FOURTEENTH YOUNG RESEARCHERS' CONFERENCE
MATERIALS SCIENCE AND ENGINEERING

December 9-11, 2015, Belgrade, Serbia

Serbian Academy of Sciences and Arts, Knez Mihailova 36

PROGRAMME &
THE BOOK OF ABSTRACTS

MATERIALS RESEARCH SOCIETY OF SERBIA

INSTITUTE OF TECHNICAL SCIENCES OF SASA

December 2015, Belgrade, Serbia

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Program and the Book of Abstracts

Materials Research Society of Serbia
&
Institute of Technical Sciences of SASA

December 2015, Belgrade, Serbia

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Aim of the Conference

Main aim of the conference is to enable young researchers (post-graduate, master or doctoral student, or a PhD holder younger than 35) working in the field of materials science and engineering, to meet their colleagues and exchange experiences about their research.

Topics

New synthesis and processing methods
Materials for high-technology applications
Theoretical modelling of materials
Nanostructured materials
Biomaterials

Scientific and Organizing Committee

Conference Secretary
Aleksandra Stojičić Institute of Technical Sciences of SASA, Belgrade, Serbia

Conference Technical Committee

Milica Ševkušić, Miloš Milović, Ljiljana Veselinović, Vuk Radmilović, Ivana Jevremović

Results of the Conference

Beside printed «Program and the Book of Abstracts», which is disseminated to all conference participants, selected and awarded peer-reviewed papers will be published in journals "Tehnika – Novi Materijali" and "Processing and Application of Ceramics". The best presented papers, suggested by Session Chairpersons and selected by Awards Committee, will be proclaimed at the Closing Ceremony.

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Programme
Fourteenth Young Researchers Conference
Materials Science and Engineering

Wednesday, December 9, 2015

08.30 Registration

09.30 – 10.00 Opening Ceremony

10.00-11.00 Master Class Prof. Dr. Bojana Obradović: Tissue Engineering Applications and Functional Characterization of Biomaterials
Faculty of Technology and Metallurgy, University of Belgrade, Belgrade, Serbia

11.00 – 12.15 1st Session – Biomaterials I
Chairpersons: Prof. Dr. Bojana Obradović and Dr. Sanja Eraković

11.00 – 11.15 Effect of graphene on mechanical strength and corrosion stability of composite coatings electrophoretically obtained on titanium substrate
Sanja Eraković,[1] Ana Janković,[1] Miodrag Mitrić,[2] Ivana Z. Matić,[3] Zorica D. Juranić,[3] Gary C.P. Tsui,[4] Chak-yin Tang,[4] Maja Vukašinović-Sekulić,[1] Kyong Yop Rhee,[5] Soo Jin Park,[6] Vesna Mišković-Stanković[1]
[1]Faculty of Technology and Metallurgy, University of Belgrade, Belgrade, Serbia, [2]Vinča Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia, [3]Institute of Oncology and Radiology of Serbia, Belgrade, Serbia, [4]Department of Industrial and Systems Engineering, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, PR China, [5]Department of Mechanical Engineering, Kyung Hee University, Yongin, Korea, [6]Chemistry, Collage of Natural Sciences, Inha University, Incheon, Korea

11.15 – 11.30 Coated calcium phosphate scaffolds for bone tissue engineering produced by foam replica method
Nenad Filipović,[1] Miodrag Lukić,[1] Abirami Sengottuvelan,[2] Sonja Kaišarević,[3] Nebojša Andrić,[3] Aldo R. Boccaccini,[2] Magdalena Stevanović[1]
[1]Institute of Technical Sciences of SASA, Serbia, [2]Department of Materials Science and Engineering, Institute of Biomaterials, University of Erlangen-Nuremberg, Germany, [3]Department of Biology and Ecology, University of Novi Sad, Serbia

11.30 – 11.45 Multifunctional opto-magnetic up-converting $NaYF_4$&Fe_3O_4/SiO_2 nanoparticles – synthesis, characterization and biological applications

Przemysław Kowalik,[1] B. Sikora,[1] J. Mikulski,[1] K. Fronc,[1] I. Kamińska,[1] M. Szewczyk,[2,3] G. Gruzeł,[4] K. Zajdel,[5] M. Naurecka,[6] R. Minikayev,[1] T. Wojciechowski,[1] M. Parlińska-Wojtan,[4] A. Sienkiewicz,[7,8] M. Łapiński,[6] M. Kwaśny,[6] A. Gardias,[9] J. Rybusinski,[9] J. Szczytko,[9] A. Twardowski,[9] M. Frontczak-Baniewicz,[5] P. Stępień,[2,3,10] W. Paszkowicz,[1] D. Elbaum[1]

[1]Institute of Physics, PAS, al Lotników 32/46, Warsaw, [2]Institute of Genetics and Biotechnology, Faculty of Biology, UW, Pawińskiego 5a, Warsaw, [3]Institute of Biochemistry and Biophysics PAS, Pawińskiego 5a, Warsaw, [4]Institute of Nuclear Physics Polish Academy of Sciences, PL-31-342 Krakow, [5]Mossakowski Medical Research Centre PAS, Pawińskiego 5, Warsaw, [6]Institute of Optoelectronics, Military University of Technology, Gen. S. Kaliskiego 2, Warsaw, [7]Laboratory of Physics of Complex Matter, EPFL, Station 3, Lausanne, Switzerland, [8]ADSresonaces, CH-1028 Préverenges, Switzerland [9]Institute of Experimental Physics, Faculty of Physics, UW, ul. Pasteura 5, Warsaw, [10]Centre of New Technologies, UW, S. Banacha 2c Warsaw

11.45 – 12.00 Multifunctional opto-magnetic nanoparticles for theranostic applications

Bożena Sikora,[1] P. Kowalik,[1] J. Mikulski,[1] K. Fronc,[1] . Kamińska,[1] M. Szewczyk,[2,3] G. Gruzeł,[4] A. Konopka,[5] K. Zajdel,[6] M. Naurecka,[7] R. Minikayev,[1] T. Wojciechowski,[1] M. Parlińska-Wojtan,[4] A. Sienkiewicz,[8,9] M. Łapiński,[7] M. Kwaśny,[7] A. Gardias,[10] J. Rybusinski,[10] J. Szczytko,[10] A. Twardowski,[10] M. Frontczak-Baniewicz,[6] P. Stępień,[2,3,11] G. Wilczyński,[5] W. Paszkowicz,[1] and D. Elbaum[1]

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12.00 – 12.15 Probing mesenchymal stem cells differentiation status by micro Raman spectroscopy

Jasmina J. Lazarević,[1] Tamara Kukolj,[2] Diana Bugarski,[2] Nenad Lazarević,[3] Zoran V. Popović,[3] and Branko Bugarski[4]

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12.15 – 12.30 Break

12.30 – 13.30 2nd Session – Biomaterials II

Chairpersons: Dr. Magdalena Stevanović and Aleksandra Nešić

12.30 – 12.45 Electrochemical synthesis of silver/polyvinyl alcohol hydrogel nanocomposites

Katarina Nešović,[1] Mohamed Mohamed Abudabbus,[1] Ivana Jevremović,[1] Ivana Matić,[2] Aleksandra Perić-Grujić,[1] Vesna Mišković-Stanković,[1]

[1]Faculty of Technology and Metallurgy, University of Belgrade, Serbia, [2]Institute for Oncology and Radiology of Serbia, Belgrade, Serbia

12.45 – 13.00 Development and characterization of composite pectin/sodium alginate films crosslinked with zinc ions

Aleksandra Nešić,[1] Sladjana Davidović,[2] Suzana Dimitrijević,[2] Roberto Russo,[3] Gabriella Santagata,[3] Mario Malinconico[3]

[1]University of Belgrade, Vinča Institute for nuclear sciences, Mike Petrovića-Alasa 12-14, Belgrade, Serbia, [2]University of Belgrade, Faculty of technology and metallurgy, Karnegijeva 4, Belgrade, Serbia, [3]Institute of chemistry and technology of polymers, Campe Flegrei 34, Naples, Italy

13.00 – 13.15 Fulleren C60: application in cosmetics and its toxicity

Katarina Jovičić Bubalo

Faculty of mechanical engineering, University of Belgrade , Belgrade, Serbia

13.15 – 13.30 Application of the fullerene C60 derivates in anti-aging treatments and their permeability through the skin

Katarina Jovičić Bubalo

Faculty of mechanical engineering, University of Belgrade , Belgrade, Serbia

13.30 – 15.00 Lunch break

15.00 – 16.15 3rd Session – Biomaterials III
Chairpersons: Dr. Đorđe Veljović and Marijana Majić Renjo

15.00 – 15.15 Influence of low temperature sintering on pure and Sr, Mg and CO_3 substituted hydroxyapatite bioceramics
Miljana Mirković,[1] Anja Došen,[1] Jovana Ružić,[1] Vesna Maksimović,[1] Marija Stojmenović,[1] Aleksandra Rosić,[2] Branko Matović[1]
[1]Vinča Institute of Nuclear Sciences, University of Belgrade, P. O. Box 522, 1100 Belgrade, Serbia, [2]Faculty of Mining and Geology, University of Belgrade, Đušina 7, Belgrade, Serbia

15.15 – 15.30 Corrosion resistance of monolithic yttria partially stabilized zirconia (Y-TZP) dental ceramic
Marijana Majić Renjo,[1] Lidija Ćurković,[1] Sanja Štefančić,[2] Zrinka Šokčević[1]
[1]Faculty of mechanical engineering and naval architecture, University of Zagreb, [2]Dental Polyclinic Zagreb, Croatia

15.30 – 15.45 The impact of the type of substrate on the morphology and structure of zinc oxide rods
Marta Fiedot, Helena Teterycz
Wroclaw University of Technology, Faculty of Microsystem Electronics and Photonics, Janiszewskiego Str. 11/17, 50-372 Wroclaw, Poland

15.45 – 16.00 Disease biomarkers detection in breath with laser absorption spectroscopy
Paweł Magryta,[1] Zbigniew Bielecki,[2] Tadeusz Stacewicz,[1] Jacek Wojtas,[2] Janusz Mikołajczyk,[2] Mirosław Nowakowski,[2] Artur Prokopiuk,[2] Dariusz Szabra[2]
[1]Institute of Experimental Physics, Faculty of Physics, University of Warsaw, [2]Institute of Optoelectronics, Military University of Technology in Warsaw , Poland

16.00 – 16.15 Break

16.15 – 17.30 4th Session – Polymers
Chairpersons: Dr. Dragutin Nedeljković and Stoja Milovanović

16.15 – 16.30 Supercritical solvent impregnation of PLA with thymol

Robert Kuska,[1] Stoja Milovanović,[2] Marija Lučić Škorić,[2] Melina Kalagasidis Krušić,[2] Sulamith Frerich,[1] Irena Žižović,[2] Jasna Ivanović[2]

[1]Institute of Thermo and Fluid Dynamics, Ruhr-University Bochum, Universitaetsstrasse 150, 44801 Bochum, Germany, [2]Department of Organic Chemical Technology, Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4, 11000 Belgrade, Serbia

16.30 – 16.45 Incorporation of thyme and hop extracts into polymer carriers using integrated supercritical extraction and impregnation process

Stoja Milovanović,[1] Jasna Ivanović,[1] Darka Marković,[1] Maja Radetić,[1] Vanja Tadić,[2] Irena Žižović[1]

[1]University of Belgrade, Faculty of Technology and Metallurgy, Karnegijeva 4, 11000 Belgrade, Serbia, [2]Institute for Medicinal Plant Research "Dr Josif Pančić", Tadeuša Košćuška 1, 11000 Belgrade, Serbia

16.45 – 17.00 Thermal aging and stability of polymer blends based on EVA/PMMA as adhesive coatings for optical fibers

Nataša Z. Tomić,[1] Đorđe Veljović,[2] Kata Trifković,[2] Bojan Međo,[2] Marko Rakin,[2] Dušica B. Stojanović,[2] Vesna Radojević,[2] Radmila Jančić-Heinemann[2]

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17.00 – 17.15 The influence of chain extender substitution on the thermal properties of polyurethane nanostructured materials

Teodora Dramićanin Janić,[1] Ivan Ristić,[1] Branka Pilić,[1] Suzana Cakić,[2] Tanja Radusin,[3] Nevena Vukić,[1] Jaroslava Budinski-Simendić[1]

[1]Faculty of Technology, University of Novi Sad, [2]Faculty of Technology, University of Niš, [3]Institute of Food Technology, University of Novi Sad, Serbia

17.15 – 17.30 The influence of the solvent polarity to the structure of butadiene block in SBM triblock-co-polymer in anionic polymerization

Dragutin Nedeljković, Aleksandar Stajčić, Aleksandar Grujić, Mirko Stijepović, Jasna Stajić-Trošić

University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Njegoseva 12, 11000 Belgrade, Serbia

Thursday, December 10, 2015

09.30 – 10.30 Master Class Prof. Dr. Velimir Radmilović: How Low Can We Go?

Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4, Belgrade, Serbia, and Serbian Academy of Sciences and Arts, Knez Mihailova 35, Belgrade, Serbia

10.30 – 12.00 5th Session – Nanostructured Materials

Chairpersons: Dr. Dragana Jugović and Vuk Radmilović

10.30 – 10.45 Hybrid material based on polyoxometalate deposited on electrochemically exfoliated graphene

Bojan Vidoeski,[1] Svetlana Jovanović,[2] Danica Bajuk-Bogdanović,[1] Milica Vujković,[1] Vladimir Pavlović,[3] Biljana Todorović-Marković,[2] Ivanka Holclajtner-Antunović[1]

[1]Faculty of Physical Chemistry, University of Belgrade, Studentski trg 12–16, 11000 Belgrade, Serbia, [2]Vinča Institute of Nuclear Sciences, University of Belgrade, P.O. Box 522, 11000 Belgrade, Serbia, [3]Joint Laboratory for Advanced Materials, Serbian Academy of Sciences and Arts, 11000 Belgrade, Serbia

10.45 – 11.00 Tailoring self-ordering TiO_2 nanotube arrays by oxidative anodization

Jelena Vujančević,[1] Veljko Djokić,[2] Andjelika Bjelajac,[2] Jovana Ćirković,[3] Vera P. Pavlović,[4] Miodrag Mitrić,[5] Djordje Janaćković,[6] Vladimir B. Pavlović[1]

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11.00 – 11.15 Silver nanowires as electrodes in solar cells

Vuk Radmilović

Innovation Center, Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4, 11000 Belgrade

11.15 – 11.30 Hydro/solvo-thermal synthesis of surface modified $NaYF_4$ co-doped Yb^{3+}/Er^{3+} up-conversion nanoparticles

Ivana Z. Dinić,[1] Lidija Mančić,[1] Maria Eugenia Rabanal,[2] Olivera B. Milošević[1]

[1]Institute of Technical Sciences of SASA, 11000 Belgrade, Serbia, [2]Materials Science and Engineering Department and IAAB, Universidad Carlos III de Madrid, 28911 Leganes, Spain

11.30 – 11.45 Pseudobrookite $TiFe_2O_5$ nanostructured thick films

Zorka Z. Vasiljević,[1] Obrad S. Aleksić,[2] Miloljub D. Luković,[2] Maria V. Nikolić,[2] Nikola B. Tasić[2]

[1]Institute of Technical Sciences of SASA, Knez Mihailova 35, Belgrade, Serbia, [2]Institute for Multidisciplinary Research, University of Belgrade, Kneza Viseslava 1, 11000 Belgrade, Serbia

11.45 – 12.00 Quantum dots and their interaction with biomolecules

Maja Stanisavljević,[1] Markéta Vaculovičová,[1,2] Vojtěch Adam[1,2]

[1]Department of Chemistry and Biochemistry, Faculty of Agronomy, Mendel University in Brno, Zemedelska 1, CZ-613 00 Brno, European Union-Czech Republic, [2]Central European Institute of Technology, Brno University of Technology, Technicka 3058/10. CZ-61600 Brno, European Union-Czech Republic

12.00 – 12.15 Break

12.15 – 13.30 6th Session – New Synthesis and Processing Methods

Chairpersons: Dr. Miodrag Lukić and Dr. Zoran Jovanović

12.15 – 12.30 Solid state synthesis and luminescence of $SrSi_2O_2N_2:Eu^{2+}$

Barbara J. Adamczyk,[1] T. Jüstel,[2] J. Plewa[2] and M. Sopicka-Lizer[3]

[1]Silesian University of Technology, Faculty of Materials Engineering and Metallurgy, Katowice, Poland, [2]Münster University of Applied Sciences, Department of Chemical Engineering, 48565 Steinfurt, Germany, [3]Silesian University of Technology, Faculty of Materials Engineering and Metallurgy, Katowice, Poland

12.30 – 12.45 The deoxidation of silicon surface using strontium oxide deposited with the PLD technique

Zoran Jovanović,[1,2] Matjaž Spreitzer,[2] Danilo Suvorov[2]

[1]Laboratory of Physics, Vinča Institute of Nuclear Sciences, University of Belgrade, P.O. Box 522, 11000 Belgrade, Serbia, [2]Advanced Materials Department, Jožef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia

12.45 – 13.00 Reliable low-cost experimental setup for material synthesis modification by applying alternating electric fields

Željko Janićijević,[1] Miodrag Lukić[2]
[1]*University of Belgrade - School of Electrical Engineering,* [2]*Institute of Technical Sciences of SASA, Belgrade, Serbia*

13.00 – 13.15 Neolithic ceramics artefact surface cleaning by pulsed lasers

Bojana Radojković,[1] Slavica Ristić,[1] Suzana Polić,[2] Radmila Jančić-Hainneman[3]
[1]*Institute Gosa, Milana Rakića 35, 11000 Belgrade, Serbia,* [2]*Central Institute for Conservation in Belgrade, Terazije 26, 11000 Belgrade, Serbia,* [3]*Faculty of Technology and Metallurgy, University of Belgrade, Serbia*

13.15 – 13.30 Supercritical extraction from Helichrysum italicum and impregnation of cotton gauze and polypropylene with the extract

Svetolik Maksimović,[1] Jasna Ivanović,[1] Vanja Tadić,[2] Irena Žižović[1]
[1]*University of Belgrade, Faculty of Technology and Metalurgy, Karnegijeva 4, 11000 Belgrade, Serbia,* [2]*Institute for Medical Plant Research "Dr Josif Pančić", Tadeuša Košćuška 1, 11000 Belgrade, Serbia*

13.30 – 15.00 Lunch break

15.00 – 16.30 7th Session – Theoretical modeling of Materials I

Chairpersons: Prof. Dr. Boban Stojanović and Dr. Marko Lubarda

15.00 – 15.15 Intrinsic quality factor of helically coiled carbon nanotube mechanical resonators

Zoran P. Popović, Milan Damnjanović and Ivanka Milošević
NanoLab, Center for Quantum Theoretical Physics, Faculty of Physics, University of Belgrade, Studentski trg 12, 11158 Belgrade, Serbia

15.15 – 15.30 Graphene functionalization for Na-ion storage applications - Theoretical insights

Ana S. Dobrota, Igor A. Pašti
University of Belgrade, Faculty of Physical Chemistry, Studentski trg 12-16, 11158 Belgrade, Serbia

15.30 – 15.45 Analysis of the low-frequency noise spectrum in graphene-based biochemical sensors and its application in analyte recognition and quantification

Adriana Peleš[1], Zoran Djurić[1,2] and Ivana Jokić[3]
[1]Institute of Technical Sciences of SASA, Belgrade, Serbia, [2]Serbian Academy of Sciences and Arts, Belgrade, Serbia, [3]ICTM-MTM, University of Belgrade, Belgrade, Serbia

15.45 – 16.00 Investigation of exotic magnetization configurations in magnetic nanostructures using advanced techniques in large-scale computational micromagnetics

Marko V. Lubarda,[1,2] Jimmy Kan,[2] Ruinan Chang,[2] Shaojing Li,[2] Keith T. Chan,[2] Vojtech Uhlir,[2] Sidi Fu,[2] Majd Kuteifan,[2] Marco A. Escobar,[2] Eric E. Fullerton,[2] Vitaliy Lomakin[2]
[1]Faculty of Polytechnics, University of Donja Gorica, 81000 Podgorica, Montenegro, [2]Center for Magnetic Recording Research, University of San Diego, California, USA

16.00 – 16.15 Hyperfine interactions in superconducting KFe_2Se_2

Ivan Madjarević,[1] Vasil Koteski,[1] Valentin Ivanovski,[1] Čedomir Petrović[2]
[1]Laboratory of Nuclear and Plasma Physics, University of Belgrade, Vinča Institute of Nuclear Sciences, 11001 Belgrade, Serbia, [2]Condensed Matter Physics and Materials Science Department, Brookhaven National Laboratory, Upton, New York 11973, USA

16.15 – 16.30 Modelling of nonparabolic effects and influence of external magnetic field through 2nd order perturbation theory in quantum cascade lasers

Aleksandar Demić, Jelena Radovanović, Vitomir Milanović
School of Electrical Engineering, University of Belgrade, Serbia

16.30 – 16.45 Break

16.45 – 18.00 8th Session – Theoretical modelling of Materials II

Chairpersons: Dr. Željka Nikitović and Dr. Stevan Armaković

16.45 – 17.00 Theoretical investigation of 1-butyl-3-methylimidazolium salicylate ionic liquid

Stevan Armaković,[1] Sanja J. Armaković,[2] Milan Vraneš,[2] Aleksandar Tot,[2] Slobodan Gadžurić[2]

[1]University of Novi Sad, Faculty of Sciences, Department of Physics, [2]University of Novi Sad, Faculty of Sciences, Department of Chemistry, Biochemistry and Environmental Protection, Serbia

17.00 – 17.15 Theoretical study on structure and stability of α, β, and γ- alane as promising material for hydrogen storage

Milijana Savić, Jana Radaković and Katarina Batalović

Laboratory for nuclear and plasma physics, Vinca Institute of Nuclear Sciences, P.O. Box 522, 11001 Belgrade, Serbia

17.15 – 17.30 Thin film Pt and Pt alloys on WC (0001) surface – The role of strain in the determination of a catalyst's properties

Igor Pašti, Fako Edvin

University of Belgrade, Faculty of Physical Chemistry, Studentski trg 12-16, 11158 Belgrade, Serbia

17.30 – 17.45 Electronic structure and magnetic properties of doped MgO nanotubes

Aleksandar Jovanović

University of Belgrade, Faculty of Physical Chemistry, Studentski trg 12-16, 11158 Belgrade, Serbia

17.45 – 18.00 Suppression of vacancy ordering and phonon energy renormalization in co-doped $K_xFe_{\{2-y\}}Se_2$ single crystals

Marko Opačić,[1] Nenad Lazarević,[1] Maja Šćepanović,[1] Hyejin Ryu,[2,3] Hechang Lei,[2,*] Čedomir Petrović,[2,3] and Zoran V. Popović[1]

*[1]Center for Solid State Physics and New Materials, Institute of Physics Belgrade, University of Belgrade, Pregrevica 118, 11080 Belgrade, Serbia, [2]Condensed Matter Physics and Materials Science Department, Brookhaven National Laboratory, Upton, New York 11973-5000, USA, [3]Department of Physics and Astronomy, Stony Brook University, Stony Brook, New York 11794-3800, USA, * Present address: Department of Physics, Renmin University of China, Beijing 100872, China*

Friday, December 11, 2015

09.30 – 10.30 Master Class Dr. Zoran Šaponjić: Titania nanocrystals of different shape - synthesis and processing

Vinča Institute of Nuclear Sciences, The Laboratory for Radiation Chemistry and Physics "GAMMA", Belgrade, Serbia

10.30 – 11.45 9th Session – Materials for high technology applications I
Chairpersons: Dr. Rastko Vasilić and Dr. Ivana Jevremović

10.30 – 10.45 Deposition of piezoelectric zinc oxide nanorods on conductive textiles

Olga Rac
Faculty of Microsystem Electronics and Photonics, Wroclaw University of Technology, Poland

10.45 – 11.00 Synthesis and characterization of composite $Na_{1.2}V_3O_8$ /C

Lazar Radisavljević,[1] Milica Vujković,[1] Ivana Stojković Simatović,[1] Slavko Mentus[1,2]
[1]University of Belgrade, Faculty of Physical Chemistry, P.O. Box 137, Studentski trg 12-16, 11158 Belgrade, Serbia, [2]The Serbian Academy of Sciences and Arts, Knez Mihajlova 35, 11158 Belgrade, Serbia

11.00 – 11.15 Corrosion protective properties of graphene coatings on copper and aluminum in a chloride solution

Ivana Jevremović,[1] Inhwa Jung,[2] Kyong Yop Rhee,[2] Vesna Mišković-Stanković[1]
[1]Faculty of Technology and Metallurgy, University of Belgrade, Belgrade, Serbia, [2]Department of Mechanical Engineering, College of Engineering, Kyung Hee University, 446-701 Yongin, Republic of Korea

11.15 – 11.30 Ballistic application of perforated plates made of austempered ductile iron

Petar Janjatović,[1] Sebastian Baloš,[1] Dragan Rajnović,[1] Igor Radisavljević,[2] Danka Labus,[1] Miroslav Dramićanin,[1] Olivera Erić-Cekić,[3] Leposava Šidjanin[1]
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11.30 – 11.45 Abrasive wear performance of ductile iron with different microstructures

Miroslav Dramićanin,[1] Sebastian Baloš,[1] Dragan Rajnović,[1] Danka Labus,[1] Petar Janjatović,[1] Olivera Erić-Cekić,[2] Leposava Šidjanin[1]

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11.45 – 12.00 Polypropylene-based composites containing sorbitol-based nucleating agents and siloxane-silsesquioxane resin

Monika Dobrzyńska-Mizera,[1] Michał Dutkiewicz,[2] Tomasz Sterzyński,[1] Maria Laura Di Lorenzo[3]

