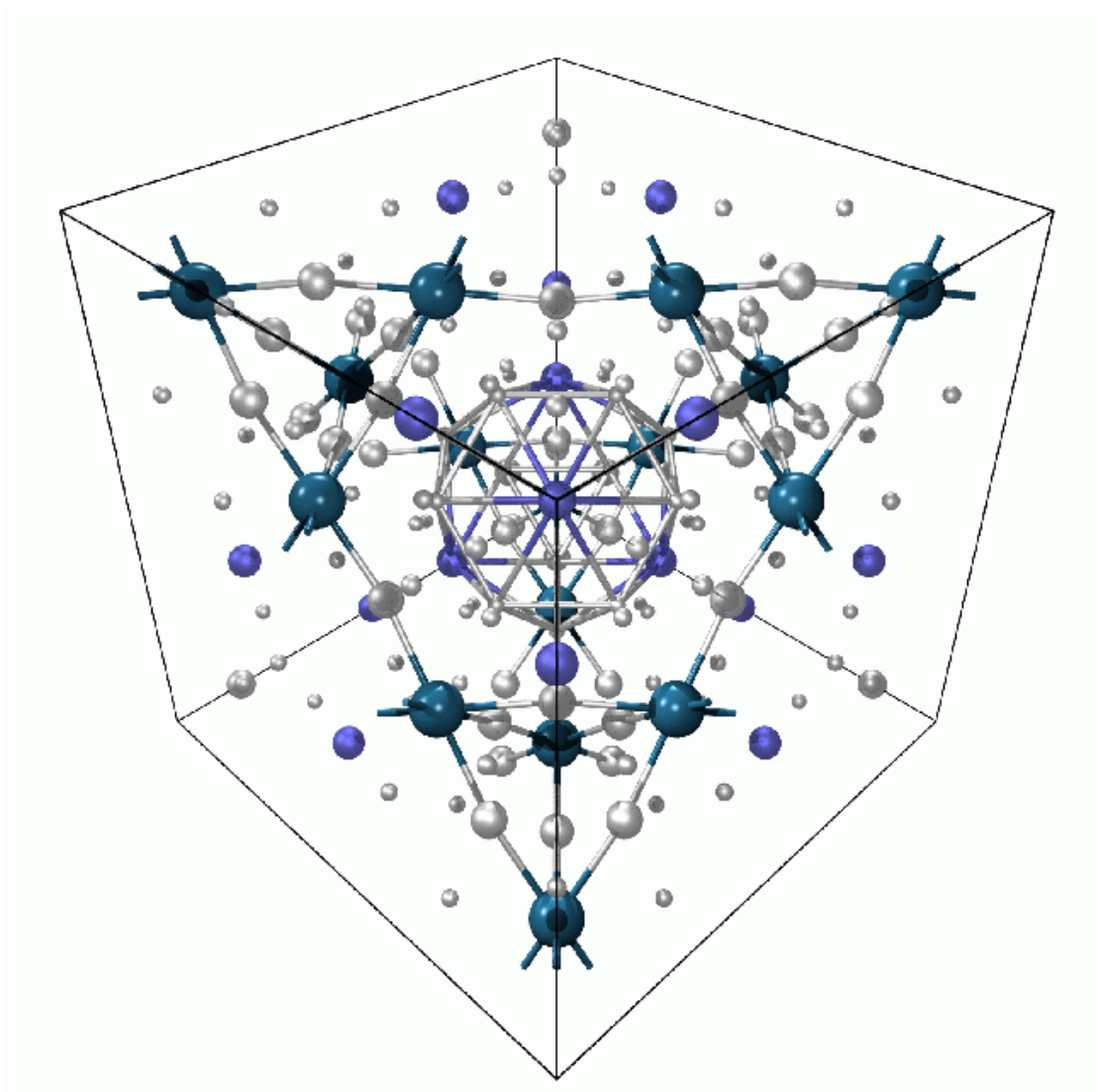


NANOVED & NANOTECH & TECHTRANSFER 2010

**5th International Conference
on Nanosciences, Nanotechnologies, Nanomaterials,
Nanomedicine and Technology Transfer**



Program and Abstracts

Bratislava, Slovakia, May 16 – 19, 2010

NANOVED & NANOTECH & TECHTRANSFER 2010

5th International Conference on Nanosciences, Nanotechnologies, Nanomaterials,
Nanomedicine and Technology Transfer

Program and Abstracts

Editors:

Peter Švec
Magdaléna Kadlečiková
Jozef Kadlečík

Slovak Academy of Sciences and Slovak University of Technology

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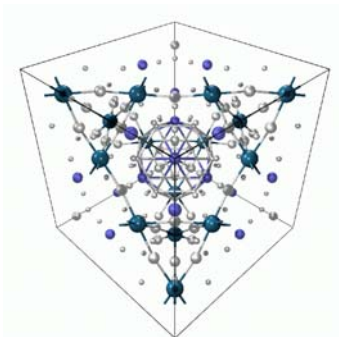
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Bratislava, Slovakia, May 16 – 19, 2010

Premises of SUZA, Drotárska cesta, 46, 811 04 Bratislava, Slovakia

Programme

Sunday, May 16, 2010

16:00 - 20:00 Registration

19:00 - 21:00 Welcome and refreshments

Monday, May 17, 2010

08:00 - 09:00 Registration (continued)

Opening ceremony

Chairperson: F. Čiampor

09:00 - 09:10 **F. Čiampor:** Welcome to the participants

09:10 - 10:00 **Inaugural addresses**
**Pavel Holík, Section for European Policy and Knowledge
Society, Office of the Government of the Slovak Republic**
Ján Mikolaj, deputy prime minister and minister of education
Jaromír Pastorek, president of the Slovak Academy of Sciences
Bibiána Remiarová, director of APVV
Vladimír Bálež, rector of the Slovak Technical University

10:00 - 10:30 **Coffee Break**

Session 1: Nanomaterials, Nanotechnologies

Chairperson: Peter Švec

10:30 - 11:15 E. Hristoforou: Behavior of magnetic structures in the nano-scale (invited lecture)

11:15 - 12:00 F. Prima: Nanostructuring strategies in titanium alloys (invited lecture)

12:30 – 14:00 Lunch Break

Session 2: 7th FP and NMP Projects

Chairperson: Jozef Kadlečík

14:00 - 14:45 P. Lobotka: 7th Framework Programme: PPP Projects and the New Call for Proposals for 2011 in the theme 4 - Nanosciences, Nanotechnologies, Materials and New Production Technologies (NMP) (invited lecture)

14:45 - 15:15 A. Siupa: NanoSight – uniquely valuable particle sizing...with potential as a biodiagnostic platform

15:15 - 15:40 F. Uherek: Advancement of the nanostructures technology and diagnostics within NANONET project

15:40 - 16:00 A. Bízik: Nanotechnology health risks

16:00 – 16:30 Coffee Break

Session 3: 7th FP and NMP Projects, Technology Transfer

Chairperson: Ivo Vávra

16:30 - 17:00 S. Sališ: Prenos poznatkov a technológií z akademického prostredia do praxe

17:00 – 17:20 J. Turňa: Role of the Slovak Centre of Scientific and Technical Information in the support of the research, development, innovation and technology transfer

17:20 - 17:40 J. Poledna: Support of innovation

17:40 - 18:00 V. Švač: Slovakia – a country with extensive R&D potential

18:00 - 18:20 J. Kadlečík: University technology transfer – expectation and reality

18:20 - 19:20 Poster Session and 7th FP Project Preparation Workshop (Lobotka, Turňa, Kadlečík, Remiárová, Danková)

19:30 – 21:00 Dinner

Tuesday May 18, 2010

Session 4: Nanomedicine and Health Risks

Chairperson: Fedor Čiampor

09:00 - 09:45 J. Boczkovski: The state of art on the toxicity knowledge of manufactured nanomaterials (invited lecture)

09:45 - 10:30 P. Zavodszky: Biological nanomachines – Self-assembling nanostructures based on proteins (invited lecture)

10:30 - 10:50 M. Drgoňová: Life cycle thinking and nanotechnology

10:50 - 11:20 Coffee Break

Session 5: Nanoparticles - Preparation and Processing

Chairperson: Evangelos Hristoforou

11:20 - 12:05 O. Schneeweiss: Metallic nanoparticles: preparation and properties (invited lecture)

12:05 - 12:25 P. Uhlík: Natural mineral nanomaterials and relevance of their knowledge

12:25 - 12:45 V. Šepelák: Flexibility of structure and variability of properties of nanostructured spinel oxides

12:45 – 14:00 Lunch Break

Session 6: Magnetic Nanomaterials – Properties and Applications

Chairperson: Vladimír Komiš

14:00 - 14:45 R. Varga: Nanocrystalline microwires for spintronic applications (invited lecture)

14:45 - 15:05 I. Škorvánek: Hard magnetic properties of Fe-(Co)-Pt-Nb-B nanocomposites from melt-spun ribbons

15:05 - 15:25 E. Hristoforou: Magnetic steel health monitoring in the nano-scale

15:25 - 15:45 M. Timko: Magnetic fluids for transformer technology

15:45 - 16:05 P. Kopčanský: Applications of magnetic fluids in medicine

16:05 – 16:30 Coffee Break

Session 7: Nanomaterials – Characterization and Processing

Chairperson: Tibor Kvačkaj

16:30 – 17:15 D. Šimek: Capability of X-ray diffractin and transmission electron microscopy for the microstructure analysis of nanomaterials (invited lecture)

17:15 – 18:00 O. Jašek: Synthesis of carbon nanostructures by plasma enhanced chemical vapour deposition at atmospheric pressure (invited lecture)

18:00 - 19:00 Poster Session and 7th FP Project Preparation Workshop
(Lobotka, Turňa, Kadlečík)

19:00 – 22:00 Conference Banquet

19.30 Best Young Researcher Contribution Award Ceremony

Wednesday May 19, 2010

Session 8: Nanocomposites I – Processing, Technologies and Applications (Session devoted to CEKOMAT Project)

Chairperson: Dušan Janičkovič

9:00 – 9:20 VI. **Kompiš:** Composite materials reinforced by short (nano) fibres – computational simulations

9:20 – 9:40 T. **Kvačkaj:** ECAR processing of OFHP copper material

9:40 – 10:00 J. **Bidulská:** Influence of ECAP on densification behaviour in the PM aluminium Al-Mg-Si-Cu-Fe alloy

10:00 - 10:30 F. **Simančík:** The effect of powder Al₂O₃ skin disruption on properties of subsequent fine Al powder compacts

