by Romanian National Authority for Scientific Research, Program PN II PCCA Contract 86/2014 VRAGEO and Program NUCLEU Contract 5N/09.03.2016, under 16 40.01.01 research theme.

S5 P5

TIME SERIES SATELLITE DATA FOR CARPATHIAN FOREST STATE ASSESSMENT UNDER CLIMATE CHANGES

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Due to anthropogenic and climatic changes, Carpathian Mountains areas in Romania are experiencing environmental degradation. Understanding how forest land cover responds to climate change requires knowledge of land-surface processes, which control the degree to which interannual variability and mean trends in climatic variables affect the surface energy budget and by this forest vegetation. The altitude and the shape of the Carpathian mountain chain in Romania are responsible of significant climate disturbances in the zonal climate and in the general atmospheric circulation.Have been reported variations of the thermal vertical lapse according to the aspect, slope and land cover, which can be reflected in the local conditions and in the other meteorological variables, such as relative humidity, wind speed, and snow cover. Mountain forests represent unique areas for the detection of climatic change and the assessment of climate-related impacts. Forest systems are all sensitive to climatic factors and extreme events and are likely to have different vulnerability thresholds according to the species, the amplitude, and the rate of climatic stressors.As a result of global climate change, there is a growing evidence that some of the most severe weather events could become more frequent in Romania over the next 50 to 100 years. In the case of Carpathian mountain forests, winter storms and heat waves are considered key climate risks, particularly in prealpine and alpine areas. Effects of climate extremes on forests can have both short-term and long-term implications for standing biomass, tree health and species composition. The preservation and enhancement of mountain forest vegetation cover in natural, semi-natural forestry ecosystems is an essential factor in sustaining environmental health and averting natural hazards. Use of remote sensing to monitor the forest changes due to climatic or anthropogenic stressors is an excellent example of the value of multispectral and multitemporal observations. Fusion technique was applied to multispectral and multitemporal satellite imagery (Landsat TM, LANDSAT ETM, MODIS Terra/Aqua and IKONOS satellite data) for a mountain forest ecosystem in Prahova Valley; Romanian Carpathians test area Romania, over a period 2000-2016.This paper aims to (i) describe observed trends and scenarios for summer heat waves, windstorms and heavy precipitation, based on results from simulations with global circulation models, regional climate models, and other downscaling procedures, and (ii) discuss potential impacts on mountain forest systems in Romania.

Keywords: time-series NOAA AVHRR and MODIS Terra/Aqua satellite data , climate change , extreme events, Carpathian forest, Romania

Acknowledgements. This work was supported by Romanian National Authority for Scientific Research by grant CNDI– UEFISCDI, project number PN-II-PT-PCCA- 86/2014 VRAGEO and Program NUCLEU Contract 5N/09.03.2016, under 16 40.01.01 and 16 40.01.02 research theme.

S5 P6

FEM MODELLING OF SPLIT RING RESONATOR BASED METAMATERIALS FOR UWB NOTCH FILTER APPLICATIONS

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A conventional circular double split-ring resonator (SRR) type unit cell structure exhibiting two resonant frequencies in the Ultra-Wideband (UWB) wireless communication domain was designed in this paper. This structure, considered as possible individual sub-wavelength building block of a notch filtering system, was numerically implemented by using the Finite Element Method (FEM) based Comsol Multiphysics software. The dependence of resonance frequencies on the SRR model parameters, like split width (g), conducting strip width (c), the gap between rings (d), substrate thickness (h) and substrate permittivity (ε_r) was investigated through this paper. Surface current density distribution for three different ring slits was also computed here for a proper selection of the slit width of the resonant rings.
Keywords: metamaterial; resonator; transmission spectra;

S5 P7

STUDY ON THE POSSIBILITY OF CONTROLLING THE CHARACTERISTICS OF A FLAME BY USING ACOUSTIC EXCITATION

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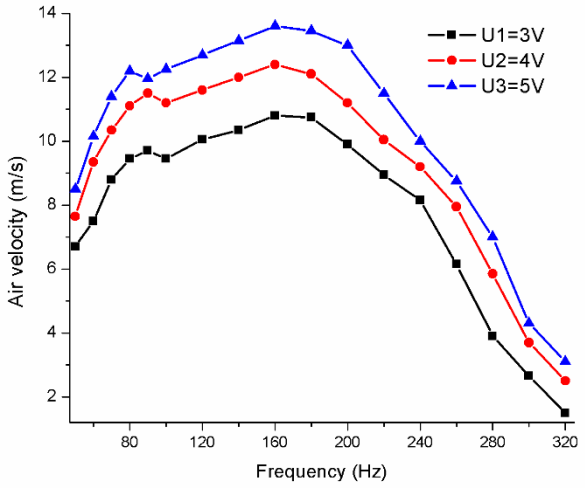
This work focuses on the influence of the acoustic excitation on the fuel flow and flame characteristics, addressed both in terms of experimental research and numerical simulations.
The experimental approach investigates the correlation between the parameters of the acoustic waves generated with a loudspeaker in an acoustic chamber and the combustion parameters, by using the methods of cold flow and hot fire modes. The cold flow mode study focuses on the coupling between the frequency of the acoustic signal and the fuel flow exiting the acoustic chamber. In the hot fire mode study, a burning methane-air compound has been acoustically excited in the acoustic chamber and the flame response is analyzed in terms of temporal variation and spatial distribution of the temperature. In both studies, the results indicate that the excitation frequency is the parameter affecting most the fuel flow exiting the acoustic chamber and the flame behavior.



Frequencies below 50 Hz have less influence on burning processes, while for values ranging from 120 to 220 Hz we can talk about a resonant effect of the acoustic excitation. In parallel, a mathematical model regarding the description of the acoustic wave-flame coupling is proposed and a set of numerical results obtained in this frame is provided. The predictions generated by numerical analysis are in very good agreement with the experimental results.

Keywords: flame, acoustic excitation, combustion parameters, numerical simulations.

S5 P8

MODELING OF THE OPTICAL EXCITATION RESPONSE: APPLICATION TO STUDIES THE SPR DETECTOR INTENDED FOR BIOMEDICAL DETECTION

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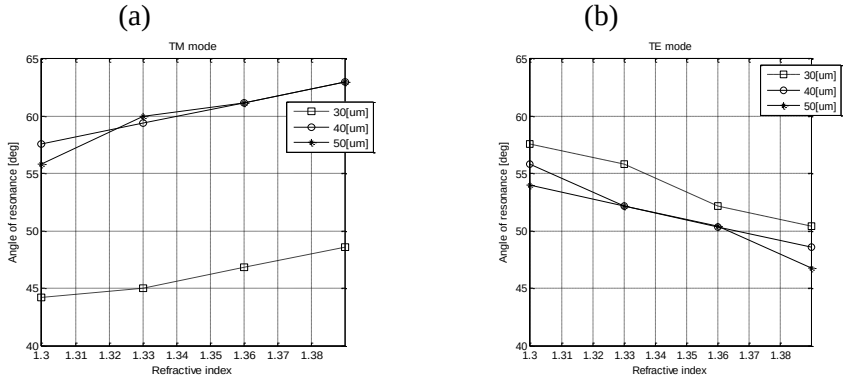
In last decay, a number of numerical methods have been developed to give a description of the plasmon field. The inhomogeneity and complexity of these medium need higher accuracy. The FEM (Finite Element Method) is a powerful method for modelling the optical excitation response in the metal/dielectric nanostructures, this later phenomena caused the surface plasmon effect which is present important application in several domains such as bio-sensing [1], biomedical [2], bio-analysis [3], optics [4], and Solar cells [10].

In our work, we proposed two devices (metallic nanostructures) and by the application of finite element method (FEM) can be studies the SPR angle in several conditions. The obtained results (fig.1) prove that we can practice this device in biomedical detection domain.



The variation of SPR angle by refractive index of detection layer (nb1) of nanostructure proposed for: a) TM mode wave plane and for different values of the metal thickness, b) TE mode wave plane and for different values of the metal thickness.

Keywords: Finite elements method, optical excitation response, metallic nanostructures, SPR detector.

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S5 P9

CHARACTERIZATION OF IMMUNOSORBENT FUNCTIONALIZED SURFACES WITH ANTIBODIES OR ANTIGENS COVALENT LINKED ON THE SURFACE BY AFM TECHNIQUE

Livia NEAGU[1], Ioan DOROBANȚU[1], Cristina IONESCU[1], Mihaela BACALUM[1], Mihai RADU[1], Liviu-Ștefan CRĂCIUN[1]

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Functionalization of surfaces of different inorganic or organic materials with immune components like antibodies or antigens is important in their use in immunochemical technique for assays of organic contaminants that pollute environmental factors (soil, water as well as agricultural products –grains, fruits). Due high sensitivity and specificity of immunochemical techniques one can measure such contaminants in samples. Aim of these work is to obtain and characterize such functionalized surface from SiO_2 with immunogenic compound 2,4-dichlorophenoxyacetic acid (2,4-D) as antigen or 2,4-D antibody covalently coupled on the surface. Among immunochemical procedures used to investigate functionalized surfaces, they will be analyzed using atomic force microscopy (AFM) technique in order to establish structural characteristics and qualities as: the surface density of the immune components, antigen or antibody covalently coupled on the surface of the materials, their uniformity of coupling and so on. These obtained immunosorbents will be used in ELISA immunochemical technique for detection of the 2,4-D pesticide from food and environmental samples.

Keywords: HnELISA, 2,4-D, AFM, nanoimmunosorbent

Acknowledgments: This work was supported by the following grants of the Romanian National Authority for Scientific Research: CNDI-UEFISCDI project number 98/2012, PN 16420203 and PN 16420205.

S5 P10

SEISMO-ACOUSTIC SIGNATURE OF THUNDERSTORMS OBSERVED AT PLOSTINA SITE (ROMANIA)

Bogdan GRECU, Daniela GHICA, Iren-Adelina MOLDOVAN, Victorin-Emilian TOADER, Dragos TATARU

National Institute for Earth Physics

The National Institute for Earth Physics (Romania) operates one of the largest seismic networks in the Europe. The network consists of 132 stations equipped with broadband or short-period velocity sensors. Most of the stations have accelerometer sensors collocated with velocity sensors.

Located in Vrancea area, the most active seismic region of Romania, the Plostina Observatory included initially two seismic stations, one at surface with both broadband and accelerometer sensors and one at 30 m depth with only short period velocity sensor. Starting with 2007, the facilities at Plostina have been upgraded so that at present, the observatory also includes one seismic array of seven elements and an aperture of 2.5 km, seven infrasound elements, two three-component fluxgate sensors, one Boltek EFM-100 electrometer and one La Crosse weather station. All the data are continuously recorded and real-time transmitted to the Romanian National Data Centre (RONDC) in Magurele.

