MATERIALS RESEARCH SOCIETY OF SERBIA
INSTITUTE OF TECHNICAL SCIENCES OF SASA

Programme and the Book of Abstracts

SIXTEENTH YOUNG RESEARCHERS' CONFERENCE MATERIALS SCIENCE AND ENGINEERING

Belgrade, December 6–8, 2017

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MATERIALS SCIENCE AND ENGINEERING

December 6-8, 2017, Belgrade, Serbia

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

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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

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

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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. Part of the award is free-of-charge conference fee at YUCOMAT 2018.

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Programme
Sixteenth Young Researchers Conference
Materials Science and Engineering

Wednesday, December 6, 2017

Hall 8, University of Belgrade
Studentski trg 1/I

08.30 Registration

09.00 – 09.30 Opening Ceremony
Dr. Smilja Marković, President of 16YRC Scientific and Organizing Comitee, Professor Dr. Ivanka Popović, Vice-rector of the University of Belgrade, Professor Dr. Dragan Uskoković, President of the Materials Research Society of Serbia

09.30 – 11.00 1st Session – Biomaterials I
Chairpersons: Prof. Dr. Bojana Obradović and Ivana Dinić

09.30 – 09.45 Spectral analysis of external magnetic field influence on magnetic oxide nano-particles in ferrofluid

Ljubica Anđelković,[1] Marija Šuljagić,[2] Aleksandar S. Nikolić[2]
[1]Department of Chemistry, IChTM, University of Belgrade, Studentski Trg 12-16, 11000 Belgrade, Serbia, [2]Faculty of Chemistry, University of Belgrade, Studentski Trg 12-16, 11000 Belgrade, Serbia

09.45 – 10.00 Photo-driven upconversion in $NaYF_4$:Yb,Er@chitosane particles for cancer cells bioimaging

Ivana Dinić,[1] Aleksandra Đukić-Vuković,[3] Marko Nikolić,[4] Olivera Milošević,[2] Lidija Mančić[2]
[1]Innovation Center of the Faculty of Chemistry, University of Belgrade, Serbia, [2]Institute of Technical Sciences of SASA, Belgrade, Serbia, [3]Department of Biochemical Engineering and Biotechnology Faculty of Technology and Metallurgy, University of Belgrade, Serbia, [4]Photonic Center, Institute of Physics Belgrade, University of Belgrade, Zemun, Belgrade, Serbia

10.00 – 10.15 The synthesis and properties of biocomposite porous hydrogels based on hydroxyapatite, poly(methacrylic acid) and casein

Vukašin Ugrinović,[1] Vesna Panić,[2] Pavle Spasojević,[2] ĐorđeVeljović,[1] Ivanka Popović,[1] Đorđe Janaćković[1]

[1]*University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia,*
[2]*University of Belgrade, Innovation Center of Faculty of Technology and Metallurgy, Belgrade, Serbia*

10.15 – 10.30 Electrophoretic deposition of biocomposite ceramic coatings of hydroxyapatyte and chitosan with silver and gentamicin on titanium for medical applications

Iva Ilić,[1] Ana Janković,[1] Marija Đošić,[2] Maja Vukašinović-Sekulić,[1] Vesna Mišković-Stanković[1]
[1]*Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4, Belgrade 11000, Serbia,* [2]*Institute for Technology of Nuclear and other Mineral Raw Materials (ITNMS), Bulevar Franše d'Eperea 86, Belgrade 11000, Serbia*

10.30 – 10.45 Silk design and conformation as biomaterial, and in vitro proliferation cell test

Adrián Blanco Fernández,[1] David Don Lopez,[1,2,3] Francisco Guitián Rivera,[1]
[1]*Instituto de Cerámica de Galicia, Santiago de Compostela, Spain,* [2]*Lawrence Berkeley National Laboratory, California, USA,* [3]*Tehran University of Medical Sciences, Tehran, Iran*

10.45 – 11.00 Experimental analysis of low density poly ethylene effect on the mechanical properties of poly ethylene vinyl acetate for prosthetic and orthotic application

Yenealem Yilma, Asmamew Tegegn
Ethiopia Biotechnology Institute, Addis Ababa, Ethiopia

11.00 – 11.15 Break

11.15 – 12.45 2nd Session – Biomaterials II
Chairpersons: Dr. Magdalena Stevanović and Željko Janićijević

11.15 – 11.30 The influence of chitosan content on antibacterial properties and silver release for silver/poly(vinyl alcohol)/chitosan/graphene hydrogels

Katarina Nešović, Ana Janković, Maja Vukašinović-Sekulić, Aleksandra Perić-Grujić, Vesna Mišković-Stanković
Faculty of Technology and Metallurgy, University of Belgrade, Serbia

11.30 – 11.45 Production of nanocomposite hydrogels based on poly(vinyl alcohol), honey and silver nanoparticles

Mina Blagojević, Jasmina Stojkovska, Bojana Obradović
Faculty of Technology and Metallurgy, University of Belgrade

11.45 – 12.00 Characterization of alginate hydrogels with honey components and silver nanoparticles

Milan Pavlović,[1] Jasmina Stojkovska,[1] Predrag Petrović,[1] Ivan Jančić,[2] Marina Milenković,[2] Bojana Obradović[1]
[1]Faculty of Technology and Metallurgy, University of Belgrade, [2]Faculty of Pharmacy, University of Belgrade, Serbia

12.00 – 12.15 Biodegradable polymer/hydrogel composite for controlled delivery of cationic formulations

Željko Janićijević,[1] Marina Ninkov,[2] Milena Kataranovski,[2] Filip Radovanović[3]
[1]School of Electrical Engineering, University of Belgrade, Belgrade, Serbia, [2]Department of Ecology, Institute for Biological Research "Siniša Stanković", University of Belgrade, Belgrade, Serbia, [3]Institute of Technical Sciences of SASA, Belgrade, Serbia

12.15 – 12.30 Adsorption studies of lignin model compounds on activated charcoal particles

Jelena Petrović,[1] Andrea Osmokrović,[1] Dragica Spasojević,[2] Ksenija Radotić,[2] Bojana Obradović[1]
[1]Faculty of Technology and Metallurgy, University of Belgrade, [2]Institute for Multidisciplinary Research, University of Belgrade, Serbia

12.30 – 12.45 Interfacial properties of titanium dioxide - chitosan - hyaluronic acid systems

Agata Gozdecka, Agnieszka Ewa Wiącek, Małgorzata Jurak
Department of Interfacial Phenomena, Faculty of Chemistry, Maria Curie-Skłodowska University, 20-031 Lublin, Poland

12.45 – 13.45 Lunch break

13.45 – 15.30 3rd Session – Biomaterials III

Chairpersons: Dr. Đorđe Veljović and Dr. Stoja Milovanović

13.45 – 14.00 Synthesis and characterization of novel spider silk-based composites

Svetlana Dmitrović,[1] Aleksandra Zarubica,[2] Branko Matović[1]
[1]Vinča Institute of Nuclear Sciences, Center for the synthesis, processing and characterization of materials for use in extreme conditions “CEXTREME LAB”, Belgrade University, Belgrade, Serbia

14.00 – 14.15 Impregnation of cellulose acetate films with carvacrol using supercritical carbon dioxide

Tijana Adamović,[1,2] Stoja Milovanović,[3] Irena Žižović[3,4]
[1]University of Belgrade, Vinča Institute of Nuclear Sciences, Serbia, 11001 Belgrade, Serbia, [2]University of Valladolid, Department of Chemical Engineering and Environmental Technology, Valladolid – 47011, Spain, [3]University of Belgrade, Faculty of Technology and

Metallurgy, Karnegijeva 4, 11120 Belgrade, Serbia, [4]Wroclaw University of Science and Technology, Faculty of Chemistry, Wybrzeze Wyspianskiego 27, 50-370 Wroclaw, Poland

14.15 – 14.30 Porous alginate hydrogels with bioactive hydroxyapatite precursors for bone tissue engineering
Nataša Stanojević, Jasmina Stojkovska, Đorđe Veljović, Bojana Obradović
Faculty of Technology and Metallurgy, University of Belgrade, Belgrade, Serbia

14.30 – 14.45 Electrochemically obtained bioactive nanocomposite coating based on hydroxyapatite and chitosan loaded with gentamicin
Milena Stevanović,[1] Ana Janković,[1] Marija Đošić,[2] Maja Vukašinović-Sekulić,[1] Vesna Mišković-Stanković[1]
[1]Faculty of Technology and Metallurgy, Karnegijeva 4, Belgrade, Serbia, [2]Institute for technology of nuclear and other mineral raw materials, Bulevar Franš d'Eperea 86, Belgrade, Serbia

14.45 – 15.00 Cation-substituted calcium phosphates containing ions of titanium and zirconium
Olga S. Antonova, Sergey V. Smirnov, Valeriy V. Smirnov, Margarita A. Goldberg, Sergey M. Barinov
Baikov' Institute of Metallurgy and Material Science RAS, Moscow, Russia

15.00 – 15.15 Influence of aluminium substitutions on phase composition and morphology of β - tricalcium phosphate and hydroxyapatite nanopowders
Margarita Goldberg,[1] Valeriy Smirnov,[1] Pavel Protsenko,[2] Olga Antonova,[1] Sergey Smirnov,[1] Alla Fomina,[1] Sergey Barinov[1]
[1]A.A. Baikov Institute of Metallurgy and Materials Science, Russian Academy of Sciences, 119991 Moscow, Russian Federation, [2]M. V. Lomonosov Moscow State University, 119991 Moscow, Russian Federation

15.15 – 15.30 Fluid flow distribution studies in macroporous gellan gum hydrogels
Marko Deak, Jovana Zvicer, Bojana Obradović
Faculty of Technology and Metallurgy, University of Belgrade, Belgrade, Serbia

15.30 – 15.45 Break

15.45 – 17.15 4th Session – Environmental Materials I
Chairpersons: Dr. Jasmina Dostanić and Marija Egerić

15.45 – 16.00 Utilization of different agro-industrialwastes for bioethanol production using an amylolytic potential from the Paenibacillus chitinolyticus CKS1
Slađana Z. Davidović, Milica D. Milutinović, Katarina R. Mihajlovski, Suzana I. Dimitrijević-Branković

University of Belgrade, Faculty of Technology and Metallurgy, Department for Biochemical Engineering and Biotechnology, Karnegijeva 4, Belgrade, Serbia

16.00 – 16.15 Activated carbons as adsorbents of siloxanes: Adsorption and desorption study by in-situ FTIR
Vu Tung Lam Tran, Patrick Gélin, Ludovic Fine, Corinne Ferronato, Jean - Marc Chovelon, Georgeta Postole
Université Lyon 1, CNRS, UMR 5256, IRCELYON, Institut de recherches sur la catalyse et l'environnement de Lyon, 2 avenue Albert Einstein, F-69626 Villeurbanne, France

16.15 – 16.30 Investigation of alginate-based absorbents for the nickel (Ni(II)) removal from water media
Aleksandar Zdujić, Katarina Trivunac, Milan Milivojević
Faculty of Technology and Metallurgy, University of Belgrade, Serbia

16.30 – 16.45 Modelling of cation removal by seashell waste based on GRNN architecture
Marija Egerić,[1] Ivana Smičiklas,[1] Davor Antanasijević[2]
[1]University of Belgrade, Vinča Institute of Nuclear Sciences, P.O. Box 522, 11000 Belgrade, Serbia, [2]University of Belgrade, Innovation Center of the Faculty of Technology and Metallurgy, Karnegijeva 4, 11000 Belgrade, Serbia

16.45 – 17.00 Application of green tea nano zero-valent iron for stabilization of river sediment
Nataša Slijepčević, Dragana Tomašević Pilipović, Đurđa Kerkez, Milena Bečelić-Tomin, Božo Dalmacija, Dejan Krčmar, Nataša Varga
University of Novi Sad, Faculty of Sciences, Department of Chemistry, Biochemistry and Environmental Protection, Trg Dositeja Obradovića 3, 21000 Novi Sad, Republic of Serbia

17.00 – 17.15 Winemaking by-products as a source of phenolic compounds
Anita T. Smailagić,[1] Milica M. Pantelić,[2] Dragana Č. Dabić Zagorac,[2] Maja M. Natić[1]
[1]Faculty of Chemistry, University of Belgrade, P. O. Box 51, 11158 Belgrade, Serbia, [2]Innovation Center, Faculty of Chemistry Ltd, University of Belgrade, 11158 Belgrade, Serbia

17.15 – 17.30 Break

17.30 – 19.00 5th Session – Environmental Materials II
Chairpersons: Dr. Veljko Đokić and John Milan van der Bergh

17.30 – 17.45 Removal of ceftriaxone from water using different types of commercial TiO_2 and newly synthesized ZrO_2/Fe_3O_4 nanopowder
Biljana Abramović, Maria Uzelac, Nemanja Banić

University of Novi Sad, Faculty of Sciences, Department of Chemistry, Biochemistry and Environmental Protection, Trg D. Obradovića 3, 21000 Novi Sad, Serbia

17.45 – 18.00 Emission monitoring of trace elements (heavy metals) in the atmosphere during usage of waste glass from cathode ray tube monitors as alternative raw material in Portland cement clinker production
Marija Nikolić, Marjan Ranđelović
Faculty of Sciences and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia

18.00 – 18.15 Influence of the photocatalytic material application procedure on functional properties of facade paints
John Milan van der Bergh, Jelena Tanasić, Snežana Vučetić, Jonjaua Ranogajec
University of Novi Sad, Faculty of Technology, Bul. Cara Lazara 1, Novi Sad

18.15 – 18.30 Characterization of selected fractions of materials recovered from mechanically treated waste printed circuit boards from electric equipment
Željko Kamberović, Milisav Ranitović, Nataša Gajić, Ivana Nikolovski, Angelina Mitrović
Faculty of Technology and Metallurgy, University of Belgrade, Serbia

18.30 – 18.45 Determination of red dye purpurin concentration isolated from Rubia tinctorum using Briggs-Rauscher oscillatory reaction
Kristina Z. Stevanović, Jelena P. Maksimović, Maja C. Pagnacco
Faculty of Physical Chemistry, University of Belgrade, Belgrade, Serbia

18.45 – 19.00 Sorption of textile dyes from simulated textile wastewater by hydrogel
Marija Lučić Škorić, Lazar Stanojković, Melina Kalagasidis Krušić
University of Belgrade, Innovation Center of the Faculty of Technology and Metallurgy, Karnegijeva 4, Belgrade, University of Belgrade, Faculty of Technology and Metallurgy, Karnegijeva 4, Belgrade, Serbia

Thursday, December 7, 2017

Hall 3, Serbian Academy of Sciences and Arts
Knez Mihailova 35/I

09.00 – 10.15 6th Session – Theoretical Modeling of Materials I
Chairpersons: Dr. Željka Nikitović and Ana Dobrota

09.00 – 09.15 Nitrogen-doped graphene nanoribbons for oxygen reduction reaction – DFT insights
Ana S. Dobrota, Igor A. Pašti
University of Belgrade, Faculty of Physical Chemistry, Studentski trg 12-16, 11158 Belgrade, Serbia

09.15 – 09.30 First principle study of Yb and Sr doped monolayer graphene
Andrijana Šolajić, Jelena Pešić, Radoš Gajić
Graphene Laboratory (GLAB), Center for Solid State Physics and New Materials, University of Belgrade, Pregrevica 118, 11080, Belgrade, Serbia

09.30 – 09.45 First principles insights in sodium storage by B- and N-doped epoxy-graphene
Nataša P. Diklić, Ana S. Dobrota, Igor A. Pašti
University of Belgrade, Faculty of Physical Chemistry, Studentski trg 12-16, 11158 Belgrade, Serbia

09.45 – 10.00 Combined theoretical and experimental investigation of $LiAlH_4$ catalyzed with Fe_2O_3
Milijana Savić,[1] Igor Milanović,[2] Zoran Jovanović,[3] Marko Bošković,[4] Jana Radaković,[1] Katarina Batalović[1]
[1]Laboratory for nuclear and plasma physics, Institute of Nuclear Sciences "Vinča", [2]Materials Science Laboratory, Institute of Nuclear Sciences "Vinča", [3]Laboratory of Physics, Institute of Nuclear Sciences "Vinča", [4]Laboratory of theoretical and condensed matter physics, Institute of Nuclear Sciences "Vinča", Belgrade, Serbia

10.00 – 10.15 Propagation of electromagnetic waves through anisotropic active medium
Nikola Opačak, Vitomir Milanović, Jelena Radovanović
School of Electrical Engineering, University of Belgrade, Bulevar kralja Aleksandra 73, 11120 Belgrade, Serbia

10.15 – 10.30 Break

10.30 – 11.45 7th Session – Theoretical Modeling of Materials II
Chairpersons: Dr. Siniša Vučenović and Yu Zhang

10.30 – 10.45 Selecting optimal stimulus frequencies for SSVEP BCI experiment
Milorad M. Vujković
School of Electrical Engineering, University of Belgrade, Bulevar kralja Aleksandra 73, 11120 Belgrade, Serbia

10.45 – 11.00 Chemometric analysis of FTIR and high resolution XRPD data of the medieval pottery from the Studenica monastery, a UNESCO world heritage site
Srna Stojanović,[1] Vesna Bikić,[2] Ivana Radosavljević Evans,[3] Suzana Erić,[4] Kristina Šarić,[4] Ljiljana Damjanović-Vasilić[1]
[1]Faculty of Physical Chemistry, University of Belgrade, Serbia, [2]Institute of Archaeology, Kneza Mihaila 35/ IV, 11000 Belgrade, Serbia, [3]Department of Chemistry, Durham University, Durham DH1 3LE, UK, [4]Faculty of Mining and Geology, University of Belgrade, Đušina 7, 11000 Belgrade, Serbia

11.00 – 11.15 Wetting of silicon <100> surface by water – experiment and computer simulations

Michał Chodkowski,[1] Paweł Bryk,[1] Konrad Terpiłowski[2]

[1]Department for the Modelling of Physico-Chemical Processes, Faculty of Chemistry, Maria Curie-Sklodowska University, ul. Gliniana 33, 20-614 Lublin, Poland, [2]Department of Interfacial Phenomena, Faculty of Chemistry, Maria Curie-Sklodowska University, Maria Curie-Sklodowska 3 Sq. 20-031 Lublin, Poland

11.15 – 11.30 Application of composite materials as radiation shielding from neutron sources using Monte Carlo simulations

Katarina Karadžić

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

11.30 – 11.45 Role of Co on gamma prime (γ′) coarsening in nickel-based single crystal superalloys based on the $[Al\text{-}Ni_{12-x}Co_x](Al_1Ti_{0.25}Ta_{0.25}Cr_1Mo_{0.25}W_{0.25})$ model

Yu Zhang,[1] Qing Wang,[1] Honggang Dong,[1] Chuang Dong,[1] Hongyu Zhang,[2] Xiaofeng Sun[2]

[1]Key laboratory of Materials Modification by Laser, Ion and Electron Beams (Dalian University of Technology), Ministry of Education, Dalian 116024, China, [2]Superalloys Division, Institute of Metal Research, Chinese Academy of Sciences, Shenyang 110016, China