10:30 – 11:00 Coffee Break

Session 9: Nanocomposites II – Processing, Technologies and Applications (Session devoted to CEKOMAT Project)

Chairperson: František Simančík

11:00 – 11:20 J. **Dusza:** Development of zirconia / carbon nanofiber composites

11:20 – 11:40 B. **Lalinská:** Mineralogy and geochemistry of Fe oxyhydroxides from various abandoned Sb deposits and usefulness of Fe oxides for remediation purposes

11:40 – 12:00 P. **Vitovič:** Physical properties of Calixarene containing monolayers at an air-water interface and their use in detection dopamine

12:00 – 12:20 I. **Vávra:** Nanocomposite films for optical coatings

12:20 – 12:30 Closing remarks

12:30 - 14:00 Lunch

End of the Conference

List of Poster Contributions

- P01: M. Balog, M. Qian,**
Partial nitridation of fine Al powders
- P02: M. Besterci, O. Velgošová, J. Ivan, T. Kvačkaj,**
Damage mechanisms of Cu-Al₂O₃ nanomaterials
- P03: Peter Billik, Mária Čaplovičová,**
Mechanochemical synthesis of nanostructured materials
- P04: E. Bretšnajdrová, L. Svoboda, J. Zelenka,**
Determination of particle shape and size distribution of model types of nanomaterials
- P05: P. Butvin, B. Butvinová, P. Švec,**
Application potential of nanocrystalline ribbons still pending
- P06: E. Csehová, J. Andrejovská, A. Limpichaipanit, J. Dusza, R. Todd,**
Indentation load-size effect in Al₂O₃ - SiC nanocomposites
- P07: M. Čavojský, M. Balog, F. Simančík, K. Iždinský, P. Švec, D. Janičkovič, E. Illeková,**
Microstructures and properties of extruded AlCrFe melt-spun ribbons profiles.
- P08: J. Degmová, J. Sitek,**
Debye temperature of nanocrystalline aluminium based alloys
- P09: A. Duszová, P. Hviščová, F. Lofaj, G. Czempura, J. Dusza,**
Coefficient of friction vs. surface roughness in nanocomposite WC-C coatings
- P10: T. Hatala, M. Pavúk, M. Miglierini,**
Co-substituted NANOPERM-type alloys studied by synchrotron radiation
- P11: Z. Križanová, I. Vávra, J. Novák,**
Structural analysis of semiconducting quantum dots by transmission electron microscopy
- P12: M. Marton, M. Vojs, M. Varga, L. Michalíková, T. Ižák, M. Veselý, R. Redhammer,**
Preparation of nanocrystalline diamond thin films by double bias enhanced HFCVD
- P13: B. Matušková, J. Škriniarová,**
Zviditeľňovanie kryštalografických defektov v GaP pomocou mokrého chemického leptania
- P14: M. Mesárošová, F. Čiampor, I. Vávra, M. Koneracká, M. Timko, V. Závišová, A. Gábelová,**
Cell distribution and cytotoxicity of magnetite nanoparticles in A549 cell line
- P15: M. Mičušík, M. Omastová, J. Prokeš, M. M. Chehimi, J. Pionteck,**
Preparation and electrical conductivity of nanocomposites based on polypropylene and modified carbon nanotubes

P16: L. Michalíková, J. Škriniarová, M. Marton, E. Regendová, A. Gábelová, M. Veselý,

Interaction of human skin cells with diamond-like carbon surfaces

P17: E. Neubauerová, M. Kuricová, A. Líšková, J. Tulinská, K. Volkovová, L. Wsolová, M. Dušinská,

Immunomodulatory effect of nanoparticles *in vitro*

P18: P. Oslanec,

Magnesium chips recycling

P19: K. Pastorková, M. Kadlečiková, F. Lazišťan, M. Kolmačka, K. Jesenák, J. Breza, M. Michalka,

Carbon nanotube bridges grown on aluminosilicates by hot filament CVD process

P20: M. Pavúk, T. Hatala, M. Miglierini,

Influence of glass-forming element (boron) on surface crystallization of NANPERM-type alloys

P21: Ľ. Šušlik, V. Pira, J. Škriniarová, D. Pudiš, J. Kováč, I. Kubicová, T. Ščepka J. Novák,

Light emitting diode with 2D photonic structure in the surface

P22: A. Poturnayová, M. Šnejdárková, T. Hianik,

Calix[4]arenes: supramolecular structures sensitive to dopamine

P23: V. Puchý, A. Duszová, O. Tapasztó, P. Kun, P. Hvizdoš, J. Dusza, Cs. Balácsi,

Tribological behavior of ZrO₂-CNF and Si₃N₄-CNT nanocomposites

P24: E. Rollerová, S. Scsuková, J. Jurčovičová, A. Mlynarčíková, E. Szabová, J. Kovřížnych, D. Zeljenková,

Neonatal exposure to polymeric nanoparticle PEG-b-PLA interferes with pubertal development in female Wistar rats

P25: T. Ščepka, J. Škriniarová,

Importance of AFM tip properties for observation results

P26: P. Šimon, D. Bakoš, M. Petková, T. Doboly,

Submicronization and nanonization of beta glucan and its application in biologically more efficient forms

P27: J. Tulinská, Z. Kováčiková, A. Líšková, M. Kuricová, E. Neubauerová, M. Dušinská, K. Volkovová, L. Wsolová, E. Tátrai,

Immunomodulatory effect of nickel oxide nanoparticles

P28: M. Vargová, G. Plesch, P. Bačík, M. Záhoran, K. Jesenák,

Photocatalytic activity of titanium dioxide powder precursors for heterogenous photocatalysis

P29: M. Vojs, E. Šípoš, V. Rehaček, M. Marton, M. Varga, M. Veselý, R. Redhammer,

Determination of Zn, Cd AND Pb by bismouth-coated microelectrode array based on nanocrystalline diamond thin film

P30: V. Vretenár, M. Kotlár, M. Marton, M. Vojs, A. Vargová, Z. Križanová, M. Michalka, M. Hulman, V. Skákalová, Š. Bederka, M. Veselý, R. Redhammer,

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P31: K. Zábranský, O. Schneeweiss,

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P32: G. Kováč, P. Blažíček,

Point of care testing (POCT), nanotechnologie a personalizovaná laboratorna diagnostika

P33: P. Pacek,

Paving the way for SME-friendly R&D&I programmes

P34: K. Dziendzikowska,

The influence of silver nanoparticles on testes of Wistar rats

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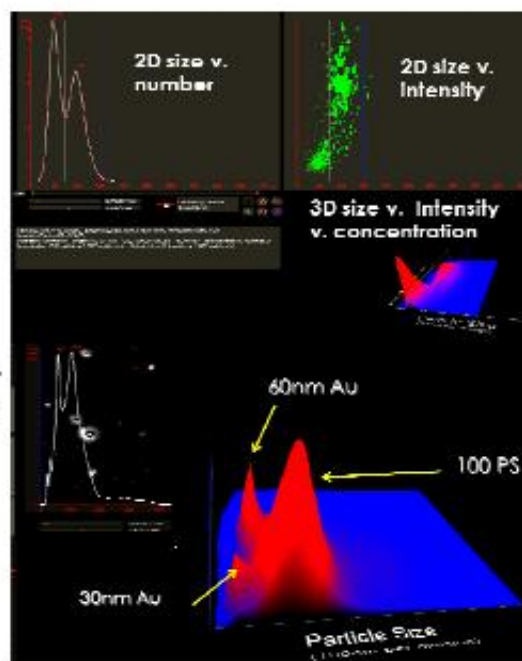
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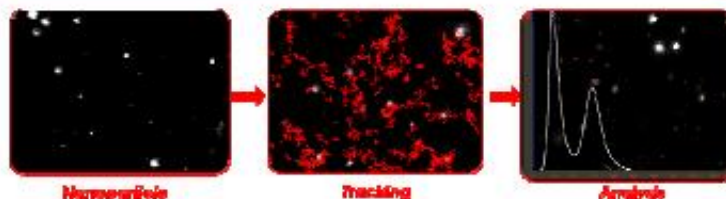
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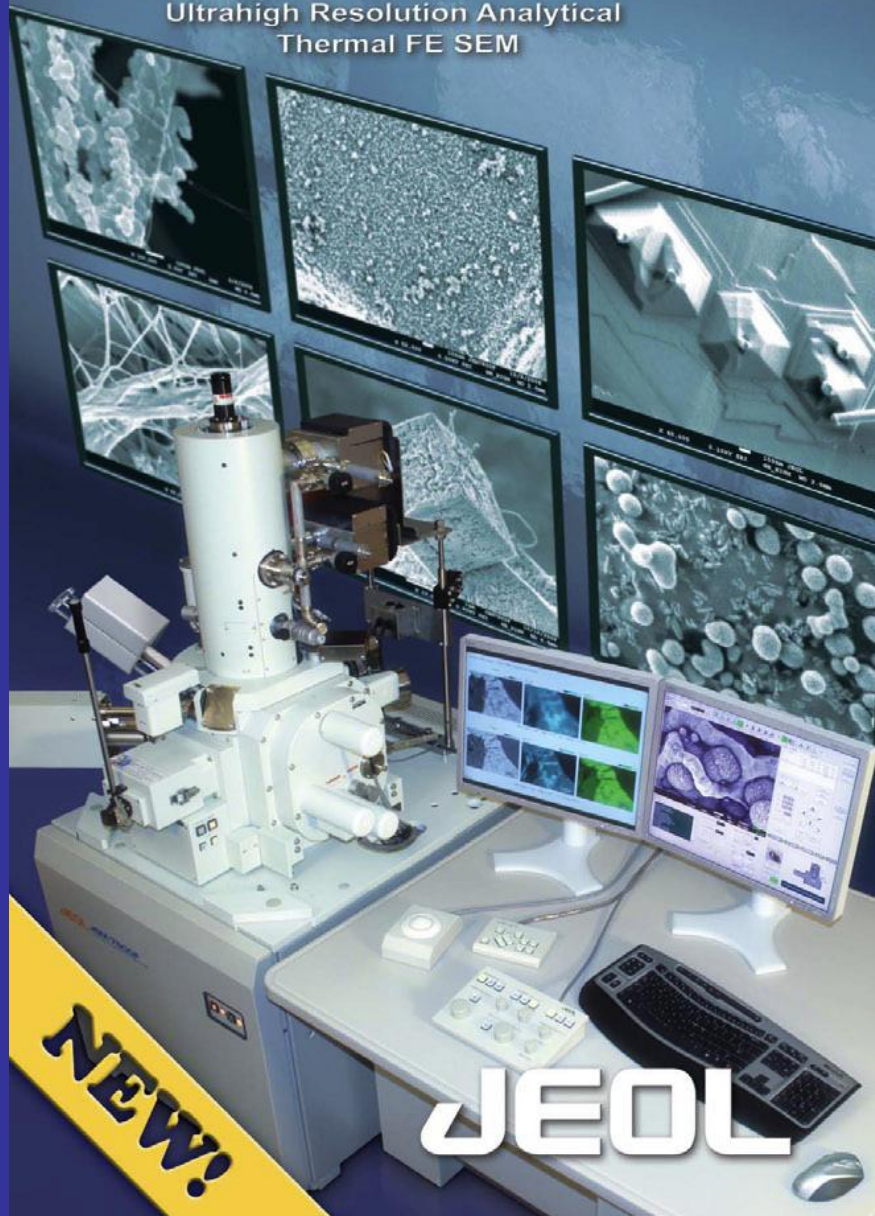
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Abstracts