The recent developments at Plostina site made possible the improvement of the local miscroseismic activity monitoring as well as conducting of other geophysical studies such as acoustic measurements, observations of the variation of the magnetic field in correlation with solar activity, observations of the variation of radioactive alpha gases concentration, observations of the telluric currents. In this work, we investigate the signals emitted due to the process of lightning and thunder during thunderstorms activity at Plostina site. These signals are well recorded by both seismic and infrasound networks and they are used to

perform spectral and specific array analyses. We also perform multiple correlations between the atmospheric parameters recorded by the weather station and seismic and infrasound signals.

Keywords: seismic array, infrasound array, thunderstorms, spectral analysis

Acknowledgements: This work was carried out within Nucleu Program, supported by Ministry of Research and Innovation, projects no PN 16 35 01 01, PN16 35 03 01, PN 16 35 03 03 and partly supported by a grant of the Executive Agency for Higher Education, Research, Development and Innovation Funding, Program Human Resources – TE, project PN-II-RU-TE-2014-4-0701.

S5 P11

INVESTIGATION OF SOURCE PARAMETERS AND CLUSTERING PROPERTIES FOR THE VRANCEA (ROMANIA) SUBCRUSTAL EARTHQUAKES

Emilia POPESCU[1], Anica Otilia PLĂCINTĂ[1], Felix BORLEANU[1], Mircea RADULIAN[1], Alina COMAN[2]

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[2]Student, Faculty of Physics, Bucharest University

The Vrancea seismic nest, located at the South-Eastern Carpathians Arc bend, in Romania,is a well-confined cluster of seismicity at intermediate depth (60 – 180 km). During the last 100 years four major shocks were recorded in the lithosphere body descending almost vertically beneath the Vrancea region: 10 November 1940 (M_w 7.7, depth 150 km), 4 March 1977 (M_w 7.4, depth 94 km), 30 August 1986 (M_w 7.1, depth 131 km) and a double shock on 30 and 31 May 1990 (M_w 6.9, depth 91 km and M_w 6.4, depth 87 km, respectively). The probability of repeated earthquakes in the Vrancea seismogenic volume is relatively large taking into account the high density of foci. The purpose of the present paper is to investigate source parameters and clustering properties for the repetitive earthquakes(located close each other) for a time interval starting on 2015 to the present. To this aim, we selected a set of earthquakes as templates for different co-located groups of events covering the entire depth range of active seismicity. For the identified clusters of repetitive earthquakes, we applied spectral ratios technique and empirical Green's function deconvolution, in order to constrain as much as possible source parameters. The present analysis represents a first attempt to provide a strategy for detecting and monitoring possible interconnections between different nodes of seismic activity and their role in modelling tectonic processes responsible for generating the major earthquakes in the Vrancea subcrustal seismogenic source.

Key words: repeated earthquake, Vrancea source, spectral ratios, empirical Green's function

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S5 P12

STRUCTURAL INVESTIGATION OF COPPER(II) OXIDE-LEAD OXIDE-LEAD VITREOUS SYSTEM OBTAINED BY ACTIVE ELECTRODES OF THE DISASSEMBLED CAR BATTERY

S. Macavei[1] , M. Rada[1], M. Zagrai[1], S. Rada[1,2] , V. Bodnarchuk[4]and R.V. Erhan[3,4]

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[3] Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering, Magurele, Romania
[4] Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Dubna, Russian Federation

Modern society is concerned with the environment and the environmental damage caused by spent acid batteries. Acid batteries can be recycled by pyrometallurgical or hydrometallurgical processes. The pyrometallurgical process is characterized by high energy consumption, and it releases a large amount of toxic gases into atmosphere. The hydrometallurgical process offers advantages such as low energy consumption,

minimal gas emission, and recovery of pure metal [1]. Recycling of lead acid batteries by melt-quenching method is a lead recovery process of lower energy consumption and environmental friendliness [2].

New vitreous system with the $xCuO\cdot(100-x)[4PbO_2\cdot Pb]$ composition where x=0-70mol% CuO were prepared using as starting materials CuO and active electrodes of the disassembled car battery mixed in suitable proportion. Structural and behavioral investigation of samples was performed by XRD, FTIR and SANS spectroscopies.

XRD patterns permits the identification of two separated phase: a metallic phase consists of Pb and PbO crystalline phases and the vitroceramic one with different oxidic and sulphate crystalline phases of the lead ions.

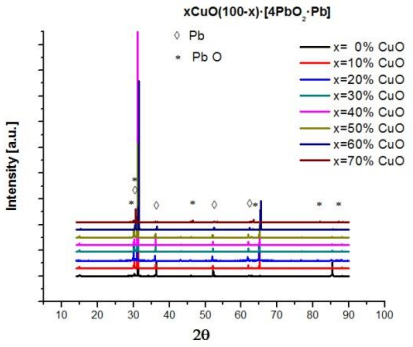

Fig. 1: XRD patterns for $xCuO\cdot(100-x)[4PbO_2\cdot Pb]$samples, where x= 0-70 mol% CuO.

IR and SANS analysis indicate the conversion of some $[PbO_6]$ and $[PbO_4]$ structural units into $[PbO_3]$ structural units and the intercalation of $[CuO_n]$ structural units in the lead-based matrix by increase of CuO content in the host matrix.

Keywords: XRD, FTIR, SANS, vitrocermic electrodes

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S5 P13

XRD AND SPECTROSCOPIC INVESTIGATIONS OF MANAGANESE-LEAD-LEAD DIOXIDE VITROCERAMICS

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Vitroceramics in the $xMnO_2\cdot(100-x)[4PbO_2\cdot Pb]$ composition where x=0 - 20 mol% MnO_2 were prepared by melt quenching method using as starting materials: PbO_2, Pb and MnO_2 powders. Obtained samples were characterized by X-Ray diffraction (XRD), InfraRed (IR), UltraViolet-Visible (UV-Vis), photoluminescence (PL) and Electron Paramagnetic Resonance (EPR) spectroscopies, in order to obtain valuable information about the competitive role played by the manganese ions in host matrix.

The FTIR spectra reveal that the addition of higher MnO_2 contents in the lead-lead dioxide vitroceramic produces a disordering in the structure with the formation of Pb-O-Mn linkages. Accordingly, the excess of oxygen atoms can be accommodate in the host network by formation of $[MnO_6]$ structural units.

The EPR spectra of the studied vitroceramics consist of two resonance lines centered at g≈4.3 and g≈2.0 values. The resonance lines situated at about g≈4.3 can be attributed to the rhombic surroundings of the Mn^{+2} ions. The resonance line located at about g≈2 may be generally attributed to isolated paramagnetic centers in octahedral symmetric sites slightly tetragonal distorted when the hyperfine structure is resolved or to couple pairs of transition metal ions.

The photofluorescence and UV-Vis data show the transitions of Mn^{2+} and Pb^{2+} ions. Our results were evidenced that the local environmental of the manganese ions were modified depending on the MnO_2 presence in their composition.

Acknowledgements

This research was supported by the PED Program Projects 2016 (PN-III-P2-2.1-PED-2016-1069). Some authors are gratefully acknowledged.

S5 P14

DETERMINATION OF TRACE ELEMENTS IN COMERCIAL AND HOMEMADE WINES BY ICP-MS TECHNIQUE

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The content of trace elements in wines is specific to vineyard *terroir*, which implies soil geochemistry, climate and wine making technology [1,2]. For present study were determined the contents of selected trace elements (Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Cd, Pb) of 5 samples of comercial wine and 6 samples of homemade wines from Huşi vineyard area (Romania).

The samples were digested using a ration 1:2 (HNO_3:wine) and the obtained solutions were analized for multi-element content using inductively coupled plasma- quadrupole mass spectrometer (ICP-MS Sciex Elan 6000, Perkin-Elmer). The ICP-MS technique offer a high sensitivity (trace and ultratrace detection) and a wide dynamic range for simultaneous quantitative determination of inorganic elements in wine matrix which is so complex because of high number of constituents [3,4].

The determined contents of selected trace elements in wine samples are within the limits reported in the literature [2,3,4,5], but lower than the OIV (International Organisation of Vine and Wine) permisible limits. Home-made wines present lower contents of selected trace elements comparing with comercial wine, probably due to exogenous sources during fermentation and aging.

Keywords: trace elements; ICP-MS; wine;

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S5 P15

IMAGING THE SURFACE OF STAPHYLOCOCCUS AUREUS BY AFM AND SEM

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The aim of this study was to compare, the most common techniques for materials characterization, Atomic Force Microscopy (AFM) and Scanning Electron Microscopy (SEM), in biological samples investigations. For this purpose, we have compared, using the two techniques, morphological modifications of *S. aureus* cells induced by different types of decontaminaton agents. *S. aureus* is one of most frequent bacteria associated with nosocaomial infections in Europe. The decontaminations agents used are very common and effective substances, like: *alcoholic solutions, bis(aminopropyl)laurylamine* (N-(3-aminopropyl)-N-dodecyl-1,3-propanediamine) and *natrium hypochlorite solution,* ,

AFM and SEM reveal high resolution details of the bacterial cells. The treatments have induced differences in term of cellular dimensions, topography and roughness in comparison with untreated cells. The results demonstrate that both AFM and SEM are needed as complementary techniques for a more complete and complex representation of the sample surface.

Keywords: Staphylococcus aureus, cells morphology, AFM, SEM
Acknowledgements: This work was partially supported by the Project PN16420205.

S5 P16

THE INFLUENCE OF FERTILIZERS ON THE CONTENTS OF CHLOROPHYLL IN SPINACH AND RADISH

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In this study, samples of spinach and radish were treated with three types of fertilizers such as Bionat Plus, Soil + and NPK 20-20-0.

The treated plants were grown faster and have developed more harmonious than untreated plants. At the same time the amount of chlorophyll decreased in the treated plants.

The content of chlorophyll in the plants was determined with a UV-VIS and FTIR spectrophotometer in the range 4000-400 cm^{-1}.

Plants that were fed with Soil+ fertilizer, with a higher content of magnesium and potassium, were grown more vigorous. The content of chlorophyll a and chlorophyll b decreased less than the chlorophyll content of the plants treated with Bionat Plus and NPK 20-20-0.

S5 P17

THE INFLUENCE OF UV RADIATION ON CHLOROPHYLL IN SALAD, SPINACH AND RADISH

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This paper presents the influence of UV radiation on chlorophyll in radish , spinach and salad. Two types of lamps have been used: UVC of 130W and UVAB of 100W. For the studied vegetables the following lighting parameters were varied: the distance between lamp and plant and the lighting time. Plants were exposed for 8, 12 and 24 hours. A UV-VIS and FTIR spectroscopy was used in order to study the influence of UV radiation on vegetables. All the plants exposured to UV-AB germinated faster than those exposed to white light. The plants exposed to white light were grown less in height than the irradiated plants but they were more vigorous. Spinach was the most sensitive and grew harder. UVAB treated radish had the best development. It was also the most resistant to UV-C exposure. The contents of chlorophyll a, b, and total chlorophyll were decreased with increasing of UV radiation. A significant variation in carotenoids content was produced in the plants which were exposed to UV radiation.