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12.00 – 12.15 Break

12.15 – 13.15 10th Session – Materials for high technology applications II

Chairpersons: Dr. Rastko Vasilić and Dr. Ivana Jevremović

12.15 – 12.30 Embrittlement behaviour of two different grades of ADI material in various environments

Danka Labus,[1] Dragan Rajnović,[1] Miroslav Dramićanin,[1] Petar Janjatović,[1] Sebastian Baloš,[1] Olivera Erić-Cekić,[2] Leposava Šidjanin[1]

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12.30 – 12.45 Porous silicon for advanced RF substrates

Nevena Damnjanović

Jean-Pierre Raskin, Universite catholique de Louvain, Belgium

12.45 – 13.00 Fabrication of gold-polymer nanocomposites

Ana Vlašić

School of Electrical Engineering, University of Belgrade, Belgrade, Serbia, Institute of Physics, University of Belgrade, Belgrade, Serbia

13.00 – 13.15 The crystal structure, microstructure, and dielectric properties of $BaTi_{1-x}Sn_xO_3$ (x = 0, 0.05 and 0.1) ceramics sintered in different atmospheres (air and Ar)

Andrej Garaj,[1] Nikola Cvjetićanin,[1] Smilja Marković[2]
[1]*Faculty of Physical Chemistry, University of Belgrade, Belgrade, Serbia*
[2]*Institute of Technical Sciences of SASA, Belgrade, Serbia*

13.15 – 14.45 Lunch break

14.45 – 16.00 11th Session – Catalysis and Environmental Science I

Chairpersons: Dr. Jasmina Dostanić and Dr. Sonja Jovanović

14.45 – 15.00 Correlation of phiysical-chemical charcteristics of CaO catalyst on activity in reaction of transesterification of sunflower oil

Radomir B. Ljupković, Marjan S. Ranđelović, Nikola I. Stojković, Miloš M. Marinković, Aleksandra R. Zarubica
Department of Chemistry, Faculty of Science and Mathematics, University of Niš, Serbia

15.00 – 15.15 Preparation of calcium containing mixed oxides as solid base catalysts for the application in biodiesel synthesis

Željka Kesić,[1] Ivana Lukić,[1] Miodrag Zdujić,[2] Ljiljana Mojović,[1] Dejan Skala[1]
[1]*University of Belgrade, Faculty of Technology and Metallurgy,* [2]*Institute of Technical Sciences of SASA, Belgrade, Serbia*

15.15 – 15.30 Photocatalytic degradation of selected pollutants using pure and Fe-doped titania nanoparticles

Milica Carević, Nadica D. Abazović, Tatjana Savić, Mirjana I. Čomor
Laboratory for Radiation Chemistry and Physics "GAMMA", Vinča Institute of Nuclear Sciences, P.O. box 522, 11001 Belgrade, Serbia

15.30 – 15.45 Influence of PEO molecular weight on properties of ZnO/PEO composites

Vladimir Rajić, Smilja Marković
Institute of Technical Sciences of SASA, Knez Mihailova 35/IV, 11000 Belgrade, Serbia

15.45 – 16.00 Safe trapping of Cs radionuclides in sintered matrix of zeolites

Mia Omeragević,[1] Miodrag Lukić,[2] Zvezdana Baščarević,[3] Jovana Orlić,[4] Miljana Mirković,[1] Marjetka Savić-Biserčić,[5] Ljiljana Matović[1]

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16.00 – 16.15 Break

16.15 – 17.15 12th Session – Environmental Science II

Chairpersons: Dr. Jasmina Dostanić and Dr. Sonja Jovanović

16.15 – 16.30 Cobalt ferrite nanospheres as a potential magnetic adsorbent of heavy metal ions

Sonja Jovanović,[1,2] Mario Kurtjak,[2] Ksenija Kumrić,[1] Matjaž Spreitzer,[2] Tatjana Trtić-Petrović,[1] Danilo Suvorov[2]

[1]Laboratory of Physics, Vinča Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia, [2]Advanced Materials Department, Jožef Stefan Institute, Ljubljana, Slovenia

16.30 – 16.45 Corn silk (Zea mays L.) as novel biosorbent for heavy metals removal

Marija Petrović, Tatjana Šoštarić, Mirjana Stojanović, Jelena Petrović, Marija Koprivica, Jelena Milojković, Zorica Lopičić

Institute for Technology of Nuclear and Other Mineral Raw Materials, Belgrade, Serbia

16.45 – 17.00 Preconcentration of selected pesticides using multiwalled carbon nanotubes as adsorbent in solid phase extraction

Nikola N. Zdolšek, Ksenija R. Kumrić, Tatjana M. Trtić-Petrović

Laboratory of Physics, Vinča Institute of Nuclear Sciences, University of Belgrade, P.O. Box 522, 11001 Belgrade, Serbia

17.00 – 17.15 Possibilities for remediation of the mining dump lakes by extraction the metal ions for nanotechnologies

Dragana Stević,[1] Milica Tomić,[1] Bojana Bjeljac,[2] Slađana Gligorić[1] and Suzana Gotovac Atlagić[1,2]

[1]University of Banja Luka, [2]Public Health Institute, Banja Luka, B&H

17.15 Closing Ceremony

Master Class

Tissue Engineering Applications and Functional Characterization of Biomaterials

Bojana Obradović
Faculty of Technology and Metallurgy, University of Belgrade, Belgrade, Serbia

Tissue engineering is an attractive strategy to repair and/or replace damaged tissues and organs by *in vitro* cultivated biological substitutes. The basic principle relies on the integrated use of, preferably, autologous cells, biomaterial scaffolds and bioreactor systems providing all necessary biochemical and physical signals for the functional tissue regeneration. In this approach, the cell is a real "architect" of the tissue while the biomaterial provides the adequate niche to induce and support cell differentiation and metabolic activity. In specific, the biomaterial is aimed to provide at least some of the following:

- adequate 3D structure for cell attachment and uniform distribution,
- assistance in guided regeneration of the extracellular matrix,
- controlled and localized delivery of active substances to the cells and/or tissues,
- immediate biomechanical properties upon implantation,
- integration with the surrounding tissue upon implantation,
- additional functions such as antimicrobial activity.

Rapid development of wide variety of biomaterials with controllable properties at different scales enhanced research in tissue engineering of almost all tissues in the body. However, in order to apply a biomaterial in biomedicine, it is necessary to conduct comprehensive evaluation regarding different aspects of the biomaterial functionality including degradation products and kinetics, biomechanical properties, cytotoxicity etc. Especially, potential uses of nanomaterials are burdened with concerns about the impact of nanoparticles on the human body, living organisms and the environment. Thus, detailed toxicology studies have to be performed, usually starting with 2D *in vitro* studies in monolayer cell cultures followed by *in vivo* studies in animals. However, extrapolation of the obtained 2D results to the *in vivo* outcome is challenging and often conflicting with the results of animal studies yielding the *in vitro-in vivo* gap. Thus, more physiologically relevant 3D *in vitro* systems are needed that would also potentially decrease the extent of necessary *in vivo* investigations. Tissue engineering can offer the solution with biomimetic systems mimicking conditions found *in vivo* and potentially providing a relevant basis for predictions of biomaterial behaviour upon application/implantation.

In this paper, we review applications of different classes of biomaterials in tissue engineering and present systems and case studies of comprehensive *in vitro* characterization of nanocomposite biomaterials.

1-1

Effect of graphene on mechanical strength and corrosion stability of composite coatings electrophoretically obtained on titanium substrate

Sanja Eraković,[1] Ana Janković,[1] Miodrag Mitrić,[2] Ivana Z. Matić,[3] Zorica D. Juranić,[3] Gary C.P. Tsui,[4] Chak-yin Tang,[4] Maja Vukašinović-Sekulić,[1] Kyong Yop Rhee,[5] Soo Jin Park,[6] Vesna Mišković-Stanković[1]

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Graphene (Gr) remarkably improved properties of the host materials. The latest researches are focused on using it as reinforcement material in hydroxyapatite (HAP) composites. Its incorporation as nanofiller reduces the brittleness of HAP and gain an improved composite. The novel hydroxyapatite/graphene (HAP/Gr) was fabricated by electrophoretic deposition to obtain uniform bioactive coatings with improved mechanical strength and favorable corrosion stability in simulated body fluid (SBF). Biomimetic mineralization was assessed by immersion in SBF. Biotests showed that HAP/Gr coatings can be classified as non-cytotoxic against peripheral blood mononuclear cells (PBMC), and exhibited no antibacterial effect against S. aureus and E. coli.

1-2

Coated calcium phosphate scaffolds for bone tissue engineering produced by foam replica method

Nenad Filipović,[1] Miodrag Lukić,[1] Abirami Sengottuvelan,[2] Sonja Kaišarević,[3] Nebojša Andrić,[3] Aldo R. Boccaccini,[2] Magdalena Stevanović[1]
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Tissue engineering (TE) is a growing field which provides helpful alternative strategies for conventional treatments in medicine. TE involves the smart combination of cells, biomolecules and engineered porous biomaterials in the form of 3D scaffolds. When it comes to bone regeneration the use of 3D scaffolds made of calcium phosphate is a well-known concept with a great potential. Here we present the foam replica method as a procedure suitable for producing highly porous scaffolds with the pore size in the range of 100-500 μm and the mean porosity of >90%. The obtained scaffolds were further coated with selenium nanoparticles (SeNp) and SeNp immobilized within poly(epsilon caprolactone) microspheres (PCL/Se). The purpose of such coating is based on the potential anticancer activity of SeNp as well as on their prolonged release from a biodegradable polymeric carrier. Scaffolds were characterized by X-ray diffraction, scanning electron microscopy, optical microscopy, thermogravimetric/differential thermal analysis (TGA-DTA) as well as Fourier transform infrared spectroscopy (FTIR). The cytotoxicity was determined employing 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay and all the samples have shown good biocompatibility. Based on these preliminary results the obtained system can be considered as a candidate for the repair of bone lesions and damages.

1-3

Multifunctional opto-magnetic up-converting $NaYF_4$&Fe_3O_4/SiO_2 nanoparticles – synthesis, characterization and biological applications

Przemysław Kowalik,[1] B. Sikora,[1] J. Mikulski,[1] K. Fronc,[1] I. Kamińska,[1] M. Szewczyk,[2,3] G. Gruzeł,[4] K. Zajdel,[5] M. Naurecka,[6] R. Minikayev,[1] T. Wojciechowski,[1] M. Parlińska-Wojtan,[4] A. Sienkiewicz,[7,8] M. Łapiński,[6] M. Kwaśny,[6] A. Gardias,[9] J. Rybusinski,[9] J. Szczytko,[9] A. Twardowski,[9] M. Frontczak-Baniewicz,[5] P. Stępień,[2,3,10] W. Paszkowicz,[1] D. Elbaum[1]

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The synthesis and characterization of optical and magnetic multifunctional $NaYF_4$&Fe_3O_4/SiO_2 nanoconstructs, for biological and medical applications, were the main aims of our research.
We obtained approximately 20 nm (diameter) β-$NaYF_4$ nanoparticles, doped with lanthanide in the system: 20%Yb/2%Er, 20%Yb/2%Tm, 20%Yb/1%Tm, 20%Yb/2%Ho, with near-infrared to visible light up-converting properties. These nanoparticles, exposed to 980nm laser light excitation, exhibited relatively high quantum efficiency luminescence. The spectrum of the emission depends on the type of the rare ions presence in the nanocrystal structure. The nanparticles properties enable to apply them for biological imaging and anticancer photodynamic therapy.
In addition, we synthesized superparamagnetic Fe_3O_4 nanoparticles. They can be applied as contrast agents for magnetic resonance imaging and hyperthermia therapy. Finally, we encapsulated the up-converting and magnetic nanoparticles in SiO_2 to create a multifunctional opto-magnetic nanconstructs.
These materials were tested on living cells cultures by commercial viability assays (MTT and Presto Blue Assay). Our research demonstrated that the opto-magnetic nanoparticles have very low toxicity level in the selected cells cultures (HeLa and HEK) up to 50 mg/ml concentrations.
Acknowledgements: The research was partially supported by the EU within European Regional Development Fund, through the grant Innovative Economy (POIG.01.01.02-00-008/08), the project „Development of the cluster center of biomedical engineering" implemented under Economy Operational Program (project no. UDA-POIG.05.01.00-00), the grants of PNSC 2013/11/B/NZ1/00089, NN UMO-2013/08/A/ST3/00297, DEC-2012/07/B/ST5/02080 and DEC-2014/15/D/ST5/02604. This work has been done in the NanoFun laboratories co-financed by the European Regional Development Fund within the Innovation Economy Operational Program, the Project No. POIG.02.02.00-00-025/09/. This research was also co-financed by the Swiss National Science Foundation through the Nano-Tera.ch Focused Project (NTF), 'NanoUp'.