Invited Lectures and Oral Contributions

BEHAVIOR OF MAGNETIC STRUCTURES IN THE NANO-SCALE

Evangelos Hristoforou

*Laboratory of Physical Metallurgy, School of Mining and Metallurgical Engineering,
National Technical University of Athens, Zografou Campus, Athens 15780, Greece*

The aim of the current work is to demonstrate a new facility for chemical vapor deposition (CVD), accompanied by a new family of precursors, namely cyclodextrines, that are able to develop 2-3 nm thick films, thus allowing for some specific sensor applications. At the first place, our group has developed a new family of CVD precursors, namely cyclodextrines, which can trap one atom of metal, thus allowing for a very slow and controlled deposition process. Furthermore, a home-designed CVD device, allowed for the development of 2-3 nm thick Co films, with an uncertainty in the order of atomic level. Intercomparison tests with molecular beam epitaxy illustrated a similar uncertainty in the developed Co films. Thus, the developed method of CVD ensures a low cost method of thin film development. The ability of developing such thin films allowed for the control of the magnetic anisotropy of the developed Co-films, offering the possibility of the developing sensitive magnetic field sensors with no Barkhausen noise on their response. Figure 1 illustrates the dependence of the magnetoresistance (MR) change in the developed Co films after biasing with a permanent magnet disk having perpendicular anisotropy. This response has been achieved due to the surface flatness and small thickness of the Co film.

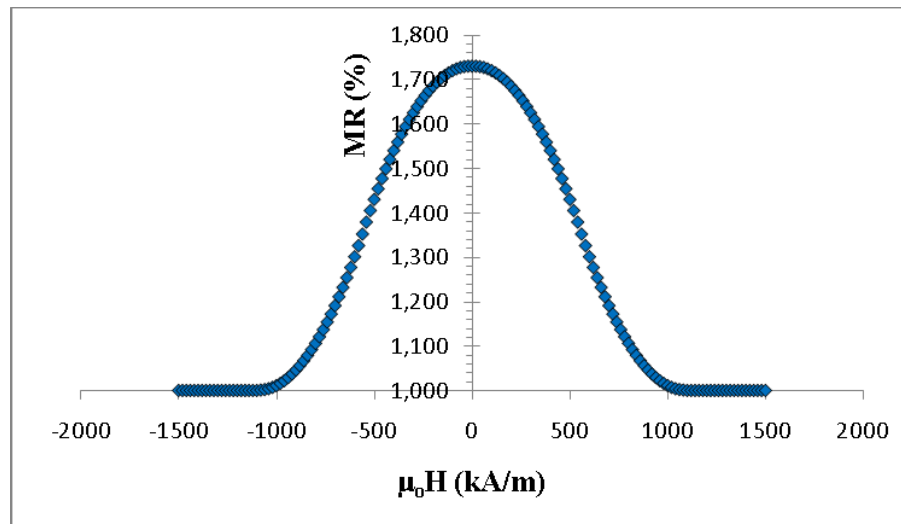


Figure 1.
Magnetoresistance change in the developed Co films with applied field, illustrating large MR response with absence of hysteresis

NANOSTRUCTURATION STRATEGIES IN TITANIUM ALLOYS

F Prima¹, K.B Kim², D. Janickovic³, P. Svec³

¹ *Laboratoire de Physico-Chimie des Surfaces, (CNRS-UMR 7045) Groupe de Métallurgie Structurale, ENSCP Paris, France.*

² *Department of Advanced Materials Engineering, Sejong University, Gwangjin-gu, Gunja-dong, Seoul, South Korea*

³ *Institute of Physics, Slovak Academy of Sciences, Dubravska Cesta 9, Bratislava, Slovak Republic*

The combination of low density (4,5g/cm³), excellent mechanical properties (strength: 1000 MPa, ductility: around 10%) and good corrosion resistance makes microcrystalline titanium alloys among the best engineering materials for many industrial applications.

Recently, a lot of research has been dedicated to the improvement of either functional properties (superelasticity, shape memory properties) or mechanical properties (fatigue, tribological resistance...) of titanium alloys. Among the different approaches, nanostructuration strategies are shown to be of the most promising ways to design new improved materials. In this talk, some of the advanced approaches to decrease the microstructural scale are compared and discussed regarding the final application. Nanostructuration using low temperature and/or flash (short duration) thermal treatments, complex thermo-mechanical treatments or rapid solidification techniques will be highlighted and discussed. The influence of chemical formulation of titanium alloys on the final microstructural state will be particularly emphasized, regarding some of those approaches

**SIEDMY RÁMCOVÝ PROGRAM: PPP PROJEKTY A NOVÁ VÝZVA
NA ROK 2011 V TÉME NMP (NANOTECHNOLÓGIE, NOVÉ
MATERIÁLY A VÝROBNÉ POSTUPY)**

**7TH FRAMEWORK PROGRAMME: PPP PROJECTS AND THE NEW
CALL FOR PROPOSALS FOR 2011 IN THE THEME 4 -
NANOSCIENCES, NANOTECHNOLOGIES, MATERIALS AND NEW
PRODUCTION TECHNOLOGIES (NMP)**

Peter Lobotka

¹Institute of Electrical Engineering, Slovak Academy of Sciences, Bratislava, Slovakia
Corresponding author: peter.lobotka@savba.sk

V príspevku bude v predstihu podaná informácia o obsahu blížiacej sa výzvy Siedmeho rámcového programu v oblasti NMP s dôrazom na témy dotýkajúce sa "nano". Ďalšou dôležitou témou prednášky bude informácia o novej forme financovania výskumu pomocou PPP projektov

Advance information about the contents of the next call of the 7FP in the field of NMP will be presented. The focus will be put on themes related to “nano” fields. Further new and important information will be put forth about the new form of funding of research by means of the PPP projects.

NANOSIGHT – UNIQUELY VALUABLE PARTICLE SIZING...WITH POTENTIAL AS A BIODIAGNOSTIC PLATFORM

Agnieszka Siupa¹, Jeremy Warren¹, Bob Carr¹

*¹NanoSight, Minton Park, London Road, SP4 7RT, Amesbury, UK
agnieszka.siupa@nanosight.com*

NanoSight was founded in 2002 by John Knowles and its current Chief Technical Officer, Bob Carr, to develop nanoparticle detection techniques based on a suite of patents that came out of their work. It is now the world leading provider of a series of unique instruments for the optical detection and real time analysis of sub-micron particles that offer significant advantages compared to existing light scattering techniques.

The Company's proprietary knowledge and expertise has enabled the delivery of technologies to blue chip companies and universities for direct visualisation of individual nanoscale particles in suspension from which immediate independent quantitative estimation of particle size, size distribution and concentration can be obtained.

Since instrument deliveries commenced in 2006, NanoSight now is approaching 250 systems in service worldwide. The revolutionary NanoSight LM10 and LM20 systems are powered by the ground-breaking Nanoparticle Tracking Analysis (NTA) software, which has been the subject of a recent major upgrade. NanoSight has been continuously expanding and since late 2008 has relocated its Headquarters to larger premises and significantly increased the headcount. New offices have been opened on the West and East coasts of the USA and the distributor network worldwide has grown to support the accelerating sales growth.

NanoSight Ltd is a venture capital backed company. Original funds from NESTA, Strathdon Investments and South West Ventures have recently been augmented by significant angel investment from members of the SWAIN and OEI Investment Networks.

ROLE OF THE SLOVAK CENTRE OF SCIENTIFIC AND TECHNICAL INFORMATION IN THE SUPPORT OF RESEARCH, DEVELOPMENT, INNOVATION AND TECHNOLOGY TRANSFER

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The **Slovak Centre of Scientific and Technical Information (SCSTI)** is the national information centre and specialized scientific library of the Slovak Republic focused on all branches of technology and selected areas of natural and economic sciences. It is the state-owned (directly managed by the Ministry of Education of the SR) institution with task to gather, process and provide science-related information and build complex information systems for research and development (R&D). The SCSTI fulfils also the function of the **National Centre for Popularisation of Science and Technology** in Slovakia and administrates the **Central Information Portal for Research, Development and Innovation**. Based on mutual agreements, the SCSTI hosts depository libraries of the EU, the OECD and the EBRD, the **Centre of Patent Information – PatLib of the European Patent Office**, as well as the Sales Office of the EU Publisher – Publications Office of the EU.

Apart from above-mentioned activities, the Slovak Centre of Scientific and Technical Information implements two national projects financed from the EU structural funds (ERDF), within the Operational Programme Research and development. The first one is **NISPEZ – National information system promoting research and development in Slovakia – Access to electronic information resources**. The main objective of the project is to ensure the access to R&D-related electronic information resources for the science community and university students in Slovakia. Project duration is 5 year (ending in June 2014) and the total amount of the grant provided is 19.881.676,23 EUR. The second national project, which is currently being implemented by the SCSTI, is called **Infrastructure for Research and Development – the Data centre for research and development**. The aim of this, 33 mil. + EUR project is to build the data centre that will store, process and provide access to information needed by Slovak scientific organisations while carrying out their R&D activities.