11.45 – 13.00 Lunch break

13.00 – 15.00 8th Session – Materials for High-technology Application I
Chairpersons: Dr. Dragana Jugović and Petar Laušević

13.00 – 13.15 The synthesis, crystal and defect structure of quintuple tetragonal perovskite $Sm_{1.875}Ba_{3.125}Fe_5O_{13.5-d}$

Mikhail Yu. Mychinko, Ivan B. Golovachev, Evgeniy I. Zyaikin, Nadezhda E. Volkova

Department of Chemistry, Institute of Natural Sciences and Mathematics, Ural Federal University, Lenin av.51, Yekaterinburg, 620000, Russia

13.15 – 13.30 Activated ion-track carbon flexible supercapacitor electrodes with different channel densities

Petar Laušević,[1,2] Predrag Pejović,[2] Vladimir Nikolić,[1] Zoran Laušević,[1] Maria Eugenia Toimil-Molares[3]

[1]Laboratory of Physical Chemistry, Vinča Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia, [2]School of Electrical Engineering, University of Belgrade, Belgrade, Serbia, [3]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

13.30 – 13.45 Electrochemical behavior of $NaNi_{0.33}Mn_{0.33}Co_{0.33}O_2$ and $NaNi_{0.61}Mn_{0.27}Co_{0.12}O_2$ in aqueous $LiNO_3$ and $NaNO_3$ solutions, prepared by the glycine-assisted combustion synthesis

Gordana Backović, Ivana Stojković-Simatović, Danica Bajuk Bogdanović, Milica Vujković

Faculty of Physical Chemistry, University of Belgrade, Studentski Trg 12, Belgrade, Serbia

13.45 – 14.00 Synthesis and structural properties of sodium cobalt oxide

Jelena Aleksić,[1] Dragana Jugović,[2] Miloš Milović,[2] Miodrag Mitrić,[3] Dragan Uskoković[2]

[1]Faculty of Sciences and Mathematics, Niš, Serbia, [2]Institute of Technical Sciences of SASA, Belgrade, Serbia, [3]Vinča Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia

14.00 – 14.15 Recovery of $LiCo_{0.415}Mn_{0.435}Ni_{0.15}O_2$ from spent Li-ion batteries, and the examination of its charging/discharging behavior in aqueous $LiNO_3$ and $NaNO_3$ solutions

Jelena Senćanski,[1] Ivana Stojković-Simatović,[2] Danica Bajuk Bogdanović,[2] Elena Tchernychova,[3] Milica Vujković,[2]

[1]Institute of General and Physical Chemistry, University of Belgrade, Serbia, [2]Faculty of Physical Chemistry, University of Belgrade, Serbia, [3]Department for Materials Chemistry, National Institute of Chemistry, Ljubljana, Slovenia

14.15 – 14.30 Digital holography of graphene paper acoustic membranes and comparison to other paper – like materials

Jelena Mitrić,[1] Dušan Grujić,[2] Denis Abramović,[3] Iva Salom,[4] Nazif Demoli,[3] Dejan Pantelić,[2] Dejan Todorović,[5] Marko Spasenović[2]

[1]School of Computing, University Union, Knez Mihailova 6, 11000 Belgrade, Serbia, [2]Institute of Physics, University of Belgrade, Pregrevica 118, 11080 Belgrade, Serbia, [3]Institute of Physics, Bijenička cesta 46, 10001 Zagreb, Croatia, [4]Institute Mihajlo Pupin, University of Belgrade, Volgina 15, 11060 Belgrade, Serbia, [5]Dirigent Acoustics Ltd, Mažuranićeva 29/9 11050, Belgrade, Serbia

14.30 – 14.45 Influence of cobalt nanoparticles and melt pouring temperature on microstructure and properties of nickel-based superalloy

Łukasz Rakoczy,[1] Rafał Cygan,[2] Małgorzata Grudzień,[3] Anna Zielińska-Lipiec[1]

[1]AGH University of Science and Technology, Faculty of Metals Engineering and Industrial Computer Science, Department of Physical and Powder Metallurgy, Mickiewicza 30, 30-059 Cracow, [2]Consolidated Precision Products Poland, 120, Hetmanska Str., 35-078 Rzeszow, [3]Foundry Research Institute, Zakopiańska 73, 30-418 Cracow, Poland

14.45 – 15.00 Phase equilibrium and crystal strukture of perovskite oxides in the system Sm-Sr-Fe-Co-O

Dzhamilia U. Khalmirzaeva, Nadezhda E. Volkova, Lyudmila Y. Gavrilova

Ural Federal University, Yekaterinburg, Mira st.,19, Russia

15.00 – 15.15 Break

15.15 – 16.45 9th Session – Materials for High-technology Application II
Chairpersons: Dr. Vuk Radmilović and Anna Makarova

15.15 – 15.30 Investigation of structural and dielectric properties of barium strontium titanate thin films prepared by spin coating

Andrea Nesterović,[1] Jelena Vukmirović,[1] Branimir Bajac,[1] Georges Dubourg,[2] Dragan Kukuruzović,[3] Branko Škorić,[3] Vladimir Srdić[1]

[1]*Faculty of Technology, University of Novi Sad, Serbia,* [2]*BioSense Institute, Novi Sad, Serbia,* [3]*Faculty of Technical Sciences, University of Novi Sad, Serbia*

15.30 – 15.45 Structure and properties of solid solutions $Ba_{1-x}Pr_xFe_{1-y}CoO_{3-\delta}$

Anna E. Makarova,[1] Nadezhda E. Volkova,[2] Vladimir A. Cherepanov[3]

[1]*Ural Federal University, Yekaterinburg, Mira-19, Russia,* [2]*Department of Physical and Inorganic Chemistry,* [3]*Department of Physical and Inorganic Chemistry*

15.45 – 16.00 Small influence of magnetic ordering on lattice dynamics in $TaFe_{1.25}Te_3$

Marko Opačić,[1] Nenad Lazarević,[1] Darko Tanasković,[2] Miloš Radonjić,[2] Ana Milosavljević,[1] Yongchang Ma,[3,4] Čedomir Petrović,[3] Zoran V. Popović[1,5]

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16.00 – 16.15 Analysis of heat loss of thick film segmented thermistors used in water flow sensor

Stanko O. Aleksić,[1] Miloljub D. Luković,[2] Zoran Nikolić,[3] Zdravko I. Stanimirović,[4] Nebojša S. Mitrović[1]

[1]*Faculty of Technical Sciences, University of Kragujevac, Svetog Save 65, 32 000, Čačak, Serbia,* [2]*Institute for Multidisciplinary Research, University of Belgrade, Kneza Viseslava 1, Belgrade 11000, Serbia,* [3]*Faculty of Physics, University of Belgrade, Studentski trg 8, 11 000 Belgrade, Serbia,* [4]*Institute IRITEL, Batajnicki put 23, 11000 Belgrade, Serbia*

16.15 – 16.30 Phonon anomalies in FeS

Ana Milosavljević[1], Andreas Baum[2,3], Nenad Lazarević[1], Miloš M. Radonjić[4], Božidar Nikolić[5], Merlin Mitschek[2,3], Zahra Inanloo Maranloo[2], Maja Šćepanović[1], Nenad Stojilović[1], Matthias Opel[2], Aifeng Wang[6], Čedomir Petrović[6], Zoran V. Popović[1], Rudi Kackl[2]

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Technische Universitat Munchen, 85748 Garching, Germany, [4]Scientific Computing Laboratory, Center for the Study of Complex Systems, Institute of Physics Belgrade, University of Belgrade, Pregrevica 118, 11080 Belgrade, Serbia, [5]Faculty of Physics, University of Belgrade, Studentski trg 12, Belgrade, Serbia, [6]Condensed Matter Physics and Materials Science Department, Brookhaven National Laboratory, Upton, NY 11973-5000, USA

16.30 – 16.45 New GeV optical center in high-quality diamonds for novel applications
Kirill Boldyrev, Marina Popova
Institute of Spectroscopy Russian Academy of Sciences, 1462-485, Zelenograd, Moscow, Russia

Friday, December 8, 2017

Hall 3, Serbian Academy of Sciences and Arts
Knez Mihailova 35/I

09.00 – 10.45 10th Session – Nanostructured Materials I
Chairpersons: Dr. Sonja Jovanović and Željko Mravik

09.00 – 09.15 Synthesis and characterization of nanofibrous polyaniline
Jana Mišurović, Gordana Ćirić-Marjanović
University of Belgrade, Faculty of Physical Chemistry, Studentski trg 12-16, 11158 Belgrade, Serbia

09.15 – 09.30 Low energy Ag ion implantation in monocrystalline silicon
Almedina Modrić-Šahbazović,[1] Mirjana Novaković,[2] Nataša Bibić,[2] Zlatko Rakočević[2]
[1]University of Tuzla, Faculty of Natural Sciences and Mathematics, 75000 Tuzla, BiH, [2]University of Belgrade, Institute of Nuclear Sciences VINCA, 11351 Belgrade, Serbia

09.30 – 09.45 Surface chemistry, thermal stability and structural properties of graphene oxide/12-tungstophosphoric acid nanocomposite
Željko Mravik,[1] Danica Bajuk-Bogdanović,[2] Smilja Marković,[3] Ivanka Holclajtner-Antunović,[2] Zoran Jovanović[1]
[1]Laboratory of Physics, Vinča Institute of Nuclear Sciences, University of Belgrade, P.O. Box 522, 11001 Belgrade, Serbia, [2]Faculty of Physical Chemistry, University of Belgrade, P.O. Box 47, 11158 Belgrade, Serbia, [3]Institute of Technical Sciences of SASA, Knez Mihailova 35/IV, 11000 Belgrade, Serbia

09.45 – 10.00 Graphene and graphene/diamonds metal composites used in military industry
Konrad Terpiłowski,[1] Michał Chodkowski,[2] Salvador Peréz-Huertas[1]

[1]Department of Physical Chemistry-Interfacial Phenomena, Maria Curie Sklodowska University, Lublin, Poland, [2]Department for the Modeling of Physico-Chemical Processes, Maria Curie Sklodowska University, Lublin, Poland

10.00 – 10.15 Is WO_3 catalyst for hydrogen desorption?
Tijana Pantić,[1] Igor Milanović,[1,3] Miodrag J. Lukić,[2] Jasmina Grbović Novaković,[1] Sandra Kurko,[1] Nikola Biliškov,[3] Sanja Milošević[1]
[1]Vinča Institute of Nuclear Sciences, University of Belgrade, P.O.Box 522, 11000 Belgrade, Serbia, [2]Institute of Technical Sciences of the Serbian Academy of Sciences and Arts, P.O. Box 377, 11000 Belgrade, Serbia, [3]Ruđer Bošković Institute, Bijenička cesta 54, 10000 Zagreb, Croatia

10.15 – 10.30 Polycaprolactone beads and foams substrates modified with colloidal TiO_2 nanoparticles for application in photocatalysis
Darka Marković,[1] Stoja Milovanović,[2] Marija Radoičić,[3] Željko Radovanović,[1] Irena Žižović,[4] Zoran Šaponjić,[3] Maja Radetić[2]
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10.30 – 10.45 Best of two worlds: Combination of magnetic and semiconductor properties in (Ga,Mn)(Bi,As) nanostructured thin films
Khrystyna Levchenko,[1] Tomasz Andrearczyk,[1] Janusz Sadowski,[1,2] Elzbieta Lusakowska,[1] Jaroslaw Domagala,[1] Malgorzata Trzyna,[3] Rafal Jakiela,[1] Igor Radelytskyi,[1] Jerzy Wrobel,[1] Tadeusz Figielski,[1] Tadeusz Wosinski[1]
[1]Institute of Physics, Polish Academy of Sciences, PL-02668 Warsaw, Poland, [2]MAX-IV Laboratory, Lund University, P.O. Box 118, SE-221 00 Lund, Sweden, [3]Faculty of Mathematics and Natural Sciences, University of Rzeszow, PL-35310 Rzeszow, Poland

10.45 – 11.00 Break

11.00 – 12.45 11th Session – Nanostructured Materials II
Chairpersons: Dr. Nadica Abazović and Halyna Klym

11.00 – 11.15 Investigation of optical properties in the of GeS_2-Ga_2S_3-CsCl chalcogenide glasses
Halyna Klym
Lviv Polytechnic National University, 12 Bandera str., Lviv, 79013, Ukraine

11.15 – 11.30 Physicochemical properties of cobalt ferrite nanoparticles doped with zinc
Jelena Rmuš,[1] Sonja Jovanović,[2] Davide Peddis,[3] Danica Bajuk-Bogdanović,[1] Danilo Suvorov[4]

[1]Faculty of Physical Chemistry, University of Belgrade, Belgrade, Serbia, [2]Laboratory of Physics, Vinča Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia, [3]nM2-Lab, Istituto di Struttura della Materia, CNR, Monterotondo Scalo (Roma) 00015, Italy, [4]Advanced Materials Department, Jožef Stefan Institute, Ljubljana, Slovenia

11.30 – 11.45 Dynamic microfluidic control of supramolecular peptide self-assembly
Zohar A. Arnon,[1] Andreas Vitalis,[2] Aviad Levin,[1] Thomas C. T. Michaels,[3] Amedeo Caflisch,[2] Tuomas P. J. Knowles,[3] Lihi Adler-Abramovich,[4] Ehud Gazit[1,5]
[1]Department of Molecular Microbiology and Biotechnology, George S. Wise Faculty of Life Sciences, Tel Aviv University, Tel Aviv 69978, Israel, [2]Department of Biochemistry, University of Zurich, Winterthurerstrasse 190, CH-8057 Zurich, Switzerland, [3]Department of Chemistry, University of Cambridge, Lensfield Road, Cambridge, CB2 1EW, UK, [4]Department of Oral Biology, The Goldschleger School of Dental Medicine, Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv 69978, Israel, [5]Department of Materials Science and Engineering, Iby and Aladar Fleischman Faculty of Engineering, Tel Aviv University, Tel Aviv 69978, Israel

11.45 – 12.00 Influence of etching duration on emission properties of thin films with Si-sponge structures
Olha Babenko,[1] Mykola Semenenko,[2] Roman Red'ko,[2] Svitlana Red'ko[2]
[1]National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", [2]V. Lashkaryov Institute of Semiconductor Physics of the National Academy of Sciences of Ukraine

12.00 – 12.15 The room-temperature ferromagnetism (RTFM) in mixed-phase TiO_2 nanoparticles
Denis A. Bobreshov, Maxim V. Kuznetsov
All-Russian Research Institute on Problems of Civil Defense and Emergencies of Emergency Control Ministry of Russia (EMERCOM), 7 Davidkovskaya Street, Moscow, 121352 Russia

12.15 – 12.30 Modeling of the planetary ball-milling process for the case of TiC powder
Mohsen Mhadhbi
Laboratory of Useful Materials, National Institute of Research and Physical-chemical Analysis, Technopole, Sidi Thabet 2020 Ariana, Tunisia

12.30 – 13.45 Lunch break

13.45 – 15.30 12th Session – New Synthesis and Processing Methods I
Chairpersons: Dr. Rastko Vasilić and Damian Migas

13.45 – 14.00 Effect of ultrasonic-assisted preparation of powders on synthesis of rare earth zirconates
Damian Migas,[1] Marta Mikuśkiewicz,[1] Grzegorz Moskal,[1] Piotr Szperlich[2]

[1]*Institute of Materials Engineering, Silesian University of Technology, Krasinskiego 8, Katowice 40-019, Poland,* [2]*Institute of Physics – Centre for Science and Education, Silesian University of Technology, Krasinskiego 8, Katowice 40-019, Poland*

14.00 – 14.15 Oxygen evolution reaction on the electrochemically synthesized nickel oxides

Stefan Đokić,[1] Maja Obradović,[2] Snežana Gojković[1]
[1]*Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4, Belgrade, Serbia,* [2]*Institute of Chemistry, Technology and Metallurgy, University of Belgrade, Njegoševa 12, Belgrade, Serbia*

14.15 – 14.30 Bipolar electrochemistry a powerful tool for simultaneous wireless synthesis and activation of electrochemiluminescent thermoresponsive Janus objects

Milica Sentić,[1,2] Oranit Phuakkong,[1,2,3] Haidong Li,[2] Chompunuch Warakulwit,[2,3] Jumras Limtrakul,[5] Milka Vidović,[1] Nešo Sojić,[2] Alexander Kuhn,[2] Valerie Ravaine,[2] Dodzi Zigah[2]
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14.30 – 14.45 Comparison of textural propertis of the Ti-SiO_2 catalyst support and novel PdRe/Ti-SiO_2 catalyst

Dragana Prokić Vidojević,[1] Sandra B. Glišić,[2] Aleksandar M. Orlović[2]
[1]*Military Technical Institute (VTI), Ratka Resanovića 1, 11132 Belgrade, Serbia,* [2]*University of Belgrade, Faculty of Technology and Metallurgy, Karnegijeva 4, 11000 Belgrade, Serbia*

14.45 – 15.00 The process of flavonoid micellar extraction

Anna Taraba, Magdalena Szaniawska, Katarzyna Szymczyk
Department of Interfacial Phenomena, Faculty of Chemistry, Maria Curie-Skłodowska University, Maria Curie-Skłodowska Sq. 3, 20-031 Lublin, Poland

15.00 – 15.15 The influence of molybdenum and tungsten bronzes on the Briggs-Rauscher reaction dynamics

Tijana V. Maksimović, Jelena P. Maksimović, Maja C. Pagnacco, Ljubinka Joksović, Zoran P. Nedić
Faculty of Science, Department of Chemistry, University of Kragujevac, Radoja Domanovića 12, 34000 Kragujevac, Serbia, Faculty of Physical Chemistry, University of Belgrade, Studentskitrg 12-16, P.O. Box 47, 11158 Belgrade, Serbia

15.15 – 15.30 Adsorption and volumetric properties of surfactants used in extraction process

Magdalena Szaniawska, Anna Taraba, Katarzyna Szymczyk
Department of Interfacial Phenomena, Faculty of Chemistry, Maria Curie-Sklodowska University, Lublin, Poland

15.30 – 15.45 Break

15.45 – 17.15 13th Session – New Synthesis and Processing Methods II
Chairpersons: Dr. Smilja Marković and Ana Kramar

15.45 – 16.00 Monitoring oxidation of cellulose fibers using zeta potential measurements

Ana Kramar, Marina Knežević, Teodora Hajnrih, Matea Korica, Jovana Milanović, Mirjana Kostić
Faculty of Technology and Metallurgy, Department of Textile Engineering, University of Belgrade, Karnegijeva 4, 11000 Belgrade, Serbia

16.00 – 16.15 Air permeability of differently softened cotton and cotton/elastane knitted fabrics

Aleksandra Ivanovska, Biljana Mangovska, Goran Demboski
Faculty of Technology and Metallurgy, Rudzer Boskovic 16 Skopje, Macedonia

16.15 – 16.30 Synergistic solid lubricants system based on selected sulfides of technology metals

Nataša Gajić,[1] Zoran Anđić,[2] Jovana Đokić,[2] Željko Kamberović[3]
[1]Innovation Center of the Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4, 11120 Belgrade, Serbia, [2]Innovation Center of the Faculty of Chemistry, University of Belgrade, Studentski trg 12-16, 11000 Belgrade, Serbia, [3]Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4, 11120 Belgrade, Serbia

16.30 – 16.45 New approaches to the problem of forests recovery by introduction of environmental friendly technologies of wood processing to obtain high-quality composite biomaterials

Alexey V. Safonov, Maxim V. Kuznetsov
All-Russian Research Institute on Problems of Civil Defense and Emergencies of Emergency Control Ministry of Russia (EMERCOM), 7 Davidkovskaya Street, Moscow, 121352 Russia

16.45 – 17.00 Influence of tensile temperature changes on mechanical properties of $Co_{20}Cr_{20}Fe_{20}Mn_{20}Ni_{20}$ and $CoCr_{26}FeMnNi_{14}$ high entropy alloys under 300 K and 77 K

Anastasiia V. Levenets, M.A. Tihonovskiy, V.S. Okovit, I.V. Kolodiy, V.V. Kalinovskiy, R.L. Vasilenko, Y.S. Lipovskaya
National Science Center "Kharkov Institute of Physics and Technology", 1, Akademicheskaya St., Kharkiv, Ukraine

17.00 – 17.15 Mechanical properties of geopolymer panel composites with different types of geosynthetics

Mehmet Metin Kose,[1] Muslum Murat Maras[2]
[1]*Department of Civil Engineering, Kahramanmaras Sutcu Imam University, 46050-9 Kahramanmaras, Turkey,* [2] *Department of Civil Technology, University of Inonu, Malatya, Turkey*

17.20 Closing Ceremony

1-1

Spectral analysis of external magnetic field influence on magnetic oxide nano-particles in ferrofluid

Ljubica Anđelković,[1] Marija Šuljagić,[2] Aleksandar S. Nikolić[2]
[1]Department of Chemistry, IChTM, University of Belgrade, Studentski Trg 12-16, 11000 Belgrade, Serbia, [2]Faculty of Chemistry, University of Belgrade, Studentski Trg 12-16, 11000 Belgrade, Serbia

Light transmitting measurements of white light and laser beam propagating through $FeFe_2O_4$, $CoFe_2O_4$ and $MgFe_2O_4$ nanoparticles coated with starch, citric and oleic acid, under the influence of an external magnetic field in the range of 30-400 mT, were presented. The unexpected and unusually large changes of transmitted light occurred. This can be explained by the model based on ordering of magnetic moments of nano-particles along the lines of magnetic field into magnetic chains and organization of magnetic chains into spatial structure - a quasi-lattice.