S5 P18

SEAZONAL ASSESMENT OF DANUBE RIVER WATER QUALITY USING STATISTICAL ANALYSIS AND NUMERICAL APPROACH: A CASE STUDY

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This paper presents the research on the temporal variability of water quality parameters for the most important river system in Romania and Europe – the River Danube. The data on the river water quality had been obtained between January 1990 and December 1998. Using the Kolmogorov-Smirnov test, and traditional statistical methods based on correlation matrix - Principal Component Analysis (PCA) and Factor Analysis (FA), and ANOVA all the samples data sets were classified in order to determine the seasonal variability of the water quality state parameters and to identify the key quality factors that cause variability (fig. 1).

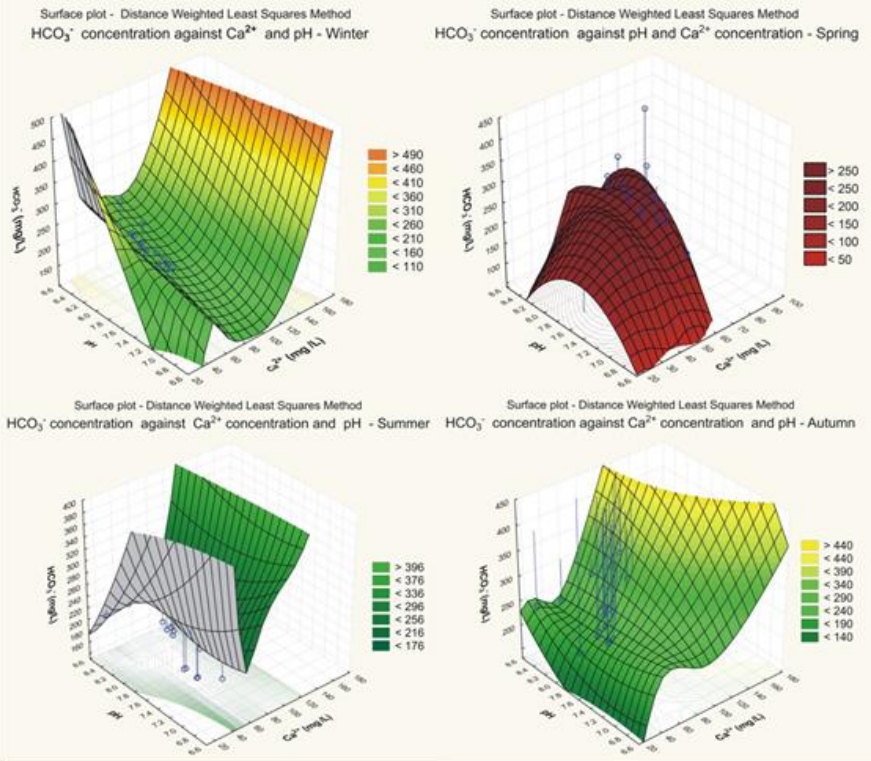

Fig. 1 - surfaces of multidimensional regression analysis for Ca^{2+} and pH versus HCO_3^- for all seasons

In the second section is presented a numerical approach in order to succeed in simulation based on the steady state and dynamic evolution of physical and chemical measured parameters.

Keywords: numerical approach, statistical analysis, ANOVA, equlibrium state

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S5 P19

MAPPING THE CRUSTAL STRUCTURE IN WESTERN PART OF ROMANIA USING RECEIVER FUNCTIONS AND SURFACE WAVE ANALYSIS

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A joint inversion method of receiver function and Rayleigh wave dispersion is employed in order to derive the 1D seismic velocity models for several seismic station locations in western part of Romania. The study use data from broadband permanent seismic network of Romania, as well as data from temporary networks.

To extract the group velocities we applied the Multiple Filter Technique analysis to the vertical components of the earthquakes recordings. This technique allowed us to identify the Rayleigh wave fundamental mode and to compute the dispersion curves of the group velocities at periods between 10 and 150 s allowing us to resolve shear wave velocities to a depth of 100 km. The time-domain iterative deconvolution procedure was employed to deconvolve the vertical component of the teleseismic P waveforms from the corresponding horizontal components and obtain radial and transverse receiver functions at each broadband station. The data are inverted using a joint, linearized inversion scheme which accounts for the relative influence of each set of observations, and allows a trade-off between fitting the observations, constructing a smooth model, and matching a priori constraints.

The results show a thin crust for stations located in the eastern part of Pannonian Basin (28-30 km). In the Apuseni Mountains the Moho discontinuity can be found between 31 to 33km depth. The stations within the Southern Carpathians are characterized by deeper crustal depths of about 31-36 km. 2D models of the

variation of the seismic velocity in depth are developed along 3 lines crossing the western part of Romania. The Moho boundary coincide generally with the isoline of seismic transverse velocity of about 3.75 km/s.
Keywords: crust, seismic velocity, surface wave, receiver function
Acknowledgements: This work was supported from project ctr.no. 90/2013, Partnership 2013

S5 P20

DETECTING ERGOGENIC AIDS BASED ON CLUSTER ANALYSIS AND SELECTED INFRARED ABSORPTIONS

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Misuse of drugs by athletes remains a problem despite the fact that, during the last decades, severe measures have been enforced by the International Olympic Commission (IOC) and individual sport federations. We are presenting a chemometrical application designed to perform the automatic detection of two of the most popular classes of ergogenic aids, i.e. ephedrines and amphetamines, with a new portable GC-IR laser spectrometer. The targeted drugs of abuse are classified based on cluster analysis performed with the infrared absorptions recorded in the limited spectral window specific to the quantum cascade laser (QCL) that is used as source of radiation.

The results obtained for two QCLs, emitting in the domains 1405 - 1150 cm^{-1} (UT8) and 1550 - 1330 cm^{-1} (UT7), respectively, have been compared. In each case, the recorded spectra have been preprocessed by using a feature weight enhancing the intensity of those absorptions found to have an important discriminant power. The preprocessed spectra have been subjected to Principal Component Analysis (PCA). The scores of the modeled compounds, calculated for the first three principal components, are then used as input for a Cluster Analysis (CA), which allows the class identity recognition based on agglomerative clustering.

The classification results obtained with each dendrogram have been assessed by calculating several figures of merit. The results obtained with several features weights, i.e. w^2_{ME}, w^2_{ME} and $(w-1)^2_{ME}$ have been compared. The classification results were then refined by generating the dendrograms with several graphical and geometrical methods, as well as by using several types of distance measures. The combination of algorithms found to provide the most effective hierarchical classification tree is presented in detail.
Key words: hierarchical clustering, drugs of abuse

S5 P21

MULTIVARIATE ANALYSIS OF POLLUTION OF ALLUVIAL SOILS SEDIMENTS AND VEGETATION WITH HEAVY METALS IN SPECIFIC AREAS OF DANUBE DELTA: A CASE STUDY

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The paper presents a study made between 2008 and 2012 in four areas of Danube Delta. The investigation were made on eight species of heavy metals and essential elements contained in alluvial soils,

sediments and vegetation. Main elements - Cd, Mn, Pb, Ni, Cr, Zn - that can seriously affect the fish production were investigated. We analysed samples collected from Miazazi Lake, Matita Lake, Merhei Lake, Somova Lake, Rorundu Lake, Uzlina Lake, Litkov Lake and Lopatna Channel.

Cluster analysis (CA) was used for clustering of locations with similar content of elements and gave 4 different clusters.

A numerical approach basing on environmental physics parameters was made in order to succeed in reaching the seasonal variation of heavy metal concentrations.

Keywords: numerical approach, statistical analysis, ANOVA, equlibrium state

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S5 P22

COMPARATIVE ANALYSIS OF FOUR HISTORICAL EARTHQUAKES FROM 19TH CENTURY WITH THE LAST MAJOR EARTHQUAKES IN THE VRANCEA (ROMANIA) REGION

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The main seismic activity in Romania is concentrated in Vrancea zone, located at the bending zone of the South-Eastern Carpathians. The major events are generated at intermediate depth and produce specific patterns of damage over extended areas, with relatively frequent destructive earthquakes of magnitude above 7. The purpose of this paper is to make a comparative analysis of the macroseismic distributions reported for the Vrancea earthquakes with magnitude around 7 occurred at the end of 19th century (1 May, 17 August, 10 September 1893 and 31 August 1894) with the instrumentally recorded major events of 20th century (1940 - magnitude 7.7, 1977 - magnitude 7.4 and 1986 – magnitude 7.1) in order to identify possible correlations in the pattern distributions and subsequently to re-compute the source parameters (depth and magnitude). All the available information collected from documents and contemporary accounts and evidence was considered to assemble the database with macroseismic data points for the historical events of 1893 and 1894. To build up the associated macroseismic maps the interpolation method of Kringing was applied. The data related to the macroseismic data points of the major events of 1940, 1977 and 1986 was provided by Kronrod et al. (2012).

Keywords: Vrancea source, macroseismic data, historical earthquake

Acknoledgements

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S5 P23

PRECURSOR PHENOMENA IN A SEISMIC ZONE

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Each active seismic zone has characteristics that determines the nature of seismic precursors. The goal of this aticle is to understand better the effects of tectonic stress before an earthquake. Prediction by definition is impossible (which are the errors of time, magnitude and epicenter?) but forcast is posibble sometimes. We

have information from a multidisciplinary network (AeroSolSys) with monitoring stations in Vrancea, a Romanian area characterized by deep earthquakes. The seismicity is correlated with radon concentration, air ionization, earth radiation, ULF radio waves disturbance, magnetic field (specialy the vertical component), telluric currents, temperation in borehole and acoustic waves. The conclusion is theire is not a single elemenet that could forecast earthquakes. Only a multidisciplinary analysis would help us to understand the precursor phenomena. There are few cases when we "see" the eathquake with few hours before. But we do not find a pattern that can help up to forecast with high probability. It is important to measure many precursors parameters but also in suitable locations. Under these circumstances geological structure is important. In each monitoring location we realized measurements VES (Vertical Electric Sounding), ERT (Electrical Resistivity Tomography), SR (seismic Refraction) and MASW (Multichannel Analysis of Surface Waves). In few situation we recorded the reaction of animals before earthquakes. One cause is the noise produced by microfracturing of rocks.
Key words: earthquake forecast, earthquake precursors, tectonic stress, multidisciplinary analysis, radon concentration, air ionization

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S5 P24

TECTONIC STRESS GENERATES PRECURSOR ACOUSTIC WAVES

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Microfracturing and rock deformation as effects of tectonic stress generates sounds called acoustic emission, AE. Many reporting on the earthquakes say that first people hear a noise and then they feel the two shocks (P and S waves). How is it possible that the speed of sound is less than the seismic P speed? What is the difference between acoustic and seismic waves? How could acoustic emission help in forecasting earthquakes? This article gives an answer for these questions. An earthquake is an effect of high tectonic stress in an area (hypocenter) and the last part of this process is the loss of elasticity of rocks followed by breaking. Basically the seismic wave generates and carries on the acoustics. We record earthquakes using seismic equipment and pressure sensors (air and ground) in Vrancea (bending area of Romanian Carpathians Mountains). In both cases you can see the P and S waves but the sounds generated by cracks contain high frequencies that are attenuated rapidly and appear to several hours prior to the event.. The sound depends on where you are registered (geological structure, seismic activity, soil, elasticity. Acoustic emission (AE) forecast earthquakes but we cannot evaluate the magnitude. We could have a big one or several small earthquake. AE is part of a multidisciplinary network that analyzes precursor phenomenon (atmospheric aerosols, ions, radon and clouds in relationship with temperature, humidity, atmospheric pressure, wind speed and direction, variations of the telluric currents, local magnetic field, infrasound, atmospheric electrostatic field, electromagnetic and seismic activity, radio waves propagation, animal behavior). Our records indicate an intensity of sounds before earthquakes greater than 4.5R with 8 - 10 houres.