In March 2010, the SCSTI has submitted the third national project called **National infrastructure for technology transfer support in Slovakia – NITT SK**, which shall be financed again from the Operational Programme Research and development. The expected start of project implementation is in June 2010, the project duration is 55 months and the total planned budget is nearly 8,5 million EUR. The project intention is to propose and implement the national infrastructure supporting the transfer of knowledge and technologies gained by R&D activities to socio-economic praxis, and thus contribute directly to more intensive and efficient state support of research and development. The national system will support those R&D activities that reflect the real needs of entrepreneurial sector, which will result in increased application of R&D results and technologies in industrial sector. At the same time, it will support the creation of long-term partnerships between academy and industry, which will help not only to academics themselves, but it will contribute to sustainable development of the whole, knowledge-based society. The NITT SK project will be implemented nationwide at the whole territory of the SR, while the primal target group of the project will be the science community coming from public sector.

NANOTECHNOLOGY HEALTH RISKS

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A nanoparticle (or nanopowder or nanocluster or nanocrystal) is a microscopic particle with at least one dimension less than 100 nm. Human exposure to nanoparticles (NPs) is not new: NP pollution caused by dust storm, volcanic ash, erosion, forest fires has always been part of human existence. Some but probably not the majority of NPs will have significant toxicity /hazard / potential , and this will a significant risk if there is a sufficient exposure.

NPs can effect human health via inhalation, ingestion or dermal contact, and because the skin is the main target tissue for exogenous materials , skin toxicity is an important issue.

The biological activities and toxicity of NPs depend on physicochemical parameters, such as, size, shape, concentration, chemistry, solubility, surface properties, aggregation, stability, temperature, and on the presence biological inhibitor.

Although the mechanism underlying NPs'-induced cytotoxicity is only incompletely understood, it has been suggested to be related to oxidative stress and to inflammatory response. Neuronal transport of NPs has been described, involving retrograde and anterograde movement in axon and dendrites as well as perineural translocation. This is importance for access of inhaled NPs to the CNS via sensory nerves existing in the nasopharyngeal and tracheobronchial regions of the respiratory tract.

Although there are anecdotal data indicating a causal relationship between long term ultrafine particle exposures in ambient air / e.g. traffic related / or at the workplace / e.g. metal fumes / and resultant neurotoxic effects in humans, more studies are needed to test hypothesis that inhaled NP cause neurodegenerative effects.

To stop NPs from becoming a serious threat to human health, we must learn what the most important parameters are in deciding the toxicity of NPs, and what measures can be taken to lessen particulate pollution and the toxic effect of NPs in human bodies. Nanomaterials represents a new occupational phenomenon. National Institute for Occupational safety and Health (NIOSH) the leading federal agency conducting research and providing guidance on the occupational safety and health implications focuses scientific expertise on answering the questions: how might workers be exposed to nano-sized particles in the manufacturing or industrial use of nanomaterials; how do nanoparticles interact with the body's systems and what effects might nanoparticles have on the body's systems.

The current body of evidence about the possible health risks of occupational exposure to engineered nanoparticles is quite small. Insufficient scientific and medical evidence now exists to recommend the specific medical screening of workers potentially exposed to engineered nanoparticles.

PRENOS POZNATKOV A TECHNOLOGIÍ Z AKADEMICKÉHO PROSTREDIA DO PRAXE

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Technologický transfer v jeho niektorých podobách nie je pre Slovenskú republiku novým fenoménom. V minulosti existovalo prepojenie akademického a podnikového prostredia, no zmeny hospodárskeho zriadenia po roku 1989 priniesli pomerne hlboké oslabenie tejto spolupráce. Rozpad bývalých odbytísk, zavedenie trhových pravidiel do hospodárskeho života a prispôsobovanie sa zmenám sú len niektoré z príčin súčasného stavu. Dobrou správou je, že existuje niekoľko iniciatív, ktoré sa snažia vyriešiť situáciu či už prostredníctvom návrhov alebo praktickou činnosťou. Jednou z nich je aj zapojenie SAV a Žilinskej univerzity do európskeho projektu pod názvom CERIM (Central Europe Research to Innovation Models) spolufinancovaného z Európskeho regionálneho a rozvojového fondu (ERDF). Medzi tri primárne komunikované odkazy patria inštitúcie verejného výskumu ako hodnotný zdroj inovácií prispievajúcich k rozvoju blahobytu v strednej Európe, vytvorenie nástroja na podporu transferu technológií a poznatkov z akademického prostredia do praxe a kreovanie nových inovatívnych firiem. Nie je úlohou, ani v možnostiach projektu vyriešiť všetky existujúce problémy, no je možné naznačiť cestu, po ktorej sa bude potrebné uberať. Proces je na počiatku a potrvá nie krátky čas, kým sa zabezpečia prvé pozitívne výsledky.

ADVANCEMENT OF THE NANOSTRUCTURES TECHNOLOGY AND DIAGNOSTICS WITHIN NANONET PROJECT

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First decade of the 21th century is devoted to the nanotechnology. Generally, nanotechnology deals with structures of the size 100 [nanometers](#) or smaller in at least one dimension, and involves developing materials or devices within that size. Nanotechnology can be much diversified from device applications up to new approaches to molecular growth such as molecular beam epitaxy and/or also for various deposition techniques. One of these is the pulsed laser deposition. This method allows create nanostructures using direct deposition from various targets in different ambient. The wide temperature range allows new approaches of small dimension layers like nanomaterials. The opposite side of the methods used for evaluation of the nanoscale dimensions and phenomena are usually rather complicated devices and systems. At ILC Bratislava there is an experience with producing of nanostructures by pulsed laser deposition (PLD). The main advantage of PLD is a wide material selection suitable for successful growth of thin films including pure elements or compounds and multilayer structures. Among them, oxides play important role in thin film structure. Oxides cover a wide range of physical and chemical properties. They are typically used as the electrical and diffusion insulating barriers, optical waveguides, mechanical anti-scratch coverings, and in countless special applications. Special role in ILC research projects plays ZnO. PLD can be applied in growth of simple nano-layers of ZnO as well as for doped films in complex multilayered structures with homo/hetero junctions. A variety of nanostructures including an array of nano-rods/wires/needles etc. have been experimentally prepared by PLD in Laboratory of laser microtechnology.

For the characterization and fundamental surface science of novel materials, nano-/micro-surface structures and devices we utilize a high resolution field emission scanning electron microscopy (FE SEM), atomic force microscopy (AFM) and scanning tunneling microscopy (STM). FE SEM offers high potentialities in variety of applications oriented to observation of surface structures and element analysis. Advanced nondestructive SEM techniques as the electron-beam-induced current method, cathodoluminescence and the method of potential contrast have found wide recognition. AFM and STM are used for investigation of samples outside vacuum. This renders feasible the visualization of surfaces and roughness analysis and measurement of local physical properties such as geometrical relief, surface conductivity, distribution of electric potentials, electrostatic and magnetic forces.

Besides the using of these sophisticated methods also the application of optical diagnostics can be applied. The main feature of the diffraction based inspection are the undemanding laboratory conditions required as well as the possibility of large area surface observation in ambient air. It has been shown that the diffraction based methods can be used for surface feature size determination in the submicron region but also for defects detection.

Acknowledgements

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UNIVERSITY TECHNOLOGY TRANSFER EXPECTATION AND REALITY

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Príspevok je venovaný analýze možností a realite univerzitného technologického transferu (UTT) s využitím existujúcich a v praxi používaných modelov a hodnotení UTT. Dotýka sa organizácie, právnej formy a financovania, ako aj jeho inštitucionálnej podpory zo strany štátu a regiónov. V EU je technologický transfer spájaný s inováciami a manažmentom 3. generácie inovácií, od ktorých sa očakáva kompetitívna výhoda EÚ voči USA a Japonsku. Slovensko sa chce zaradiť do 2. generácie inovácií. Znalostná (vedomostná) ekonomika sa implementuje v porovnaní s informačnou ekonomikou pomalšie.

Na Slovensku sú inštitucionalizované základy podpory UTT a vznikajú start-up firmy metódou research based spin off v inkubátoroch, vznikajú prvé spin-out a spin-off firmy, beží proces vytvárania sietí informačných databáz ako i sociálnej výskumnej siete.

Podľa môjho názoru sme v UTT v prvej bráne - etape procesu transferu duševného vlastníctva - v zabezpečovaní jeho ochrany. V globalizovanej ekonomike staré lineárne modely (60. a 80. roky) technologického transferu už efektívne nefungujú. Kreujú sa nové koncepty kancelárií určených na ochranu duševného vlastníctva (IPO) a kancelárií transferu (UTTO) na profit a non-profit báze, na trhu sa objavujú biznis anjeli a draci, začíname rozumieť pojmom pre-seed, seed, mezanine, development capital.

Proces inkubácie novej firmy (pre-start-up a start-up) zameranej na komercionalizáciu výskumného produktu s vysokou pridanou hodnotou má časový horizont 3 až 5 rokov. Proces vytvárania spin-off a start-out firiem trvá približne rovnako. Rýchlosť generovania firiem s vysokou pridanou hodnotou je nízka. Privátne zdroje do výskumu a vývoja na Slovensku prakticky neexistujú. Podnikový výskum a vývoj je minimálny a je mimo Slovenska, existuje však jeho podpora programom podnikateľských poukazov (business voucherov).

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LIFE CYCLE THINKING AND NANOTECHNOLOGY

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Life cycle thinking seeks to identify possible improvements of goods and services in the form of lower environmental impacts and reduced use of resources across all life cycle stages. The key aim of Life Cycle Thinking is to avoid burden shifting. This means minimising impacts at one stage of the life cycle, while helping to avoid increases elsewhere.

Life Cycle Approach can be used to identify and reduce the environmental and health impacts of the products we use. It underlines the importance of considering these issues across the entire life cycle of a product.

There are several ways how to assess the life cycle impacts of products. ISO Life Cycle Assessment quantifies and assesses the emissions, resources consumed, and pressures on health and the environment that can be attributed to different goods or services over their entire life cycle. It seeks to quantify all physical exchanges with the environment, whether these are inputs in the form of natural resources, land use and energy, or outputs in the form of emissions to air, water and soil.

When the inputs and outputs associated with a product life cycle are collated in a „balance sheet“ or life cycle „inventory“, they are grouped into impact categories such as „human toxicity“ or „climate change“ or others. The inputs and outputs are then converted into indicators for each impact category using models and scientific knowledge.

As it is already known Nanotechnology is in many cases in the line with Sustainable Consumption and Production Policy, thanks to reduced use of resources, using energy more efficiently and reduced production of Green House Gases.

Despite the Nanotechnology is a significant contributor to sustainable development of life, there is beginning of doubts about secondary impacts to human health and environment and the Life Cycle Assessment is an applicable tool for identification and examination of potential Nanotechnology risks.