Under the influence of external magnetic field, a precipitation of all studied samples was obtained. To the best of our knowledge, the field-induced precipitation effect of ferrites in ferrofluid was not analysed so far and its significance and influence on the further laser treatment of patients previously exposed to ferrite-based MRI agents is not well recognized. This should be of great importance, since neglecting of the precipitation effect would lead to inappropriate response when patients are exposed to diagnostic and/or therapy procedures.

1-2

Photo-driven upconversion in $NaYF_4$:Yb,Er@chitosane particles for cancer cells bioimaging

Ivana Dinić,[1] Aleksandra Đukić-Vuković,[3] Marko Nikolić,[4]
Olivera Milošević,[2] Lidija Mančić[2]
[1]Innovation Center of the Faculty of Chemistry, University of Belgrade, Serbia, [2]Institute of Technical Sciences of SASA, Belgrade, Serbia, [3]Department of Biochemical Engineering and Biotechnology Faculty of Technology and Metallurgy, University of Belgrade, Serbia, [4]Photonic Center, Institute of Physics Belgrade, University of Belgrade, Zemun, Belgrade, Serbia

Lanthanide doped up-converting nanoparticles (UCNPs) have significant role in biomedical field, especially in cell imaging and target drug delivery, due to their convenient luminescent properties. For that purpose UCNPs should have the specific morphological and luminescent characteristics. In this study the biocompatible $NaYF_4$:Yb,Er@Chitosane particles were synthesized through one-step hydrothermal synthesis. Obtained particles were characterized in detail using X-ray powder diffraction (XRPD), Fourier-transform infrared (FTIR) spectroscopy, field emission scanning and transmission electron microscopy (FESEM and TEM) and photoluminesce measurement (PL). Structural refinement data show the presence of cubic (Fm-3m) phase in spherical shaped nanoparticles size up to 200 nm, while the FTIR analysis revealed the presence of chitosan on the particle surface which have no influence on the luminescence efficiency of the UCNPs. Cytotoxicity as well as cell labeling capability of synthesized UCNPs were tested in vitro on the human gingival fibroblasts (HGF) and head and neck squamous carcinoma cells (HNSCC). The results show excellent biocompatibility against HGF, and successful in- vitro visualization of HNSCC cell cultures upon 980 nm laser irradiation.

1-3

The synthesis and properties of biocomposite porous hydrogels based on hydroxyapatite, poly(methacrylic acid) and casein

Vukašin Ugrinović,[1] Vesna Panić,[2] Pavle Spasojević,[2] ĐorđeVeljović,[1]
Ivanka Popović,[1] Đorđe Janaćković[1]
[1]University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia,
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Scaffolds are inserted into a human body in order to, temporarily or permanently, retake the function of the damaged bone tissue. So far, the composites based on polymers and ceramics have been recognised as the most perspective materials for the bone tissue engineering scaffolds, as they resemble the structure of the natural bone.

In this work, composite hydrogels, composed of calcium hydroxyapatite (HAp) and poly(methacrylic acid) (PMAA), were synthesized by free-radical polymerization. Thereby, the neutralization degree of the monomer was varied. All of the hydrogels presented have a high content of HAp (>60 wt%). In order to enhance the biocompatibility and bioactivity, one series of hydrogels containing protein casein was synthesized as well. The composites were characterized by the methods of scanning electron microscopy (SEM) and dynamic mechanical analysis (DMA). Equilibrium swelling degree (SDeq) was determined in the water and in the simulated body fluid (SBF). It was found that the increase in the degree of neutralization increased the SDeq of the composites. The addition of the casein increased the SDeq. The SDeq of all the composites were significantly lower in SBF than in the water. SEM examinations revealed the uniform distribution and the strong bond of HAp particles within the polymeric matrix. Incubation in SBF in the 14 days period demonstrated the formation of crystals of similar shape to HAp, which could indicate the bioactivity of composites. The increase in the degree of neutralization led to the decrease in storage modulus of composites, while the incorporation of HAp nanoparticles significantly enhanced the mechanical properties of the neat PMAA hydrogels.

1-4

Electrophoretic deposition of biocomposite ceramic coatings of hydroxyapatyte and chitosan with silver and gentamicin on titanium for medical applications

Iva Ilić,[1] Ana Janković,[1] Marija Đošić,[2]
Maja Vukašinović-Sekulić,[1] Vesna Mišković-Stanković[1]
[1]Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4, Belgrade 11000, Serbia, [2]Institute for Technology of Nuclear and other Mineral Raw Materials (ITNMS), Bulevar Franše d'Eperea 86, Belgrade 11000, Serbia

Biocomposite ceramic coatings hydroxyapatite (HAP), silver/hydroxyapatite (Ag/HAP) and silver/hydroxyapatite/graphene (Ag/HAP/Gr) are obtained on titanium by electrophoretic deposition (EPD). The goal of this research was to develop multifunctional composite coatings as a suitable strategy to improve the surface properties of metallic implants. The deposition was performed on titanium electrodes with specific geometry suitable for implantation in the frontal bone of rabbits for in vivo experiments. The effect of deposition parameters on deposited mass was investigated by varying different values of constant voltage for various deposition time. Uniform and compact HAP coatings were successfully deposited at applied voltage of 30 V for 45 s, whereas Ag/HAP and Ag/HAP/Gr coatings with satisfying adhesion and coverage were deposited at applied voltage of 60 V for 1 min. Bearing in mind certain toxic effects of the nanoparticle silver, the deposition of the coating of hydroxyapatite/chitosan/graphene (HAP/CS/Gr) of the same composition with the addition of the antibiotic gentamicin was performed, in order to replace the silver nanoparticles. The antimicrobial activity of the coating HAP/CS/Gr without and with gentamicin against Staphylococcus aureus and Escherichia coli was examined by agar diffusion test. Moreover, disc diffusion test showed improved bactericidal effect of gentamicin-loaded composite coatings against Staphylococcus aureus and Escherichia coli compared to control non-gentamicin-loaded coatings.

1-5

Silk design and conformation as biomaterial, and in vitro proliferation cell test

Adrián Blanco Fernández,[1] David Don Lopez,[1,2,3] Francisco Guitián Rivera,[1]
[1]Instituto de Cerámica de Galicia, Santiago de Compostela, Spain, [2]Lawrence Berkeley National Laboratory, California, USA, [3]Tehran University of Medical Sciences, Tehran, Iran

Nowadays, science of biomaterials has been developed to obtain materials that, in addition to being biocompatible, interact with living tissue. This bioactive behavior allows new applications in fields such as biomedicine and pharmacology, improving current disease treatments which affect world´s population.

This study has focused in developing pieces with different conformations and composition. The main aim is to design pieces that can inducing cell proliferation. Moreover, an in vitro cell proliferation test is carried out. The main material used in this study is silk fibroin. Its special and versatile properties provide it good levels of biocompatibility, bioactivity and biodegradation. The silk has been subjected to a process of dissolution and extraction in which the proteins that compose it are separated. Through this process the fibroin is obtained. The other two materials used are hydroxyapatite and BioGlass 45s5. Hydroxyapatite shows good biocompatibility and it has been demonstrated that promotes osteogenic process. BioGlass 45s5, also has osteoinductive and osteoconductive properties, which promote cell regeneration. Three different types of conformations were designed: gels, films and spongy sccafolds. Each of them has been designed with three different compositions: silk fibroin, silk fibroin with hydroxyapatite and silk fibroin with BioGlass 45s5. The scaffolds were designed through a lyophilization process and then crosslinked using NHS (N-hydroxysuccinimide) and EDC (1-ethyl-3- (3-dimethylaminopropyl) carbodiimide). Finally, all structures obtained in this study were tested in vitro (WST-1 cell proliferation assay) using mesenchymal stem cells. Interesting results were obtained, where some conformations apparently cause an increase in cell proliferation and others appear to be potentially cytotoxic.

1-6

Experimental analysis of low density poly ethylene effect on the mechanical properties of poly ethylene vinyl acetate for prosthetic and orthotic application

Yenealem Yilma, Asmamew Tegegn
Ethiopia Biotechnology Institute, Addis Ababa, Ethiopia

In this comparative study, the effect of low density poly ethylene and ethylene vinyl acetate loading ratio by melt blending with additives and without additives on mechanical properties for prosthetic and orthotic application was analyzed. To carry out this thermoplastic materials such as low density poly ethylene (LDPE), Ethylene vinyl acetate (EVA), color pigment, calcium carbonate, titanium dioxide and black carbon have been used as raw material to produce the sample in sheet form and to achieve comfortable prosthetic and orthotic application. The method used were blending, molding, testing of produced materials. Increasing the content of EVA and decreasing content of LDPE had effect on compatibility, tensile strength and elongation at break vice versa. The blended composite with additives have no significant effect on molding and without additive have significant effect on molding due to molecular mobility which leads shrinkage. The maximum tensile strength reached to 10.5Mpa and minimum tensile strength reached 2.8Mpa and the maximum elongation at break reached 469.8% and minimum elongation at break 40.2%.The other result are in between of these ranges, which have better than existing one has maximum tensile strength of 2.3Mpa and elongation at break have 265%.The mean value of maximum tear load is 74.4N/mm and minimum tear load have 38.9N/mm which have better result than existing one has 10.5N/mm. Scanning electron microscope (SEM) test result showed that specimen with more filler and less content of EVA become poor in its morphology and compatibility.

2-1

The influence of chitosan content on antibacterial properties and silver release for silver/poly(vinyl alcohol)/chitosan/graphene hydrogels

Katarina Nešović, Ana Janković, Maja Vukašinović-Sekulić,
Aleksandra Perić-Grujić, Vesna Mišković-Stanković
Faculty of Technology and Metallurgy, University of Belgrade, Serbia

In this work, in situ electrochemical reduction of silver ions in the hydrogel matrices was employed to obtain nanocomposite silver/polyvinyl alcohol/chitosan/graphene (Ag/PVA/CHI/Gr) hydrogels. In order to investigate the influence of chitosan content on physico-chemical and biological properties of the hydrogels, 0.1 wt. % and 0.5 wt. % CHI were used. The silver nanoparticles (AgNPs) exhibit strong absorption in the wavelength range of 400–410 nm due to surface plasmon resonance effect, which was used to prove the silver nanoparticles in polymer matrix by UV–visible spectroscopy. Raman spectroscopy and Fourier-transform infrared spectroscopy (FT-IR) indicated strong bonding between AgNPs and functional groups of poly(vinyl alcohol) and chitosan, which contributed to the stabilization of AgNPs inside the polymer matrix. The antibacterial properties of the synthesized nanocomposite hydrogels were tested against Staphylococcus aureus and Escherichia coli bacterial cultures using the disc-diffusion method. Finally, the release of silver as an antibacterial agent was monitored for 28 days in a modified phosphate-buffered saline (PBS). The obtained profiles indicated that the kinetics of silver release is in line with the requirements for topical wound dressing materials, namely the initial burst-release behavior to prevent the biofilm formation and later slower release to ensure prolonged use. Additionally, the release data were fitted against several kinetic diffusion models to quantitatively determine the kinetic parameters. The value of diffusion coefficient of silver was greater for hydrogel with 0.1 wt. % CHI in respect to hydrogel with 0.5 wt. % CHI, indicating stronger stabilization and better characteristics of the hydrogels with higher CHI content.

2-2

Production of nanocomposite hydrogels based on poly(vinyl alcohol), honey and silver nanoparticles

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The purpose of this study was to produce nanocomposite hydrogels based on poly(vinyl alcohol) (PVA), honey and silver nanoparticles for potential use as biocompatible, antimicrobial wound dressings that will enhance wound healing by stimulative effects of honey as well as by antimicrobial activity of released silver. The hydrogels were produced by a freezing-thawing technique that was studied regarding the influences of: i) PVA concentration (8-17 mass%), ii) temperature (-20 °C and -30 °C), iii) addition of a gelling solution (92 % w/w monoethylene glycol, 1.5 % w/w sodium metasilicate, 2 % w/w sodium tetraborate decahydrate, 0.35 % w/w benzotriazol) and iv) number of freezing-thawing cycles. The obtained disc-shaped hydrogels were biomechanically characterized using a biomimetic bioreactor with dynamic compression (337.5 mm/s compression rate, frequency in the range of 0.24-0.56 Hz, and 10 % deformation). Discs containing 12 % w/w PVA made by freezing at -30 °C in 4 cycles without the gelling solution were selected as the most promising candidates exhibiting the highest compression modulus of 124,3 ± 0,4 kPa.

2-3

Characterization of alginate hydrogels with honey components and silver nanoparticles

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In this study, we have produced and characterized alginate hydrogels with incorporated honey components and silver nanoparticles (AgNPs) aimed for biomedical applications. AgNP synthesis was carried out in 50% w/w aqueous honey solution followed by mixing with sodium alginate solution (2% w/w final concentration) and gelation in 6-well plates to yield nanocomposite hydrogel discs. The presence of AgNPs was confirmed using UV-visible spectroscopy while the total silver content was determined by atomic absorption spectroscopy (AAS) amounting to 5.64 ± 0.44 mM. The retention of honey components in nanocomposite hydrogels was confirmed by Fourier-transform infrared spectroscopy (FTIR). Ultimately, bactericidal effects were demonstrated against S. aureus and E. coli. These results show promise in application of nanocomposite alginate hydrogels in wound treatment, as a possible substitute to antibiotics.

2-4

Biodegradable polymer/hydrogel composite for controlled delivery of cationic formulations

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Composites of biodegradable polymers and hydrogels are promising materials for controlled delivery systems with prolonged drug release. In this contribution, we present an innovative implant design comprising poly(DL-lactide-co-ε-caprolactone) copolymer base and a crosslinked poly(acrylic acid) hydrogel. Implants were prepared in the form of disks using the modified traditional liquid phase inversion process. Solutions containing all implant precursors were dispensed into transparent non-stick molds and cured by UV irradiation. UV curing was followed by immersion into the phosphate buffer solution bath to achieve phase separation and solidification. Structure and composition of the implant were characterized using SEM and FTIR. Obtained implants exhibited high loading capacity for cationic formulations and a moderate degree of swelling. Studies of implant loading and subsequent release of methylene blue into the phosphate-buffered saline demonstrated diffusion-controlled delivery kinetics over a period of several weeks. To assess biocompatibility of implants as possible materials for drug delivery systems in mammals, we evaluated their effects on viability (Trypan blue exclusion assay), metabolic activity, proliferation (MTT assay) and priming (nitric oxide/NO production) of freshly isolated rat splenocytes during 24 h and 48 h of cultivation. The viability was unaltered, metabolic activity/proliferation was increased after 48 h and the decrease of NO production, as well as drop in responsiveness to cell mitogen concanavalin A (ConA) in cells on implants were observed. These results suggest that implants could be used as a suitable material for drug delivery systems, but their capacity to stimulate cell proliferation and their immunosuppressive potential deserve further investigations.

2-5

Adsorption studies of lignin model compounds on activated charcoal particles

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In this work we have investigated possibilities for immobilization of lignin model compounds (LMCs) as potential antimicrobial agents on activated charcoal particles aimed for applications in wound dressings. LMC adsorption kinetics was determined for different initial LMC concentrations (0.1, 0.5 and 1.1 mg ml^{-1}) by using UV-visible spectroscopy over 24 h when the equilibrium was reached. LMC adsorption on charcoal particles was confirmed by Fourier-transform infrared spectroscopy (FTIR). Adsorption kinetics was successfully modeled by the pseudo-second order Lagergren model while the adsorption isotherm at room temperature could be described by both Freundlich and Langmuir models showing satisfactory agreements. The maximal capacity of activated charcoal particles for LMCs according to the Langmuir model was 312.5 mg g^{-1}. However, the immobilizates did not exhibit antibacterial activity against Pseudomonas aeruginosa indicating the need for further studies of LMC adsorption mechanism with the specific aim to elucidate exact compounds or functional groups responsible for antimicrobial action and their conformation on activated charcoal.