1-4

Multifunctional opto-magnetic nanoparticles for theranostic applications

Bożena Sikora,[1] P. Kowalik,[1] J. Mikulski,[1] K. Fronc,[1] . Kamińska,[1] M. Szewczyk,[2,3] G. Gruzeł,[4] A. Konopka,[5] K. Zajdel,[6] M. Naurecka,[7] R. Minikayev,[1] T. Wojciechowski,[1] M. Parlińska-Wojtan,[4] A. Sienkiewicz,[8,9] M. Łapiński,[7] M. Kwaśny,[7] A. Gardias,[10] J. Rybusinski,[10] J. Szczytko,[10] A. Twardowski,[10] M. Frontczak-Baniewicz,[6] P. Stępień,[2,3,11] G. Wilczyński,[5] W. Paszkowicz,[1] and D. Elbaum[1]

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Multifunctional nanoconstructs based on β-$NaYF_4$ up-conversion nanoparticles doped with rare earth ions (UCNPs) and superparamagnetic Fe_3O_4 nanoparticles (SPIONs) co-encapsulated in SiO_2 were synthesized and characterized. These nanoconstructs (UCNPs&SPIONs@SiO_2) combine the capability of up-conversion of near-infrared into visible light with superparamagnetic properties.

The capability of up-conversion has a potential for clinical imaging applications of pathological tissues and for in situ generation of reactive oxygen species (ROS). The latter process occurs via energy transfer from VIS-light emitting NaYF4 nanoparticles to photosensitizer molecules, which are attached to their surface. As such, the functionalized up-converting β-$NaYF_4$ nanoparticles can be used for both photodynamic diagnosis (PDD) and therapy (PDT). Additionally, paramagnetic and superparamagnetic properties of the nanoconstructs offer numerous advantageous functionalities, including: nanoparticles tracking with the external magnetic field, enhanced contrast in magnetic resonance imaging (MRI), as well as pathological tissue eradication via local heating with alternating magnetic field (hyperthermia).

Prior to obtaining UCNPs&SPIONs@SiO_2 (by co-encapsulation), UCNPs with sizes < 20 nm and high efficiency of up-conversion luminescence (UCL), were synthesized by co-precipitation. The whole palette of UCL emission bands, resulting from the presence of various rare earth ions, was obtained. Moreover, under NIR light stimulation, the UCL of thus obtained UCNPs could excite molecules of a well-established photosensitizer, Rose Bengal, towards an efficient ROS generation.

Toxicity remains one of the fundamental issues concerning biological and medical application of advanced materials. Therefore, we tested our materials in living HeLa, HEK293 and astrocytes cells using commercial viability tests, i.e. MTT and Presto Blue assays. We demonstrated that the opto-magnetic nanoconstructs are relatively non-toxic thus they are potentially useful for the selected medical application.

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1-5

Probing mesenchymal stem cells differentiation status by micro Raman spectroscopy

Jasmina J. Lazarević,[1] Tamara Kukolj,[2] Diana Bugarski,[2] Nenad Lazarević,[3] Zoran V. Popović,[3] and Branko Bugarski[4]

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The main goal of tissue engineering, a rapidly growing field in regenerative medicine, is to cultivate tissues and organs in vitro that can be used as transplantation grafts. The leading role in this area belongs to stem cells due to their unique potential to differentiate into various cell types. However, suitable analytical tools for stem cell differentiation capacity and homogeneity investigation are still to be defined (and improved). Micro Raman spectroscopy is non-destructive and non–invasive optical technique, which requires neither sample preparation nor exogenous labels that can affect chemistry of the sample. Owing to this features, it might be a potential method of choice for biological samples. The focus of this research was on multilineage differentiation potential of human mesenchymal stem cells isolated from periodontal ligament. These cells were stimulated to osteogenic, adipogenic, and chondrogenic differentiation. We used micro Raman spectroscopy as a tool for probing inner cell structure and assessing the differentiation status. The difference between spectra obtained from undifferentiated and differentiated cells has been observed. Moreover, a comprehensive statistical analysis has been performed.

2-1

Electrochemical synthesis of silver/polyvinyl alcohol hydrogel nanocomposites

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Nanocomposite materials based on polymeric hydrogels with incorporated silver nanoparticles (AgNPs) have potential for use in biomedical purposes, due to good antimicrobial properties of silver. In this paper, silver/polyvinyl alcohol (Ag/PVA) and Ag/PVA with graphene (Ag/PVA/Gr) nanocomposites were obtained by in situ electrochemical reduction of silver in the hydrogel matrices, cross-linked by the freezing-thawing method. Samples were characterized using cyclic voltammetry (CV), atomic absorption spectroscopy (AAS) and cytotoxicity tests (CT). Cyclic voltammograms of 0.25 mM and 1.0 mM Ag/PVA and Ag/PVA/Gr have proved the existence of AgNPs in the polymer matrix. Silver release profiles, measured using AAS, point to retention of 35 % Ag in Ag/PVA, i.e. 20 % Ag in Ag/PVA/Gr nanocomposites at the end of 28-day experiment. Biocompatibility of 0.25 mM Ag/PVA and Ag/PVA/Gr was proved using CT.

2-2

Development and characterization of composite pectin/sodium alginate films crosslinked with zinc ions

Aleksandra Nešić,[1] Sladjana Davidović,[2] Suzana Dimitrijević,[2]
Roberto Russo,[3] Gabriella Santagata,[3] Mario Malinconico[3]
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In this paper, physico-chemical and antimicrobial properties of films based on pectin/sodium alginate blends crosslinked by zinc ions were investigated. The polyglycerol was used as plasticizer. The blending of pectin with alginate improved properties such as tensile strength, elasticity and water vapour barrier properties, when compared to the neat pectin film. The introduction of the cross-linking points caused an appreciable change in the physical properties due to increased free volume during the cross-linking process with zinc ions. In addition, zinc-crosslinked films evidenced antimicrobial activity against pathogens: Staphylococcus aureus, Candida Albicans and Escherichia coli. Overall, the characteristics of the pectin/sodium alginate films crosslinked with zinc showed their potential interest as materials for wound dressing.

2-3

Fulleren C60: application in cosmetics and its toxicity

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The theme of this research is use the fullerene C60 in cosmetics and properties that determine its application. The fullerene C60 is nanomolecule, an alotrope of carbon, and in cosmetics was used in anti-aging treatments to reduce wrinkles. In this paper, there was the word about its toxicity, ie. there was defined the concentration and conditions under which it is used, as well as the physicochemical characteristics of nanoparticles, such as size, shape, surface charge, purity, solubility, surface modifications and aggregation.
Keywords: fullerene C60, cosmetics, toxicity.

2-4

Application of the fullerene C60 derivates in anti-aging treatments and their permeability through the skin

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This paper gives review of the application of different derivates of fullerene C60 in cosmetics. One derivate is fullerene C60 in a solution of squalene (LF-SQ) and the other is fullerene C60 encapsulated in a liposome (Lpsm-Flln). I compared these two derivates of fullerene C60 for treatment of the skin against UV radiation. Also, it was described their permeability through the skin.
Keywords: fullerene C60, squalene, liposome, permeability.

3-1

Influence of low temperature sintering on pure and Sr, Mg and CO_3 substituted hydroxyapatite bioceramics

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Synthesis of hydroxyapatite, major mineral constituent of hard tissues has been studied in great detail due to its biocompatibility and the need for optimization of bone fillers and cements. Low temperature sintering is one of the important methods for obtaining porous materials. Hydroxyapatite as well as Sr, Mg and CO_3 substituted hydroxyapatite materials were synthesized by simple and cost effective precipitation method and sintered at 400°C. We investigated the effect of low temperature sintering and the presence of Sr, Mg and CO_3 dopants on crystal symmetry, microstructure and mechanical properties of these four materials. Sintered as well as untreated samples were analyzed by XRPD, FTIR, SEM and Vickers hardness of the sintered samples was determined.

3-2

Corrosion resistance of monolithic yttria partially stabilized zirconia (Y-TZP) dental ceramic

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The aim of this study was to investigate the chemical stability of monolithic yttria partially stabilized zirconia (Y-TZP) dental ceramics. Chemical stability was monitored by determining the amount of Al^{3+}, Na^{+}, Ca^{2+}, K^{+}, Si^{4+}, Fe^{3+}, Zn^{2+}, Mg^{2+}, Sr^{2+}, Ba^{2+}, Y^{3+} and Zr_{4+} ions released after 16 h immersion of Y-TZP dental ceramics in the 4 wt. % acetic acid solution at 80 °C, according to ISO Standard 6872 method. Mass concentration of eluted ions was determined by means of inductively coupled plasma mass spectrometry (ICP-MS). In the order to determinate corrosion rate, corrosion experiments were extended up to 32 days (768 hours) in following interval 16, 192, 384 and 768 hours. Obtained results indicated that dissolution of Y-TZP dental ceramics is negligible. Experimental results followed parabolic equation with the rate constant of $5.3 \times 10\text{-}5\ mg^2\ cm^{-4h\text{-}1}$.

3-3

The impact of the type of substrate on the morphology and structure of zinc oxide rods

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Textiles materials are manufactured for a long time by people. At the beginning there were used as protection from variable weather conditions. Later it started to be more important not only their functionality, but also their design. Nowadays it is observed a trend for creation of new multifunctional textiles which could for example change their colour or be antibacterial. One of methods which could be used to achieve second of mentioned properties is surface modification of textiles. There are a lot of antibacterial agents which could be deposited on polymer. Actually the most popular are nanomaterials such silver or zinc oxide nanoparticles.

In this research ZnO will be deposited on surface of three types of textiles: polypropylene (PP), polyamine (PA) and polythene terephthalate (PET). As a synthesis method chemical bath deposition was chosen in which mixture of aqua solutions of zinc nitrate and Hexamethylenetetramine was used. The deposition process was carried out in temperature 90 0C during definite time from 1 h to 9 h. The aim of this study was to determine influence of the type of polymer substrate and time of deposition process on the amount, morphology and structure of zinc oxide structures. As tested methods scanning electron microscope (SEM) and X-ray diffraction (XRD) were used. Obtained results clearly showed the time and kind of polymer substrate have great impact on zinc oxide deposition. The longer of the process the more structures were obtained. Furthermore it was observed that zinc oxide is better deposited on polar polymers.

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3-4

Disease biomarkers detection in breath with laser absorption spectroscopy

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Air exhaled from human lungs contains about 2000 various gaseous substances. Biomarkers are the compounds which excessive concentration in breath might indicate a disease state. In many cases the volatile biomarkers appear in breath at initial stage of the disease. Their detection in exhaled air provides opportunity for early disease reveal, which increases the chances of a cure. Moreover such medical examination is painless and non-invasive. Therefore a fast progress of breath analysis techniques is observed recently.

High precision laser absorption techniques such as wavelength modulation with multipass spectroscopy (MUPASS) and cavity ring down spectroscopy (CRDS) are the appropriate methods for sensitive detection of biomarkers in breath. In both approaches one uses laser radiation that is precisely tuned to peaks of absorption lines characteristic for the compounds of interests. One also has to avoid the interferences caused by light absorption by other compounds, which are present in breath at high concentration, especially H2O and CO2 molecules (5%).

In this communication we will present our achievements about optical detection of the following biomarkers in air: CO, CH4, NH3 (MUPASS – 2333, 2254 and 1540 nm respectively) as well as OCS, NO, ethane NO2 and acetone (CRDS – 5257, 5263, 3348, 410 and 266 nm respectively).

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4-1

Supercritical solvent impregnation of PLA with thymol

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The present study was aimed to investigate swelling kinetics of polylactic acid (PLA) and its impregnation with thymol in the supercritical carbon dioxide ($scCO_2$) medium. Thymol was used as an impregnation agent because of its antimicrobial, antioxidant and anti-inflammatory properties. The influences of pressure, temperature, soaking time, thymol to PLA mass ratio and depressurization rate on the swelling kinetics and impregnation yield of PLA disc and film was observed. Swelling experiments were performed in a high pressure view cell at 10 30 MPa and 40 100 °C (ρCO_2 = 119.96 910.61 kg/m³) up to 24 h. High pressure differential scanning calorimetry (HP-DSC) was used to examine thermal behaviour of PLA within the same pressure range. Soaking of PLA in $scCO_2$ at 30 MPa and 100 °C during 24 h followed by fast decompression (1 MPa/s) resulted in the largest swelling extent (23.5%) and creation of porous foam. PLA film obtained by solvent casting method using chloroform as solvent underwent to negligible swelling at 10 MPa and 40 °C (0.12% after 24 h). Supercritical solvent impregnation (SSI) of PLA samples was performed at 10 MPa and 40 °C for 2-24 h. Sufficiently high impregnation yield of thymol was already achieved after 2 h (10.0% for disc and 6.6% for film). A thymol to PLA ratio of 1:1 did not have negative effect on the PLA structure. Non-porous PLA forms impregnated with thymol could be suitable for active food packaging and sterile medical disposables. On the other hand, porous PLA impregnated with antibacterial substances has great potential for tissue engineering applications and will be further investigated.

Keywords: Carbon Dioxide; PLA; Supercritical impregnation; Swelling; Thermal behaviour; Thymol.