THE STATE OF ART ON THE TOXICITY KNOWLEDGE OF MANUFACTURED NANO –MATERIALS

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Nanotechnologies, defined as technologies aimed to conceive, characterize and produce material at the nanometer scale, represent a fully expanding domain, and one can predict without risk that production and utilization of nanomaterials will increase exponentially in the coming years.

Applications of nanotechnologies are numerous, in constant development, and their potential use in the medical field as diagnosis and therapeutics tools is very attractive. The size particularity of these nanomaterials gives them novel properties, allowing them to adopt new compartments because of these laws of quantum physics that exist at this scale. However, worries are expressed regarding the exact properties that make these nanomaterials attractive, and questions are raised regarding their potential toxicity, their long-term secondary effects or their biodegradability. These questions are justified by the knowledge of the toxic effects of atmospheric pollution micrometric particles on health, and the fear to get an amplification of these effects because of the size of the materials blamed.

In this talk, we will first describe the physicochemical and molecular determinants responsible for potential nanomaterials toxicological effects. Secondly, we will present a synthesis of the actual knowledge regarding toxicological effects of the most used nanomaterials.

It is clear, in regard to the almost empty field of what is known on the subject, there's an urge to better understand biological effects on nanomaterials, which will allow their safe use

BIOLOGICAL NANOMACHINES

SELF-ASSEMBLING NANOSTRUCTURES BASED ON PROTEINS

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Technology can borrow solutions from living cells for a number of practical problems. Cells do synthesize complex organic molecules, convert solar energy into chemical one or chemical energy into mechanical work, use miniature motors, operate recognition and signal transduction mechanisms etc.

Bacterial flagellar filaments are polymers approximately 23 nm in diameter and 10-15 μ m in length, composed of 51-kDa protein subunits, called flagellin, organized into a helical tubular structure. The flagellum has a hollow core. During growth, subunits are synthesized in the cytoplasm, secreted through the central channel and added to the distal end. There are three potential nanotechnological applications of the flagellar system:

1. **Export machinery.** In biotechnology *E. coli* is the workhorse for bacterial expression of recombinant proteins and peptides. It has great practical significance to obtain the product secreted into the medium. The type III flagellar export apparatus could be used for this purpose. We have identified a 22 amino acid residue long, 26-47 segment within the disordered N-terminal region of *Salmonella* flagellin which contains the recognition signal for the flagellar export machinery. It has been shown that the flagellar export system can be used to secrete overexpressed recombinant proteins into the culture medium by generating fusions to the secretion signal. The experimental work to adapt this secretion technology to *E. coli* is in progress.
2. **Flagellin based biosensors.** Since the central 3D domain of flagellin has no role in self organization it is a good target for genetic engineering. In medical diagnostics, in the production of pharmaceuticals, as well as in environmental analysis and food safety control, it is a frequent task to detect individual components in complex mixtures. Protein based biosensors and protein chips are good candidates for such applications. Conventionally antibodies are used as sensory units. However, antibodies are expensive and sensitive to degradation. Filamentous receptor structures can be constructed from flagellin after creating suitable binding region on the 3D domain capable to recognize target molecules (e.g. steroids in waste water). Production of flagellin receptors is less expensive, simpler than that of antibodies, and it can be done without lysing the cells. This sensory protein is robust and appropriate to build various supra-molecular objects.
3. **Proton flow driven nanomotor.** The flagellar filament is connected to a molecular motor embedded in the cell membrane. The rotor is composed of rings which typically rotate at 300 revolutions per second. The stator also contains proteins which are capable of switching the direction of rotation. The motor is powered by a proton gradient through the inner membrane. The flagellar motor involves about 20 distinct proteins. Approximately 11 MotA-MotB protein pairs form two half proton channels, while an other protein FliG serves as the rotating proton carrier. Displacement of the half channels allows the protons to pass into the cell, converting the energy of the proton gradient into rotary motion. The property of self assembly and efficient conversion of chemical energy into mechanical work makes flagellar motors a prototype of biological nanomachines.

METALLIC NANOPARTICLES: PREPARATION AND PROPERTIES

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Metallic nanoparticles (MNs) are full of contrasts: old but terribly contemporary, simple but present in highly sophisticated systems [1]. From their beginning with Faraday [2] to current days, metallic nanoparticles are present and important in our life, thanks to their optical and magnetic properties, use in chemistry, biology and medicine. Many procedures were already developed for preparation of MNs but questions about tailoring their properties for a specific application remain. Controls of phase, size, and shape, physical and chemical properties are prerequisites for various applications.

The methods of preparation of MNs are based on physical or chemical principles. The physical based methods can be controlled precisely and therefore they usually yield well tailored particles or thin films of various shapes and sizes. Small amounts of prepared materials are the basic drawbacks of these methods. The chemical methods which allow producing large amount of materials can be roughly divided into two parts – wet and dry. The wet processes are namely used for preparation of colloids of MNs. The dry processes are based on solid state reactions. Their drawbacks are broad size distribution and formation of agglomerates. Regardless of preparation methods pure MNs exhibit strong chemical interaction with surrounding medium.

Formation of alloy nanoparticles by simple alloying of the mixture of pure element nanoparticles with requested chemical composition exhibits some obstacles. They can be overcome at elevated temperatures where particle coalescence and grain growth are not negligible. Therefore coarse particles are usually obtained by alloying of nanoparticles of pure elements. These troubles can be passed by direct preparation of alloy nanoparticles from suitable precursors.

The pioneering research in the field of preparation and research of properties of MNs was done by Gleiter [3] and coworkers. They synthesized ultrafine-grained materials and showed that these materials have properties significantly different from those of conventional grain sized ($>1 \mu\text{m}$) polycrystalline or amorphous materials of the same chemical composition, namely they possess exceptional mechanical, diffusion and magnetic properties. Size effect in nanomaterials from the point of view mechanical and magnetic properties was analyzed and explained satisfactorily in [4,5].

Recently, heat generation by MNs under optical illumination has attracted much interest [6]. The heat generation process involves not only absorption of incident photons, but also heat transfer from the nanoparticle to the surrounding matrix.

Interesting chemical properties and applications of MNs in chemistry, biology and medicine are out of scope of this contribution.

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NATURAL MINERAL NANOMATERIALS AND RELEVANCE OF THEIR KNOWLEDGE

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Natural mineral nanomaterials are defined on the base two features. Firstly, at least one of material dimensions is in the nanoscale range (1-100 nm). Secondly, the material is a product of geological and/or pedological processes. According to previous definition, phyllosilicates (predominantly clay minerals), zeolites and Fe, Al and Mn oxides, hydroxides are major representatives of natural nanomaterials. They perform important functions in present-day society. Mentioned natural nanomaterials can be accumulated in economic quantity and mined. They are used in wide variety of applications from heavy industry through paper industry to environmental protection. Besides, the natural nanomaterials are disseminated in various rocks, sediments and soils. Most of them arose at specific conditions therefore they are significant indicators of geological processes that help at the prospection of ore or hydrocarbon deposits. Furthermore, occurrence of recently originated Fe oxides and hydroxides in mining or industrial areas is indicator of possible accumulation of heavy elements.

One of the important natural nanomaterials is bentonite. Bentonite is clay consisting of essentially smectite-clay mineral, which is responsible for bentonite's unique physical and chemical properties. Bentonite has significant sorptive, sealing, swelling and adhesive properties. On that account it is not surprising that bentonite is considered as part of engineering barrier in the deep geological disposals of high-level nuclear waste. The crucial role of bentonite as a barrier is protect the container with nuclear waste against rock fluids and on the other side prevent a contamination of the biosphere by radionuclides after failure of metal container. For that reason one of the most significant research subjects of natural mineral nanomaterials is investigation of smectite stability in environment of simulated conditions of nuclear waste disposal.

The natural mineral nanomaterials do not play only positive role. Alberta's oil sands deposits (Canada) represent the second largest reserve of oil in the world. Oil sands consist of of 55–80% inorganic materials (primarily quartz), 4–18% bitumen, and 2–15% water. They are mined more than 40 years and production of crude oil increases every year. A general trend has been observed during this time: as the fines content (mainly clay fraction) of an ore increases, the bitumen recovery from that ore decreases. The hot water processing is the main technology of the bitumen extraction. This process produces huge amount of wastewater that is deposited to tailings. Clay minerals play also negative role there. They caused problem with consolidation of tailing solid phase. Only particular research of clay mineralogy and interaction of clay minerals with bitumen can bring new light to solvation of the problems mentioned above. Our the first results determined a small amount of smectitic layers that explain the increased surface activity of some slurries in the bitumen extraction proces.

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FLEXIBILITY OF STRUCTURE AND VARIABILITY OF PROPERTIES OF NANOSTRUCTURED SPINEL OXIDES

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Nanocrystalline spinel oxides of the type MX_2O_4 (M is a divalent metal cation, $X = \text{Fe, Al, Sn}$) are an important class of nanostructured materials that attract special attention, for example, as advanced ceramics, magnetics, sensors, actuators, pigments, refractories, catalysts and sorbents. In this contribution, the results of the systematic Mössbauer, NMR, neutron diffraction, XRD, HRTEM, XPS, and SQUID studies of the structure and properties of the series of related spinel nanoparticles (ferrites, aluminates, stannates) are presented. Quantitative microstructural information on the nonequilibrium cation distribution, the noncollinear spin arrangement, the alteration of the nearest neighbor configuration, and the deformation of the polyhedron geometry, in the nanostructured spinels is provided. A great effort is directed towards the separation of the surface/interface effects from the core/grain effects in oxide nanoparticles. Selected examples of the magnetic behavior of nanostructured spinel oxides are presented. Both, the magnetization enhancement and magnetic degradation observed for nanoscale ferrite particles are discussed in terms of a competition between the effects of spin canting and site exchange of cations in the surface shell of nanoparticles.

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NANOCRYSTALLINE MICROWIRES FOR SPINTRONIC APPLICATIONS

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As a part of spintronics, the domain wall propagation in thin magnetic wires is used to transfer or store information [1,2,3]. The speed of such devices is determined by the domain wall propagation velocity. Hence, new materials are necessary to be developed having very fast and well-defined domain wall dynamics.

Amorphous glass-coated microwires are characterized by very fast domain wall dynamics, having the domain wall velocity up to 20 km/s [4,5,6]. However, their structural stability is poor, because of their amorphous nature. The solution can be found in application of nanocrystalline microwires that combine perfectly the low anisotropy of amorphous materials (necessary for fast domain wall dynamics) and high structural stability and high magnetization of crystalline materials [7].