Key words: earthquake forecast, granular mechanics, acoustic emission, micro cracking, tectonic stress, multidisciplinary analysis

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S5 P25

SYNTHESIS OF SPINEL $NaCo_2O_4$ NANOSTRUCTURES BY NOVEL UREA ASSISTED POLYMERIC CITRATE ROUTEFOR CATHODE Na- ION BATTERY

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Sodium ion batteries (SIBs) have recently received significant attention as battery alternative to lithium ion batteries (LIBs), Sodium ions batteries are promising for large-scale storage applications because the abundance and very low costof sodium-containing precursors used to make the componentsas compared to lithium- and the similar chemistry between the two elements.$NaCo_2O_4$has been prepared by novel urea assisted polymeric citrate routewith different calcinations temperatures and evaluated as a positive electrode for sodium-ion batteries in term capacity, energy density and cycle life. Electrochemical properties measured by cyclicvoltammertic(CV) under NaOH, NaClO4aqueous solutions, (PC):(EC) propylene carbonates:ethylene carbonates as electrolytes. physicochemical properties were performed by scan electron microscopy (SEM), X-ray diffraction (XRD), Thermal Gravimetric analysis (TGA), Raman spectroscopy. The results indicates by selective controlling of the electrochemical reactions (Na ions diffusion, high Na ions intercalation) leads to improving the performance of cathode SIB.
Keywords: sodium ion battery, electrochemical properties, cathode materials, electrolytes.

S5 P26

SODIUM MANGANESE OXIDE SYNTHESIS BY PECHINI METHOD FOR SODIUM ION BATTERIES APPLICATIONS

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Nanomaterials of sodium manganese oxides were prepared according to Pechini's method for applications as cathode materials for Sodium Ion Batteries (SIBs), Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM), X-ray diffraction (XRD) and Raman Spectroscopy were used to investigate the prepared nanomaterials. Our Nano-powders were employed as cathode materials of SIBs to improve the cathode performance in terms of current density and capacity by selectively controlling oxidation and reduction reactions. The electrochemical properties of cathode materials were examined by cyclic voltammetry (CV) to obtain the current density, capacity and life cycle for cathode material of SIB.

Keywords: sodium manganese oxides, Pechini method, sodium ion batteries (SIBs), electrochemical properties.

S5 P27

ARC-DISCHARGE SYNTHESIS Ti and W oxides FOR PHOTOCATALYTIC APPLICATIONS

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We produced Titanium (Ti) and Tungsten (W) samples through an arc-discharge submerged in liquid and analyzed them as catalysts for photo-electrochemical applications.

Titanium and W oxides , analysed by XRD, SEM, Raman, UV-Vis, show mixtures of various phases, structures, morphologies and band-gap. The photoelectrochemical properties are investigated with Zahne -cell related to the photoelectrolysis, photodegradation, water splitting. The yield of water splitting has been increased when the mixture of phases have a band-gap close 2.4-2.6 eV

Keywords: arc-discharge, Ti and W nanoparticles, photocatalytic applications

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S5 P28

PHASE CHANGE MATERIALS: PARAFFIN-FE/NI NANOCOMPOSITES. THERMAL PROPERTIES

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Storage of latent heat using organic phase change nanocomposite materialsbased on paraffin-nanoparticlesshows a growing interest in thermal energy storage systems. Paraffin low thermal conductivityis the main drawback associated with such applications.To tackle this issue, we propose a composite materialwith more effective thermal properties: paraffin-metallic nanoparticles, i.e.nano-iron-nickel composite (Fe-Ni) dispersed in different ratios (0.5-5%) in paraffin. The Fe-Ni particles were synthesized using co-precipitation methodwith microwave heat treatment.Structure and morphology of Fe-Ni were investigated by X-ray diffraction and scanning electron microscopy. Differential scanning calorimetry was used to identify the thermal properties of the paraffin/Fe-Ni of various Fe-Ni ratios. A test rig of rectangular shape supplying a constant heat flux from one vertical side and thermally insulated from the other sides wasemployed for estimating the heat transfer rate of paraffin-as reference and of paraffin/Fe-Ni. Results show a significant increase in the heat transfer rate due to the Fe-Ni particle addition, which makes this type of material appropriate for thermal energy storage applications.

Keywords: Phase change material, nanoparticles, thermal energy storage, thermal conductivity.

S5 P29

ELECTRODES OBTAINED BY THE RECYCLING OF SPENT CAR BATTERIES AND THE DOPING WITH MANGAN (IV) DIOXIDE

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The lead acid batteries are widely used in automobile and provide spent electrodes composed of $PbO_2/PbSO_4$ and $Pb/PbSO_4$. Almost 95% of the materials in a lead-acid battery are recyclable and lead is the most important of them. Today, car batteries are treated and recycled using the best available techniques. However, these techniques have some important disadvantages: i) the small lead recovery rate (due to the rapid oxidation of the electrolytic Pb powder in the atmosphere); ii) the important amount of energy and time spent to convert oxides and sulphates into metal, which is subsequently reconverted to oxides; iii) the harmful emissions and their negative environmental impact.

Vitreous system with the $xMnO_2 \cdot (100\text{-}x)[4PbO_2 \cdot Pb]$ composition where x=0, 5, 8, 10, 15, 20 and 30mol% MnO_2 were prepared using as starting materials active electrodes of disassembled car batteries mixed in suitable proportions with MnO_2 powder. Obtained samples were characterized by investigations of X-ray diffraction (XRD), UltraViolet-Visible (UV-Vis) spectroscopy and cyclic voltammetry measurements.

XRD patterns indicate in all samples two solid phases, one of a metallic nature and the second of a vitroceramic nature. The diffractograms of metallic phase (the subject of this paper) consist of an overlap of some sharp diffraction peaks characteristic of the cubic metallic lead, orthorhombic PbO_2, orthorhombic and tetrahedral PbO crystalline phases.

An examination of the UV-Vis spectra reveals that with progressive MnO_2 addition a shift of the absorption edge toward longer wavelength side and an increase in intensity in both of the UV and visible regions were evidenced. These compositional evolutions suggest that other species than Cu^{+2} ions alone such as Mn^{+3} ions contribute to the overall absorption spectra.

Electrochemical performances of synthetized samples were evaluated by the cyclic voltammetry technique. Discs of prepared samples were used as working electrode, platinum electrode as counter, calomel as reference electrode and sulfate acid solution as liquid electrolyte. All experiments were conducted in solution of H_2SO_4 with the concentrations of 5% and 38%.

In cyclic voltammograms appear anodic and cathodic waves corresponding to the following redox reactions:

$$Pb^0 + 2\,HO^- \rightarrow PbO + H_2O \qquad -0.51V$$
$$PbO_2 + H_2O \rightarrow Pb + 2HO^- \qquad -0.65V$$

In the anodic region a hydrogen evolution process can be observed which will produce the inhibition of the electrode performance.

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S5 P30

THE SEISMICITY, ACTIVE STRESS PATTERN AND SEISMOTECTONICS SETTING IN THE WESTERN TERRITORY OF ROMANIA - THE CASE OF BANLOC-VOITEG SEISMOGENIC AREA

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The study area (Banloc-Voiteg seismogenic zone) is characterized by i) the highest level of the crustal seismic activity in the western Romania (Mmax=5.7 12.07.1991), ii) a complex geotectonic setting with active

tectonics controlled by a specific active stress field and 3D geometry of the faults systems in the area. The South Transylvania and South Carpathians Faults Systems are the main faults systems in the area. The local seismicity is grouped within particularly small focal volumes at different depth levels at the intersections of the major faults systems and/or along of their planes. The strongest events have different time-space models of the seismic activity/seismic sequences: 1) main shock-aftershocks, ii) fore-shocks – main event–aftershocs and 3) swarms (several events having the biggest but equal magnitudes). The active stress field model obtained through formal inversions of the focal mecansims solutions (Oros et al., 2016) shows a SHmax oriented NE-SW parallel to the regional first order compression governed by Africa-Europe collision (Adria Microplate pushing). The main faulting recorded in the area is of strike-slip type, often with different contributions of the normal and reverse components. The major seismic crisis occurred in 1991 and it is characterized by two strong events having Imax=VIII EMS (Mw=5.7, 12.07.1991 and Mw=5.5, 02.12.1991). These ones were followed by thousands of aftershocks in the next few years, some of them with significant macroseismic effects (e.g. 19.12.1992, Io=VI EMS).

Acknowledgements:

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S5 P31

STRUCTURE AND ELECTROCHEMICAL PERFORMANCES OF THE OF THE ELECTRODES OBTAINED BY THE RECYCLING OF LEAD ACID BATTERIES AND THE ADDITION OF VANADIUM (V) OXIDE

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Nowadays, hundreds of millions of lead-acid batteries are produced worldwide, which makes the lead-acid battery the most successful power source of all time. For a spent battery, the positive electrode and negative electrode as active materials are composed of $PbO_2/PbSO_4$ and $Pb/PbSO_4$. Lead is the most important raw material of lead acid batteries and it is the most reused material. Secondary lead obtained by recycling car batteries become the most important source of the world lead production. Approximately 80% of the total production of lead is used in the manufacturing of batteries. This demonstrates the inseparable bond between the manufacturing and recycling processes of car batteries.

In this paper, novel a method of recycling of the lead-acid bateries by melt-quenching technique and the obtain of new electrodes of batteries with improved electrochemical performances will be proposed by their doping with vanadium (V) oxide.

The main objective of this present work provides a study on structure, spectroscopic and electrochemical properties of the $xV_2O_5 \cdot (100-x)[4PbO_2 \cdot Pb]$ glasses where x=0-20% V_2O_5. A second objective is to understand the conduction mechanisms assisted by hopping of the electrons between the multivalent states of the vanadium ions.

XRD patterns permit the identification of the metallic lead phase and of the vitroceramic one with different oxide crystalline phases of the lead ions.