2-6

Interfacial properties of titanium dioxide - chitosan - hyaluronic acid systems

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The cosmetic industry recognizes titanium (IV) oxide as a brightening and covering substrate that ideally act as an interference pigment in lipsticks, undercoats or toothpastes. TiO_2 is a common and durable amphoteric oxide, is non-toxic and the pH of its aqueous dispersion is similar to that of the skin. In cosmetics, it also can be used as a natural UV filter that has the ability to absorb, reflect, and split sunlight. TiO_2 nanoparticles also have antimicrobial properties, similarly as chitosan (CH) - a highly biocompatible and biodegradable polymer. An important feature that allows the widespread use of chitosan in pharmaceuticals and cosmetics is the presence of free amino and hydroxyl groups in the chain of its macromolecules, which determine its high adhesion and adsorption capacity. Immunologically active CH also fulfills protective functions by retarding product aging and water loss, while TiO_2 improves CH thermal stability and oxidation resistance. Due to its unique physicochemical and antibacterial nature, both compounds can be incorporated into skin substitutes. The biocompatibility of substitutes improves the presence of hyaluronic acid (HA). The hyaluronic acid molecule contains in its structure free hydroxyl groups which bind water molecules by means of hydrogen bonds. Due to its water-binding properties, hyaluronic acid, used even in small concentrations, forms a hydrophilic film on the epidermis surface, limiting the evaporation of water, protecting against the adverse effects of external factors, including climate. Because the titanium (IV) oxide particles can have a negative impact on biological cells, understanding the interaction of titanium dioxide with cell membranes is an important step towards understanding the biological effects. The main membrane components are phospholipids. Their amphiphilicity makes it possible to test their properties in the interfacial areas. Particularly frequently used membrane model system is Langmuir monolayers (L) formed on the water-air interface.

The aim of the study was physico-chemical characteristic and interfacial properties of TiO_2 - CH - HA systems. This goal was achieved by examining the changes of surface free energy, the wettability of the examined systems and their topography. Phospholipid DPPC (dipalmitoylphosphatidylcholine) was used as a universal component of biological membranes. The surface’s character has been developed based on wetting test of three test liquids. The obtained results were interpreted in relation to the energy parameters and topography of the examined surfaces. Variable wettability can be a convenient parameter to inform about the properties of artificial skin. The rational combination of applied research techniques allowed for the full characterization bio materials. Physico-chemical systems have been developed that can be used in the controlled release of active ingredients as well as in the production of antibacterial films and imitation skin composites.

3-1

Synthesis and characterization of novel spider silk-based composites

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Spider silk (SS) has been well known by its extraordinary mechanical properties paired with biocompatibility and possibility of transformation into a various material forms. In this work SS was used as a template for synthesis of three novel biomaterials: SS-calcite composite, SS coated with europium doped ceria nanoparticles, and SS coated with superparamagnetic γ-Fe_2O_3 nanoparticles. SS-calcite composite was synthesized by simple method using biomineralization approach. The biomineralization process was observed during five days and it was found that two days of treatment were sufficient to obtain pure rhombic-shaped calcite crystals homogeneously dispersed trough 3D spider mesh. With increasing the incubation time, the number and size of crystals increased. SS coated with Eu doped nanoceria was easily obtained by time and cost effective precipitation synthesis procedure. The SS fibers were homogeneously coated with Eu doped CeO_2 nanoparticles with average nanoparticle size of 3 nm due to a great affinity of ceria to oxygen rich functional groups of SS proteins. Eu^{3+} was introduced as an activator ion in ceria crystal lattice and luminescent properties of the obtained composite were investigated by excitation spectra. SS coated with superparamagnetic γ-Fe_2O_3 nanoparticles was obtained with similar precipitation technique. Maghemite nanoparticles were uniformly distributed on the surface of SS fibers and magnetic properties of obtained composite were described. These three novel composites open new possibilities for spider silk based materials in various fields, especially for biomedical application.

3-2

Impregnation of cellulose acetate films with carvacrol using supercritical carbon dioxide

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Cellulose acetate films were produced by the solvent casting method and subsequently impregnated with carvacrol using supercritical carbon dioxide. Supercritical impregnation process in a static regime at temperature of 50 °C was optimized by variation in pressure (10 MPa and 21 MPa), processing time up to 2 hours and decompression rate from 0.3 MPa/min to 36 MPa/min. Topography of the cellulose acetate films was recorded by Atomic Force Microscopy (AFM) while Differential Scanning Calorimetry (DSC) was used to estimate change in thermic properties of non-impregnated and carvacrol-impregnated films. Obtained carvacrol impregnated cellulose acetate films can find application in food industry as active food packaging or in medicine considering its biocompatibility and biodegradability as well as its antimicrobial activity.

3-3

Porous alginate hydrogels with bioactive hydroxyapatite precursors for bone tissue engineering

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The aim of this work was to investigate possibilities for production of novel macroporous scaffolds based on alginate hydrogels with addition of β-tricalcium phosphate (β-TCP) as a bioactive precursor of hydroxyapatite for potential use in bone tissue engineering. We have examined influence of two alginate concentrations (1.5 % and 2 %) and four β-TCP concentrations (0.5 %, 0.67 %, 1.5 % and 2 %). Produced samples were characterized regarding mechanical properties using a bioreactor with dynamic compression at the rate of 337.5 µm/s, frequency of 0.42 Hz and a deformation of 10 %. Scanning electron microscopy has shown uniformity of the non-organic phase within the obtained scaffolds and high porosity with open pores. The increase in β-TCP concentration led to the increase in dynamic compression modulus. The obtained results indicated potentials of novel scaffolds for use in bone tissue engineering.

3-4

Electrochemically obtained bioactive nanocomposite coating based on hydroxyapatite and chitosan loaded with gentamicin

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A broad spectrum antibiotic-gentamicin was loaded in a composite coating of hydroxyapatite (HAP) with natural polymer chitosan (CS) using electrophoretic deposition (EPD) technique. EPD was carried out at the constant voltage on pure titanium plates from an aqueous suspension. The aim was to assemble porous homogenous coating with improved mechanical strength and favourable antibacterial properties. HAP/CS/Gent coating was characterized by X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FT-IR), thermogravimetric analysis (TGA) and field emission scanning electron microscopy (FE-SEM). Obtained results confirmed the formation of a new composite coating HAP/CS/Gent. In the XRD spectrum of HAP/CS/Gent only characteristic crystal planes of HAP were detected. FTIR analysis confirmed the formation of intermolecular and intramolecular hydrogen bonds in the composite coating. TGA analysis was employed to investigate the thermal stability of HAP/CS/Gent. The bioactivity of HAP/CS/Gent composite coating was proved by SEM analysis. The obtained SEM micrographs indicate the biomimetic growth of a new apatite layer after immersion in SBF. The antibiotic loaded coating (HAP/CS/Gent) exhibited good antibacterial activity against Staphylococcus aureus and Escherichia coli, indicating the high potential for biomedical applications. Additionally, the results have shown that the antibacterial effect of HAP/CS/Gent was more pronounced against S. aureus compared to E. coli.

3-5

Cation-substituted calcium phosphates containing ions of titanium and zirconium

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In this work, we conducted complex research on the effect of substitution of tetravalent biocompatible cations of titanium and zirconium on the crystal lattice parameters of hydroxyapatite (HA) and tricalciumphosphate (TCP), depending on the degree of substitution. Substitution was carried out in the range from 0.1 to 20 mol.% of the substituted cation (calcium). Syntheses were carried out by chemical deposition at a pH close to neutral (6.6-7.4) for TCP and alkaline (9.0-10.0) for HA. Materials based on HA were subjected to aging in the mother solution at physiological temperature (37 C) for 21 days. The powders were calcined at 900 °C. The resulting powders were examined by x-ray analysis. The solid solutions limits have been identified. It was detected a decrease in the unit cell parameters for the cation-substituted TCP with increasing degree of substitution. In the case of HA compounds substitution Ca ions to Zr ions decreases the unit cell parameters. When replacement of Ca ions to Ti ions in HA - the value of the crystal lattice parameters increase, which is associated with the HA structure.

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3-6

Influence of aluminium substitutions on phase composition and morphology of β - tricalcium phosphate and hydroxyapatite nanopowders

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Al-substituted beta-tricalcium phosphate (β-TCP) and hydroxyapatite (HA) nanopowders containing 0-20 mol.% of Al were obtained via precipitation method. The effect of Al content on the phase composition, lattice parameters, crystallite size, specific surface area and morphology of powders was established. Over the substitution range 0 – 1 mol.% the synthesis products consist of single whitlokite-like phase for Al-β-TCP and single apatite phase for Al-HA. For 5 – 20 mol.% of Al for β-TCP two separate whitlokite-like phases were indentified: Al enriched $Ca_9Al(PO_4)_7$ and β-TCP solid solution. For Al-HA the apatite phase distabilization and β-TCP formation were established since 5 mol. % of Al. For both series of materials - Al-β-TCP and Al-HA , the general trend is a reduction of crystalline and particle size with an increase of Al content. Al-HA with 20 mol.% substitution was formed by needle-like particles with average lenth of 70 nm and surface area of 90 m^2/g. Al-β-TCP with the same substitution was formed by spherical particles with average diameter 20-30 nm and surface area of 128 m^2/g.

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3-7

Fluid flow distribution studies in macroporous gellan gum hydrogels

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High porosity is one of the main requirements for biomaterials aimed for use in bone tissue engineering providing uniform cell seeding and efficient mass transport within scaffolds during in vitro cultivation as well as vascularization and good integration of bone grafts to the surrounding tissue upon implantation. Porous gellan gum (GG) hydrogels can be produced by freezing and lyophilization but it is important to preserve open and interconnected pores throughout the rehydration process. In this work, we have studied porosity of rehydrated GG discs (12 mm diameter, 5 mm thick) by using a tracer method in perfusion bioreactors at the flowrate of 1.1 ml/min. A step signal of ink was used and the ink concentration in the outlet samples was determined by UV-visible spectroscopy. From the obtained F curves, residence time distribution E curves were determined and fitted by the axial-dispersion model. The applied modeling has indicated flow channeling into one main (~50%) and one side channel (~35%) accompanied by many small channels indicating preserved porosity in scaffolds.

4-1

Utilization of different agro-industrialwastes for bioethanol production using an amylolytic potential from the Paenibacillus chitinolyticus CKS1

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Agro-industrial waste worldwide represents renewable resources (raw materials) that accumulate throughout the year. To awoid excessive accumulation of wastemore attention has been paid to the bioconversion of waste raw materials by microorganisms for obtainingthe biotechnologically valuable products. During the last few decades, enzymes mainly produced by microorganisms used in a hydrolysis process of agroindustrial waste substrates for obtaining liquid fuels are specifically requested.Bioethanol, as an alternative to petroleum based fuel, is one of the dominating renewable liquid fuels on the market. Released simple sugars by enzymatic hydrolysis of waste materials are fermented by yeast Saccharomyces cerevisiae into ethanol.

In this study, four different agroindustrial wastes: damaged rice grains, barley bran, corn meal and wastewater from transport packaging that contains starch glue were used as substrates for enzymeamylase production by P. chitinolyticus CKS1. Among them barley bran (4% barley bran, yeast extract 3g/l and casein hydrolysate 5g/l; 30 °C, 120 rpm, 48 h) showed maximum amylase production 1.65 U/ml. Enzymatic hydrolysis of different strach waste materials: damaged rice grains, barley bran, corn meal and wastewater from transport packaging using crude amylases showed that maximu reducing sugars 21.11 mg/ml were obtained using damaged rice grains. Optimal concentration of damaged rice grains for hydrolysis was 10% (50 °C, 150 rpm, 120h). After enzymatic hydrolysis of damaged rice, the obtained hydrolysate was used as a substrate in fermentation process with waste brewer`s yeast S. Cerevisiae (2% of inoculum).After 24 hours of fermentation at 30 °C 0.95% of ethanol was obtained. Theresults obtained in this study showed that agro-industrial wastes could be used as substrate for enzymes production and enzymatic hydrolysis. Among tested waste materials, damaged rice grains are the most suitable for bioethanol production.

4-2

Activated carbons as adsorbents of siloxanes: Adsorption and desorption study by in-situ FTIR

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Biogas produced from sludge in waste water treatment plant, as well as from landfills, can be collected and utilized as a clean energy source. However, a special issue regarding biogas concerns the presence of traces siloxanes, semi-volatile methylated organosilicon (VMS) compounds containing Si–O bonds originating from hygiene, health care and industrial products. During the biogas combustion, siloxanes are converted into crystalline silica inducing the engine damage.

The present work aims to investigate the adsorption and thermodesorption of decamethyltetrasiloxane (L4) over two commercial activated carbon (AC) samples (STIX and AP4-50 from ChemEnvirocarb) using the Diffuse Reflection Infrared Spectroscopy (DRIFTS). The physicochemical properties of ACs were characterized using various techniques like N_2 adsorption at 77 K, XRD, SEM and TGA. The adsorption experiments were performed by contacting a stream of L4 (40 ppm) in nitrogen with a mixture of AC/KBr at room temperature. The spectra recorded during this step are dominated by the response of the gas phase. Therefore, the adsorbed phase can be hardly observed. Upon saturation, the cell was purged under N_2 flow during 16h to eliminate L4 in the gas phase. The exhausted ACs underwent thermal programmed desorption from 25 °C to 300 °C (for STIX) or 400 °C (for AP4-50). At 25 °C, the spectra of ACs exhibit very weak bands of L4 in adsorbed phase. Upon heating, STIX sample shows mainly the decomposition of L4 into L2 between 80 and 200 °C accompanied by a small desorption of L4. Further heating leads to the polymerization of L4 into PolyDimethylSiloxane (PDMS). This compound is weakly volatile and cannot be completely removed at 300°C. For AP4-50, the release of L4 into the gas phase can be observed throughout the heating process (mainly between 175 and 350 °C). Small formation of L2 is noticed when heating up to 145 °C. No evidence of the polymerization can be found for this sample. The transformation of L4 during the thermodesorption can be related to its reaction with the surface functional groups of ACs. The determination of these groups which are responsible for the formation of PDMS seems to be important for improving the regenerability properties and the reuse of ACs.

4-3

Investigation of alginate-based absorbents for the nickel (Ni(II)) removal from water media

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In environmental engineering alginate can be used as biosorbent for heavy metal removal as well as for immobilization of living or dead cells, zeolites, active carbon or other material for removal of different pollutants. The aim of this work was investigation of Ca-alginate beads and alginate hemp fibers for low cost, efficient and evironmentally acceptable nickel removal from water media. Ca-alginate beads were prepared by drop-wise continuous extrusion of 2% water solution of sodium alginic acid into a 2% water solution of $CaCl_2$ under vigorous stirring. Alginate spherical beads, immediately formed when sodium alginate drops contacted with $CaCl_2$, were kept in $CaCl_2$ solution for 24 h, then washed with distilled water, left to dry at room temperature and soaked in the distilled water for rehydration. Alginate hemp fibers were made by soaking hemp fibers into 2% water soluton of sodium alginic acid. Fibers were kept in solution for 24 h, afterwards washed with distilled water, dried at room temperature and soaked in the distilled water for rehydration. Adsorption capacity of either Ca-alginate beads or alginate hemp fibers for nickel(II) removal was investigated by using a $NiCl_2$ water solution of different starting concentrations (20 to 75 ppm). The change of Ni(II) concentration was measured by atomic absorption spectroscopy (AAS). Two isotherm models, Langmuir and Freundlich, were employed to analyze Ni(II) uptake of alginate beads and alginate hemp fibers. The apsorption kinetics was analyzed by pseudo-first and pseudo-second order kinetics. Obtained results indicate that both adsorbents can be used as efficient and low-cost materials for heavy metal, namely Ni(II), removal from water.

4-4

Modelling of cation removal by seashell waste based on GRNN architecture

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Seashell waste (SW) is a high capacity sorbent, a neutralizing agent, and a promising substitute for geological carbonates in resolving environmental issues. SW reaction with divalent metal solutions (Cu^{2+}, Zn^{2+}, Pb^{2+} and Sr^{2+}) was found to be a complex processes that cause retention of metals, as well as the pH changes. The analyses and comparison of the sorption data, collected at different experimental conditions, have indicated non-linear interactions between various factors of the process. The aim of this study was to propose a non-linear model based on general regression neural network (GRNN) architecture, for data analysis and prediction of two important system responses: cation removal efficiency and final pH. A total of 80 batch sorption experimental sets were used to train, validate and test GRNN models. The GRNN had employed three inputs related to the sorption process (initial concentration, initial pH and contact time), and four metal specific parameters (ionic radius, covalent radius, electronegativity and solubility product constants for their carbonate compounds). The model performance was determined in term of mean absolute error (MAE), root mean squared error (RMSE) and coefficient of determination (R2). Individual smoothing factors (ISFs) obtained through GRNN training, were used to compare the significance of independent variables. The cation initial concentrations and covalent radii were the most important factors influencing process efficiency, whereas final pH values were the most affected by the initial pH and initial cation concentration. The proposed GRNN modeling approach displayed advantages in analyzing complex sorption processes, and capabilities for predicting metal removal efficiency and other process outputs.

4-5

Application of green tea nano zero-valent iron for stabilization of river sediment

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Sediment of the Great Backi Canal, often reffered to as a “black spot” of Vojvodina (Serbia), was used in this study, due to the presence of very large concentrations of various inorganic and organic pollutants. Applying the stabilization technique with certain immobilization agents for the contaminated river sediment successfully reduces the release of heavy metals into the environment. This is why stabilization as a remediation technique has been successfully applied for decades as a solution for this and similar problems. In recent times, nanomaterials are increasingly used as immobilizers for heavy metals in river sediments. In this study green tea nano zero-valent iron was applied as an immobilization agent. The characterization of this nanomaterial was carried out using point of zero charge, scanning electron microscopy (SEM), energy dispersive X-ray spectrometry (EDS) and Fourier-transform infrared spectroscopy (FTIR). By applying these methods, it was concluded that the nanoparticles are spherical in shape, with no agglomeration, and with confirmed presence of certain functional groups. The use of this nanomaterial for the immobilization of heavy metals from the sediment was demonstrated by the extraction tests in one step: DIN-Standard German leaching test (DIN 38414-4), TCLP-Toxicity Characteristic Leaching Procedure, Method 1311 and WET- Waste Extraction Test. Based on the applied extraction tests, mixtures with sediment and green tea nZVI, were proved to be non-hazardous waste, because the values of tests were below the prescribed permitted limits.

4-6

Winemaking by-products as a source of phenolic compounds

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Recovering bioactive compounds from agricultural waste is attracting an increasing attention in the past years. The wine industry produces a large portion of waste that represents an ecological and economical issue as grape pomace (seeds and skins), stems and lees are residues left behind after pressing and fermentation in the production process. These winemaking by-products are rich in various phytochemicals, especially polyphenols, and therefore could be used as an inexpensive and sustainable source in biotechnological applications (nutraceutical, medical, pharmaceutical, and cosmetic industry).

The objective of this work was to characterize red grape pomace and to establish its phenolic profile. The content of total polyphenols (TPC) and anthocyanins (TAC), along with the radical scavenging activity were investigated, and the influence of three different extraction solvents (acidified MeOH/H_2O, acidified EtOH/H_2O and 0.1M HCl) was assessed. Quantification of phenolics in grape pomace extracts was done using the available standards by UHPLC coupled with a diode array detector (DAD) and connected to a triple-quadruple mass spectrometer. The concentration of total phenolics was determined using Folin-Ciocalteu method, scavenging activity of pomace extracts was evaluated using DPPH$^{\cdot}$ reagent, while the content of anthocyanins was determined using pH-differential method. The results obtained for TPC, RSA and TAC varied due to different solvents used for the extraction (2.1-6.5 mg GAE/100 g DW, 12.2-34.5 µmol TE/100 g DW, and 406.9-695.3 mg mal 3-glu/100 g, respectively). Among polyphenols the most abundant was catechin (34.4 mg/100 g DW). Also, high concentrations of gallic acid, ellagic acid, and syringic acid were found (7.8 mg/100 g DW, 2.3 mg/100 g DW, and 2.1 mg/100 g DW, respectively). Our investigations indicated that analysed extracts were rich in polyphenols and therefore could be considered in food supplements production.