4-2

Incorporation of thyme and hop extracts into polymer carriers using integrated supercritical extraction and impregnation process

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Integrated supercritical extraction and impregnation (SCE-SCI) process was proposed for plant material extraction and impregnation of the obtained extract into polymeric carriers in order to fabricate added value solvent-free materials.
Valuable natural bioactive compounds were extracted from Thyme (Thymus vulgaris) and hop (Humulus lupulus) and subsequently impregnated into polymeric carriers (polypropylene, starch gel and polycaprolactone) using supercritical CO_2. Operating pressure and temperature were selected on the basis of previously optimized extraction processes (15 MPa and 35 °C for thyme and 29 MPa and 50 °C for hop) while operating time (5 h) was based on the previous optimization of integrated process. Morphology of polymers was analyzed by SEM method.
Obtained impregnation yields were in the range from 0.65% to 9.04%. The highest impregnation yield was obtained for polycaprolactone (9.04% with thyme extract and 6.04% with hop extract) which can be attributed to its swelling during processing with supercritical CO_2.

4-3

Thermal aging and stability of polymer blends based on EVA/PMMA as adhesive coatings for optical fibers

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Thermal stability of polymer blends based on poly (ethylene-co-vinyl acetate) (EVA) and poly (methyl methacrylate) (PMMA) were studied. Two different kinds of samples were prepared, whereby one kind was a mechanically mixed blend of commercial polymers in a solution of toluene and the other was a grafted EVA-g-PMMA polymer in a toluene solution, produced via in situ free radical polymerization using redox system initiators. Optical fibers were glued together using both of the solutions and subjected to a micro mechanical testing machine. Adhesive properties, after accelerated aging on 60°C and natural aging, were tested. An FTIR spectral analysis presented the changes that were obvious on tensile test. The tensile test showed that the graft copolymer had better mechanical properties as an adhesive than the physical polymer blend. Coupled TG-MS analysis revealed thermal stability of the samples and showed degree on acetalization. These results presented the aim of grafting MMA on EVA where is reduced amount of acetyl groups where the graft polymer had better and thermally stable adhesive properties.

4-4

The influence of chain extender substitution on the thermal properties of polyurethane nanostructured materials

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Thermoplastic polyurethane elastomers are very important class of polymer due to possibility of fine tuning the properties of final materials by varying the structure or the molecular weight of reaction components. The goal of this research was to analyse the influence of substitution of traditional chain extender, butanediol, with isosorbide, as renewable raw material, on the thermal stability of thermoplastic polyurethane elastomers. The series of thermoplastic polyurethane elastomers were synthesized by two-step solution polymerization, using two types of isocyanates, isophorone diisocyanate and hexamethylene diisocyanate, poly(propylene glycol) and two types of chain extender butanediol and isosorbide. In order to improve the properties of the obtained materials, the polyurethane nanocomposite were synthesised by addition of hydrophilic and hydrophobic silicon (IV) oxide nanoparticles. The molecular structures of resulting materials were estimated by FT-IR spectroscopy. The thermal properties of polyurethane hybrid materials were investigated by termogravimetric analyses (TGA) and differential scanning calorimetry (DSC) methods. Thermal analysis confirmed that by replacing butanediol with isosorbide, thermal stability of resulting materials increase, which can be explain with cyclic and rigid structure of isosorbide. Also, thermal stability increased when nanoparticles were added. Further analysis of thermal properties showed that by adding hydrophilic silicon (IV) oxide in polymer matrix glass transition temperature, Tg, of soft segment increase, which can be explained with strong interaction between soft segment and hydrophilic nanoparticles. Addition of hyrophobic nanoparticles had influence on Tg of hard segments, which can be explained with strong interaction between hard segment and hydrophobic nanofilers.

4-5

The influence of the solvent polarity to the structure of butadiene block in SBM triblock-co-polymer in anionic polymerization

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Anionic polymerization technique is the powerful technique for obtaining polymers of determined structure and polydispersity. The mechanisms of polymerization in polar and non-polar solvents are well understood for different types of monomers. Among the monomers, the polymerization of styrene is easily controlled and irrespective of the solvent, while the microstructure of the polybutadiene block can be tailored by using different solvents. The most challenging task appeared to be the controlled polymerization of poly (methyl methacrylate) in non-polar solvents due to the aggregation and network formation of living carbanion chain ends. Those effects can be overcome by using certain additives and catalysts.

Master Class

How Low Can We Go?

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This presentation will focus on the advances in transmission electron microscopy and spectroscopy in an aberration-corrected environment that has become possible in recent years and has allowed us to achieve resolution below 50 picometers. Remarkable instrumentation development for transmission electron microscopes will be demonstrated, such as novel detectors and stages. The new revolutionary stage design dramatically increases stability. The new detector allows for direct detection of electrons, remarkably decreasing radiation damage of samples. In addition to aberration correction, which improves brightness, signal to noise ratio, and chemical sensitivity, these instruments will make it possible to achieve single-atom spectroscopy and atomic resolution tomography. The performance of the new aberration-corrected instruments will be illustrated with examples ranging from monodispersed core/shell nanostructures and graphene monolayers to Pt/Al_2O_3 nanocomposites and functional oxide nanostructures.

5-1

Hybrid material based on polyoxometalate deposited on electrochemically exfoliated graphene

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In this paper we demonstrated successful synthesis of Keggin-type POM (MoPA)/exfoliated graphene (EG) nanocomposite. By different characterization techniques (micro-Raman spectroscopy, Fourier transform infrared spectroscopy, atomic force microscopy, scanning electron microscopy and cyclic voltammetry) we investigated structural and morphological properties of MoPA/exfoliated nanocomposite. Microscopy analysis showed the presence of MoPA clusters on the surface and edges of EG sheets. The strong electrostatic interaction between MoPA and EG sheets was confirmed by Raman, FTIR spectroscopy and cyclic voltammetry. Cyclic voltammetry has shown that capacitive characteristics of the obtained material may be improved by increased quantity of graphene.

5-2

Tailoring self-ordering TiO_2 nanotube arrays by oxidative anodization

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Having in mind that anodic oxidation method can be used for tailoring desired structure and morphology of TiO_2, herein the synthesis of self-ordered TiO_2 nanotubes via electrochemical anodization of high purity Ti foil is reported. The influence of synthesis parameters such as oxidative voltage, different electrolyte, annealing temperature and annealing atmosphere were explored and correlate with obtained TiO_2 nanotube arrays. The results show that applied potential is the main factor that controls the diameter of the nanotubes, while annealing temperature influence on crystal type and morphology is related to different contents of electrolyte. Investigated method gives opportunity to enhanced performance of TiO2 nanotubes, providing many applications in different field.

5-3

Silver nanowires as electrodes in solar cells

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One of the main components of optoelectronic devices, such as solar cells, are usually highly transparent electrodes with low electrical resistivity. In our research we observed the phenomenon of thermally induced welding of silver nanowires (AgNWs). After welding, nanowires were coated with an aluminum doped zinc oxide layer (AZO) formed by atomic layer deposition (ALD), which assures uniform coating of the wires and tightens the junctions for conductivity enhancement. Subsequent to AZO deposition, welded nanowires exhibited local sintering at the junctions as a result of solid state wetting and homoepitaxial growth. High resolution scanning transmission electron microscopy (HRSTEM) revealed the presence of significant strain and stacking faults in the pentagonal twinned Ag NW. The developed nanocomposite AgNW/AZO layers are a technologically relevant cheap alternative as transparent electrodes in energy related applications. This work was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia, under contract No. III45019. Many thanks to collaborators on this project: Manuela Göbelt, Silke Christiansen, Erdmann Spiecker and Velimir Radmilović.

5-4

Hydro/solvo-thermal synthesis of surface modified $NaYF_4$ co-doped Yb^{3+}/Er^{3+} up-conversion nanoparticles

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Surface modified up-conversion rare earth fluorides have attracted attention in recent years. Owing to their unique optical properties they can be used for biomedical application such as bio-detection, fluorescene imaging and in drug delivery systems. Different synthesis methods which generate nano- and micro-crystals with controllable compositions have been reported. For improved control of size, shape and morphology of the particles surfactants or structure directing agents are used. In this work PEG or PVP capped $NaYF_4$ particles were synthesized using hydro/solvo-thermal synthesis at 200 ºC (3h). Their structural, morphological and luminescence characteristics have been studied based on X-ray powder diffractometry (XRPD), Fourier transform infrared spectroscopy (FTIR), energy dispersive spectroscopy (EDS), scanning and transmission electron microscopy (SEM/TEM) and photoluminescence measurements. Both polymers proved to be a good structure directing agents enabling generation of the well crystalline polymer coated upconverting particles with efficient emissions in visible spectrum. It was shown that generation of the hexagonal P63/m β-$NaYF_4$:Yb^{3+}/Er^{3+} phase with the most efficient green emission (CIE 0.31, 0.66) is enhanced when PVP is used during synthesis, while formation of the cubic Fm-3m α-$NaYF_4$:Yb^{3+}/Er^{3+} phase that has a yellowish spectral output (CIE 0.41, 0.56) was observed in the particles produced in the presence of PEG. Increase of the luminescence intensity was achieved with additional particles annealing in argon atmosphere at 400 ºC (5h).

5-5

Pseudobrookite $TiFe_2O_5$ nanostructured thick films

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TiO_2 (anatase) and Fe_2O_3 (hematite) nanopowders were mixed in the weight ratio 1:1.5 and 1:2 and homogenized in a planetary ball mill for an hour. After that pastes were prepared of the two powder mixtures, organic vehicle and glass frit. The pastes were screen printed on FTO coated glass substrates and sintered at 800°C/10 minutes. Formation of monoclinic pseudobrookite was confirmed by XRD analysis of the thick film samples. The thick film crystal structure and optical properties were observed by SEM and UV/Vis spectroscopy. Current-voltage analysis was performed on a sandwich structure formed of thick film and two conductive FTO layers (bottom and top).

5-6

Quantum dots and their interaction with biomolecules

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Quantum dots (QDs) are nanomaterials successfully applied in biosensing, drug delivery, in vitro and in vivo imaging and other fields. They are brought into the spotlight due to their specific optical and electronic properties, relatively simple synthesis and possibility of versatile surface modification.
In this study CdTe QDs were synthesized via microwave irradiation method. Further they have been modified for purposes of their interaction with biomolecules using different conjugation approaches. Applied conjugation chemistries were streptavidin-biotin affinity, non-specific interaction and peptide-mediated interaction. Glutathione modified CdTe QDs of 2 nm size were capable of non-specific interaction with major groove of DNA, while streptavidin modified CdTe QDs served as specific linker for biotinylated oligonucleotides. Further, peptide-mediated interaction was used for high specific bonding to the Fc region of human immunoglobulin G as target biomolecule.

6-1

Solid state synthesis and luminescence of $SrSi_2O_2N_2:Eu^{2+}$

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The present paper concerns the photoluminescence of $SrSi_2O_2N_2:Eu^{2+}$ powders obtained via a solid state reaction method. A set of samples with 3 or 5 wt. % addition of Na_2CO_3 as a flux was prepared from appropriate blends of nitrides and carbonates and subsequent thermal treatment in flowing Nitrogen in a graphite furnace.
A reference material was prepared in the same way without any flux. XRD studies show the positive impact of the flux addition on the formation of single phase samples. Moreover, the addition of the flux yields a narrower particle size distribution too. Analysis of emission and excitation spectra proved the improvement of photoluminescence intensity in comparison to the reference material. Thermal quenching measurements in the temperature between 80 and 500 K were conducted as well.
The obtained results are useful for an initial discussion on the optimization of type and amount of a flux for the synthesis of $SrSi_2O_2N_2:Eu^{2+}$ powders on a lab and technical scale.

6-2

The deoxidation of silicon surface using strontium oxide deposited with the PLD technique

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The epitaxial growth of functional oxides on silicon substrates requires atomically defined surfaces, which are most effectively prepared using Sr-induced deoxidation. Since the manipulation of metallic Sr is very delicate we investigated the applicability of the chemically much more stable SrO in the process of native-oxide removal and silicon-surface stabilization using the pulsed-laser deposition technique (PLD). For that purpose we have examined the effect of PLD conditions, such as deposition atmosphere, number of pulses, temperature, deposition rate, mask size and fluency, on SrO-induced deoxidation of silicon surface. The as-derived surfaces were analyzed in situ using reflection high-energy electron diffraction and ex situ using X-ray photoelectron spectroscopy, X-ray reflectivity and atomic force microscopy. The results are showing that careful control of PLD experimental conditions, especially temperature and the amount of SrO, play the critical role in the optimization of deoxidation process. The results of study reveal an effective pathway for the preparation of smooth, 2×1 Sr-reconstructed silicon surface which can be used for integration of functional oxides on silicon substrate.