With addition of higher V_2O_5 content (20mol%) in the host matrix, the V^{+5} ions will coordinate with excess of oxygen ions causing the breaking of the regular structure of the host network, the appearance of vanadate structural units takes place and the glass structure becomes more randomized. As a result of this, band gap decreases.

Cyclic voltammograms of the recycled electrodes doped with variated V_2O_5 concentrations show a good reversibility in the diluted H_2SO_4 electrolyte solution. In addition, the some cathodic and anodic peaks

corresponding to the oxidation and reduction processes of the vanadyl active species are indicative of the improvement homogeneity of the electrodes.

In brief, note that the recycling of lead acid batteries by melt-quenching is a method implying a separation of the components from battery electrodes by a lead recovery process with lower energy consumption and the absence of toxic residuals by integration of these ones in a vitroceramic phase.

Acknowledgements

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S5 P32

COMPLEX INVESTIGATION OF THE UNCONSOLIDATED SEDIMENTS OF SEVERAL ROMANIAN PLAIN SALT LAKES

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Salt lakes from Romanian Plain are part of different genetic categories, such as, liman (e.g Lake Caineni, salinity max. 45 g/L) and loess saucer (e.g Lake Movila Miresii, salinity max. 76 g /L) and shows anoxic hypolimnetic horizons and a density stratification, and the depth of these horizons being dependent by the intake of freshwater which coming from rainfall or temporary tributaries. These salt lakes accurately reflect the climatic conditions with a strong aridity character of the Romanian Plain. In these conditions it was collected sediment samples from two lakes (i.e. Caineni and Movila lakes) previously uninvestigated at last three cores from each lake by using a vibrator corer. After collection, each core will be examined radigraphicaly to check at which extent the layer remained undisturbed. Depending on the observed structure, each core will be either extruded and sampled at every 5 mm at will be cut in two halves, one for reference and the other for sampling. Further, from each segment was take an amount of about 3 g to be treated by hydrochloric acid to remove the carbonates, indispensable treatment to calculate the CIA and CIW by determining by XRF the content of major, rock forming elements. The rest of material will be divided in more aliquots for Inductively Coupled Plasma Mass Spectrometry (ICP-MS) as well as for Scanning Electron Microscopy (SEM). Reference Materials NIST SRM 2710a Montana Soil I, and SRM 2702 Inorganics in Marine Sediment were used for a well interpretation. In some cases was identified the nature of organic material, especially in the case of sapropelic mud by means of Attenuated Total Reflectance - Fourier Transform Infrared Spectrometry (ATR-FTIR) and FT Raman spectrometry. All final results were represented as vertical profiles of determined descriptors and interpreted by means of various discriminating diagrams.

Keywords: salt lake, SEM-EDS, ICP-MS, ATR-FTIR, Raman spectrometry.

Acknowledgment: The research leading to these results has received funding from 03-4-1128-2017/2019, Topic: Investigations of Neutron Interaction with the Nuclei and Neutrons Properties, Protocol 4607-4-2017/2019 - Complex investigation (Neutron Activation Analysis, Fourier Transform Infrared and Raman Spectroscopy, Inductively Coupled Plasma – Mass Spectroscopy, Scanning Electron Microscopy + Multielemental Analysis, Optical Microscopy and Image Analysis) of the unconsolidated sediments of Romanian Plain salt lakes.

S5 P33

DETERMINATION OF THE FAULT PLANE SOLUTIONS USING P WAVE POLARITIES AND AMPLITUDE RATIOS FOR THE SEQUENCE OF NOVEMBER 22nd, 2014 RECORDED IN PETRESTI AREA

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The purpose of this work consists in analysis of the fault plane solutions using P wave polarities and amplitude ratios for the 20 crustal depth earthquakes that occurred in Vrancea region, wich are part of the seismic sequence recorded on November 22nd .

The largest shock M_L 5.7 occurred on November 22nd at 19:14:17:11 UTC, at 41 km depth, is the largest crustal event instrumentally recorded at the bending of the Eastern Carpathians.

Using the method developed by (Hardebeck and Shearer, 2002) termed the Hash method, (incorporated in Seisan software) we determined the focal mechanisms of the seismic sequence of November 22nd .

The mainshock was followed by a long aftershock sequence which lasted until around 1st February, 2015; 271 earthquakes with local magnitude $M_L \geq 0.1$ were localized in the area during this time interval, 6 of them being larger than M_L 3.

We use the S/P amplitude ratios computed from three-component seismograms, to determine mechanisms- Hash (Hardebeck and Shearer, 2002).We had also investigated the spatial variation in focal mechanism type (e.g. strike-slip, normal, or thrust) and inferred fault strike.

Most of the mechanisms are normal faulting, with the nodal planes oriented SE - NW, in agreement with the tectonic characteristics of the zone.This crustal seismicity is related to the normal fault system associated to Peceneaga - Camena major fault, which separates the Focsani Basin, part of the Moesian Platform, from the North Dobrogea promontory.

Keywords: crustal earthquakes, seismic sequence, focal mechanisms, Vrancea region

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4.

S5 P34

MONITORING THE BLACK SEA NATURAL HAZARDS USING NEW TECHNOLOGY AND EQUIPMENT

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The Black Sea is prone area to many natural hazards such as earthquakes, tsunamis, storms, strong winds and other meteorological conditions. In order to monitor some of these hazards, the National Institute for Earth Physics (NIEP) has installed and implemented different types of equipments into a system that can monitor and send warnings for tsunamis and earthquakes generated in the Black Sea.

As part of the routine earthquake and tsunami monitoring activity, the first tsunami early-warning system in the Black Sea has been implemented in 2013 and is active during these last years. In the framework of this system, three new seismic stations were installed in the coastal area at Constanta, Mangalia and Sulina sites, along with sea level sensors, radar and pressure sensors, meteorological and GPS/GNSS stations at each of these sites, providing tide gauges and seismic data exchange with the Black Sea surrounding countries. Besides this equipment, an infrasound micro-barometer was installed in Mangalia and a meteorological station and a vertical electric field monitor are added to the seismic sensor in Eforie Nord.

For tsunamis monitoring, a number of 3 sea level monitoring stations, and 7 GPS/GNSS stations were installed in different locations in Dobrogea area, along and near the Romanian shore. Various parameters are measured using this equipment, from water level variations to temperature, wind speed, wind direction, precipitation rates and other meteorological conditions. In order to centralize these data, a web portal for worldwide and regional tsunami monitoring was developed and implemented by NIEP (tsunami.infp.ro), mostly with a focus on the Black Sea area. The data are directly stored and also made available in real time at international level, on other profile websites and portals.

Some other important objectives of NIEP are to continue monitoring the natural hazards triggered in the Black Sea, to increase the regional and international collaboration in this field, and to add new seismic, GPS/GNSS and sea level monitoring equipment to the existing network.

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This work was partially supported by the "Global Tsunami Informal Monitoring Service - 2" (GTIMS2) Project, JRC/IPR/2015/G.2/2006/NC 260286, Ref. Ares (2015)1440256 - 01.04.2015.

S5 P35

THE INTENSITY ASSESSMENT OF THE APRIL 25, 2009, VRANCEA SUBCRUSTAL EARTHQUAKE FROM MACROSEISMIC DATA

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On April 25, 2009, at 20:18:48 (local hour) the Romanian territory was shaken by a moderate size earthquake centered beneath the bending area of the southeastern Carpathians, in the Vrancea seismogenic region (Romania). In the present paper we present intensity map, macroseismic intensities, and community observations of effects for the M_W=5.4 Vrancea subcrustal earthquake of 25 April, 2009. For many locations, for the estimation of the macroseismic intensities besides questionnaires other type of sources such as press reports, internet were used. The highest intensity assigned for this Vrancea earthquake was VI MSK, estimated for eleven locations, situated in the northeastern part of Vrancea seismogenic zone, which include parts from Vrancea, Bacau, and Galati counties. At the lowest intensities, the 2009 earthquake was felt to a distance of 500 km from the epicentre, in Rep. of Moldova, Bulgaria, Ukraine, and Serbia. A non-uniform distribution of intensity resulted for locations on different directions from the epicenter. A scatter of as much as one-two intensity units were observed for places situated very close.
Keywords: Vrancea seismogenic zone, Subrustal earthquake, Macroseismic questionnaires, Intensity map

Acknowledgements
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S5 P36

THE INFLUENCE OF MECHANICAL ALLOYING IN NiTi MATERIALS PREPARED BY POWDER METALLURGY

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In this paper were studied Ni(50.8at%)-Ti and Ni(51.5at%)-Ti materials obtained by different mechanical alloying times, spark plasma sintering and heat treatment. The NiTi materials were analysed by X-ray diffraction, differential scanning calorimetry and nanoindentation measurements in order to determine the phase transformations, the effects of mechanical alloying and the superelasticity behaviour. The results shows a direct correlation between the phase transformations and the superleasticity behaviour of the NiTi studied materials.

Keywords: mechanical alloying, spark plasma sintering and phase transformation

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S5 P37

DISCRIMINATION OF PLANT FOSSILS USING ATR-FTIR, XRD AND CHEMOMETRIC METHODS

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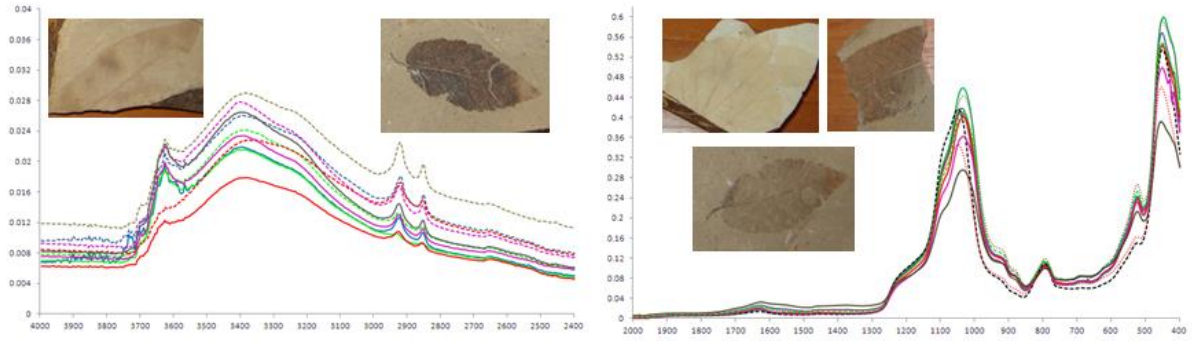
The "Răzvan Givulescu" fossil-bed Reservation of Chiuzbaia stocks the relict structures of some lakes where there are stored vegetal remains of a luxury forest dated before the appearance of the human on earth i.e. Late Miocene Epoch (11.6 million to 5.3 million years ago). The richness of the fossil material and the species make the flora of Chiuzbaia be unique in the south-east part of Europe [1].