5-1

Removal of ceftriaxone from water using different types of commercial TiO_2 and newly synthesized ZrO_2/Fe_3O_4 nanopowder

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Over the past few years, antibiotics have been considered emerging pollutants due to their continuous input and persistence in the aquatic ecosystem even at low concentrations. They have been detected worldwide in environmental matrices. In this study, removal of ceftriaxone (β-lactam antibiotic, Mr = 554.58 g/mol, CAS No 73384-59-5, $C1_8H1_8N_8O_7S_3$), which belongs to third generation cephalosporin antibiotic, were studied using different types of TiO_2 (Degussa P25, Hombikat, and Wackherr) under simulated solar irradiation. The obtained results were compared to those in the presence of newly synthesized ZrO_2/Fe_3O_4 nanopowder. The kinetics of degradation was monitored by ultra fast high performance liquid chromatography with diode array detector.

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5-2

Emission monitoring of trace elements (heavy metals) in the atmosphere during usage of waste glass from cathode ray tube monitors as alternative raw material in Portland cement clinker production

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In this paper will be presented results of emission measurements of trace elements (heavy metals) during usage of waste glass from cathode ray tube monitors in Portland cement clinker production. Waste glass was added in raw mix, together with limestone and marl, in percentage of 0.54%, as alternative raw material. Analysis of heavy metals in waste glass used in clinker production was done by using XRF instrument and concentration of heavy metals in gas samples was measured by ICP-OES instrument. The measurement of air emissions is done in a direct and combined mode of operation of the furnace. Received results show that waste glass can be used in clinker production as alternative raw material in controlled quantities without significant influence on emission of heavy metals in the atmosphere.

5-3

Influence of the photocatalytic material application procedure on functional properties of façade paints

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Façade paints – consisting of binders, pigments, fillers, additives and solvents – present complex multicomponent mixtures. Impregnation of photocatalytic materials into conventional façade paints poses a challenge both regarding the methodology of photocatalytic activity testing, as well as determination of the optimal moment of application of the photocatalytic material. The latter is especially important for future commercial application of the photocatalytic material for conventional façade paints as it determines whether or not the material can be applied simultaneously with the application of façade paint to the wall. Therefore, the aim of this paper is to examine the influence of the application procedure of the photocatalytic materials on the functional characteristics of the façade paints. A UV/Vis spectrophotometric method with Rhodamine B as a model pollutant for evaluation of photocatalytic activity and a colorimetric test of the façade paints were applied. It has been shown that there is no significant difference in the activity of the photocatalytic material between the chosen application procedures.

5-4

Characterization of selected fractions of materials recovered from mechanically treated waste printed circuit boards from electric equipment

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Progressive development in the 21st century, in particular through the use of synthetic materials, as well as hyper production and cultivation of consumer mentality, human civilization has led to disbalance of the ecosystem and higher generation of electrical and electronic waste. If the same trend continues, the ecosystem can overcome its capacity. For this reason, the importance of pollution control of the environment is emphasized, and the special advantage is that waste has economic value. The study was conducted through characterization of metallic and magnetic granulate which was got by mechanical treatment of printed circuit boards of televisions and computers. The physical characterization includes determining morphology and structure by optical microscopy, determining the moisture content, granulometric composition, bulk density, and magnetic properties of the sample. Chemical characterization is based on analysis of the present metals, and it is performed by combining XRF and spectrophotometric methods. The determination of the content of precious metals in solid residue, after the pyrolytic removal of polymeric and other organic compounds, was done using a cupellation method. Based on experiments and theoretical knowledge, and in order to reduce the loss and reuse of the precious and other useful metals, the choice of an optimal technological solution for the mechanical treatment of WPCB will be shown.

5-5

Determination of red dye purpurin concentration isolated from Rubia tinctorum using Briggs-Rauscher oscillatory reaction

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Here, we investigated red pigment purpurin (1,2,4-trihydroxyanthraquinone), extracted from a Rubia tinctorum from Kopaonik Mountain, which has been often used as a dye for fabrics. With the aim to investigate its properties, purpurin was added in Briggs-Rauscher (BR) oscillatory reaction, as an extremely sensitive matrix toward different active analytes. It is well-known practical aspect of BR oscillatory reaction, where change in reaction dynamics is used for the investigation of different analyte properties (antioxidant, antiradical, catalytic, mechanistic in general) as well as for the analytic purposes. All experiments were carried out in a closed, well-stirred (σ = 900 rpm) reactor at the temperature of 37.2 ± 0,1 °C and initial concentrations of reactants: $[\text{Malonic acid}]_0 = 0.0789$ M, $[MnSO_4]_0 = 0.00752$ M, $[HClO_4]_0 =$ 0.03 M, $[KIO_3]_0 = 0.0752$M and $[H_2O_2]_0 = 1.269$ M. The analyte has been added in the oscillatory regime, 50 s from the beginning of the reaction, and the inhibition of oscillations were immediately occurred. It has been shown that in investigated range of concentrations, purpurin has a strong influence on BR dynamics, as well as powerful antioxidant capacity. From the calibration curve, obtained by measuring the response of BR system to purpurin perturbations, for a series of standard solutions, the unknown concentration of purpurin in the test sample was successfully determined. Obtained good redox properties of purpurin can be used as a novel organic electrode material for lithium ion batteries. The extracted and chemically lithiated purpurin shows very good reversible lithium ion storage characteristics. Due to the fact that very low concentration of purpurin can be measured by BR reaction (order of magnitude 10-6 M), results obtained in this work could be used for the development of a green and sustainable Li ion battery.

5-6

Sorption of textile dyes from simulated textile wastewater by hydrogel

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With the excessive risks that are present in today's environment, it is of great importance to treat wastewaters before their discharge in water streams. One of the everyday challenges is design of a low-cost and environmentally friendly sorbent, such as hydrogel based on chitosan, that can remove wide range of textile dyes. In the present study, this hydrogel has been utilized for removal of azo dyes (C.I. Basic Red 1 and C.I. Acid Orange 7) from simulated textile wastewater. It was found that pH value of the solution had significant effect on dye sorption: removal of basic dye was successful at higher pH values, while sorption of acid dye was possible only at low pH value. Regardless of complex composition of simulated wastewater, excellent removal degree was achieved (more than 80% of dyes were removed), which makes this hydrogel attractive for use under real conditions.

6-1

Nitrogen-doped graphene nanoribbons for oxygen reduction reaction – DFT insights

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Increasing energy demands and the need for pollution reduction require development of new energy conversion and storage systems. Fuel cells are thought to be the next generation of chemical power sources, but demand cheap and effective oxygen reduction reaction (ORR) catalysts. Many experimental studies have reported excellent performance of N-doped graphene towards ORR. However, the reasons for such an improvement are still under debate. We investigate how various N-containing groups alter the reactivity of graphene and graphene nanoribbons towards the reactants and intermediates of ORR by means of Density Functional Theory calculations. We discuss which N-groups on graphene promote ORR, and in what way. Based on the obtained results we reveal which N-functional groups provide improved ORR catalytic activity and enhanced selectivity. The importance of including graphene edges into such considerations is emphasized.

6-2

First principle study of Yb and Sr doped monolayer graphene

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Since the experimental discovery in 2004, graphene is attracting enormous attention due to many unusual effects and extraordinary properties. By doping, those properties can be tailored and even new effects can be obtained that pristine graphene lacks. Graphite intercalation compounds (GIC) have been studied since the 1960s, showing many new properties that are not present in pristine graphite, but the interest for them has significantly raised with the discovery of the superconductivity in some of those structures. By intercalating with the alkali or alkaline earth metal atoms, the superconductivity can be achieved. In the last few years, as the interest for 2D materials has raised, the question of the superconductivity in the atomically thin materials has appeared again. In a similar manner to GICs, the structures based on alkali/alkaline earth metal adatoms doped graphene have been investigated. Superconductivity in graphene was first experimentally verified in the Li-doped graphene. Therefore, the Li-doped graphene has inspired many to search similar structures, such are the Ca or K doped graphene. Motivated by superconductivity in the bulk SrC_6 and YbC_6 compounds, we studied electronic and vibrational properties of Sr and Yb doped monolayer graphene, using the density functional theory. We are first to report the results for those structures. The calculations were performed using Quantum Espresso software package, based on the plane waves and pseudopotentials.

6-3

First principles insights in sodium storage by B- and N-doped epoxy-graphene

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Due to its unique physical and chemical properties, graphene is being considered as a promising material for energy storage application. Functional groups and introduction of dopants in graphene is a useful strategy for tuning its properties. In order to fully exploit its potential, atomic-level understanding of its performance is required. We present a DFT study of the interaction of sodium atoms with epoxy-graphene doped with boron and nitrogen. Apart from the oxidation, it has been shown that both dopants contribute significantly to the reactivity of graphene. Dopants act as attractors of epoxy group, enhancing the sodium adsorption on doped epoxy-graphene compared to that on non-doped epoxy-graphene. Furthermore, by considering thermodynamics of Na interaction with doped epoxy-graphene it has been concluded that such materials are able to store Na. Therefore, controlled oxidation of doped carbon materials could lead to the development of advanced anode materials for rechargeable Na-ion batteries.

6-4

Combined theoretical and experimental investigation of $LiAlH_4$ catalyzed with Fe_2O_3

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Recently, complex metal hydrides started to receive attention due to their outstanding characteristic: capacity, thermodynamics, optimal kinetics, etc. $LiAlH_4$ is considered as promising solid state candidate for hydrogen storage, with capacity of 10.5wt% of hydrogen. Study uses theoretical and experimental methods in order to explain more closely the catalytic effect of iron (III) oxide, as an affordable and effective dopant, on lowering of the desorption temperature of $LiAlH_4$. The main obstacle for rehydrogenation and wide application of $LiAlH_4$ is its high stability, so the influence of oxidation on stability and local structure is studied; promising results are obtained. Calculations, based on density functional theory are performed using Wien2k and Quantum Espresso programs. Experimental investigation is performed using X-ray diffraction, temperature programmed desorption, nuclear spectroscopy and Mössbauer spectroscopy.

6-5

Propagation of electromagnetic waves through anisotropic active medium

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We have considered propagation of electromagnetic waves through double barrier structure and analyzed transmission characteristics. In our previous work [1], we have shown that it is possible to achieve infinite transmission probabilities in resonant electron tunneling through double complex potential barrier if the potential satisfies certain conditions and has positive imaginary part. It is known that direct analogy exists between Schrödinger and Helmholtz equations and that the dielectric permittivity has a similar role in the light propagation as the potential in quantum mechanics. Hence it can be shown that the same effect of infinite transmission can be achieved if the light propagates through medium which has complex permittivity with negative imaginary part. Consequently we wanted to investigate if this phenomenon is achievable with realistic parameters and materials. A quantum cascade laser (QCL) in population inversion regime of operation shows characteristics of an anisotropic dielectric with permittivity represented with a tensor. The parallel component of the permittivity has a constant value equal to the value in bulk material. However, the perpendicular component of the permittivity has a complex value with a negative imaginary part for arbitrary wavelength [2]. The barriers medium in our analysis is considered to be comprised of a QCL-like material, and the surrounding medium is passive, isotropic and linear. Analytical expressions for transmission, reflection and absorption probabilities for the analyzed structure are obtained, and an investigation of their values as a function of the parameters of the material and wavelength of the incident wave is conducted.

References:

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7-1

Selecting optimal stimulus frequencies for SSVEP BCI experiment

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Brain Computer Interface (BCI) is communication system where subject sends commands to computer directly using brain activity without any peripheral muscular activity. The most popular approach for recording brain activity is Electroencepalography (EEG). Main task for BCI is correct and robust detection of different brain states, where each state corresponds to appropriate command. BCI system based on Steady State Visually Evoked Potentials (SSVEP) offers best signal to noise ratio (S/N) and because of that provides highest information transfer rate (ITR). Flickering light or flickering objects cause Visually Evoked Potentials (VEP). Because different stimulus frequencies cause different S/N ratios it is necessary to carefully select these frequencies. There are a lot of papers concernig this area, but most of them use LED diodes as visual stimulator. The others describe usage of LCD displays, but use only one flickering object.

In this paper selection of stimulus frequencies on LCD display is discussed. Because LCD display has constant refreshing rate production of finite number of different frequencies is possible. Experiment in which real EEG data is aquired and processed is explained. Based on results from three different classification algorithms on this data, conclusion is drawn and recommendation for usage in SSVEP BCI systems is given.

7-2

Chemometric analysis of FTIR and high resolution XRPD data of the medieval pottery from the Studenica monastery, a UNESCO world heritage site

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The main focus of this work is application of chemometric analytical techniques for classification of the medieval pottery samples excavated at the Studenica monastery which was founded in the late 12th century and represented cultural and spiritual center of medieval Serbia. Archaeological investigations identified two different cultural horizons: the first (from the late 12th to the late 13th century) and the second (the 14th and the first half of 15th century). The investigated material from the first cultural horizon consists of 21 samples, mostly undecorated and unglazed cookware pottery, with some rare parts of tableware pottery. The 43 investigated ceramic fragments from the second cultural horizon consist of equally represented cookware and tableware, and some are decorated with sgraffito and painted motives.

Physicochemical methods like FTIR and XRPD provide information about mineralogical composition of pottery, and offer information about its origin and production methods. In this work 64 Fourier transform infrared (FTIR) spectra and 58 high resolution powder X-ray diffraction patterns, recorded at Australian Synchrotron Beamline 10-BM-1, of ceramic body of investigated pottery shards were analyzed by unsupervised statistical methods: principal component analysis-PCA and hierarchical cluster analysis-HCA. These statistical pattern recognition techniques were used to determine similarities or differences between pottery samples classified by archaeologist in two different cultural horizons. Chemometric analysis did not show significant differences among samples from two cultural horizons indicating continuous pottery production process from 12th until 15th century in the Studenica monastery. Results of our work also show suitability of FTIR and XRPD data in statistical analysis instead of the chemical composition traditionally used for this purpose in studies of ancient pottery.

7-3

Wetting of silicon <100> surface by water – experiment and computer simulations

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Wetting is the ability of a liquid to maintain contact with a solid surface, resulting from intermolecular interactions when the two are brought together. Wettability studies usually involve the measurement of contact angles as the primary data, which indicates the degree of wetting when a solid and liquid interact. The contact angle of a liquid drop on an ideal solid surface is defined by the mechanical equilibrium of the drop under the action of three interfacial tensions: liquid-vapor, solid-vapor, and solid-liquid interfacial tensions, describing by Young's equation. Computer simulation is an important tool enabling the modelling of physicochemical properties of materials, surfa ces and interfaces. In order to be effective, a computer "experiment" requires a reasonable force field as an input. While numerous and accurate force fields for bulk systems are available, the modelling of interfacial phenomena, such as wetting, requires an additional set of force field parameters describing the interactions of fluids with a model surface. A given surface force field can be verified by comparison with wetting experiment on well-defined surfaces. Silicon wafers has monocrystalline structure and can be considered as a smooth surface. The Young equation assumes a perfectly flat surface. Even in such a smooth surface a drop will assume contact angle hysteresis. The equilibrium contact angle can be calculated from advancing and receding contact angle as was shown theoretically by Tadmor and confirmed experimentally.

In order to calculate equilibrium contact angle advancing and receding contact angle have been measured at 25 °C using sessile drop technique as follows: 6µl droplet was settled on the examined surface and advancing contact angle was measured, then 2µl of water was sucked from the droplet into the syringe and receding contact angle was measured. The value of contact angles decreases with temperature decreasing; this data served as a guide in developing a force field used in molecular dynamics simulation of water droplets on silicon <100> surface at 298K.

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7-4

Application of composite materials as radiation shielding from neutron sources using Monte Carlo simulations

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Neutrons can readily pass through most materials and interact with the nuclei of the target atom. Exposure to neutron radiation is particularly hazardous to body tissues since they are capable of generating a much denser ion path as they deposit their energy within the target material. Standard materials used as shielding can offer adequate protection from neutron sources, but their dimensions and weight serve as limitation factor for their application. Protection abilities of composite materials were investigated for their use as shielding materials for ^{241}Am-Be neutron source using MCNP code. Simulation results show that composite materials can attenuate neutron beam with the factor of 1.2 to 1.5 on the entire spectrum range with maximum attenuation factor of 2.5.

7-5

Role of Co on gamma prime (γ') coarsening in nickel-based single crystal superalloys based on the $[Al\text{-}Ni_{12\text{-}x}Co_x](Al_1Ti_{0.25}Ta_{0.25}Cr_1Mo_{0.25}W_{0.25})$ model

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It has been recently pointed out that the compositions of industrial alloys are originated from cluster-plus-glue-atom structure units in solid solutions. Specifically for Ni-based superalloys, after properly grouping the alloying elements into Al, Ni-like ($\overline{Ni}$), γ'-forming Cr-like ($\overline{Cr}^{\gamma'}$), and γ-forming Cr-like ($\overline{Cr}^{\gamma}$), the optimal formula for single-crystal superalloys is established $[Al\text{-}\overline{Ni}_{12}](Al_1\overline{Cr}^{\gamma'}_{0.5}\overline{Cr}^{\gamma}_{1.5})$. The Co substitutions for Ni at the shell sites are conducted on the basis of the first-generation single crystal superalloy AM3, formulated as $[Al\text{-}Ni_{12\text{-}x}Co_x](Al_1Ti_{0.25}Ta_{0.25}Cr_1W_{0.25}Mo_{0.25})$, with x = 1.5, 1.75, 2, and 2.5 (the corresponding weight percents of Co are respectively 9.43, 11.0, 12.57, and 15.71). The microstructure and creep behavior of the four (001) single-crystal alloys are investigated. The mean size of the γ' precipitates in the heat-treated state ranges from 0.55 to 0.70μm, with the minimum size found in sample containing 11Co. The γ' volumic fraction is increased from 60 to 70% within increasing Co contents. The creep rupture lifetime is reduced as Co increases. The alloy with the lowest Co (9.43Co) shows the longest lifetime of about 350 hours at 1050 °C/120 MPa and all the samples show N-type rafting after creep tests. The 900 °C long-term ageing follows the Lifshitz-Slyozov-Wagner theory (LSW theory) and the Co content does not have noticeable influence on the coarsening rate of γ'.