In contrary to the classical nanocrystalline materials like FINEMET, NANOPERM, nanocrystalline microwires must exhibit positive magnetostriction. Moreover, glass-coating apply an additional mechanical stress that could result in appearance of additional non-magnetic phases in Finemet or Nanoperm. Hence, new classes of nanocrystalline microwires are necessary to be developed in order to achieve nanocrystalline microwires suitable for spintronic applications.

In the given contribution, we present two new classes of nanocrystalline microwires based on FeNiMoB and FeCoMoB compositions. They exhibit magnetic bistability even in nanocrystalline state [8,9]. Moreover, FeCoMoB-based nanocrystalline microwires are characterized by high Curie temperatures that make them suitable also for hi temperature applications. Annealing in a wide range of temperatures leads to the same nanocrystalline structure, hence, the thermal treatment is not very crucial for their preparation. Finally, they exhibit fast domain wall dynamics in a very low magnetic field.

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HARD MAGNETIC PROPERTIES OF Fe-(Co)-Pt-Nb-B NANOCOMPOSITES PREPARED FROM MELT-SPUN RIBBONS

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The Fe(Co)Pt-based nanocrystalline alloys belong to the family of exchange spring magnets, which are composed of magnetically hard and soft phases interacting by magnetic exchange coupling. The continuing interest in these alloys is mainly due to their promising hard magnetic properties, which makes them attractive for various applications. The objective of the present work is focused on the development of new Fe-(Co)-Nb-B nanocrystalline alloys prepared by isothermal annealing of parent melt-spun ribbons. The relationship between microstructure and magnetic properties was investigated by X-ray diffraction and transmission electron microscopy on one hand and the SQUID magnetometry on the other hand. The microstructure of optimum heat treated hard magnetic nanocomposite consists of L1₀-FePt hard magnetic grains with a size of 15-50 nm dispersed in a soft magnetic medium composed by Al FePt, Fe₂B and FeBPtNb remainder phase. The good exchange coupling between hard and soft magnetic phases leads to a maximum energy product $(BH)_{\max} \approx 70\text{kJ/m}^3$. A thermal processing under the simultaneous application of high magnetic field results only in minor changes of the hard magnetic properties.

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MAGNETIC STEEL HEALTH MONITORING IN THE NANO-SCALE

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The aim of the current work is to demonstrate the ability of determining the number, density and distribution of dislocations and nano-precipitations in steels. Magnetization process is evidently dependent on the microstructure of the magnetic substance. The presence of dislocations and nano-precipitates affects both magnetic domain wall mobility and magnetic domain rotation. Thus, the B-H loops, the Barkhausen noise, the magnetoacoustic emission and the surface magnetic permeability of steels are modified with the level of plastic deformation, the presence of sub-grains in the grain, as well as the size and distribution of nano-precipitates in the grain. These four types of magnetic measurements are in agreement with microstructural changes observed mainly by electron back scattering diffraction (EBSD), but also with transmission electron microscopy (TEM) and XRD based stress tensor analysis. The dependence of the magnetic properties change on the microstructure is modeled with respect to the dependence of domain wall motion and domain rotation on dislocations and nano-precipitates. A typical dependence of the crystalline mis-orientation angle in a grain on the coercive field is illustrated in Figure 1, while Figure 2 shows the agreement in the increase of the Barkhausen noise with the Vicker's hardness, thus allowing for a magnetic non destructive determination of hardness in steels. As a result of the whole magnetic procedure, one may use the above mentioned magnetic techniques in order to determine the level of plastic deformation of steels, in other words the nano-cracks of steels, thus improving significantly the existing state of the art in steel non-destructive testing and offering the possibility of early stage steel health monitoring.

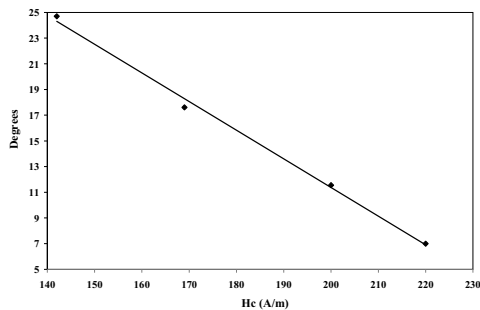


Figure 1. Typical dependence of the crystalline mis-orientation angle in a grain on the coercive field

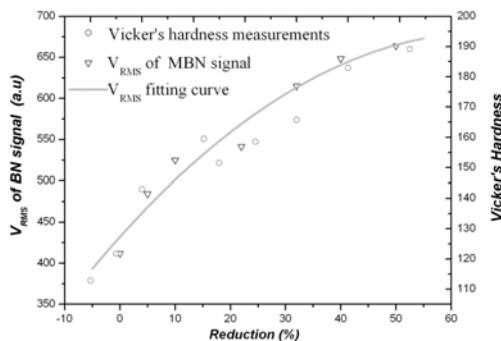


Figure 2. Agreement in the increase of the Barkhausen noise with the Vicker's hardness

MAGNETIC FLUIDS FOR TRANSFORMER TECHNOLOGY

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Magnetic fluids have been shown to provide both thermal and dielectric benefits to the power transformers. They can improve the cooling by enhancing the fluid circulation within transformer windings, as well as they can increase the transformer capacity to withstand lightning impulses [1, 2]. These benefits may be utilized to design smaller, more efficient new transformers, or to extend the life or loading capability of existing units. On the other hand, it is known that the permittivity of magnetic liquids is dependent on the presence of magnetic field that is called magnetodielectric effect.

In our experiments we have used the transformer oil ITO 100 based magnetic fluid with various concentration of magnetite nanoparticles covered by oleic acid. The prepared magnetic fluids were characterised by measurements of magnetic, thermal and dielectric properties, by measurements of partial discharges and dielectric breakdown strengths in AC and DC electrical fields. The magnetodielectric effect in magnetic fluids was confirmed in high electric fields 0.5–2.5 MVm⁻¹ at magnetic field of value $B = 40$ mT. The magnetite particles (MP) covered with oleic acid as a surfactant are electrically charged by adsorbed ions and counter ions (opposite charged) from the surrounding atmosphere may be attracted to them. We suppose that increase of permittivity with increasing voltage is caused by non-linear dependence of polarisation from applied electric field followed from larger charge that is adsorbed on a surface of particles. At low concentrations of MP the non-linear effects are absented and its permittivity is approximately constant. We suppose, that the increasing of permittivity with increasing of MP concentration is caused by higher permittivity of magnetic particles in comparison to permittivity of pure ITO 100 transformer oil.

The observations of the time development of the AC dielectric breakdown in magnetic fluid show the presence of luminous and audible discharges long before the complete breakdown occurrence. The observations of the DC and AC dielectric breakdown strengths of pure transformer oils and transformer-oil based magnetic fluids show that studied magnetic fluids, if their volume concentration of magnetic particles $\Phi < 0.01$ ($I_S < 4$ mT), have better or not worse dielectric properties than pure transformer oil. Regarding to the better heat transfer, provided by magnetoconvection effect in magnetic fluids, their application in power transformers may lead to the improvement of the operation of these devices or construction smaller one at the same performance.

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APPLICATIONS OF MAGNETIC FLUIDS IN MEDICINE

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Magnetic fluids belong to one of the first produced materials containing nanoparticles. The used nanoparticles are magnetic and are dispersed in liquid carriers. Magnetic fluids are compromise to produce liquid magnets ie materials which have magnetic and liquid properties simultaneously. They are unique connection of electrodynamics and fluidness This fact give the possibility to many their technical applications because it is easy to use magnetic forces for the change of their various properties. Magnetic nanoparticles can be functionalized by various materials depending on the applications of these. Of course nanoparticles can be functionalized by biological active molecules which are needed for biological and medical applications. In lecture will be presented magnetic fluids ie technology, basic properties, some technical applications but main focus will be in medical applications such as magnetic drug targeting, magnetic separation, magnetic detection, hyperthermia, magnetic resonance imaging(MRI).The obtained results of group in the field of functionalized magnetic particles by anticancer drug Taxol , in hyperthermia treatment as well as influence of magnetic fluids on the amyloid aggregation will be presented too.

CAPABILITY OF X-RAY DIFFRACTION AND TRANSMISSION ELECTRON MICROSCOPY FOR THE MICROSTRUCTURE ANALYSIS OF NANOMATERIALS

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In order to develop new materials, knowledge of the relationship between their microstructure and their properties appears to be a key issue. The modification of the microstructure by different preparation conditions is then a means of ‘tailoring’ the properties for a desired purpose. Microstructure itself denotes an arrangement of structure defects on the mesoscopic scale like grain (or phase) boundaries or dislocation walls. An intentional modification of the defect structure, referred to as ‘defect engineering’, requires an appropriate identification of the defects and a quantitative description of their density and ordering. Amongst of materials in which the defects play a key role there are undoubtedly nanocrystalline materials and nanocomposites. Here the volume of the microstructure defects like the crystallite and grain boundaries or the interfaces between different phases approaches the volume of the ‘undistorted’ material.

In order to apply a directed microstructure design in a technological process a thorough microstructure analysis of the process results depending on the process parameters is to be employed previously. The capability of the combination of the X-ray diffraction (XRD), conventional transmission electron microscopy (TEM) and transmission electron microscopy with high resolution (HRTEM) to perform the microstructure analysis on nanocrystalline materials and on nanocomposites will be illustrated. As examples of the analysed materials, hard Ti-Al-(Si)-N, Cr-Al-(Si)-N and Zr-Al-(Si)-N thin films nanocomposites, ultrahard BN-nanocomposites and hot-rolled pearlitic steels will be presented. The contribution will show that XRD, TEM and HRTEM are complementary experimental methods for microstructure analytics; they allow the following microstructure features to be determined: the crystallinity, the phase composition and the homogeneity of individual phases in nanocomposites. For crystalline phases, it will be discussed, how the combination of these experimental methods can furthermore be utilised to visualize and to determine the size, the shape and the global preferred orientation of nanocrystallites, the local disorientation of neighbouring nanocrystallites, the atomic ordering at the nanocrystallites boundaries and the microstructure defects that are responsible both for the formation of the internal interfaces and for development of the internal stresses. Additionally, some microstructure-related phenomena will be discussed, which are related to the mechanical properties of the nanocomposites, like a strong anisotropy of the elastic constants and the partial coherence of adjacent nanocrystallites.