In this paper, we have investigated ten samples representing fossil leaves (class A) and their mineral matrices (class B) using attenuated total reflectance - Fourier transform infrared spectroscopy (ATR-FTIR), X-ray diffraction (XRD) and chemometric methods i.e. Cluster Analysis (CA), Principal Component Analysis (PCA). By using ATR-FTIR technique, we have identified the presence of organic and inorganic chemical groups in the studied samples. The organic carbon, derived from the decomposition of plants, was identified in the fossil leaf samples by the presence of two sharp absorption peaks at around 2922 and 2850 cm^{-1} which have a higher intensity than those of the mineral matrix. An improvement of discrimination power between samples from classes A and B by using ATR-FTIR spectra combined with chemometric method was performed. Also, the mineralogical composition of samples using XRD technique is discussed.

Keywords: plant fossils, ATR-FTIR, XRD, PCA



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S5 P38

APPLICATION OF ATR-FTIR SPECTROSCOPY TECHNIQUE FOR THE ANALYSIS OF BORON NITRIDES

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In this paper we present some results of Fourier-Transform Infrared Spectroscopy (FTIR), applied for the investigation of micro-structure of high purity materials such as boron nitrides (BN), obtained at National Academy of Sciences of Belarus, in dependence with the synthesis conditions. BN exhibits a good resistance to corrosion, low density, high temperature stability, high melting point, intrinsic electrical insulation, anti-oxidation ability, and excellent chemical stability. These unique features promise a number of potential applications such as optical and electronic materials.

Attenuated Total Reflectance - Fourier-Transform Infrared Spectroscopy (ATR-FTIR) is effective to characteristically determine the structural nature of BN powders. ATR-FTIR was employed at Dunarea de Jos University of Galati (UDJG), in the frame of a Romanian-Russian collaboration between UDJG and Joint Institute for Nuclear Research (JINR) (project no. 79/2017) for the the analysis of the spectral region of absorption peaks and vibrational spectra of BN. ATR-FTIR spectra were obtained with the aid of a diamond attenuated total reflectance accessory on a Bruker Tensor 27 FTIR spectrometer with a scanning range of 4000 to 400 cm^{-1}, in absorbance mode. All the spectra were collected as a mean of 32 scans, at a resolution of 4 cm^{-1}, and a background spectrum was recorded before each individual analysis.

The ATR-FTIR spectra of the BN samples synthesized in various conditions demonstrated the changes in the spectra intensities, as well as the presence of two characteristic active phonon modes at around 810 cm^{-1} and 1372 cm^{-1}, attributable to the active vibration modes related to the B-N bond. Specifically, the stronger band at roughly 1372 cm^{-1} is related to the in-plane B-N stretching vibration while the sharp band at 810 cm^{-1} is associated with the B-N-B out-of-plane bending vibration.

The spectroscopic technique is used in complementarity with nuclear and atomic techniques (SEM-EDX, INAA, XRD) to determine the influence of the catalyst composition and synthesis conditions on the crystallization processes and characteristics of the chrystalline BN powder samples.

Keywords: ATR-FTIR, boron nitride, microstructure.

S5 P39

RESIDUAL STRESS ANALYSIS IN WELDED JOINTS BY HIGH RESOLUTION NEUTRON DIFFRACTION

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Residual stresses and structural distortions very often occur in welded joints as a result of the local heating during welding and the non-uniform temperature distribution. The residual stresses can significantly reduce the quality and reliability of the welded components. Therefore, the investigation of the influence of welding and the development of methods for prediction and investigation of residual welding stresses and distortions proposes large possibilities for effective increasing the quality and reliability of the welded structures.

In present work the residual stress and microstrain distributions induced by laser beam and arc multi-pass welding techniques were investigated using high-resolution time-of-flight (TOF) neutron diffraction. The neutron diffraction experiments were performed on FSD diffractometer at the IBR-2 pulsed reactor in FLNP JINR (Dubna, Russia). The experiments have shown that the residual stress distribution across weld seams exhibit typical alternating sign character. As expected, the residual stress is falling down in regions remote from the weld area. Significant diffraction peak broadening effect was observed at the centre of welded joint due to the change in the material's microstructure during weld process. Such microstructural change near weld region is often confirmed by microhardness increase because of martensitic (or martensitic-bainitic) structure forming in weld region and HAZ. Usually this process is followed by increase in dislocation density in material, which in turn affects the diffraction peak broadening effects. The obtained experimental results are in good agreement with FEM model which enables to study the influence of different conditions and process parameters on the development of residual welding stresses.

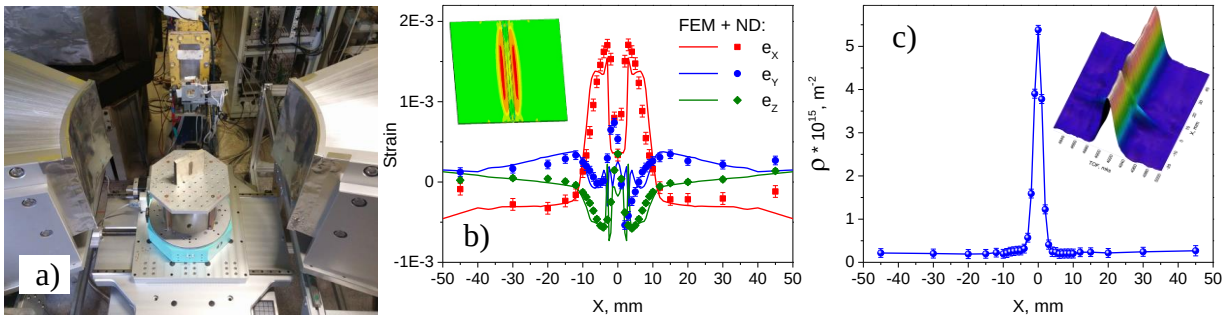

Fig. 1. a) The bulk sample with welded joint on FSD neutron diffractometer for residual stress investigation. b) Comparison of measured residual strain with numerical calculations for sample welded by laser beam. Inset: FEM results for longitudinal residual stress distribution. c) Dislocation density estimated from diffraction peak broadening. Inset: 3D intensity map near Fe(110) reflection with pronounced peak broadening effect at weld seam center.

Keywords: *neutron diffraction, residual stress, microstrain, welding*

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S5 P40

SEISMIC HAZARD AND RISK ASSESSMENT FOR POIANA UZULUI (ROMANIA) BUTTRESS DAM ON UZ RIVER

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The Poiana Uzului dam and accumulation lake are located nearby Sălătruc town (Darmanesti, Bacau County) The Poiana Uzului Dam was developed in order to provide the water supply for neighbouring villages: Bacau, Onesti, Comanesti, Moinesti, Darmanesti. In addition, the lake highlight the hydropower potential of the area. The dam behind which the lake was formed is a concrete barrage, built between 1965 and 1973. It is the first buttress dam from Romania, and has 33 plots in first class of importance and 28 transversal galeries. The crest length is 500 m long and crest width is 8m. The maximum height of dam above foundation is 82 m and the maximum base width is 72m (Figure 1).

Figure 1. Poiana Uzului Dam

In this work, the dam was rated into seismic risk classes for different return periods, using the theory of Bureau, 2003, taking into account the maximum expected peak ground motions at dams' site, the structures vulnerability and the downstream risk characteristics. The maximum expected values for ground motions at dam site have been obtained using probabilistic seismic hazard assessment approaches. The structural vulnerability was obtained from dam characteristics (age, high, water volume) and the downstream risk was assessed using human, economical, touristic, historic and cultural heritage information from the areas that might be flooded in the case of a dam failure. A couple of flooding scenarios have been performed. The results of the work consist of local and regional seismic information affecting Poiana Uzului Dam, specific characteristics of the dam, seismic hazard values and risk classes for different return periods. The studies realized in this paper have as final goal to provide in the near future the local emergency services with warnings of a potential dam failure and ensuing flood as a result of a large earthquake occurrence, allowing further public training for evacuation.

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Keywords: seismic hazard, risk classes, dams

S5 P41

TRANSYLVANIA ENERGY CLUSTER – Innovative Cluster for Pilot Technology in Alternative Energy

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Transylvania Energy Cluster – TREC is part of the **TREC Danube** - the transnational network of regional clusters in the field of renewable energy, energy systems and bioeconomy. We are linking networks,

business partners and R&D organisations from Nord West Region of Romania – Transylvania Area. TREC is a platform for R&D driven innovations in alternative energy, renewables, energy efficiency and advance environmental technologies and environment protection.
In our project :Innovative Cluster for Pilot Advanced Technologies in Renewables Energy- CITAT-E, we intend to build an demonstrative mixed alternative energy framework in the Cluj-Napoca area in order to show that combining this renewable sources will be obtained a better energy efficiency. By showing the results to the potential investors we consider that their trust in sustainable energy obtained by alternative sources will be increased and they will invest in this idea in the future. We will also build an mix energy platform which will be able to calculate the energy efficiency and this will give us the possibilities to give different solutions adapted with the climate condition and the necessities of different investors. During the project we will improve the energy efficiency of this park by experience exchange between partners and the result will be compared in order to show which is the best solution for best energy efficiency and storage adapted with the area and the results we expect to obtain.

S5 P42

METAL NANOPARTICLES INVESTIGATION BY SEM AND AFM TECHNIQUES

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The aim of this study was to characterize metal nanoparticles and their adsorption mode on QCM sensors. Considering the fact that nanomaterials are difficult to investigate under normal conditions, we choose to use a Quartz Crystal Microbalance (QCM-200 by Stanford Research Instruments) in order to remove the liquid and retain only the nanoparticles on the sensor surface for the further investigations. In our study was used 0.5 mL from different colloidal samples (i.e. Ti, Fe, Pd, Ag, and Au). These samples were pipetted over the QCM sensor surface and let to be adsorbed for 6 h at constant 20 °C temperature.

Afterwards, the QCM sensors have been analyzed by Atomic Force Microscopy - AFM (Ntegra Prima by NT-MDT) and Scanning Electron Microscopy - SEM (SU-70 by Hitachi) coupled with Energy Dispersive X-Ray Spectrometer (UltraDry EDS by Thermo Scientific) in order to determine the metals adsorption topography and morphology. By these techniques it has been observed some important aspects regarding the shape and size of metal nanoparticles. First, is that nanoparticles were uniformly adsorbed over the entire sensor surface, but from place to place were formed clusters. Depending of the metal and the size of the nanoparticles, the formed clusters have different shapes. The AFM images were processed with Nova Px software and acquired data reveal that the average size of these nanoparticles was: Ti - 76 nm, Fe - 60 nm, Pd - 62 nm, Ag - 80 nm and Au - 60 nm.