8-1

The synthesis, crystal and defect structure of quintuple tetragonal perovskite $Sm_{1.875}Ba_{3.125}Fe_5O_{13.5-d}$

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Solid oxides based on cobaltites and ferrites of samarium-barium attract a great attention as promising cathodes for medium and high temperature solid oxide fuel cells due to their high electroconductivity, fast oxygen-ion exchange and transfer kinetics and wide range of thermodynamic stability. Since barium and samarium have a significant difference in their ionic radii they can occupy different positions in crystal structure, depending on Sm/Ba molar ratio in the compound, and therefore form layers containing only barium, samarium or both. For example, there is a well-known class of compounds with nominal composition $LnBa(Co,Fe)_2O_{6-d}$ (Ln = Sm, Pr, Nd, Gd, etc) named double perovskites because of their structure with two alternating layers containing only samarium and barium respectively. Recently the new type of superstructure ordering was found for the samples of nominal composition $Ln_2Ba_3Fe_5O_{14-d}$ where Ln = Nd, Sm, Eu. Solid oxides with such type of ordering was named quintuple perovskites due to their tetragonal structure with 5 layers packed in the following order: (Ba)-(Sm)-(Ba)-(Ba/Sm)-(Ba/Sm). Thus, the main purposes of this work were synthesis, studying of crystal and defect structure of the perovskite of nominal composition $Sm_{1.875}Ba_{3.125}Fe_5O_{13.5-d}$ with slight excess of barium compared to Sm/Ba=2/3 ratio.

In order to obtain phase-pure sample glycerol-nitrate synthesis technique was used. By means of X-ray diffractometry the crystal structure was shown to be cubic with no any additional ordering. However, further investigation of the structure using transmission electron microscopy techniques (SAED, HRTEM) showed the presence of additional reflexes proving the existence of before mentioned quintuple perovskite-like structure. Oxygen content of the sample were studied using both iodometric and coulometric titration in the wide range of temperatures and oxygen partial pressure. Received data on oxygen nonstoichiometry was then verified with number of model equations of defect structures, based on such quasichemical reactions as, for example, the reaction of oxygen exchange of the sample and ambient atmosphere.

8-2

Activated ion-track carbon flexible supercapacitor electrodes with different channel densities

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The optimization of activated ion-track flexible supercapacitor electrode performance can be achieved by varying fluence, type, energy and orientation of the ions, as well as varying the thickness of the starting polymer foil and a set of chemical etching conditions. Amongst all of these parameters this paper focuses on analyzing the influence of different ion fluences on the electrochemical properties of flexible supercapacitor electrodes, while other parameters where kept constant. The starting 25 µm Kapton foil was irradiated with Au ions of different fluences (106, 107, 108, 5x108 and 109 ions/cm^2) all chemically etched carbonized and activated under the same conditions. The electrochemical properties of the flexible supercapacitor electrodes were investigated by cyclic voltammetry, constant current charge and discharge technique and electrochemical impedance spectroscopy.

8-3

Electrochemical behavior of $NaNi_{0.33}Mn_{0.33}Co_{0.33}O_2$ and $NaNi_{0.61}Mn_{0.27}Co_{0.12}O_2$ in aqueous $LiNO_3$ and $NaNO_3$ solutions, prepared by the glycine-assisted combustion synthesis

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By the glycine-nitrate combustion process layered-type oxides $NaNi_{0.33}Mn_{0.33}Co_{0.33}O_2$ and $NaNi_{0.61}Mn_{0.27}Co_{0.12}O_2$ were synthesized. The initial ratio of transition metal nitrates in aqueous solution was adjusted to obtain targeted oxide composition, while total nitrates versus glycine mole ratio was kept to amount to 1.2:1. Upon calcination of oxide samples at temperatures 700 °C and 850 °C, the effects of oxide composition and calcination temperature on both structural and electrochemical properties were examined. Particle morphology and crystal structure were characterized by Scanning Electron Microscopy X-ray powder diffraction and FTIR spectroscopy, and these properties were correlated to the electrochemical properties, examined by cyclic voltammetry in both $NaNO_3$ and $LiNO_3$ aqueous solutions. For both oxides XRD results revealed dominantly layered crystal structure characteristic of $Na(Ni\text{-}Mn\text{-}Co)O_2$ compounds. Impurities are also observed corresponding to carbonates, which was confirmed by FTIR spectroscopy. The morphology of the samples may be described as porous micron-sized agglomerates, composed of either nearly spherical or both rod- and polyhedral-like shaped nanoparticles, at lower and higher calcination temperature, respectively. In alkaline nitrate electrolyte solutions, each of the examined samples exhibited irreversible surface changes during the first potentiodynamic cycle, and stable intercalation/deintercalation redox activity in the next cycles, becoming more pronounced after low scan rate of 1 mVs^{-1}. No significant influence of oxide composition on sodium redox behavior was observed, while this effect on lithium redox activity was more pronounced. For the illustration, at a relatively high scan rate of 20 mVs^{-1}, $NaNi_{0.33}Mn_{0.33}Co_{0.33}O_2$ calcined at 700 °C delivered relatively low initial sodiation/desodiation capacity amounting to ~26 $mAhg^{-1}$, and significantly better lithiation/delithiation capacity amounting to ~80 $mAhg^{-1}$, while corresponding values for $NaNi_{0.61}Mn_{0.27}Co_{0.12}O_2$ calcined at 700 ˚C were ~25 $mAhg^{-1}$ and ~48 $mAhg^{-1}$, respectively. Furthermore, calcination temperature increase resulted in lower sodium and lithium storage capacity amounting to ~19,5 $mAhg^{-1}$ and ~30 $mAhg^{-1}$, respectively, at the same scan rate.

8-4

Synthesis and structural properties of sodium cobalt oxide

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Sodium transition-metal oxides with general formula Na_xTMO_2 (TM = Co, Mn, Ni, etc.) have attracted a lot of interest in the battery community due to low cost of sodium in contrast to lithium. Sodium cobalt oxide is the most attractive of them for cathode application because of its conductive, thermic and magnetic characteristics. In this study, sodium cobalt oxide, Na_xCoO_2 , was synthesized by simple method which involves solid state reaction in air, at temperature of 900 ºC; starting materials were Na_2CO_3 and Co_3O_4 in stoichiometric amounts. Additionally, fluorination of the synthesized sodium cobalt oxide was carried out in vacuum at 200 ºC; NH_4HF_2 was used as a fluorine source. Then, structural and microstructural properties of the obtained powders were examined.

8-5

Recovery of $LiCo_{0.415}Mn_{0.435}Ni_{0.15}O_2$ from spent Li-ion batteries, and the examination of its charging/discharging behavior in aqueous $LiNO_3$ and $NaNO_3$ solutions

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Since the rising use of Li-ion batteries, containing hazardous metals and electrolytes increases the danger of environmental pollution, the recycling of this kind of waste is a primary task for researchers. In this work we report the recycling of Li-ion batteries having common electrode materials, namely layered type $LiCo_{0.415}Mn_{0.435}Ni_{0.15}O_2$ on Al collector as cathode and carbon on Cu collector as anode. The recycling procedure described includes mantle cutting and manual separation of battery components such as crust, Al-collector containing cathode material, Cu-collector containing anode material and separator. The hardest step of recycling procedure is the separation of electrode materials from metal current collectors, particularly the separation of the cathode components, due to a thin and fragile Al support. Three methods of cathode disintegration was examined: 1. by removing organic binder by means of the N-methyl pyrrolidone solvent, 2. by heating in air to combust both organic binder and carbon, and 3. by dissolving the Al-collector in NaOH solution. The last method was proven to be most effective. Further strategy included the determination of the chemical formula of the separated cathode material after its dissolution in HNO_3 and H_2O_2, by means of Flame Atomic Absorption Spectrometry. For the re-synthesis of the $LiCo_{0.415}Mn_{0.435}Ni_{0.15}O_2$ cathode material we used co-precipitation by means of Li_2CO_3 solution, added in an amount to satisfy the molar ratio $Li:\Sigma M=1:1$. The morphology of the re-synthesized material was observed by both SEM and TEM. The electrochemical properties of the obtained cathode material in an aqueous solution of $LiNO_3$ and $NaNO_3$, were studied by Cyclic voltammetry. Initial coulombic capacity for Li-intercalation was found to be ~64 mAh g^{-1} at 20 mV s^{-1}, while the corresponding Na intercalation capacity was ~30 mAh g^{-1}. Compared to Li-storage, the Na-storage was characteristic of a lower initial capacity, but less capacity fade. The origin of these differences was examined by XRD and Raman spectrometry. The results indicated that during Li^+ extraction, nickel ions located in Li-layers migrate into emptied octahedral Li^+ sites, thus blocking the return of extracted Li^+ ions. In the case of Na^+ extraction, nickel ions don't have tendency to occupy emptied sodium ion sites, providing thus more reversible sodiation/desodiation processes. The reason of halved storage capacity lies in the fact that the crystal structure allows only 0.5 mol of sodium to be inserted into the cathode material, compared to 1 mol of Li intercalation capability. Apart of environmental protection, another possible practical significance of this study is the contribution to the development of aqueous Na-ion batteries, which are cheaper and more environmentally friendly in comparison to commercial Li-ion batteries.

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8-6

Digital holography of graphene paper acoustic membranes and comparison to other paper – like materials

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Paper – like materials are becoming an important component of industrial technology. Their applications are numerous, starting from protective and adhesive layers, chemical filters to electronic or optoelectronic components. Graphene paper, as one of the youngest paper – like materials has favorable properties for all those applications, but also for novel applications in acoustics. Graphene paper is superior to other acoustic materials because it is lightweight, stiff, and has a large tensile strength. The aim of our project is to investigate the real – world potential of graphene – based acoustic membranes.

Here we report acoustic membranes made of graphene paper. We use time – averaged digital holography to study the vibrational modes of the membranes. Graphene paper shows a rich modal behavior in the audible part of the spectrum with multiple interesting and complex modes at frequencies between 40 Hz and 4 kHz. Numerical calculations confirm our experimental data, indicating a low pre – tension force (12.5 – 75 Nm^{-1}). For comparison, we performed the same holographic measurements on membranes made of Mylar polyester film, paraffin film, aluminum foil and different kinds of filter paper. We have found resonant modes for each tested membrane, with graphene paper showing the richest behavior. Our calculations indicate that more tightly pulled graphene paper membranes could be useful for applications in acoustics.

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8-7

Influence of cobalt nanoparticles and melt pouring temperature on microstructure and properties of nickel-based superalloy

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The influence of cobalt aluminate inoculant ($CoAl_2O_4$) content and pouring temperature on the microstructure and properties of Inconel 713C was investigated. Cobalt aluminate is the most frequently used inoculant in the investment casting process of nickel based superalloys. The main move to control the quality of aviation components like cast blades and vanes was the control of grain size. The $CoAl_2O_4$ compound in the prime coat of shell moulds and pouring temperature have a significant role in grain size modification. The influence of casting parameters and inoculant content on mechanical properties was studied on the basis of stress rupture, tensile testing, and hardness survey. The influence of grain refinement on properties is consistent with established theories. Tests conducted at room temperature indicate a favorable effect of grain refinement both on tensile strength and Vickers hardness. In contrast at high homologous temperature during stress rupture, the reverse trend was presented.

8-8

Phase equilibrium and crystal strukture of perovskite oxides in the system Sm-Sr-Fe-Co-O

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The samples $Sr_{1-x}Sm_xFe_{1-y}Co_yO_{3-\delta}$ were synthesized by solid-state and glycerin nitrate techniques. XRD patterns of the single phase samples were refined by Rietveld method within the cubic structure (Pm^3m sp. gr.) or within the tetragonal structure (I4/mmm sp. gr.). It was found, that gradual substitution of strontium by samarium leads to the decrease of unit cell parameters and unit cell volume, that can be explained by the relative cation. The projections of isothermal–isobaric phase diagrams for the $SmCoO_3$ - $SmFeO_3$ - $SrCoO_3$ - $SrFeO_3$ system to the compositional square of metallic components was presented.

9-1

Investigation of structural and dielectric properties of barium strontium titanate thin films prepared by spin coating

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Over the years, technology development is closely linked with materials engineering. Investigation of materials for production of microwave tunable devices becomes popular in last decades. Ferroelectrics, as materials with high dielectric constant and low dielectric losses even in paraelectric state, are recognized as good potential candidates for mentioned purpose. Paraelectric state of ferroelectric materials distinguishes absence of hysteresis dependence of polarization and electric field, so problems caused by presence of hysteresis, during the measurements and work are minimized. Barium strontium titanate is the most investigated ferroelectric for potential application in microwave tunable devices. Partially substitution of barium ions by strontium provides decreasing of the Currie point near the room temperature, and formation of paraelctric phase. Large amount of investigation were performed on bulk barium strontium titanate, but due the miniaturization in electronics, production of doped barium titanate thin films is still a big challenge.

$BaTiO_3$ and $Ba_{1-x}Sr_xTiO_3$ ($x = 0.1, 0.2, 0.3, 0.4$) thin films were prepared by chemical solution deposition (CSD) technique. Barium carbonate and strontium acetate were used as precursors, and acetic acid and 2-metoxyethanol were used as solvents. The solutions were deposited on platinized silicon substrates by spin coating technique, and then sintered at the different temperatures up to 1000 °C. Structural and functional properties of obtained thin films were examined by XRD, Raman spectroscopy, dielectric and ferroelectric measurement etc.

9-2

Structure and properties of solid solutions $Ba_{1-x}Pr_xFe_{1-y}CoO_{3-\delta}$

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The complex oxides $Ba_{1-x}Pr_xFe_{1-y}Co_yO_{3-\delta}$ were synthesized using a glycerol-nitrate technology. The crystal structure of the all single-phase samples was identified as cubic (Pm^3m space group). The values of oxygen content in the samples were determined using a high temperature thermogravimetric analysis and iodometric titration. Total conductivity and Seebeck coefficient of complex oxides were measured using a 4-probe technique as a function of oxygen partial pressure.

9-3

Small influence of magnetic ordering on lattice dynamics in $TaFe_{1.25}Te_3$

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The $TaFe_{1+y}Te_3$ single crystal is a layered system with monoclinic crystal structure, composed of FeTe chains along the b-axis, separated by a Ta/Te network, with additional Fe ions randomly situated on interstitial sites. It is a correlated bad metal which orders antiferromagnetically at T_N\approx 200 K. The magnetic structure consists of double zigzag spin chains, although the type of intra- and interchain magnetic interactions is still under debate. We present polarized Raman scattering spectra of $TaFe_{1.25}Te_3$ single crystal in a wide temperature range. Nine out of 15 Raman active modes are observed and assigned using measured spectra in different polarization configurations and lattice dynamics calculations. Unlike the case of related FeTe compound, $TaFe_{1.25}Te_3$ do not show significant changes near magnetic transition temperature T_N, which lead us to conclude that the phase transition is continuous. Temperature dependence of energy and linewidth is conventional, with the only exception in the vicinity of T_N, where some of phonon modes broaden. This is probably the consequence of spin fluctuations near the critical temperature. Our results suggest very small changes in the electron-phonon coupling and density of states at the Fermi level in the investigated temperature range.

9-4

Analysis of heat loss of thick film segmented thermistors used in water flow sensor

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The processing of custom designed thick film segmented thermistors with reduced dimensions and their main electrical properties are described in brief. The forming of water flow sensor prototype with measuring electronics and principle of operation is also given in brief. The flowmeter was tested on waterworks at different water flows and input water temperatures in the laboratory for climate-mechanical measurements. The responses of flowmeter were measured for steady flow (static regime) and for changeable flows (dynamic regime).The flowmeter electrical response on water flow was measured as electrical current of the selfheating thermistor at constant power supply. Input water temperature was measured by "cold" thermistor placed on flowmeter input. The results measured were compared with ultrasonic flow meter placed in series with heat loss flowmeter as a reference for calibration. After that the inertia of heat loss flowmeter was measured and analyzed using responses on different impulse water flows.The modeling of heat loss in the water flowmeter was based on radial and axial heat transfer to water during steady state and water flow respectively. Several equations were developed for both regimes(static and dynamic) using equations for electrical power generationon thermistors and equations for heat transfer from selfheating thermistor to water (convection and conduction during flow). The correlation between experimental and modeled results and analysis of main properties such as sensitivity, stability delay (inertia) and inaccuracy was done recently as the second step in flowmeter application.

9-5

Phonon anomalies in FeS

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In the iron-based superconductors (IBS) magnetic order, structure, nemacity and superconductivity are closely interrelated. Influence of correlation effects seems to increase from 122 systems, such as $BaFe_2As_2$, to the 11 chalcogenides FeTe, FeSe and FeS. Although, isostructural and isoelectronic, 11 class members differ significantly. FeSe undergoes a structural transition at 90 K, shows electronic nemacity, with no long range magnetic ordering down to lowest temperatures, and superconductivity at 9 K. On the other hand, FeTe exhibits magneto-structural transition at 67 K, but no superconductivity. FeS has a superconducting transition at 5 K, but it does not show structural transition. Magnetic ordering in FeS still remains an open question.

Here we present light scattering data on phonons in tetragonal FeS. We identified two out of four Raman-active phonon modes, and a second order scattering process involving two acoustic phonons. Additionally, DFT calculations verify experimentally obtained results. Calculated phonon density of states and selection rules for two-phonon process based on the modified group projector technique confirm second order scattering process within a gap in the projected density of states. Low temperature experiments revealed that temperature dependence of all modes is mainly governed by lattice contraction, except for deviations at 50 K and below 20 K. The anomaly below 20 K coincides with the observation of the possible short range magnetic order.

9-6

New GeV optical center in high-quality diamonds for novel applications

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At present, a growing interest is observed to diamond as a material for modern applications. Color centers in diamond can serve as single-photon emitters for different quantum information processing and communication technologies, for quantum optics, for the detection of weak magnetic fields with high spatial resolution, for bionanoscopy and super-resolution microscopy, as in-vivo biology markers, for the cancer diagnostics and therapy, etc. For these applications, narrow luminescence lines and reproducible properties of color centers are necessary. Recently, a new color center emitting at 602 nm (red-orange light) was found in germanium-doped diamond. Using Ge-doped isotopically enriched diamonds synthesized at high pressures, it has been unambiguously shown that Ge enters the diamond lattice (but not resides on the surface or inside some impurity phase). Narrow zero-phonon line (ZPL) of the luminescence at 602 nm demonstrates a four-line fine structure at low temperatures, similar to the silicon-vacancy (Si-V) center. Within the accuracy of the measurements (1 nm), position of ZPL in the luminescence spectrum coincides with that in the luminescence excitation spectrum,indicating a negligible Stokes shift. ZPL (both in luminescence and in excitation) is accompanied by a vibronic wing, the integrated intensity of which is of about 30% of the total intensity at 10 K. Position of the peak 380 cm^{-1} (~ 615 nm) is sensitive to isotopic substitution in the Ge subsystem, so this peak was attributed to a quasilocal vibration of the Ge atom. A weak broad UV band tentatively assigned to a higher electronic level is observed in the excitation spectrum. The quantum yield of the luminescence from Ge-V centers in nano- and microcrystalline diamonds under the excitation with the wave length 552 nm at room temperature was found to be 3±1%. The luminescence decay time measurements have shown a single-exponential decay with the time constant 6.2±1 ns.

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10-1

Synthesis and characterization of nanofibrous polyaniline

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Polyaniline (PANI) has been one of the most intensively studied electroconductive polymers for many years due to its favourable properties (high electrical conductivity, redox activity, paramagnetism, large number of acid-base and redox states, excellent environmental stability), relatively simple and cheap synthesis and potential for a large number of applications (sensors, electrochromic devices, antistatic coatings, radar-absorbing materials). The interest in the synthesis, properties and application of 1-D nanostructured PANI has continuously been growing over the past decade since these materials, in comparison with granular PANI, show improvements in many properties relevant to the application, such as enhanced response in sensors, improved dispersibility and processability.