SYNTHESIS OF CARBON NANOSTRUCTURES BY PLASMA ENHANCED CHEMICAL VAPOUR DEPOSITION AT ATMOSPHERIC PRESSURE

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Carbon nanostructures present leading field in nanotechnology research. Wide variety of carbon nanostructures, including fullerenes, nanotubes and lately graphene, belong to the most researched topics. Wide range of chemical and physical methods was used for carbon nanostructures synthesis including arc discharges, laser ablation and chemical vapour deposition. Plasma enhanced chemical vapour deposition (PECVD) with its application in modern microelectronics industry became soon target of research in carbon nanostructures synthesis. The selection of the ideal growth process depends on the application. For development of composites and other structural applications, the merit is the ability to produce "tons a day" at reasonable price. In contrast, the ability to achieve controlled growth (of specified thickness) on patterns is important for applications in nanoelectronics, field emission, displays, and sensors. PECVD is able to address both of these areas. Most of PECVD techniques work at low pressure requiring vacuum systems. However for industrial applications it would be desirable to work at atmospheric pressure. In the talk carbon nanostructures synthesis by plasma discharges working at atmospheric pressure will be reviewed. Special attention will be paid to microwave discharges and atmospheric pressure glow discharge (APG). Our group has successfully synthesized multi-walled carbon nanotubes directly on substrate or in volume by microwave plasma torch. We were able to growth several micrometers high layer of nanotubes in time less than 1 minute, without any external heating source. The carbon nanotubes layer could be also grown on substrates without a buffer layer or with predefined patterns. Lately APG discharge became an attractive method to growth single-walled carbon nanotubes with good alignment. Critical factor for growth of carbon nanotubes is the catalyst. Properties of buffer layer between substrate and catalyst and catalytic particles size considerably influence final product and are key to control of nanotube properties and growth conditions such as temperature and gas mixture. Influence of these parameters will be discussed and demonstrated on the carbon nanostructures growth by our and other groups. In the end possibility to synthesize graphene with atmospheric pressure discharges will be discussed.

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COMPOSITE MATERIALS REINFORCED BY SHORT (NANO) FIBRES – COMPUTATIONAL SIMULATIONS

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Composites reinforced by short fibres/tubes are often defined to be materials of future with excellent electro-thermo-mechanical (ETM) properties. The aspect ratio of the short fibres is often $1:10^3$ - $1:10^6$, or even more. Because of these properties very large gradients are localized in all ETM fields along the fibres and in the matrix. These fields define the interaction of the fibres with the matrix, with the other fibres and with the boundaries of the domain/structure. Method of Continuous Source Functions (MCSF) developed by authors using 1D continuous source functions distributed along the fibre axis enables to simulate the interaction. Although the Carbon Nano-Tubes (CNT) have diameter of several nano-meters, their length is much larger and so, methods of continuum mechanics can be used also for the simulation of CNT with the matrix material.

Largest gradients of the field variables are in vicinity of fibre ends, where also finest mesh of points is required in order to receive good accuracy and numerical stability of the model. Usually less than 100 equations are enough to simulate the inter-domain continuity for one fibre using the MCSF. However, if the model contains large number of fibres, the model would be large, the system of equations full and the computation time are very consuming. Assuming that the thermal conductivity of the fibre is much larger than that of the matrix, it is possible to obtain temperature increments for each fibre by the interaction of the fibres with the matrix. Resulting temperature of fibres in the CV is obtained as a result of interaction of all pairs of fibres in the model.

As far in thermal fields the heat sources are scalars, mechanical fields require sources functions defined by force vector, e.g. dimension of equivalent problem comparing to that of heat transfer is three times larger. Even if the axial stiffness of fibre is much larger than that of the matrix, the fibres with large aspect ratio are very flexible in bending and torsion. To satisfy the inter-domain continuity between fibre and matrix for such conditions, the continuous source functions are defined by forces, force dipoles and force couples. Solving the interaction for each pair of fibres, rigid body displacement (RBD) increments are obtained for corresponding pair of fibres and resulting RBD for each fibre is obtained when all interactions are obtained for the solution. If material properties of fibres and matrix are not very different and-or the aspect ratio of fibres is very large, final solution has to be solved using iteration methods. In this way, data are obtained for homogenization of the composite and for multi-scale modelling.

Main aim of our presentation is to show some results of computational simulation for the interaction of fibres with the matrix and their contribution to increase stiffness, conductivity, strength and other properties of the composite material.

ECAR PROCESSING OF OFHP COPPER MATERIAL

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The influence of severe plastic deformation (SPD) on distribution of effective stresses, effective strains and temperatures during equal channel angular rolling (ECAR) process is mathematical simulated. Effect of ECAR processing on substructural and mechanical properties of oxygen free high purity (OFHP) Cu material is investigated too. Mathematical simulations in software DEFORM-3D, ECAR technology, tensile tests were used as experimental methods. Mathematical simulations of first ECAR pass referred on following results: effective normal stress had low heterogeneity with value 385 MPa, effective strain was distinguished with high heterogeneity in cross section of sample ($\varphi=1,5-3$) and temperature in deformation zone achieved value 150 °C. Mechanical properties after cold drawing were: $R_{p0,2} = 217$ MPa, $R_m = 260$ MPa, $Z = 63$ % and after sixth ECAR pass were: $R_{p0,2} = 412$ MPa, $R_m = 426$ MPa, $Z = 72$ %. From experiments is resulting the stabilization of mechanical properties after fourth ECAR pass were obtained.

INFLUENCE OF ECAP ON DENSIFICATION BEHAVIOUR IN THE PM ALUMINIUM Al-Mg-Si-Cu-Fe ALLOY

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The main aim of this paper is to show how ECAP influences the densification behaviour of PM aluminium alloys. The dimensional and morphological characteristics of investigated materials were measured individually for each pore. A commercial ready-to-press aluminium based powder (Al-Mg-Si-Cu-Fe) was used as material to be investigated. After applying different compacting pressures (400 - 700 MPa), specimens were debinded in a ventilated furnace at 400 °C for 60 min. Sintering was carried out in a vacuum furnace at 610 °C for 30 min, with an applied cooling rate of 6 °C/s. The ECAP was realized by hydraulic equipment at room temperature, which makes it possible to produce the maximum force of 1 MN. The specimens were ECAPed for 1 pass. Optical characterization was carried out on the minimum of 10 different image fields. The results were measured for each pore individually in order to describe the dimensional and morphological porosity characteristics. The liquid phase sintering leads to swelling of the compacts and the presence of secondary pores was determined. ECAP influences the porosity distribution in terms of the severe shear deformation involved. When severe plastic deformation is applied, the stress distribution in deformed specimens causes the powder particles to squeeze together to such an extent that the initially interconnected pores transform to small isolated pores, determining a given value of secondary porosity. Consequently, large amount of nanoporosity, strongly influences both the dimensional and morphological porosity characteristics, considering that small pores evolve easily to a circular form despite of well-known ability of ECAP to alignment of particles and pores.

THE EFFECT OF POWDER Al_2O_3 SKIN DISRUPTION ON PROPERTIES OF SUBSEQUENT FINE AL POWDER COMPACTS.

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The compacts of ultra-fine Al powders offer excellent mechanical properties, creep performance and structural stability at elevated temperatures. The compacts properties are determined by ultra-fine grained microstructures stabilized with ~4 nm thick native Al_2O_3 layer, present on the surface of as-atomized Al powder. Depending on processing route, the amorphous Al_2O_3 layer either disrupts into separate nano-metric dispersions or remains as continuous 3D skeleton within final compact. In the presented work we characterize the extent of oxide disruption achieved by various powder metallurgical routes and how presence, morphology and distribution of Al_2O_3 dispersions affect properties of subsequent powder compacts. Commercially available, fine (1,31 μm), gas atomized Al 99.8 % powder with large surface area (4,54 $\text{m}^2 \cdot \text{g}^{-1}$) was used in this study. Three consolidation routes: direct extrusion, forging and hot isostatic pressing were chosen in order to prepare three representative types of compacts microstructures with different extent of Al_2O_3 skin disruption. Microstructural characterization showed ultra-fine grained microstructures, reflecting the fineness of used powder, strengthened with nano-metric Al_2O_3 phase. Consolidation in all cases yielded crystallization of amorphous oxide into the most stable $\alpha\text{-Al}_2\text{O}_3$. Depending on processing route, either highly sheared Al grains decorated by disrupted lamina-like Al_2O_3 dispersions (direct extrusion), polyedric Al grains surrounded by 3D oxide skeleton (forging) or by fine spherical Al_2O_3 dispersions (hot isostatic pressing) were observed. All compacts featured high thermal stability against long-term exposures up to 450 °C. However, mechanical properties at room and elevated temperatures (up to 500 °C), creep performance and thermal properties of compacts altered substantially depending on processing route. High temperature characteristics of presented materials, namely those prepared via forging, were far superior to conventional Al alloys.

APLIKÁCIA NANOSÓLOV PROSTREDNÍCTVOM SÓL – GÉL TECHNIKY S CIEĽOM ZÍSKANIA SUPERHYDROFÓBNÝCH TEXTILNÝCH POVRCHOV.

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Využitie nanosólov pripravených na báze prekursorov z organosilánov je jeden zo spôsobov nanoštrukturalizácie textilných povrchov s cieľom zvýšenia ich hydrofóbných vlastností s dosiahnutím efektu samočistenia (lotosový efekt). V príspevku sú prezentované doterajšie vlastné výsledky prípravy nanosólov a ich aplikácie na vybrané textílie. Zároveň sú uvedené metódy pre hodnotenie superhydrofóbných vlastností (uhol rolovania, kontaktný uhol, dynamický kontaktný uhol, REM snímky).

Príspevok bol spracovaný v rámci riešenia VTP č. VMSP-P-0023-09 „NANOSÓL“, spolufinancovaného z prostriedkov APVV Bratislava.

APPLICATION OF NANOSOLS USING SOL-GEL TECHNOLOGY AIMED AT ACHIEVEMENT OF SUPERHYDROPHOBIC TEXTILE SURFACES

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Application of nanosols prepared on the basis of precursors from organosilanes is one of methods used for nanostructuralization of textile surfaces focused on enhancement of their hydrophobic properties and achievement of a self-cleaning effect (lotus effect). Own results of preparation of the nanosols achieved up to now and their application on selected textiles are presented in the lecture. Besides methods for evaluation of superhydrophobic properties (rolling angle, wetting angle, dynamic angle, REM images etc.) are mentioned as well. Ways how to achieve permanent superhydrophobic finish of textiles are indicated in next part of the presentation.