6-3

Reliable low-cost experimental setup for material synthesis modification by applying alternating electric fields

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Building of laboratory hardware in-house can reduce overall equipment costs and respond to the specific requirements of the experiment. The aim of this contribution is to present the novel design and implementation of the low-cost module for AC electric excitation of chemical systems, mainly intended for modifying wet chemical synthesis of nanomaterials. Results of preliminary modelling and experimental tests indicate good module reliability and applicability of the modification methodology on various material types (ceramics, metals and proteins). Possible underlying mechanisms correlating the influence of alternating electric fields and material properties, as well as potential improvements in module construction are discussed.

6-4

Neolithic ceramics artefact surface cleaning by pulsed lasers

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In order to determine appropriate laser parameters for efficient and safely laser cleaning of ceramic artefacts, the research was conducted on the samples from two different archaeological sites. The effects of irradiation by pulsed lasers: TEA CO_2 (10.6 μm wavelength) and Nd:YAG (wavelengths 1064 nm and 532 nm) have been studded. Samples were sourcing from archaeological sites Obrenovac, Belgrade, Serbia and from region of Tyre and Sidon, Lebanon. They are dating from Neolithic. Ceramics surface modifications induced by pulsed laser treatment were examined by optical and scanning electron microscope. Some surface modifications induced by pulsed laser treatment below and above damage threshold were analyzed. The composition was determined by energy dispersive X-ray, EDX analysis. Analytical results can be used for obtaining, as much as possible, information about the appropriate choice of materials and techniques for the further conservation and restoration of these items. Chemical analyses results are useful for ceramic classification and analysis of samples provenance, too.

6-5

Supercritical extraction from Helichrysum italicum and impregnation of cotton gauze and polypropylene with the extract

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Helichrysum italicum presents a valuable source of natural bioactive compounds. Supercritical CO2 extraction from H. italicum was performed at 350 bar and 40° C with aim to determine yield and chemical composition of the obtained extract. GC-MS method was applied.
Cotton gauze and polypropylene textile material were selected as solid carriers for active principles isolated from H. italicum. Extraction from H. italicum and cotton gauze/polypropylene impregnation was performed using integrated supercritical extraction-impregnation process at 350 bar and 40° C during the 5h. Extraction and impregnation yields, as well as impregnation efficiency were discussed. Finally, effect of ethanol as co-solvent on extraction yield, chemical profile of H. italicum extract and impregnation process was also discussed.

7-1

Intrinsic quality factor of helically coiled carbon nanotube mechanical resonators

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Nanoscale mechanical resonators can be used as extremely sensitive force, charge or mass detectors or ultrasensitive thermometers. Fundamental sensitivity limit of mechanical oscillators is determined by the intrinsic quality factor, defined as the ratio of the energy stored in the resonator and the energy lost in a single oscillation cycle.
We investigate intrinsic mechanism of oscillation energy loss through the three phonon decay processes in helically coiled carbon nanotubes. Our calculations, based on quantum theory, are performed in approximation that dissipated energy is transferred from the lowest flexural mode to phonon states of higher energy. Strength of phonon-phonon interaction, which dictates the scattering rate intensity, is calculated for all allowed processes using anharmonic part of the interatomic potential and exact phonon polarization. Quality factor dependence on geometrical parameters and temperature of the resonator is examined and compared to the results of the corresponding straight carbon nanotubes which we have obtained using the same method.

7-2

Graphene functionalization for Na-ion storage applications - Theoretical insights

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Graphene is currently in the focus of Materials Science community due to its intriguing properties and a number of possible applications. While pristine graphene interacts weakly with alkali metal atoms, its functionalization brings up new possibilities in employing graphene-based materials in electrochemical capacitors and rechargeable batteries. In the present work we employ DFT calculations to analyze the roles of oxygen functional groups, such as hydroxyl and epoxy groups, as well as the introduction of heteroatom moieties into the graphene basal plane, in the Na-ion storage by functionalized graphene. Fundamental insights in the Na interactions with functionalized graphene will be provided, as well as the general guidelines for enhancing Na storage capabilities of functionalized graphene.

7-3

Analysis of the low-frequency noise spectrum in graphene-based biochemical sensors and its application in analyte recognition and quantification

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In this study, we use the theoretical model of low-frequency noise in an adsorption-based sensor to analyze the possibility for the recognition and quantification of the analyte based on the measured fluctuations spectrum. We have developed an analytical expression for the spectral density of the fluctuations of the number of analyte particles adsorbed onto the sensing surface which takes into account the processes of mass transfer through the sensor reaction chamber, adsorption and desorption, and surface diffusion of adsorbed particles [1,2]. The numerical calculations performed using the derived theory are in agreement with the experimental data from the literature obtained for graphene-based gas sensors [3,4]. While analyzing the dependence of specific features in the fluctuation spectra of various parameters, we investigate which type of information about the analyte and its interaction with the graphene surface can be obtained from the experimentally obtained noise spectrum.

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7-4

Investigation of exotic magnetization configurations in magnetic nanostructures using advanced techniques in large-scale computational micromagnetics

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Static equilibrium configurations generally correspond to metastable or ground-state configurations of a particular system. In magnetic materials, at the nanoscale, the complex interplay between various physical interactions, such as the spin-orbit interactions, the exchange interaction, and the magnetostatic interaction, makes the prediction of the magnetization configuration very difficult. Yet, it is the very knowledge of the magnetization configuration that is particularly important in the engineering of new magnetic nanodevices for memory and processing applications. In this work, recently developed methods in large-scale computational micromagnetics are employed to assess the equilibrium magnetization configurations of a set of magnetic objects of various geometries, sizes and symmetries. Exotic magnetization patterns are revealed in select magnetic thin films and nanowires, the topology of which is analyzed. Preceding experimental observations of periodic stripes in nickel nanowires agree well with micromagnetic simulation results, giving deeper insight into the competition between different governing interactions. Implications to magnetic random access memory and magnetic domain wall nanotechnologies are discussed.

7-5

Hyperfine interactions in superconducting KFe_2Se_2

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The discovery of high-Tc superconductivity in iron-based chalcogenides $AyFe_{1.6+x}Se_2$ (A=K, Rb, Cs and Tl) raised much attention because of its unusual physical properties. The Tc of $KyFe_{2-x}Se_2$ has been reported to be about 31 K, with two coexisting tetragonal space groups: one superconducting (I4/mmm) and the other insulating (I4/m) phase which exhibits antiferromagnetic and Fe-vacancy ordering (Tn ~ 559K). We measured the hyperfine fields at the Fe sites in KFe_2Se_2 using the Mössbauer spectroscopy to compare them with "ab initio" calculations (Wien2k, VASP) of the superconducting and insulating phase. Investigation of this puzzling coexistence of superconductivity and magnetism is considered to be crucial to understand not only this type of superconductors but maybe even cuprates.

7-6

Modelling of nonparabolic effects and influence of external magnetic field through 2nd order perturbation theory in quantum cascade lasers

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Nonparabolicity effects (NPE) in quantum nanostructures are significantly important in determining their electronic structure, especially when energy differences are small. We model NPE in presence of external electric and magnetic field by using second order perturbation theory and apply our model on active region of a quantum cascade laser (QCL). By including first order correction for the wave function, which is usually neglected in literature, we are able to examine behaviour of dipole matrix element and see how NPE and magnetic field affect the gain of QCL structures.

8-1

Theoretical investigation of 1-butyl-3-methylimidazolium salicylate ionic liquid

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In this work we have investigated a representative of the third generation of ionic liquids, 1-butyl-3-methylimidazolium salicylate ([BMIM][Sal]), within the framework of density functional theory (DFT). Beside the M06-2X functional, which is suitable for investigation when non-covalent interactions occur, we also employed the dispersion-corrected variant of the B_3LYP and M06-2X, namely the B_3LYP-D_3 and M06-2X-D_3. Molecular orbital theory and quantum molecular descriptors were used in order to investigate global reactivity properties. Charge distribution and local reactivity properties have been investigated with molecular electrostatic potential (MEP) and average local ionization energy (ALIE) surfaces. Strong electrostatic interaction between ions was confirmed through calculations of ion-pair binding energies, while analysis of non-covalent interactions based on the reduced density gradient (RDG) surface provided further insight into the interactions between ions. We also paid attention to the aromaticity of ions through calculations of nucleus-independent chemical shift (NICS) parameter, which indicated that significant changes in the charge delocalization on each ion occur when the two ions interact.

8-2

Theoretical study on structure and stability of α, β, and γ- alane as promising material for hydrogen storage

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Air pollution due to the use of the fossil fuels in traffic and industry is one of the main problems that modern civilization faces nowadays. To overcome this problem, it is necessary to increase usage of renewable energy sources. Hydrogen is considered to be the fuel of the future. It is readily available as a component of water which covers 70% of our planet, has no harmful emissions, it is efficient, and the most important-renewable. The problem for wide use of hydrogen energy is its storage. Hydrogen is held in the form of compressed fluid, and over time it partly evaporates. Investigations are aimed to find a way to make hydrogen bound to some suitable material – for example by absorbtion in that material. The ideal storage material should be safe, non-toxic, inexpensive, and to contain at least 6.4 wt% of hydrogen. One compound with all these characteristics is aluminum hydride (AlH3) which has at least seven crystalline phases with different physical properties and with large hydrogen content (10.1 wt% (1)). Al is commonly available and can be recycled; also that is why AlH_3 is considered as a promising hydrogen storage material. In our work, quantum mechanical method based on density functional theory (DFT) is used to examine structural, electronic and thermodynamical properties of various AlH_3 phases: α, β, and γ-AlH_3. Calculations are performed in program package Wien2k(2), (using FP LAPW+lo method). The electronic exchange-correlation interactions are treated within approximation of Perdew-Burke-Ernzerhof (PBE). The crystal structures of studied hydrides, electronic structure, as well as charge transfer based on the Bader's theory of hydrides, are discussed. In order to accurately calculate band gap, modified Becke-Johnson (mBJ) exchange potential is used. This allows calculations of band gaps with accuracy similar to GW calculations. In our investigation we have attempt to clarify the structural, electronic and thermodynamics properties of AlH_3 by first principle calculations. These results will enhance future studies in order to determine how AlH3 may be used as a hydrogen storage material.

8-3

Thin film Pt and Pt alloys on WC (0001) surface – The role of strain in the determination of a catalyst's properties

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Transition metal alloys have been proven both by experimental and theoretical examination to have characteristics favourable in many catalytic processes, may it be in the form of thin film, or core-shell catalysts. Studies have shown that it is possible to influence parameters that affect the catalytic activity, such as on the segregation, dissolution energy and the d-band centre, by choosing the right alloy composition, film thickness, and support. In this study the properties of mono-, bi- and trilayer alloys on WC as a support, as well as pure strained alloys were analyzed by DFT calculations, and the results are presented. The chosen alloys had Pt or Pd as a parent metal and were alloyed with ether Cu, Ag or Au, in the ratio 3:1. The pure alloys were submitted to tensile strain by the increase of the elementary cell size, whereas films were strained due to the difference between the lattice constants of the alloy and support. It was found that significant correlation exists between the properties of pure strained alloys and thin films strained on a support versus the amount of strain, starting at a certain film thickness. More specifically, in certain systems the only parameter determining its properties is the difference of the lattice constants of the support and alloy. This correlation can potentially provide guidelines for synthesis of catalysts with predictable and tuneable behaviour.

8-4

Electronic structure and magnetic properties of doped MgO nanotubes

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Oxide materials have a wide range of application in various fields of technology. Oxides exhibit diverse electronic and crystalline structures, so some can behave as insulators, others as semiconductors, while some have the conductive properties similar to those of metals. MgO is on of the oxides whose properties are being intensively studied. Due to its availability, ease of preparation, stability and chemical inertness, it can be used in investigating adsorption, as a catalyst support, or it can be functionalized by introducing defects or impurities into its structure.

Shown in this paper are the results of DFT calculations of the properties of MgO nanotubes of varying size. Properties of the nanotubes were altered by introducing an oxygen vacancy or by replacing the oxygen with a dopant X (X = B, C, or N) at different sites along the nanotube. It is demonstrated that with increasing size, the properties of nanotubes converge to those of bulk MgO. Change of electronic structure and the induction of magnetization at the dopant site points towards the possible use of these systems as adsorbents or catalysts, or as new types of magnetic materials.