In this work nanofibrous PANI was synthesized by the oxidative polymerization of aniline using two procedures, in the presence of oxidant(s) (ammonium peroxydisulfate (APS) and a mixture of APS and hydrogen peroxide) in excess. The reaction course was monitored by measuring temperature and acidity changes over time. The influence of polymerization time and post-synthetic treatment on the structure, morphology and electrical conductivity of the obtained PANI was examined. Evolution of the molecular structure of the reaction intermediates/products was studied by in situ Raman spectroscopy. Also, molecular structure of isolated powdered PANIs was studied by Raman and FTIR spectroscopies and their morphology was characterised by scanning electron microscopy (SEM).

10-2

Low energy Ag ion implantation in monocrystalline silicon

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In the present paper we have investigated structural and optical properties of silver nanoparticles in monocrystalline Si, obtained by low energy ion implantations. In the first series, single charged Ag ions were implanted into Si (100) substrates. The ion energies were 60 or 75 keV with fluences in the range of 1×1013 –1×1016 ions/cm^2. Another set of samples was prepared by multiple Ag implantations, where 60 and 75 keV silver ions were sequentially implanted into Si to the total fluences of 2×1013 –2×1016 ions/cm^2. The changes of structural and optical properties induced by irradiation are analyzed by Rutherford backscattering spectrometry, X-ray photoelectron spectroscopy and spectroscopic ellipsometry. The results revealed that the Ag atoms are situated in the near surface region of the implanted Si, with a peak at ~40 nm. In the case of single 60 or 75 keV ion implantations the samples implanted with the fluences higher than 1×1014 ions/cm^2 are found to show an absorption band in the region of 300-500 nm, corresponding to the surface plasmon resonance (SPR) of Ag nanoparticles in silicon. The shift in the SPR peak position with increase in ion fluence has been observed, which is correlated to the changes in nanoparticles size and distribution. The multiple (60+75 keV) implanted samples show enhancement in the optical absorption in the visible range of the spectrum.

10-3

Surface chemistry, thermal stability and structural properties of graphene oxide/12-tungstophosphoric acid nanocomposite

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In recent years the nanocomposites of graphene oxide (GO) and different inorganic and organic compounds have shown great potential for charge storage applications. In present work we have investigated the influence of 12-tungstophosphoric acid (WPA) on surface chemistry of graphene oxide and thermal stability of nanocomposite. For this purpose nanocomposites with different mass ratios of GO and WPA were prepared. The thermal stability of nanocomposites was investigated by thermogravimetric and differential thermal analysis (TGA-DTA) while changes in surface chemistry of GO and structural properties of WPA were investigated by Fourier transform infrared spectroscopy (FTIR) and temperature programmed desorption (TPD) method. The TGA-DTA measurements of composites have shown that the major mass loss, due to carbon combustion, is shifted to higher temperatures (~500 °C vs. 380 °C of pure GO). Furthermore, when the amount of WPA is higher than 25 mass percent the nanocomposites start to act like individual components, which was also confirmed by FTIR analysis. The amount of surface oxygen groups, monitored by both TPD and FTIR methods, showed ˝V˝ shaped dependence from the quantity of WPA with minimum at about 12 mass percent of WPA. At the same time, the FTIR spectra revealed the structural changes of WPA, displayed as shifting and splitting of characteristic bands of Keggin anion structure.

10-4

Graphene and graphene/diamonds metal composites used in military industry

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Graphene has been one of the most important materials obtained during the last years. Scientists still work on the method of obtaining huge and well defined graphene sheets. However, in some fields of industry the addition of graphene even with defects can help obtain better properties of materials. The most important there should be sintered carbide tools for metalworking. In this case the graphene addition should help extend the use of these tools. The materials presented in this study were obtained in the Diamond and Sintered Tools Factory Kraśnik in Poland. The base of the obtained materials was 95% WC (tungsten carbide) with the addition of about 5% Co 0,1% Nb and 0,15% Tl. In the case of the first sample during sintering flake graphene was added and in the case of the second nano diamonds and flake graphene were added into the top layer. The surface properties of the obtained materials were determined by wettability of probe liquids (water, formamide and diiodomethane). Moreover, the apparent surface free energy was determined using, the acid-base and hysteresis approaches. For better description of wettability the equilibrium contact angles, calculated from the Tadmor's theory were used. Surface roughness of the obtained materials was determined using optical profilometry. Functional groups on the surface were investigated using Raman spectroscopy.The obtained materials differed when the RRMS (root mean square) roughness parameter was calculated for material A it was 2.2 µm and for the material with diamond it was 13.7 µm. Mechanical parameters and physicochemical properties will be most likely used materials as elements of precision metalworking machines.

10-5

Is WO_3 catalyst for hydrogen desorption?

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Magnesium hydride, as hydrogen storage material, meets the requirements such as high gravimetric hydrogen capacity (7,6 wt%), low cost and weight, abundance and H_2 absorption/desorption cycling possibility. Given that the oxide additives show the good impact on desorption properties, mechanical milling of MgH_2 with addition of 5, 10 and 15% wt. WO_3 was performed. The microstructure and morphology of composites were analysed by XRD, PSD and SEM and correlated to hydrogen desorption properties which have been investigated by DSC. The results have shown that WO_3 has a positive effect on the desorption kinetics as well as on the change of the desorption mechanism.

10-6

Polycaprolactone beads and foams substrates modified with colloidal TiO_2 nanoparticles for application in photocatalysis

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The aim of this study was to investigate the possibility of TiO_2 nanoparticles (NPs) immobilization onto polycaprolactone (PCL) beads and foams for potential application in photocatalysis. PCL foam (PCLf) was fabricated using the PCL beads (PCLb) by environmentally friendly treatment in supercritical carbon-dioxide. PCLb and PCLf were subsequently loaded with colloidal TiO_2 NPs and they were used as a photocatalyst (PCLb+TiO_2) and a floating photocatalyst (PCLf+TiO_2), respectively. Photocatalytic activity of both photocatalysts was investigated in an aqueous solution of textile dye which was exposed to lamp that simulates the sun light. PCLb+TiO_2 photocatalyst did not provide complete photodegradation of investigated dye even after 24 h of illumination. In contrast, the PCLf+TiO_2 was achieved complete photodegradation of dye after 24 h of illumination. Additionally, its photocatalytic activity was preserved within three repeated photodegradation cycles. Floating photocatalyst remained chemically stable.

10-7

Best of two worlds: Combination of magnetic and semiconductor properties in (Ga,Mn)(Bi,As) nanostructured thin films

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In a highly-demanding time of the Information Age requirements for new ideas to push the classical limits of the electronics are very high. Several technological approaches are evolving simultaneously: miniaturization to quantitatively increase number of active units per area (e.g. transistors on a microprocessor chip), search of new/enhanced materials with improved characteristics and state of the art development of alternative concepts. In our research we try to combine all three of this methods within a spintronic nanostructures made from quaternary alloy of (Ga,Mn)(Bi,As) thin ferromagnetic semiconductor.

In order to provide an overall description of the material, a quick overview of the III-V ferromagnetic semiconductors theory is given, ensured by samples structure and magnetization characterization check. Results for a wide range of non-destructive techniques, applicable for thin layers investigation, will be presented: typical superconducting quantum interference device (SQUID) magnetic measurements, general layers quality description by X-ray diffraction (HR-XRD) and secondary mass ion spectroscopy (SIMS). Furthermore, we'll show cross-like and ring-shape geometries of nanostructures, tailored using electron-beam lithography patterning and chemical etching from 10-nm thick (Ga,Mn)(Bi,As) epitaxial layers with 6% Mn and 1% Bi contents. An interplay between original magnetic in-plane anisotropy of the material, that arose from the lattice mismatch with a substrate during growing procedure and patterned-induced anisotropy, introduced via the lithography process, creates well-defined magnetic defects (domains). As a result, we achieve resistance difference between contacts pairs, that can be driven by an applied low magnetic field or a spin-polarized current and increased as a result of enhanced spin-orbit coupling by bismuth incorporation. Series of thorough magneto-transport and magnetic measurements on similar structured thin layers of (Ga,Mn)(Bi,As)/GaAs and earlier concepts based on well-known (Ga,Mn)As/GaAs semiconductor proves stability and utility of such a magnetic memory unit.

11-1

Investigation of optical properties in the of GeS_2-Ga_2S_3-CsCl chalcogenide glasses

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FTIR spectroscopy is employed to study the properties of $80GeS_2$-$20Ga_2S_3$-CsCl chalcohalide glasses with CsCl additives in 77 to 293 K temperature range. It is established that three main vibrational bands are identified for ($80GeS_2$-$20Ga_2S_3$)100-x(CsCl)x, x = 5; 10; 15 glasses. The fundamental S-H absorption band is observed at 2500 cm^{-1}. The maxima at ~3700 cm^{-1} are very likely an O-H related absorption, common for many chalcogenide glasses. The band at around 1580 cm^{-1} corresponds to H_2O impurity that resides in structural voids. The feature at ~1100 cm^{-1} could be due to inorganic sulfate ion absorption. For each temperature, the intensities of the identified bands are increased with CsCl amount in $80GeS_2$-$20Ga_2S_3$ ChG. The S-H and O-H absorption bands are very weak for $(80GeS_2\text{-}20Ga_2S_3)_{95}(CsCl)_5$ glasses. There is a minor band near 1580 cm^{-1} that corresponds to H_2O. Obviously, the structures of Ge-Ga-S glasses containing smaller amount of CsCl are more stable against adsorption of water due to small amount of free-volume voids. Increasing of CsCl content in ($80GeS_2$-$20Ga_2S_3$)100-x(CsCl)x glasses to x = 10 and x = 15 results in higher intensities of the bands corresponding to 1580 cm^{-1} and ~3700 cm^{-1} at all measured temperatures. These transformations are connected with changes in the inner structure of ChG with CsCl that facilitate more intensive H_2O adsorption. Most probably, $(CsCl)_{15}$ glasses could be enriched by the water molecules, having an effect on its structure. As it follows from the measurements results, main vibration bands are somewhat shifted to lower energies at 77 K and 150 K, but as temperature rises up to 220 K and 293 K, these changes become more obvious. Such temperature shifts of vibrational frequencies can be caused by possible thermal expansion of the lattice and nanovoid agglomeration. The vibrational spectra of $(80GeS_2\text{-}20Ga_2S_3)_{100-x}(CsCl)_x$, x = 5; 10; 15 glasses collected at different temperatures for each composition are shown in Fig. 3. It can be observed that bands located near 1580 cm^{-1} appear for all glasses and show no shifts. In $(CsCl)_5$ and $(CsCl)_{10}$ ChG samples there is a very slight shift of S-H absorption band located near 2500 cm^{-1} at elevating temperatures. However, the temperature shift of vibrational frequencies towards lower energies for $(CsCl)_{15}$ glasses is detected for S-H vibrational band and O-H related peaks also shift with the increase of temperature from 77 K to 293 K. We tend to think that this effect may be due to the differences in water absorption in the structure at higher temperatures. All transformations of vibrational modes of $80GeS_2\text{-}20Ga_2S_3)_{85}(CsCl)_{15}$ glasses are related to the excessive amount of CsCl additive, resulting in the damage to the inner structure the host material. Thus, the CsCl addition effects on the vibrational spectra for GeS_2-Ga_2S_3-CsCl glasses are investigated. It is demonstrated that the transmission in visible region increases with CsCl concentration from 60 % in (CsCl)0 to 80 % in $(CsCl)_{10}$ and $(CsCl)_{15}$. Sharp peak at 4000 nm for base $(CsCl)_0$ glass is attributed to S-H stretching and is considerably damped for samples with CsCl in mid-IR spectra. There are also features at 6300 nm corresponding to H_2O, 6700 nm and 2900 nm related to O-H strectching vibrations. The intensity of absorption bands associated with water is increased with CsCl amount, confirming the hygroscopicity of CsCl. It is established that for each measured temperature (77 K, 150 K, 220 K and 293 K), the intensities of the observed vibrational bands increase with CsCl amount in 80GeS$_2$-20Ga$_2$S$_3$ ChG. Principal vibrational bands centered near 1100 cm^{-1} 1580 cm^{-1}, 2500 cm^{-1} and 3700 cm^{-1} in (CsCl)$_{15}$ glasses are slightly shifted to lower energies between 77 and 150 K. The shift is more pronounced between 220 and 293 K. Such temperature shifts of vibrational frequencies can be caused by possible thermal expansion of the lattice and agglomeration of nanovoids formed by CsCl additives. Temperature dependences of FTIR spectra also indicate the lower-energy shift of vibrational frequency of S-H related band for (CsCl)$_{15}$ glasses and the shift of O-H related peaks at elevating temperatures.

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11-2

Physicochemical properties of cobalt ferrite nanoparticles doped with zinc

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In the present work, solvothermal synthesis method was used for preparation of cobalt ferrite nanoparticles with different zinc content (Co$_{(1-x)}$Zn$_x$Fe$_2$O$_4$; x=0, 0.05, 0.1, 0.3 and 0.5) but with the same capping agent and particle size and shape distribution. The X-ray diffraction patterns show diffraction maxima typical for a single-phase cubic spinel structure. TEM analysis revealed the presence of sphere-like particles with average particle size of about 5nm. The thermogravimetric and Fourier-transform infrared spectroscopy (FT-IR) analyses revealed a complete monolayer of oleic acid molecules that form bridging bidentate bond with the surface metal ions. Since the Me–O (Me = Co, Fe, Zn) stretching modes of spinel ferrites belong to the fingerprint range of FT-IR spectra, the shift of this mode toward lower wavenumbers with increase of zinc content indicates a gradual substitution of cobalt ions by zinc ones. Field dependence of magnetization recorded at 300 K show the superparamagnetic behavior of all synthesized samples.

11-3

Dynamic microfluidic control of supramolecular peptide self-assembly

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The dynamic nature of supramolecular polymers plays a key role in their organization. Yet, the manipulation of their dimensions and polarity remains a challenge. Here, the minimalistic diphenylalanine building block was applied to demonstrate control of nano-assemblies growth and shrinkage using microfluidics. To fine-tune differential local environments, peptide nanotubes were confined by micron-scale pillars and subjected to monomer flows of various saturation levels to control assembly and disassembly. The small-volume device allows the rapid adjustment of conditions within the system. A simplified kinetic model was applied to calculate parameters of the growth mechanism. Direct real-time microscopy analysis revealed that different peptide derivatives show unidirectional or bidirectional axial dimension variation. Atomistic simulations show that unidirectional growth is dictated by the differences in the axial ends, as observed in the crystalline order of symmetry. This work lays foundations for the rational control of nano-materials dimensions for applications in biomedicine and material science.

11-4

Influence of etching duration on emission properties of thin films with Si-sponge structures

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Thin films of the Si-sponge structures were formed by galvanic anodization. Current density was ranged from 1 mA/cm^2 to 5 mA/cm^2 during 1-15 min of the etching times. The composition of electrolyte was 1:1 of HF (48%) and C_2H_5OH (96.5%). The H_2O_2 was added to initial solution in order to control of the current density. H_2O_2 as a component decreases of electrode potential of Si wafer (boron doped p-Si with 10 Ohm•cm) inside the electrolyte and facilitates of etching of wafer.

Photoluminescence (PL) excitations were carried out using nitrogen laser radiation (wavelength = 337 nm, pulse duration τ = 8 ns). The PL signal was detected in photon counting regime. The strobe duration was 250 ns. The duration of the strobe and related to the laser pulse delay were increased up to hundreds of microseconds for the measurement of subsequent PL spectra at relaxation times. The PL spectra of Si-sponge structures were obtained from the wafers which were processed under various values of densities of etching current. All spectra were composed with one broad complex band which position was near 1.8 eV. Increase of the density of etching current resulted in the rise of PL intensity, the decrease of half-width of all curves, as well as the shift of the maxima of PL spectrum toward the long-wavelength range. The rise of PL intensities can be explained by increase of the porosity of Si-sponge structure. After Gauss deconvolution of the PL spectra, the positions of the maxima for each components of observed complex band were calculated and corresponded to the range from 1.71-1.75 eV and to 1.84-1.91 eV, respectively. These PL bands are usually can be explained as PL from nanostructured Si particles which are formed during the electrochemical etching of Si-bulk wafer under illumination. The shift of the PL maximum and its relation to the radius R of Si-particle is well known. Based on the obtained results and use of the formula, some assumption can be formulated. At first, during the electrochemical etching of the wafer, two groups of Si particles were formed with sizes of 1.09-1.18 nm and 1.33-1.41 nm, respectively. The increase of the density of etching current up to 2 mA/cm^2 resulted in a significant increase of number of smaller particles rather than larger ones. The following increase of the current density didn’t enhance the result. At the same time, the intensities of deconvoluted PL curves corresponded to the samples obtained at the smallest etching current are almost equal. The rapid growth of the PL maxima is occurred when the density of the etching current is ranged from 1 mA/cm^2 to 1.5 mA/cm^2. Such small value of the density of the current is not well controlled during the etching. To make the process more flexible and controllable H_2O_2 was added. Thus, we assume that the structures should consist of the particles with the smallest radius in contrast to the samples obtained at higher etching current densities. The halfwidths of observed bands are highest at lowest current density. So, the etching of Si wafers with 1 mA/cm^2 current density allows us to form more uniform thin films of Si-based sponge structures which thickness is less than 1 mkm.

Galvanic anodization used to etch Si-wafers supports to this technics to be cost effective and applicable for other technological stages.

11-5

The room-temperature ferromagnetism (RTFM) in mixed-phase TiO_2 nanoparticles

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Spherical mixed-phase TiO_2 nanoparticles (with various ratio of anatase/rutile) ranging in average size from 22 to 140 nm have been prepared by levitation-jet aerosol synthesis through condensation of titanium metal vapor in an inert-oxygen gas flow under appropriate oxidation conditions. The nanoparticles have been characterized by using scanning electron microscopy, X-ray diffraction, BET measurements, UV-Vis, FT-IR, Raman spectroscopy, XPS and vibrating-sample magnetometry. The predominant roles of mix-phase compositions, interface and oxygen vacancies in the formation of RTFM and other properties of the nanoparticles has been demonstrated. Room-temperature ferromagnetism with maximum magnetization of up to 0.2 emu/g (which is relatively high for such materials) and coercive force 25-100 Oe was discovered. The maximum magnetization values of nanoparticles are proportional to their specific surface, average sizes and anatase/rutile interface ratio, which related with the favorable defects concentrations. In order to enhance the RTFM of nanoparticles it was required to obtain an optimal value of the certain anatase Raman peak width and decrease in some of the XPS peaks areas of O 1s and Ti 2p3/2. The results indicates, that the observed ferromagnetic ordering related to the defect Ti-O structures in the interface between the both anatase/rutile crystal phases of the nanoparticles, containing Ti and O vacancies, whose concentrations and degree of mutual interactions may be controlled by varying of the nanoparticles preparation conditions. This suggestion is in good correlation with the number of spectroscopic data. Such nanoparticles may be used as a base for developing an advanced semiconducting material for spintronic applications.