S5 P43

CHARACTERIZATION OF INSULATORS USED IN ROTATING MACHINES BY SEM-EDS, ATR-FTIR AND RAMAN TECHNIQUES

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For these investigations, the chosen insulator was made by thin layers of polyethylene terephthalate impregnated with resin. The aim of the resin presence in polymeric material was to protect insulator against high temperatures (200 ºC). In order to obtain a real feedback regarding the insulating properties of polyethylene, five electric rotating machines were developed and equipped with this insulator. These five machines were simultaneously turned on and let to function in the same parameters at 120 ºC for 80, 160, 240, 320 and 400 hours. In all this time, the insulator was aging bit by bit; therefore when the machines were disassembled, the insulator was extracted for structural investigations. The thermo-oxidative process of slot insulation was investigated by ATR-FTIR and Raman Spectrometry. The morphological structure and chemical content of the samples was performed by SEM-EDS technique. On before and after aging the obtained SEM images show that initial structure texture (fibers of approximately 10μm) was degraded after use. It was also observed the presence of carbonyl group by ATR-FTIR investigations, more than that, its stretching intensity varies from 3.01 for first electric machine to 12.09 for the fifth one. Another interesting aspect concerning these results is that the elemental composition shown several content modifications such as: initial 67.66 % C, 32.16 % O and final 57.91 % C and 41.91% O - as results of an oxidation process in insulation.

Keywords: insulator, thermal aging, SEM-EDS, ATR-FTIR and Raman spectroscopy.

Acknowledgment: The research leading to these results has received funding from PNII 2013 under the project PN-II-PT-PCCA-2013-4-0792 "High performance polymeric insulations for electrical rotation machines. Technology and modeling approaches" (IsMach).

S5 P44

SEQUENTIAL CHEMICAL EXTRACTION OF COPPER FROM CLAY: AN OVERVIEW

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In general the total content of heavy metals and trace elements in soils is useful, but the speciation (bioavailability) is also in need for agricultural purpose, for example. The present paper studies the efficiency of some remediation treatments on soils polluted, especially with copper, by using sequential chemical extraction (SCE). Usually SCE is fractioned, according to Tessier in five fractions: exchangeable, carbonate bound, Fe and Mn oxide bound, organic matter bound and residual. Copper (Cu) is one of the contaminants in many soils around the world, in small concentration is an essential microelement for plants, but in high concentrations is harmful for the entire ecosystem. Because the contents of Cu are associated with soil texture and several other parameters, many remediation treatments are based on organic mixture by converting the element into less exchangeable and thus less bioavailable forms. In this study is investigated the efficiency of organic matter (OM), zero-valent iron with organic matter (OMZ), dolomite (DL) and organic matter with

dolomite (OMDL) applied on soils affected by Cu pollution collected from Gironde, France. The results indicated that OMDL and OMZ treatments had the best efficiency on Cu pollution, by stabilization of the element, decreasing the level of bioaccessibility.

Keywords: Cu pollution, sequential chemical extraction, migration index, organic amendments.

S5 P45

INVESTIGATIONS TO INCREASE PHOTOVOLTAIC PANELS ENERGY EFFICIENCY

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The growing interest in the use of alternative energy sources, both to reduce pollution and to cover the increase in global energy demand, has led to the optimization of processes for their use. Together with hydro and wind powers, photovoltaics (PV) are the most important renewable energy source in terms of globally capacity. PV systems have the major disadvantage that the power output is dependent on direct sunlight, so an important amount is lost if a tracking system is not used, since the cell will not be directly facing the sun at all times. In this sense, there are three types of photovoltaic systems namely as: fixed panel system, single axis system and double axis system [1]. The PV efficiency is temperature dependent, so that it is reccomanded that the PV is cooled [2].

The aim of this work is to present the advantages of using a tracking and the cooling systems designed in our institute in order to obtain a better energy efficiency. The work is performed at small lab scale in our Center for Research and Advanced Technologies for Renewable Energy - CETATEA.

Financial support from the National Authority for Scientific Research and Innovation - ANCSI, Core Programme, Project PN16-30 01 02 is gratefully acknowledged.

Keywords: renewable energy, photovoltaics, energy efficiency, tracking system

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S5 P46

CONCENTRATED SOLAR POWER CONVERSION THROUGH THERMOELECTRIC DEVICES

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Solar thermoelectric power generation is known as an economic way to utilize the full solar spectrum energy with less dependency on daylight and weather conditions [1]. There have been significant progress in the development of thermoelectric (TE) materials with improved figures-of-merit in different forms.

We developed a micro-thermoelectric device mounted on a two axis tracking system using a Fresnel lens as solar concentator. The heating source is a hexagonal black body that takes the concetrated solar energy

from Fresnel lens. For the cold side we have used a water cooling system. A total of 12 Peltier elements were installed with a maximum power capacity of 250 W.

The aim of the study was to investigate the power produced and the efficiency of the solar-thermoelectric system in order to optimize the shape and dimmension of the black body.

Financial support from the National Authority for Scientific Research and Innovation - ANCSI, Core Programme, Project PN16-30 01 02 is gratefully acknowledged.

Keywords: concetrated solar power, thermoelectric generator, black body

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S5 P47

STANDARDIZED TEST VERSUS NEW DEVELOPMENT TEST TO EXPLORE REAL-WORLD CONTEXT FOR PROJECT BASED LEARNING IN EDUCATION RESEARCH

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It can be noted an increased reliance on standardized tests (Suwatthipong, Thangkabutra, & Lawthong, 2015) to determine if students' are getting the appropriate environmental education they need. Definitely there is a safety situation when we use standardized tests in education research to explore real-world context for Project Based Learning (PBL) (Ruggiero & Boehm, 2017) in education research. However, these do not capture the particularities of interest, and do not highlight any hidden latent factors that may play an important role in educational research. Students' behavior is provided by a lot of individual's attitudes and motivations (Nasser-Abu Alhija, 2017). The first debate in planning such a research is the question of exploration requirement. A number of main features that investigate the students' behaviors during education process have recently received improved consideration. For that reason, this paper will focus to ascertain key factors specifically to biophysics education (Wiener et al., 2014) that may respond to increase the quality in teaching and learning activities. The paper presents the results of two projects which used the eco-friendly issues from the community as real-world context and the impact on students' degree of biophysics responsiveness and motivation. Also, we compare the results obtained from the new development test with an appropriate standardized test to explore the real-world context for PBL in order to highlight the differences, weaknesses and strengths of each test. Even if the projects based learning were developed in biophysics area, due to the multidisciplinary features of research, the strategy can be simulated in other topics also.

Keywords: biophysics, education, Project Based Learning (PBL), standardized tests

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S5 P48

EVALUATION OF THE ELECTROMAGNETIC POLLUTION IN AN URBAN ENVIRONMENT

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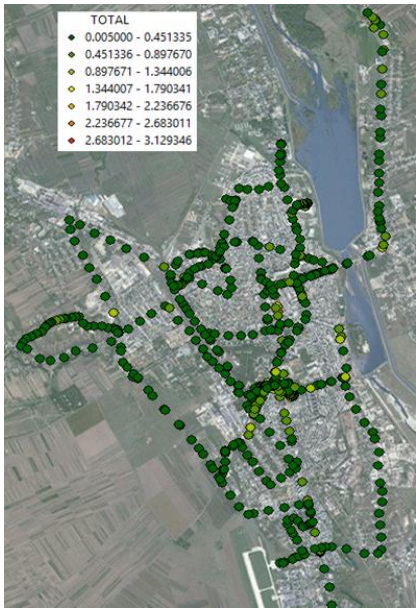
The problem of electromagnetic pollution is not very clear at this moment, many scientific publications being focused on the effects of electromagnetic field (EMF) on environment. Especially the radiofrequency electromagnetic fields used in tele-communications have been intensively studied in the last years [1].

The scope of this study is to evaluate the degree of electromagnetic pollution in the a large radiofrequecies (RF) domain in the city of Bacău and to elaborate a distribution map for several most used RF bands.

The first step of the research was the analysis of the variability of the EMF intensity across the city, during the day and depending on the weekday. The statistical analysis of different correlations included also the meteorological data.



Data were collected using the EME Spy 200 dosimeter. Primary measurements were made in ten different points of the city, three times by day (in the morning, in the afternoon and in the evening).

The next step was to measure the field intensity along the major roads in the city. The first result is presented in the figure.

Primary results show that, like in other European cities [2, 3], the dominant RF bands are GSM, FM and WiFi 2G, with significant variations from a point to another and depending on the day and on the menet of the day.

Keywords: electromagentic pollution, radiofrequency

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S5 P49

THE SENSITIZATION OF ZINC OXIDE NANOPARTICLES WITH ANTHOCYANINS FOR ENHANCEMENT OF PHOTOCATALYTIC ACTIVITY

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Keywords: zinc oxide, functionalized nanoparticles, photocatalytic activity, anthocyanins.

Zinc oxide is a well-known ecofriendly photocatalyst, which was widely studied in a variety of photocatalytic processes [1]. Despite of its qualities, zinc oxide cannot absorb the visible region of the solar spectrum, and only a low part of the solar energy is captured [2,3]. One solution to expand the adsorption range of ZnO in visible domain is the sensitizing of the ZnO surface with pigments [4]. We obtained blue ZnO nanoparticles, sensitized with anthocyanins, by two synthesis routes. The ZnO nanopowders were characterized by transmission electron microscopy, electron diffraction, and UV-vis spectroscopy. The photocatalytic properties were demonstrated in the degradation of an azo dye. The results indicated the enhancement of properties (lower crystallites size, lower aggregates, higher band gap energy and higher photocatalytic activity) mainly for ZnO nanoparticles functionalized with anthocyanins obtained by one-pot synthesis, in comparison with pristine ZnO nanoparticles obtained by chemical precipitation.

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S5 P50

STUDY FOR DETERMINATION THE RADIOACTIVITY LEVELS IN THE LOCAL NATURAL ROCKS USED AS BUILDING MATERIALS IN OUR COUNTRY

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In this paper we presents the results of the study by determination radionuclides concentrations measurements and something chemical parameters obtained for different type of natural rocks (with different origins: calcareous, silico-aluminous, volcanic) which can be extract in Romania and their to be uses as raw materials in various industries.

The natural rocks samples (collected from different area of the our country) were analyzed for their natural radionuclide content (gamma radionuclides) and for a heavy metals content. Different types of natural rocks (limestone, marl, clay, gypsum, sand, volcano tuff) and some types of residues derived from processing these rocks (steam power plant ash, blast-furnace cinder, granulated slag and mining sterile) were analyzed.

The radioactivity measured by gamma-ray spectrometry, using a Canberra-Packard germanium hyper-pure detector and Genie 2000 soft. The chemical analysis focused on several parameters for the purity of sample, in generally heavy metals. The concentration of heavy metals in the samples was determined by Atomic Absorption Spectroscopy using an Avanta Σ spectrometer produced by GBC Scientific Equipment Pty Ltd, Australia. The activity concentrations of natural radionuclides were in the ranges: 30–80 Bq/kg for ^{226}Ra; 5–50 Bq/kg for ^{232}Th and 60–570 Bq/kg for ^{40}K. The concentrations of heavy metals in the natural samples are between : 8-40 µg/mL for Cr, 2-235 µg/mL for Cu, 100-59000 µg/mL for Fe, 10-1200 µg/mL for Pb, 20-2400 µg/mL for Zn, 2-6 µg/mL for Co. Lower range value for assay for determination the concentration of some heavy metals of the samples (µg element/g sample) are: 0.14µg/mL Cr, 0.02µg/mL Cu, 0.1µg/mL Fe, 0.5µg/mL Pb, 0.01µg/mL Zn, 0.08µg/mL Co, 0.01µg/mL Cd.