8-5

Suppression of vacancy ordering and phonon energy renormalization in co-doped $K_xFe_{\{2-y\}}Se_2$ single crystals

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The iron chalcogenide superconductor $K_xFe_{\{2-y\}}Se_2$ have attracted a lot of attention due to its unique features. Some of them are the nanoscale phase separation between an antiferromagnetic, vacancy-ordered phase and vacancy-free superconducting phase, relatively large superconducting transition temperature T_C and large iron magnetic moments. We present the detailed temperature analysis of Raman spectra of superconducting $K_xFe_{\{2-y\}}Se_2$ and non-superconducting $K_{\{0.8\}}Fe_{\{1.8\}}Co_{\{0.2\}}Se_2$ single crystals, together with the phonon spectra of $K_xFe_{\{2-y\}}Se_2$ doped with various Co-concentrations. Two Raman active modes from the I4/mmm phase and seven from the I4/m phase are observed and assigned in $K_xFe_{\{2-y\}}Se_2$ and $K_{\{0.8\}}Fe_{\{1.8\}}Co_{\{0.2\}}Se_2$ single crystals, revealing the presence of ordered vacancies. Temperature dependence of phonon linewidth is well described by the phonon anharmonicity, whereas change of Raman mode energies is mainly governed by the lattice thermal expansion. Abrupt hardening of the $A_{\{1g\}}$ mode below T_C, observed only in the superconducting sample, is attributed to the superconductivity-induced redistribution of the electronic states. With increasing Co-concentration, Raman modes originating from the I4/m phase disappear and disorder-induced broad asymmetric structure emerges. Only two modes from the I4/mmm phase can be observed in Raman spectra of samples with high Co-concentration. The presence of $A_{\{1g\}}$ mode in all samples confirms the existence of the I4/mmm phase for all doping levels.

Master Class

Titania nanocrystals of different shape - synthesis and processing

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Heterogeneous photochemical oxidation and reduction processes promoted by TiO_2 nanocrystals gained much attention. Due to low toxicity, high photocatalytic activity, chemical stability, availability and low price, TiO_2 became the most studied semiconductor.
The possibility of engineering the multifunctional textile nanocomposite materials by immobilization of colloidal TiO_2 nanoparticles (d~45Å) on polyester (PET), cotton and cotton/(PET) fabrics was investigated in this study. The multifunctionality of such nanocomposite materials was evaluated by analyzing their UV protection efficiency, antibacterial and photocatalytic activities. Textile nanocomposite materials modified by colloidal TiO_2 nanoparticles exhibited outstanding UV protection efficiency (rating 50+) and antibacterial activity against Gram-negative and Gram-positive bacteria. Their excellent photocatalytic activity under UV illumination was proved by self-cleaning of stains and photodegradation of methylene blue in aqueous solution.
The potentiality of *in situ* photoreduction of Ag^+ ions using TiO_2 nanoparticles (45 Å) deposited on cotton and cotton/PET fabrics was also studied. Cotton and cotton/PET fabrics impregnated with TiO_2/Ag nanoparticles provided excellent antibacterial properties without illumination against *Escherichia coli* and *Staphylococcus aureus*. The presence of TiO_2 nanoparticles in this system provided maximum level of UV protection.
In order to impart conductivity to polyester textile material, controlled deposition of conductive polyaniline (PANI) layer in the presence of colloidal TiO_2 nanoparticles was performed. The AC conductivities of PANI/TiO_2 coated PET fabrics increased by two orders of magnitude compared to the AC conductivity of neat PET fabric. Also, significant enhancement of dielectric properties of PANI/TiO_2 coated PET fabrics was observed.
Furthermore, the ultrasonic spray pyrolysis as a "bottom-up" approach for powder processing, was applied for synthesis of submicronic TiO_2 powder particles with preserved optical properties i.e. decrease of band gap energy (1.9 eV) of constituent nanoparticles. As a precursor, aqueous colloidal solutions consisting of surface modified 45 Å TiO_2 nanoparticles with dopamine were exploited. Polycrystalline nature of the synthesized particles, with grain size that corresponds well to the size of precursor TiO_2 nanoparticles observed. Also, aerosol processing proved to be suitable method for generation of non-agglomerated submicronic titania spherical assemblies using colloidal 1D nanotubular titania as a precursor. The advantage of the reported method relies on the fact that the morphology, size and phase composition of hierarchical 3D structures could be controlled simply by varying the processing temperatures.

9-1

Deposition of piezoelectric zinc oxide nanorods on conductive textiles

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Recently, there is high demand for various types of functional textiles with antibacterial or photochromic properties, or likely to charge the small electrical appliances. For this application piezoelectric nanogenerators are designed. Very common material used in these generators is a zinc oxide. ZnO is a piezolelectric material because its molecule is polar, every zinc cation is tetrahedrally surrounded by oxygen anions and its crystallographic cell does not have a centre of symmetry. The polarity of the particles of zinc oxide corresponds to the base plane. It is formed by positively charged cations of zinc with an orientation (0001) and oxygen anions on orientation (0001-). Thanks to use the chemical bad deposition (CBD) and electrophoretic deposition (EPD) obtain of hexagonal rods of ZnO is possible. For this purpose it is necessary to deposited on an electrically conductive substrate. During the presentation the method of zinc oxide deposition on conductive textiles and structural characterization of obtained ZnO crystal will be presented.
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9-2

Synthesis and characterization of composite $Na_{1.2}V_3O_8$ /C

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The $Na_{1.2}V_3O_8$ is a promising anode material for different types of metal-ion batteries with aqueous electrolytes (Li, Na and Mg batteries). The cycling performance and discharge capacity of this material can be improved by the addition of carbon during its synthesis. In this work, $Na_{1.2}V_3O_8$ in the form of $Na_{1.2}V_3O_8$/C composite was synthesized by the sol-gel method and the source of carbon was LTX. The structural and morphological properties of the synthesized powder were characterized by X-ray diffraction and TEM, respectively. The LTX percent in the composite was determined by the TGA analysis. The electrochemical properties of $Na_{1.2}V_3O_8$/C in different aqueous electrolytes solutions (lithium, sodium and magnesium nitrates), were examined using the cyclic voltammetry. The implementation of LTX carbon in $Na_{1.2}V_3O_8$ resulted in the significantly better electrochemical behaviour of composite than that of the pure $Na_{1.2}V_3O_8$ due to greater electron conductivity. A very high initial discharge capacities of obtained composite, amounting to 132.88 mAh $g^{-1,}$ 100.45 mAh g^{-1} and 117.78 $mAhg^{-1}$ in saturated aqueous solutions of $LiNO_3$, $NaNO_3$ and $Mg(NO_3)_2$, respectively, were found. Also, the capacity retention during cycling depended on the type of inserted ions and was shown to be the best in an aqueous electrolyte of $Mg(NO_3)_2$.

9-3

Corrosion protective properties of graphene coatings on copper and aluminum in a chloride solution

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The graphene coatings were deposited on a Cu surface by chemical vapour deposition and then mechanically transferred onto Al surface by a transfer technique. The corrosion stability of graphene coatings was followed by electrochemical impedance spectroscopy while the corrosion rate was measured using potentiodynamic sweep measurements. The structure and composition of the samples were investigated by scanning electron microscopy and energy dispersive spectroscopy. Obtained results indicate that Cu coated with graphene shows corrosion-inhibiting properties in 0.1 M NaCl. On the other hand, a multilayer graphene coating does not give a significant contribution to the corrosion resistance of Al.

9-4

Ballistic application of perforated plates made of austempered ductile iron

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In this paper, austempered ductile iron (ADI) has been used for perforated plates in the ballistic defence of armoured vehicles. Various parameters of heat treatment enabled to obtain two types of austempered ductile iron: one with a higher strength (austempering temperature 275 °C), and the other with a higher ductility (austempering temperature 400 °C). Perforated plates having two thicknesses of 7 and 9 mm with hole diameter of 11 mm and ligament length of 3.5 mm were mounted at 400 mm in front of 13 mm armour steel basic plate. To test ballistic properties armour-piercing incendiary ammunition (12.7×99 mm) was fired from 100 m of the armour system setup. The plates austempered at a lower temperature possess greater ballistic resistance (five out of five armour-piercing incendiary shots stopped) than plates austempered at higher temperature. Furthermore, the thicker plate is more effective than a thinner one, especially if the damaged areas are considered. However, the major advantage of a thinner plate is its higher mass efficiency. Lower ballistic performance of ADI material austempered at a higher temperature, besides a lower hardness, was due to transformation of bulk retained low-carbon metastable austenite into martensite through strain induced mechanism, causing a partial brittle fracture.

9-5

Abrasive wear performance of ductile iron with different microstructures

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The abrasive wear performance of ductile iron (DI) with different microstructures (ferritic; pearlitic; and ausferritic - austempered at 300, 350 and 400°C) was studied. It was found that abrasive wear resistance primary depends on materials microstructure, corresponding hardness and transformation during wearing (SATRAM). The lowest wear resistance has ferritic-DI with the lowest hardness, followed by the pearlitic-DI, and the ausferritic-DI: ADI400, ADI350 and ADI300. However, if the SATRAM effect is present, then ADI400 wear resistance is comparable to the hardest ADI300. The SATRAM effect occurs only under high local pressure and if metastable, low carbon enriched, retained austenite is present.

9-6

Polypropylene-based composites containing sorbitol-based nucleating agents and siloxane-silsesquioxane resin

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Composites based on polypropylene (iPP) modified with sorbitol derivatives (NX8000, DMDBS) and siloxane-silsesquioxane resin containing reactive phenyl groups (SiOPh) were prepared by melt extrusion. These iPP-based formulations were investigated to evaluate the influence of such additives on the crystallization behaviour and morphology, as well as on thermal and mechanical properties. The addition of sorbitol fastens crystallization kinetics of isotactic polypropylene and leads to higher transparency of iPP films. Upon the incorporation of siloxane-silsesquioxane resin, changes in iPP crystallization kinetics are evidenced by calorimetry and optical microscopy analysis. The effect of the siloxane-silsesquioxane resin on properties of composites, including mechanical properties and material transparency, was rationalized taking into account compatibility of the components and morphology of the composites.

10-1

Embrittlement behaviour of two different grades of ADI material in various environments

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ADI material is advanced material with excellent combinations of mechanical properties, low cost, high machinability and excellent castability. However, it was noticed that under load ADI suffers an embrittlement phenomenon in contact with water and other liquids. This phenomenon causes significant decrease in tensile strength and ductility of ADI. In this study, tensile testing of two ADI grades in water and gaseous environments (air, helium and hydrogen) was performed. The highest decrease of mechanical properties was in water environment, followed by hydrogen atmosphere, while helium did not display any decrease. Consequently, the embrittlement was correlated to chemisorption of hydrogen atoms.

10-2

Porous silicon for advanced RF substrates

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The increasing expansion of telecommunications applications leads to the integration of analogue and digital processing units on the same chip, known as system-on-chip. RF passive devices, as part of all analogue circuits, are limited in their performance by the proximity of lossy Si substrate that is being used in digital circuitry. Porous silicon may overcome this problem. Si with a resistivity range of 10 Ohm.cm to 20 Ohm.cm (p-type) is anodized with an ethanol:HF (49 %) v.v. solution in a 1:2 ratio using different current densities (from 2 mA/cm^2 to 20 mA/cm^2). The obtained sponge-like structure gave a calculated value of porosity of approximately 64 %. Different PS layer thicknesses (10, 30, 50, 100, 150 μm) are obtained using a current density of 10 mA/cm2 and a 50 μm PS layer is obtained using different current densities (2, 5, 10, 15 and 20 mA/cm^2). Further, a multilayer (double-layer) PS structure is investigated using two current densities (5 mA/cm^2 and 20 mA/cm^2) and two different thicknesses (50 μm and 70 μm).
Also, two different annealing techniques were investigated. RF characterization of these porous silicon layers is conducted using coplanar waveguide transmission lines and best results are obtained for current density of 10 mA/cm^2 (alpha= 0.35 dB/mm at 10 GHz) when comparing the same PS layer thickness. When comparing PS layer thickness using the same current density, the best result is obtained for 100 μm PS layer (alpha=0.25 dB/mm at 10 GHz). The comparison with the other state-of-the art is not entirely precise, because of the varieties of parameters that are not set as a standard.

10-3

Fabrication of gold-polymer nanocomposites

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Nanocomposites are defined as multiphase materials where at least one phase has a dimension under 100 nm. Metal nanoclusters have exerted quantum effects, which means they have different properties than bulk metal. Additionally, materials with metal-polymer interface can have applications in plasmonics, in the presence of surface plasmons. As a consequence of this, metal-polymer nanocomposites have interesting features and a wide range of applications. The purpose of this work was creating plasmonic composites with optical properties similar to amorphous metamaterials, with two resonant transmittance and reflectance peaks. [1]

Experimental procedure was executed in the Laboratory for Plasma Spectroscopy and Lasers in the Institute of Physics, Belgrade. It included creating polymer substrates by coating sample slides with polymethyl metacrylate (PMMA) in an improvised spin-coater. Satisfactory level of uniformity in polymer layers was achieved by adjusting needle width, polymer volume and rotation speed and duration. Pulsed laser deposition (PLD) was used for adding gold nanoclusters to the substrates. The procedure was accomplished by ablating a gold target with excimer laser, in high vacuum. Particles of various sizes were deposited by varying laser energy density and duration of the deposition process. Finished samples showed colouring, mostly in the purple range, which was a confirmation of successful deposition of gold nanoparticles.

Scanning electron microscope (SEM) images show that dimensions of deposited particles fall well within nanometer range, with average size around 10 nm. Optical characterization of samples showed existence of surface plasmon resonance and its dependence on particle size. Transmittance measurements were done on two spectrophotometers with different ranges. Results show only one surface plasmon resonance in the range from 360 nm to 2400 nm.