11-6

Modeling of the planetary ball-milling process for the case of TiC powder

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In this work we discussed the milling parameters of high energy ball mill (Fritsch Pulverisette 7) like vial geometry, ball number and size and speed of the mill. Simulations provide correlation between the milling parameters and the resulting microstructure of the TiC powder. A mathematical model is used to improve and develop this process.

12-1

Effect of ultrasonic-assisted preparation of powders on synthesis of rare earth zirconates

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The ever-increasing needs for high efficiency in thermal barrier coatings systems drive research concerning potential alternatives for commercially used yttria-stabilized zirconia 8YSZ as insulation layer of thermal barrier coatings. The papers regarding physical properties of these materials (especially thermal diffusivity or ionic conductivity) are easily available, as well as studies on solid state reactions and wet chemical methods of powders synthesis. Nonetheless data concerning performance of previously mentioned processes with ultrasonic assistance are limited.

This study aims to determine the influence of sonochemical treatment of feedstock powders on the synthesis of various rare earth zirconates and their microstructure and thermal properties. The morphology of feedstock powders as well as chemical composition in micro areas were analysed by SEM/EDS method. The distribution of powder particles size was evaluated using laser diffraction method. The compounds were prepared from rare earth oxides and ZrO_2 powders, weighed in the mass ratio 1:1. Initially ultrasound treatment was applied. 750 Watt ultrasonic processor VCX-750 equipped with sealed converter VC-334 and horn 630-0219 with the diameter of 13 mm (Sonics & Materials, Inc.) was used as a source of ultrasound. Applied ultrasound frequency was 20 kHz, power density was controlled in the range from 75 W/cm^2 to 340 W/cm^2. Investigated compounds were synthesized via solid-state reaction (SSR). The Differential Scanning Calorimetry (DSC) was used in order to investigate the effect of sonochemical treatment on the synthesis of prepared mixtures. Afterwards, sintering processes were performed with various temperature parameters, accorded to the data obtained from DSC analysis. SEM/EDS and XRD were used to analyse the differences in obtained sinters.

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12-2

Oxygen evolution reaction on the electrochemically synthesized nickel oxides

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Oxygen evolution reaction was examined in 0.1 M KOH solution on nickel mesh electrode. The formation of nickel oxides and their subsequent reduction were studied by cyclic voltammetry. Polarization curves for oxygen evolution reaction were obtained by steady state technique and by linear sweep voltammetry using low sweep rate. Nickel oxides were synthesized on the surface of metal under the potential cycling conditions. By varying number of cycles and potential limits, oxides of different degree of hydration and thickness were obtained. Characteristics of oxides and rate of the reaction were also examined by electrochemical impedance spectroscopy.

Results indicated that current density for oxygen evolution reaction increased with the increasing thickness of oxide films, regardless of the potential cycling limits. Rise in the current density on oxides obtained using narrower potential limits was proportional to the rise of film thickness, while on hydrous oxides, which were obtained using wider potential limits, rise in the current density was smaller than rise in the film thickness. Oxide films of approximately the same thickness obtained by using aforementioned ways of preparation showed the same electrocatalytic activity for oxygen evolution reaction. Tafel slopes determined from the polarization curves and from the electrochemical impedance spectroscopy were between 36 and 38 mV dec^{-1}. Using electrochemical impedance spectroscopy it was possible to calculate adsorption pseudocapacitance that originates from the formation of adsorbed intermediates in oxygen evolution reaction. It was shown that the pseudocapacitance increased from the open circuit potential towards more positive values without reaching constant value in the potential window investigated.

12-3

Bipolar electrochemistry a powerful tool for simultaneous wireless synthesis and activation of electrochemiluminescent thermoresponsive Janus objects

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Nowadays surface modifications of carbon materials have attracted considerable attention. Among the various techniques used to modify carbon, bipolar electrochemistry is very attractive. In this work, bipolar electrochemistry (BPE) is used as a dual wireless tool to generate and to activate a thermoresponsive electrochemiluminescent (ECL) Janus object. For the first time, BPE allows regioselective growth of a poly(N-isopropylacrylamide) (pNIPAM) hydrogel film on one side of a carbon fiber. By controlling the electric field and the time of the bipolar electrochemical reactions, it is possible to control the length and the thickness of the deposit. Further ruthenium complex luminophore Ru(bpy)$^{32+}$, was incorporated in the hydrogel film by using BPE to activate remotely the electrogenerated chemiluminescence (ECL) of the Ru(bpy)$^{32+}$ moieties in the film. It is therefore shown that BPE is a versatile tool to generate highly sophisticated materials based on responsive polymers, which could lead to sensitive sensors.

12-4

Comparison of textural propertis of the Ti-SiO_2 catalyst support and novel PdRe/Ti-SiO_2 catalyst

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Textural characteristics of catalysts and catalysts supports are important factor for their application in the processing of high molecular weight compounds. Bifunctional catalysts with noble metals are getting more involved in petroleum refining processes. In this paper, textural characteristics of the Ti doped silica supports are compared before and after active metals incorporation. Two Ti- SiO_2 (Si/Ti atomic ratio of 40) catalysts supports are prepared using sol-gel method followed with hydrothermal drying. The neutral templating route procedure was applied, using dodecylamine as a template in both cases, modified with 1,3,5-trimethylbenzene (mesitylene) in one case. The latter support was impregnated with Pd and Re active metals. Specific surface area, mesoporosity and pore volume of the catalyst and both supports are compared as the most important parameters for the catalysts application. The materials are characterized using FT-IR spectroscopy, N_2 physisorption and SEM micrographs.

12-5

The process of flavonoid micellar extraction

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Surfactant molecules are build from a hydrophilic head group and a hydrophobic tail. At water–air or water–organic interfaces these molecules align so that the hydrophilic portion is directed toward the aqueous component of the mixture. With the increase of concentration the dispersed hydrophobic chains start to self-assemble into colloidal-sized aggregates. When a concentration known as the critical micelle concentration (CMC) is reached, these colloidal aggregates are called micelles.). One of the latest solutions is the use of micellar solution of surfactants for the extraction of biologically active plant based compound for example flavonoids such as quercetin and rutin. These flavonoids occur naturally in plants. They have pro-health properties and they can be obtained in the process of extraction. The presented results are expected to contribute to understanding interactions of natural flavonoids with interfaces modelled by non-ionic surfactant systems.

12-6

The influence of molybdenum and tungsten bronzes on the Briggs-Rauscher reaction dynamics

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For the preparation of molybdenum and tungsten bronzes, as starting materials were used heteropoly acids (12-molybdophosphoric and 12-tungstophosphoric acid), belonging to the family of polyoxometallates. The bronzes practical application is in their installation in batteries and fuel cells (such as cathodes). Due to their chemical and electrochemical stability, bronzes can also be successfully used as good catalysts for the reduction of oxygen in acid electrolytes.

In this paper, the Briggs-Rauscher (BR) reaction was used as a test medium for different types of bronzes. The BR reaction is an oscillatory reaction in which the oxidation of malonic acid [$CH_2(COOH)_2$] in the presence of hydrogen peroxide (H_2O_2) and potassium iodate (KIO_3), catalyzed with manganese ion (Mn^{2+}) in acid solution ($HClO_4$). This reaction is well known as a matrix for determination of reactive analyte concentration, as well as its potential catalytic and antiradical activities. Since one of the BR reaction products is gaseous oxygen, the basic idea of this paper is that bronzes as catalysts for oxygen reduction, change the reaction pathways of the BR reaction and thus allow indirect examination of the catalytic activity of different bronzes. The effect of the investigated bronzes on the BR dynamics is reflected in the inhibition of the oscillatory period.

12-7

Adsorption and volumetric properties of surfactants used in extraction process

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Surfactants are usually organic compounds, that are amphiphilic, meaning they contain both hydrophobic groups (tails) and hydrophilic groups (heads). Therefore, a surfactant contains both a water-insoluble and water-soluble component. Surfactants are usually classified into four main families: anionic, cationic, amphoteric and nonionic. Nonionic surfactants are second to anionic surfactants in the world production. Most of them are obtained by condensation of ethylene oxide on the compounds possessing a reactive hydrogen, such as alkylphenols or fatty alcohols. They exhibit some superficial or interfacial activity. Above the critical micelle concentration (CMC) in the solution, the surfactants start to aggregate. They form aggregates which are called micelles. This aggregates can be used in the extraction process, especially in cloud point extraction and micelle-mediated extraction. The aim of presented study was to investigate the adsorption and volumetric properties of two nonionic surfactants: Tween 20 and Tween 80 at different temperatures.

13-1

Monitoring oxidation of cellulose fibers using zeta potential measurements

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Oxidation of cellulose fibers is usual procedure for surface cleaning and introducing new functionalities in their structure. Due to the presence of three hydroxyl groups on each glucopiranose unit, cellulose is very susceptible to oxidation. The most desirable and positive effect of oxidation is introduction of acidic carboxyl groups in cellulose structure. Acidic groups contribute to the surface charge of fibers and have influence on streaming potential of fibers. In this work cellulose fibers (cotton and viscose) with different amounts of COOH groups were prepared via oxidation with $KMnO_4$, $NaIO_4$ and $NaClO_2$ under various treatment conditions. Carboxyl group content and zeta potential measurements were carried out in order to investigate influence of acidic groups' quantity on surface charge of fibers. Results could help to anticipate how processing technique such as oxidation would influence further textile fibers processing, since surface charge is directly related to the reactivity of cellulose to a different agents, e.g. dyes, finishing agents, drug compounds for wound treatment, etc.

13-2

Air permeability of differently softened cotton and cotton/elastane knitted fabrics

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The influence of different amount of elastane and different processing stages on the structural properties and air permeability of knitted fabrics have been studied. Samples made of 100% cotton yarn; elastane yarn in alternating courses (half plating) and elastane yarn in every course (full plating) were scoured, bleached or dyed with reactive dyes, finished or not finished with cationic or silicone softener in industrial conditions. Elastane in blends increased the fabric weight and thickness and decreased the air permeability. Considerable differences in structural properties and air permeability after different finishing stages were found. Bleached knitted fabrics which were not softened have smaller thickness compared to softened. Softened knitted fabrics have higher weight compared to not softened. Air permeability of 100% cotton bleached and dyed knitted fabrics increases in the following way: not softened < softened with cationic softener < softened with silicone softener. Air permeability of cotton/elastane bleached and dyed knitted fabrics increases in the opposite direction of 100% cotton knits.

13-3

Synergistic solid lubricants system based on selected sulfides of technology metals

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Technology advances have resulted in a growing demand for the new tribology materials. In development of the properties of tribology materials, improvements can be achieved by combining materials in form of composites. The aim of this work was production of solid lubricants composites based on sulfides of technology metals. Selected solid lubricant powders, tin sulfides (Sn_xS_y) and tungsten disulfide (WS_2), were synthesized by pyrometallurgical method in rotary tilting tube furnace (ST-1200RGV). The chemical thermodynamic parameters of the synthesis were determined using HSC Chemistry software modeling package. Characterization of the obtained powders included analysis of chemical composition by optical emission spectroscopy, phase composition identification by X-ray diffraction (XRD) and microstructural examination by the scanning electron microscopy (SEM) and energy-dispersive spectroscopy (EDS). Finally, the tribological properties of the as-synthesized powders in composite mixture were estimated. It has been shown the beneficial synergistic effect due to unique combination of properties between tin sulfides and tungsten disulfide in composite. In addition, advantage of synergistic tribology material (Sn_xS_y/WS_2) is simple method of synthesis and environmentally acceptable components of the composite.

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13-4

New approaches to the problem of forests recovery by introduction of environmental friendly technologies of wood processing to obtain high-quality composite biomaterials

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Several new comprehensive and progressive proposals for the problems solution facing EMERCOM of Russia, Ministry of Nature Protection, Forest Service and other agencies responsible for fire safety, forests rehabilitation and ensure their environmental safety are offering. These tasks should be solved in conjunction with the provision of economic benefits due to the introduction in the wood production of fundamentally new technological approaches to ensure virtually waste-free use of all kinds of wood materials, including dry rot affected and various types of pests of trees, and all kinds of waste wood, chipboard production and waste remaining after felling. The suggested method of thermochemical treatment of wood provides rearrangement in micro- and nanoporous structure of both wood fiber and wood matrix as a whole. A natural binder fills intracellular and intercellular micro- and nanopores of wood-fiber filler. Suggested technology allows modification of not valuable types of wood and provides the merits of expensive noble types of wood: birch, asp and other parquet materials whose hardness, water and fire resistivity are higher than those of conventional oak parquet; facing boards for inner and outer coatings are high water resistant and inexpensive; figured ware made of inexpensive types of wood, which are prepared by pressing in the “thermolithography” conditions are similar to encrusted ware in aesthetic and artistic features but are less expensive. This method for preparation of wood chip composite material is fully ecological due to the absence of synthetic resin binders; shows higher durability, water and fire resistance; provides for environmentally friendly utilization of waste ware; Progressive and environmentally friendly processing technology and use of all of the above substandard species of woody materials proposed by the authors will contribute to the ecological situation improvement in the forests, providing them with fire safety and increasing production volumes of useful wood products through high-quality composite wood-strand materials and commercial products made from them.

13-5

Influence of tensile temperature changes on mechanical properties of $Co_{20}Cr_{20}Fe_{20}Mn_{20}Ni_{20}$ and $CoCr_{26}FeMnNi_{14}$ high entropy alloys under 300 K and 77 K

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High-entropy alloys (HEAs) have a whole number of unique properties such as high mechanical characteristics, elevated radiation tolerance et al. The special interest is invoked by the alloys with FCC-lattice that have high ductility at the room temperature for which we can see simultaneous increasing strength characteristics and ductility at decreasing tests temperature till the nitrogen temperature. Corresponding for these behavior mechanisms should be further investigated.

This study represents the results of two investigated $Co_{20}Cr_{20}Fe_{20}Mn_{20}Ni_{20}$ and $Co_{20}Cr_{26}Fe_{20}Mn_{20}Ni_{14}$ high-entropy alloys which have the difference in stacking fault energy (19,0 и 3,5 mJm^{-2}, accordingly). $Co_{20}Cr_{20}Fe_{20}Mn_{20}Ni_{20}$ and $Co_{20}Cr_{26}Fe_{20}Mn_{20}Ni_{14}$ alloys were melted in arc furnace in argon atmosphere. Obtained ingots were preliminarily rolled, homogenization annealed at 1050 ºC, and rolled again in 0.4 mm strip. Specimens 1.0x0.4x5.3 mm for mechanical tests had been obtained by spark machining and after recrystallized at 1050 ºC for 1h. X-ray diffraction analysis shown the presence single FCC-phase in the both alloys (the lattice parameters are $3{,}5941 \pm 6 \cdot 10^{-4}$ Å и $3{,}5830 \pm 6 \cdot 10^{-4}$ Å, respectively). Microstructure investigation shown that the both alloys have dendritic structure with average dendritic branches about 20-30 μm and after homogenizing annealing alloys have a grain microstructure with a grain size 7-8 μm and 3-5 μm for $Co_{20}Cr_{20}Fe_{20}Mn_{20}Ni_{20}$ и $Co_{20}Cr_{26}Fe_{20}Mn_{20}Ni_{14}$, accordingly. The mechanical properties were examined at electro-mechanical testing machine at 300 K and 77 K with a constant tensile rate of $10^{-3}s^{-1}$. Experiments were at constant tensile temperature (77 K or 300 K) and at changing tensile temperature, i.e. 20% preload at 77K and final deformation at 300 K, and vice versa (conversely). Preload at established temperature allow considerable increasing tensile and yield strength at the another temperature. Deformation coefficients behavior at room and nitrogen temperatures was analyzed and deformation mechanisms at different temperature of these alloys were discussed.

13-6

Mechanical properties of geopolymer panel composites with different types of geosynthetics

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Geopolymers are a type of inorganic polymer that can be formed by using industrial waste and it is seen as a potential alternative to standard concrete, and an opportunity to convert a variety of waste streams into useful by-products. Ordinary Portland Cement (OPC) production accounts for nearly 7% of all anthropogenic CO_2 emissions each year in the world. However, Geopolymer binder can be used in applications to fully or partially replace OPC with environmental and technical benefits, including an 80 - 90% reduction in CO_2 emissions and improved resistance to fire and aggressive chemicals. In this paper, the experimental behaviour of Geosynthetics Geopolymer Panels (GGP) under flexural loading was investigated with different types of geosynthetics. The length of GGP was chosen as 550 mm, width 150 mm and depth of the section was 150 mm according to ASTM C 78. As result, three types of geosynthetics—Polypropylene (PP) geogrid, carbon geotextile, and polyfelt geotextile were used for reinforcing panel. The tension loading of geosynthetic reinforcement products according to ASTM test methods D 4595, D 6637 and D 5262 was studied to characterize the load-elongation properties of the geosynthetics. Additionally, ultimate load carrying capacity and load-deformation behavior of GGP was investigated with different types of geosynthetics. Consequently, the use of PP geogrid leads to higher strength and significant improvement in the flexural strength test.

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Michaels Thomas C. T.		54
Migas Damian	damian.migas@outlook.com	57
Mihajlovski Katarina R.		17
Mikuśkiewicz Marta		57
Milanović Igor		28, 50
Milanović Jovana		63
Milanović Vitomir		29
Milenković Marina		8
Milivojević Milan		19
Milosavljević Ana	anam@ipb.ac.rs	42, 44
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Milošević Sanja		50
Milovanović Stoja	smilovanovic@tmf.bg.ac.rs	13, 50
Milović Miloš		37
Milutinović Milica D.		17
Mišković-Stanković Vesna		4, 7, 14
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Mitrić Miodrag	mmitric@vin.bg.ac.rs	37
Mitrović Angelina		24
Mitrović Nebojša S.		43
Mitschek Merlin		44
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Moskal Grzegorz		57
Mravik Željko	zeljkomravik@gmail.com	48

Perić-Grujić Aleksandra		7
Pešić Jelena		27
Petrović Čedomir		42, 44
Petrović Jelena	jelenapetrovic.co@gmail.com	10
Petrović Predrag		8
Phuakkong Oranit		59
Popova Marina		45
Popović Ivanka		3
Popović Zoran V.		42, 44
Postole Georgeta		18
Prokić Vidojević Dragana	drprokic@yahoo.co.uk	60
Protsenko Pavel		16
Radaković Jana		28
Radelytskyi Igor		51
Radetić Maja		50
Radoičić Marija		50
Radonjić Miloš M.		42, 44
Radosavljević Evans Ivana		31
Radotić Ksenija		10
Radovanović Filip		9
Radovanović Jelena		29
Radovanović Željko		50
Rakoczy Łukasz	lrakoczy@agh.edu.pl	40
Rakočević Zlatko		47
Ranđelović Marjan		23
Ranitović Milisav		24
Ranogajec Jonjaua		24
Ravaine Valerie		59
Red’ko Roman		55
Red’ko Svitlana		55
Rmuš Jelena	sonja.jovanovic@vinca.rs	53
Sadowski Janusz		51
Safonov Alexey V.	safa2004@mail.ru	65

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