S5 P51

PRACTICAL INSIGHTS ON SEISMIC RISK EVALUATION FROM SITE-STRUCTURE DYNAMIC BEHAVIOR PERSPECTIVE FOR BUCHAREST URBAN AREA

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The paper aims to discuss some aspects regarding the influence of the dominant periods of the location and fundamental periods of the built structure, starting from earthquakes records and using already known data about the fundamental period of vibration of the subsoil.

It is well known that major damages appear at resonance, when the natural period of structure is equal or very close to the dominant period of the site. For this reason, a correct evaluation of site dominant period is of high importance.

We will focus our analysis on Bucharest Metropolis foundation soils, where buildings are placed in an area exposed to high seismic hazard. The regions of the south-east and south of Romania are affected mainly by the Vrancea strong earthquakes, generated at the South-Eastern Carpathians Arc bend at intermediate depth. In the XXth century four major earthquakes ($M_w > 7$) were reported.

The methods used for computing the oscillation period of the soil and the oscillating periods of structures are shortly reviewed. In this respect, we have used the only available record for the 1977 strong earthquake recorded at seismic station INCERC.

By knowing the dominant periods over the Bucharest area, we can appreciate if a building is suitable or not for a specific site. In the authors' opinion, it is safer to pick the right structure to be build up in a given area than to force a non-resonance design in that place.

Consequently, a *soil – foundation – structure interaction analysis* will be proposed with considering the nonlinear behaviour of the soil deposit affected by strong earthquakes. This will have to be a very effective way of getting the right answers when trying to build a special construction on a site. This ultimate analysis considering the whole system in a dynamic behaviour under the seismic action, yields many essential design data for the soil deposit and structure itself.

Keywords: site evaluation, structure natural period, dynamic behaviour, seismic action

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ABSTRACTS

S6 – Topics in Physics Education Research

- *Physics curriculum design*
- *Active learning techniques*
- *Classroom teaching, demonstrations and laboratory experiments*

S6 P1

IMPORTANCE OF LEARNING STYLES-BASED METHODOLOGY IN TEACHING PHYSICS: A CASE-STUDY

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A controversial issue of current education, intrinsic-part of quality assurance in education (assessment and self-assessment) is the designing process of teaching strategies according to learning styles of students. Since the learning styles of students are heterogeneous and their interests, experiences, talents and values are different, it is necessary that teaching strategies and methodologies to have varied forms, in order to increase student motivation and engagement in learning.

Any progress (surplus additional value) in the development of a child can be considered successful as long as it can be measured. Therefore teaching strategies should be developed according to Deming's Circle "Plan-Do-Check-Act". The present research was conducted on a relevant number (N = 75) of students in the 11th grade from two high schools, in fact 3 classes - technical and mathematics/informatics profiles, with different learning styles, two demonstration groups and a control group.

The testing process was carried out by using learning units and tests designed by the authors. The test contain multiple-choice questions and explanation questions. The results were statistically analysed using appropriate programs.

Teaching physics according to learning styles seems to be useful for students.

Key words: physics, learning styles, conceptual maps, quality assurance in education.

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S6 P2

A VIEW ON HIGH SCHOOL STUDENTS KNOWLEDGE ABOUT NANOTECHNOLOGY

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Nowadays, almost each high school student uses cutting edge technology in daily activities whether those devices are used for fun or work. Technological evolution registered in different fields of knowledge imposed challenging technological situations for all members of society, not just high school students but public at large. At different age to interact with freshly gained scientific knowledge can become a big problem. These interactions suggest various learning situations, each developing a specific set of cognitive links, based as well on users previous interactions with technology. This informal learning leads to the development of cognitive structures which sometimes do not cover the real scientific facts, while through formal education students would be able to form cognitive connections that reflect scientific reality. The main problem in this situation is that curricula does not contain updated information regarding scientific progress, unpreparing this way the foundation for a coherent understanding. The adaptation of education can be achieved by changing

the structure of contents and skills teached in the classrooms or transferred in extracurricular activities so that it reflects current society requirements.

Following this hypothesis we conducted a study whose purpose was to determine the level of knowledge that high school students have about nanotechnologies and theirs applications. The instrument used in this study was a questionnaire containing 12 items referring to various aspects regarding nanotechnologies and some peculiar addressing the knowledge of magnetic materials applications. The sentences were built using carefully chosen words, in order to keep them as short and as pointed as one can be. Some of the questions were open format so that pupils could respond as they felt at that moment and for some of them, students could choose the answer believed to be good of those available. Questionnaires were applied in the second semester of scholar year 2015-2016 on a sample of 650 students from seven high schools in the south region of Vaslui County, four high schools from urban areas and three high schools from rural areas. The questionnaires used were focused on three main issues: magnetism, fluid state and nanotechnologies. Some questions watching to determine the quantity and quality of knowledge obtained in formal education in the classrooms, and others were built to probe students interest on nanotechnologies and knowledge obtained during informal education sequences. Through this study, we managed to determine the level of knowledge and interest that high school students manifest towards the field of nanotechnology. Another issue identified is that although many students know the science, they do not know the connections between science and applications used by them in daily life.

An important issue of the survey was that students would like to participate in lessons explaining how nanotechnology is working in gadget and devices they use (phone, PC).

Keywords: education, nanotechnology, high schools students' survey

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S6 P3

ENHANCING DIGITAL COMPETENCE DURING CLASSES

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Over the last few years, the Ministry of Education seems to be more and more preoccupied by modernizing education through the use of the Internet, so that students stay motivated all through the teaching – learning process.

Teachers, in turn, are looking for new ideas to enliven the class atmosphere, trying to integrate the IT and pedagogical new techniques without neglecting the quality of human interactions.

So, computers, the Internet, interactive number tables are more and more frequently used in class.

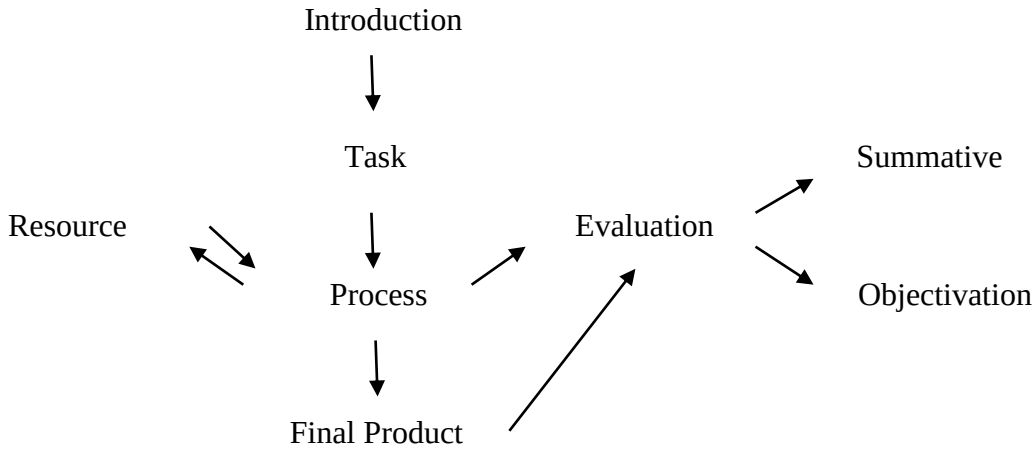
I started from the premise that you don't necessarily have to be an IT specialist to use the IT instruments in class, as long as there are training sheets for teachers, offering them the means of acquiring new reflections, new ideas, as well as activities to be used in class, adapted of course, to the audience aimed at. There are also the students' worksheets with activities ready-to-use in class, followed by pedagogical instructions on how to use the material.

I have made a sort of "guide" for searching the Internet, showing the general / specialized searching engines for finding the audio / video documents, photographs, real / virtual people, etc.

In this type of pedagogical scenario, the students look for information on the Internet, starting from questions or clues, which they use afterwards to accomplish a specific final task. In this way they train themselves in a learning process based on mutual aid and cooperation.

Each student is made responsible in his own learning which becomes authentic, linked to reality, creating in this way a motivating climate.

I used the track suggested by the authors of the work "Les TIC, des outils pour la classe" (I. Barrière, H. Emile, F.Gella, 2011, page 14):



Conclusions: Teachers must learn to realy also on students competence which, more often that not, are more competent in IT.

So the courses will proceed as an exchange of experience, as a sharing of every one's digital competence: teacher – student, student – student.

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ABSTRACTS

LAST SUBMISSIONS

S6 P3

OBSERVATIONAL GEOPHYSICAL OPEN DATA AS VALUABLE RESOURCES FOR LEARNING PHYSICS IN A NON-FORMAL ENVIRONMENT

Dragos TATARU[1], Dragos TOMA-DANILA[1], Eduard Ilie NASTASE[1]

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Geophysics is heavily based on massive data acquisition, management, processing and analysis. Huge amount of data have been put together by different institutions, all over the world, in the framework of dedicated data centers or simple data collections. More and more open data policy is embraced by those institutions, and together with it took shape and easily grew the application in education and learning.

In general, when we talk about geophysics, we refer to the systematic and comprehensive study of the Earth and geospace. In this regard, some of the branches of geophysics, due to their "subject of study" and specific tools, are more than suitable for learning purposes. Here we can mention, without restricting, seismology, geomagnetism or geodynamics. Even if observations about geophysical phenomena have been done from ancient times, nowadays modern instruments and tools, allow almost everybody to access, visualize and reuse research data and products, taking the path of a true researcher.

Recent studies show that, even if open access starts to be a practice, quite mandatory for different data collected using public funds, examples of good practices regarding the use of these data in educational (didactic) activities cannot easily be spotted. In this direction educational research projects should make the difference. Teachers can be "taught" how to properly design activities based on available data allowing students to gain experience working with the same raw data researchers use. Special educational software and apps could be developed and delivered to facilitate, at least in a pilot stage, access to data.

In the present paper we will present examples of such good practices, implemented and/or ongoing in Romania, in the framework of research projects. They focus on non-formal education and the dissemination of science in general and seismology in particular at pre-universitary school level.

They comprise in developing learning resources, place them in a non-formal context (e.g museums) and propose and test them as an alternative, complementary for the classic approach, for teaching physics. Special educational tools (applications) have been developed for easy access and process earthquake and GPS open data and GIS modules have been adapted to illustrate results. Going further, interdisciplinary classes focusing on specific themes (e.g. earth processes and phenomena) have been proposed and tested during school program, with emphases on the way they influence students' interest in science (STEM) disciplines.

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