Reference:

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10-4

The crystal structure, microstructure, and dielectric properties of $BaTi_{1-x}Sn_xO_3$ (x = 0, 0.05 and 0.1) ceramics sintered in different atmospheres (air and Ar)

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Due to specific dielectric and ferroelectric properties, functional ceramics based on barium titanate ($BaTiO_3$) have found application in semiconductor industries. Appropriate electrical properties of barium titanate-based materials, such as magnitude of relative dielectric permittivity and the Curie temperature, could be achieved by varying the sintering conditions (which influenced ceramics' microstructure) and/or by doping with various cations.
Here, we investigated an influence of sintering atmosphere (air and argon) on the crystal structure, microstructure, and dielectric properties of barium titanate-stannate (BTS; $BaTi_{1-x}Sn_xO_3$) ceramics. The BTS powders (with x = 0, 0.05 and 0.1; denoted BT, BTS5 and BTS 10, respectively) were synthesized by solid-state reaction technique. In the following, the powders were uniaxially pressed (P = 240 MPa) into cylindrical compacts (∅ 6 mm and $h \approx$ 2 mm) and sintered in SETSYS TMA (Setaram Instrumentation, Caluire, France) by heating rate of 10 °/min up 1420 °C and with dwell time of 2 hours. To establish the influence of a sintering atmosphere two sets of experiments were performed: (1) in air, and (2) in Ar. During sintering, the shrinkage was recorded in axial (h) direction. The crystal structure of BTS ceramics were studied at room temperature by X-ray diffractometry and Raman spectroscopy. The microstructure and chemical (Ti/Sn) composition were examined by SEM–EDS methods. The electrical measurements were made in air, at 1 kHz using a Wayne Kerr Universal Bridge B224; the measurements were done in cooling, from 160 to 20 °C. A profound effect of argon atmosphere on the magnitude of relative dielectric permittivity of sintered BTS ceramics has been found.

11-1

Correlation of physical-chemical characteristics of CaO catalyst on activity in reaction of transesterification of sunflower oil

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Calcium oxide is widely used in industry as catalyst for various processes. One of the use is production of biodiesel by transesterification of vegetable oils. Mostly, CaO requires thermal activation in order to release adsorbed CO^2 and moisture. Activation, so called calcination is carried out at high temperatures between 500 and 900°C. Different researches were conveyed over CaO as heterogeneous catalyst dealed with physical-chemical properties of catalyst, different calcination temperatures as activation procedures performed over CaO-based precursors, and various process parameters affected final catalytic performances. To the best of our knowledge, there is no complete consensus on different activation procedures applied in the preparation of CaO-based catalysts published and on the relevance of the physicochemical properties of catalysts for beneficial catalytic performances.

In this paper we tried to make a correlation between physical-chemical characteristics of CaO catalyst and its catalytic activity in transesterification of sunflower oil. We prepare three samples of catalysts by calcining at three different temperatures. Complete physical-chemical characterization of obtained catalysts was done (SEM, XRD, TG/DTA, FTIR). Catalytic activity was investigated in reaction of transesterification.

Obtained results showed that there is a strong correlation between temperature of calcination and physical-chemical characteristics of CaO catalysts which have impact on catalytic activity in biodiesel production. Calcium oxide prepared and thermally activated at higher temperatures has exhibited itself as a very effective catalyst in short run transesterification reactions of refined sunflower oil with methanol to yield biodiesel. A number of key physicochemical features of the CaO catalysts − the great specific surface area and average pore diameter, almost exclusive presence of CaO crystal phase with crystallites up to limited dimensions, the total amount of surface basic sites and the two types of basic active sites − were found to be the reasons for the observed high catalytic efficiency.

11-2

Preparation of calcium containing mixed oxides as solid base catalysts for the application in biodiesel synthesis

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Biodiesel (fatty acid methyl esters - FAME) has been found suitable for using as an alternative fuel in diesel engine. The conventional method for biodiesel production is transesterification of vegetable oils or animal fats with short-chain alcohols in the presence of catalysts. From an economic point of view, calcium oxide (CaO) is the most widely used and exhibits good catalytic properties for transesterification of triglycerides to biodiesel.
In order to study the effect of solid base catalysts for biodiesel production, transesterification of edible sunflower oil with methanol was carried out in the presence of series of CaO-based oxides, obtained by mechanochemical treatment of CaO or $CaCO_3$ with other metal oxides, followed by calcination.
Mechanochemical treatment of starting powders mixtures was performed in a planetary ball mill using two different milling media, hardened steel or zirconia vials and balls. The prepared catalysts were characterized by X-ray diffraction (XRD), base strength using Hammett indicator method and the particle size using laser diffraction distribution (PSLD). All the experiments were carried out at different reaction conditions in 300 cm^3 batch autoclave equipped with a heater and mixer. The calcium containing mechanochemically prepared catalysts were found to have enhanced activity compared to conventionally prepared catalysts.

11-3

Photocatalytic degradation of selected pollutants using pure and Fe-doped titania nanoparticles

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Pure and Fe-doped TiO_2 samples were synthesized via sol-gel method and characterized using various techniques such as X-ray powder diffraction, UV-Vis and EPR spectroscopy and BET measurements. The photocatalytic activity of pure and Fe-doped TiO_2 samples was tested before and after the heat treatment in order to investigate the influence of doping with Fe-ions as well as crystallinity and the crystalline structure (heat treatment) on their photocatalytic activity. The doping of TiO_2 induced a shift in the absorption threshold towards the visible spectral range. Crystal growth and agglomeration of nanoparticles during the heat treatment induced an increase in crystallinity and particle sizes in the obtained samples. Photodegradation reactions of Rhodamine B and 2,4,6-trichlorophenol under simulated Solar light were used as a model reactions to investigate the photocatalytic activity of prepared samples. These two model compounds were also used for the evaluation of the influence of the chemical structure of the substrate on the photocatalytic activity of synthesized titania based materials. In the photocatalytic activity tests the best photocatalyst for the degradation of Rhodamine B was the annealed pure TiO_2 sample, while for the degradation of TCP it is the annealed Fe-doped TiO_2 sample. Our results showed that the doping and the annealing processes as well as the chemical structure of the pollutant strongly influence the photodegradation properties of the obtained materials.

11-4

Influence of PEO molecular weight on properties of ZnO/PEO composites

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The removal of inorganic, organic and biological pollutants from drinking water and wastewater is one of the key steps in environmental protection. In recent 10 years a heterogeneous photocatalysis, as an efficient method for the degradation and mineralization of pollutants from water, has been widely studied and developed. For heterogeneous photocatalysis mostly used materials to initiate the photoreaction are oxide semiconductors such as TiO_2 and ZnO. However, these oxide semiconductors, having band gap energies around 3.3 eV, can absorb UV light only. Since sunlight is a source of clean and cheap energy, where UV light makes no more than 3–5% of the total sunlight, it is highly desirable to modify the oxide semiconductor materials to be capable for visible light photocatalysts. Numerous approaches have been applied to modify the optical absorption properties and to improve the visible light photocatalytic activity including: (1) the incorporation of transition metal ions into the crystal structure, (2) sensitization of the particles' surface, (3) hydrogenation, (4) the incorporation of crystalline defects in metal oxide semiconductors in the form of vacancies and interstitials, etc. Microwave processing is recognized as an attractive synthesis technique to introduce lattice defects.

In this study ZnO spheroidal nanoparticles, synthesized by microwave processing, were used for preparation of composites with polyethylene oxide (PEO). The phase purity and crystal structure of the composites were investigated by X-ray diffraction (XRD) and Raman spectroscopy. The composites' particles morphology and size distributions were studied by FE–SEM and laser diffraction particle size analyzer, respectively. The optical properties were studied using UV–Vis diffuse reflectance and photoluminescence spectroscopy. It is found that ZnO and ZnO/PEO composites absorb about 50% of visible light, also red-shift of band gap energy (0.12-0.15 eV) compared to bulk ZnO was determined. The effect of PEO molecular weights, 200.000, 600.000 and 900.000 g/mol, on photocatalytic activity of ZnO/PEO composites were examined via degradation of methylene blue (MB) under direct sunlight irradiation. A large efficiency of MB degradation was found after 6 h of irradiation. The enhanced photocatalytic activity of ZnO/PEO composites is attributed to the: (1) lattice defects introduced in ZnO crystal structure by rapid microwave processing, and (2) presence of PEO as a source of oxygen interstitials. In order to confirm and further clarify the experimental results ab initio calculations based on density functional theory (DFT) were performed.

11-5

Safe trapping of Cs radionuclides in sintered matrix of zeolites

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Cesium aluminosilicate phases are of the great interest as possible host for Cs immobilization in radioactive waste management. The possibility to use zeolite as a host material for radioactive Cs immobilization was investigated. Cs-exchanged forms of clinoptilolite and 13X which were prepared by ion-exchange treatment were compacted. The powders compacts of exchanged zeolites were thermally treated at 1200 °C. The XRD analysis showed that Cs was successfully immobilized after heat treatment by formation of stable cesium-aluminosilicate ceramic forms. Thermal and mechanical properties of the sintered samples were investigated. From the perspective of these characteristics, Cs-exchanged zeolite (clinoptilolite and 13 X) can be considered as a potential material for safe waste disposal.

12-1

Cobalt ferrite nanospheres as a potential magnetic adsorbent of heavy metal ions

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In the present work the cobalt ferrite (CFO) nanospheres were prepared via one-step, template free solvothermal method and used as a magnetic adsorbent of heavy metal ions. The obtained samples were characterized by X-ray powder diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM) and vibrating sample magnetometry (VSM), while determination of chromium ions in aqueous solution was performed by voltammetric measurements in the hanging mercury drop electrode mode (HMDE). The XRD results confirmed the cubic spinel structure of CFO, while the SEM revealed sphere-like morphology of the obtained CFO with diameters in the range of 100-300 nm. TEM images showed that each CFO nanosphere is being composed of smaller CFO nanoparticles with size around 7-8 nm. The magnetic measurements reviled ferrimagnetic character of CFO nanospheres with the maximum saturation magnetization and coercivity of 75 emu/g and 677 Oe, respectively. The 0.02 g of as-obtained CFO was used as magnetic adsorbent for the extraction of 10 ppm of chromium (VI) ions from aqueous solution (pH 6). The results indicate that CFO nanospheres have potential as an adsorbent for sorption of chromium (VI) ions from aqueous solution. Using a fast separation method the obtained CFO nanospheres can potentially be used for magnetic removal of heavy metals in wastewater.

12-2

Corn silk (Zea mays L.) as novel biosorbent for heavy metals removal

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The development of waste biomaterials as adsorbents for heavy metals removal has been extensively examined in recent years. In this study, the novel biosorbent corn silk (Zea mays L.) was investigated for Cd(II) removal from aqueous solutions. Adsorption experiments were performed in batch system. Effect of operating parameters such as pH of solution, initial metal concentration, biosorbent dosage and contact time was studied. The corn silk before and after adsorption was characterized by SEM-EDX and FTIR-ATR techniques. Desorption study was performed in order to investigate biosorbent recovery. High adsorption capacity and reusability indicates that the corn silk is an effective and low-cost adsorbent for the removal of Cd(II) from aqueous solutions.

12-3

Preconcentration of selected pesticides using multiwalled carbon nanotubes as adsorbent in solid phase extraction

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The aim of this study was to evaluate the possibility of preconcentration of pesticides from water samples applying multiwalled carbon nanotubes (MWCNTs) as an adsorbent in Solid Phase Extraction (SPE). Six pesticides of different polarity (acetamiprid, imidacloprid, carbendazim, simazine, linuron and tebufenozide) were chosen in the study. The experimental parameters which affect the adsorption and desorption of the pesticides were investigated. The pesticides concentration was determined by high-performance liquid chromatography (HPLC) with DAD detector. The adsorption efficiency was higher than 90% for all selected pesticides. Desorption of pesticides was investigated using four organic solvents and two different elution volumes. The desorption efficiency for most pesticides was higher than 90%, except for carbendazim and linuron where was 30% and 70%, respectively, and in order of methanol > acetonitrile > acetone > dichloromethane. Also, desorption efficiency increased with increasing elution volume of the solvent. The calibration curves of the pesticides showed good linear relationship in the concentration range from 1 to 50 μg L-1. Depending on the selected pesticide, the detection limits were from 3 to 8 μg L-1. Results from this research suggest that MWCNTs could be successfully applied as an adsorbent for the preconcentration of pesticides present in trace levels in water.

12-4

Possibilities for remediation of the mining dump lakes by extraction the metal ions for nanotechnologies

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Mining industry leaves a very high negative impact on the land and water surrounding the excavation sites. In Bosnia and Herzegovina, usual way of dealing with the mining waste is to form the dump lakes where the waste water from ore washing process is accumulated. The method is developed to recover significant quantities of metal ions from this waste sludge and to use them as an ionic solution in synthesizing the nanoparticles. The case for the iron and manganese will be discussed with the particular crystalline nanoparticles of commercial value and the highly pure sulphate for manganese as the potential raw material for nano-synthesis.

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