The contribution has been elaborated in the frame of the scientific-technical project VMSP-P-0023-09 „Research, preparation and introduction of manufacture of nanosols for nanostructural modification of textile materials“ financed from the means of the Slovak Research and Development Agency (APVV), Bratislava.

MINERALOGY AND GEOCHEMISTRY OF Fe OXYHYDROXIDES FROM VARIOUS ABANDONED Sb DEPOSITS AND USEFULNESS OF Fe OXIDES FOR REMEDIATION PROPOSALS

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Iron oxyhydroxides are represented by a variety of minerals characteristic by their small crystal size (nm range). Because of their high surface area and reactivity, these minerals are active in many processes, such as adsorption and transport of metals from mine drainage waters.

The objective of our study was to examine the mineralogy and chemical composition of Fe oxyhydroxides accumulated in the area of four abandoned Sb deposits from Slovakia and subsequently to test ability of Fe oxides for remediation proposals.

Each of the studied samples was from different geological settings and there were also differences between types of mineralization and mine processing. Samples were collected mainly from mine drainages and fraction under 0.063 mm was analyzed using conventional methods, including X-ray diffraction, IR spectroscopy, transmission electron microscopy and sequential extractions. Schwertmannite was identified as predominant mineral phase in acidic conditions, but while carbonates are very common in most of the studied localities, neutral pH prevails and therefore ferrihydrite is precipitating most often. In older sediments ferrihydrite transforms to more stable goethite. Total content of As is 2128 mg/kg in case of schwertmannite sample and varies from 433 mg/kg to 134 g/kg in ferrihydrite samples; Sb content in schwertmannite is 35 g/kg and in ferrihydrite samples is in range from 893.2 mg/kg to 19 g/kg.

The problem of contaminated groundwater in the areas of studied abandoned Sb deposits is significant and one of the possible remediation methods is the Permeable Reactive Barrier system (PRB). We have performed 3 batch and 4 column tests to study the usefulness of zero-valent iron for arsenic and antimony removal from contaminated water. In the first phase, batch tests were run with three different types of iron. All pilot experiments were successful, with the best results observed in case of laboratory Fe chips (100% removed in 4 hours). In the second phase we have focused on effectiveness of these materials in column experiments. The best results were observed by using iron turnings as the reactive material, where content of As decreased from 22.5 mg/l to 20 µg/l and content of Sb decreased from 4480 µg/l to 29 µg/l. Minerals formed by iron oxidation, which were the adsorbents of studied contaminants were identified as mixture of goethite and lepidocrocite.

Acknowledgement

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THE PHYSICAL PROPERTIES OF CALIXARENE CONTAINING MONOLAYERS AT AN AIR-WATER INTERFACE AND THEIR USE IN DETECTION DOPAMINE

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Calix[n]arenes are macrocycles based on the synthesis of phenols and aldehydes, where [n] denotes to the number of the macrocyclic cycles forming the hydrophobic cavity. This peculiar feature has allowed the calix[n]arenes to be widely employed in the recognition of ions, organic molecules, proteins, and other ligands [1,2]. Herein, the results on the study of the physical properties of monolayers formed by two calix[n]arenes, differing in the number of the phenolic units forming the rim of the hydrophobic cavity, as well as in the hydrophobic part, and their mixtures with dipalmitoyl phosphatidylcholine (DPPC) formed at the air/water interface are presented. To investigate their properties, methods of surface-pressure area isotherms, and surface potential were used [3]. Due to their amphiphilic character, both the calixarenes and DPPC formed stable monolayers, as well as their mixtures at different molar ratios. Analysis of the isotherms revealed twice larger area per molecule observed for the bulkier calixarene. The differences in the compressibilities and surface potentials, were attributed mainly to the presence of the particular chemical groups in the structure of both the calixarenes. Generally, increasing content of calixarene in the monolayers was followed by the shift of the mean molecular area towards higher values accompanied by the decrease in the compressibility modulus. Moreover, no mutual miscibility of both the components, especially at the higher surface pressures when the monolayers were in solid state was observed at all the molar ratios studied. Presence of neurotransmitter dopamine in the water subphase was responsible for the destabilization of the calix[4]resorcinarene monolayers as it was deduced from the decrease of the monolayer compressibility modulus. The reason for such an effect might be due to the linking of dopamine to the hydrophobic cavity of calix[4]resorcinarene weakening thus the strength of the lateral forces acting between the adjacent molecules in the monolayer. The analysis of dipole moment of calix[4]resorcinarene showed, that the orientation of calix[4]resorcinarene at higher surface pressures is a crucial factor for dopamine binding.

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NANOCOMPOSITE FILMS FOR OPTICAL COATINGS

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The vacuum preparation methods of metallic nanoparticles are generally well known. By these methods there is possible to prepare the pure metallic nanoparticles of good crystalline perfection. For this goal in thin film technology the early stage (nucleation) of thin film growth is used. Joining the technology of non-continuous metallic films together with the technology of periodic multilayers we can create thin film nanocomposite of nanometal/insulator type. The structural parameters of resulting composite can be adjusted by multilayer periodicity and by metal nanoparticles shape.

Microstructure of PVD deposited metallic layers is described by well known Thornton diagram of film growth. Detailed study of Thornton's model for the deposition at low substrate temperature was performed in 2003 by Petrov et al [1]. In this work there was shown the possibility to deposit non - continuous films with various aspect ratios of individual (consisting) metallic particles. By other words there is possibility to prepare non - continuous metallic film consisting of separated metallic needle-shape crystallites.

In our study we present the results of magnetron deposition of Mo/SiO₂ periodic multilayers with non - continuous Mo sub-layers with various nanostructure parameters. The dc magnetron sputtering was used for Mo deposition; rf magnetron was used for SiO₂ deposition. The discontinuity of Mo layers was achieved by the deposition at relatively high Ar pressure (0.1 Pa). On the other hand the SiO₂ layers were deposited at 5.10⁻² Pa. At this pressure SiO₂ layers are always continuous. By this procedure we obtain the nanocomposite of metallic particles (of various shape) embedded in amorphous SiO₂ matrix. The nanostructuring of prepared composites was controlled by in- plane and cross-sectional transmission electron microscopy. The optical reflectivity measurements showed the reflectivity dependence on the nanostructuring parameters. Generally the very low reflectivity in ultraviolet light range was achieved.

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Development of Zirconia / Carbon Nanofiber Composites

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Zirconia/carbon nanofiber composites were prepared by hot pressing and spark plasma sintering with 2.0 and 3.3 volume percentage of carbon nanofibers (CNF). The effect of the processing route and the carbon nanofibers addition on the microstructure, fracture/mechanical and electrical properties of the CNF/3Y-TZP composites was investigated. The microstructure of the ZrO₂ and ZrO₂-CNF composites consisted of a small grain sized matrix (approximately 120 nm), with relatively well dispersed carbon nanofibers in the composite. All of the composites showed significantly higher electrical conductivity (from 391 to 985 S/m) compared to the monolithic zirconia (cca. $1 \cdot 10^{-10}$ S/m). The spark plasma sintered composites exhibited higher densities, hardness and indentation toughness but lower electrical conductivity compared to the hot pressed composites. The improved electrical conductivity of the hot pressed composites is caused mainly by a thin disordered graphite layers at the ZrO₂/ZrO₂ boundaries.

Abstracts

Poster Contributions

PARTIAL NITRIDATION OF FINE AL POWDERS

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Following the SAP (sintered aluminium powder) concept, we present an experimental study on the partial nitridation of fine aluminium powder (1.3 μm) in nitrogen at atmospheric pressure, with a view to fabricating dispersion-strengthened Al-AlN composites. The nitridation behaviour of fine aluminium powder was studied by using thermogravimetry (TGA), differential scanning calorimetry (DSC) and dilatometry. The formation of AlN was confirmed by x-ray diffraction (XRD) and transmission electron microscopy (TEM). It was found that fine aluminium powder nitrides readily at 590 °C in a flowing nitrogen atmosphere; there is no need for the introduction of magnesium because of the strong self-gettering effect of the fine aluminium powder for oxygen. However, obvious overheating is detected due to the rapid and highly exothermic nitridation. An addition of 0.3 wt.% Sn can effectively prevent the powder from being overheated and bring the process back into control. Also, it enables partial nitridation through the whole volume of green bodies with homogenous formation of core-shell structure. Shell structure grown on Al powder particles has thickness of ~ 150 nm and consists of number of small AlN crystals embedded in Al matrix (**Fig. 1**). Once Sn content exceeds 0,3 wt.% intensive liquid phase sintering of Al particles takes place before nitridation is triggered, what disables AlN formation, eventually. Partially nitrided Al-AlN pellets will serve as feedstock for subsequent processing (via extrusion, forging, infiltration, squeeze casting,...) into final metal matrix composites structural parts with expected exceptional properties.

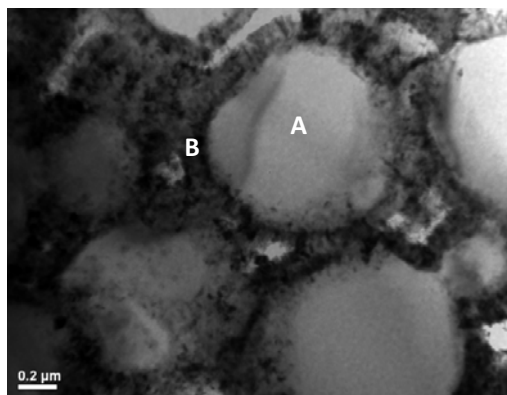


Fig. 1 BF TEM images of core-shell structure of partially nitrided Al powder precursors (A – initial powder area, B – shell composite structure of Al+AlN)

DAMAGE MECHANISM OF Cu-Al₂O₃ NANOMATERIALS

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The method of “in-situ tensile testing in SEM” is suitable for investigations of fracture mechanisms because it enables to observe and document deformation processes directly, thank to which the initiation and development of plastic deformation and fracture can be reliably described.

The deformation and fracture mechanisms of Cu-Al₂O₃ nanomaterials with 5 vol. % of Al₂O₃ phase has been analyzed using technique of the “in-situ tensile testing in SEM”. It has been shown that the deformation process causes break-up of large Al₂O₃ particles and decohesion of smaller ones. The final fracture path is influenced also by boundaries of nanograins, through which the principal crack propagates towards the sample exterior surface. Based on the experimental observations a model of damage and/or fracture mechanisms has been proposed.

MECHANOCHEMICAL SYNTHESIS OF NANOSTRUCTURED MATERIALS

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The field of nanocrystalline materials preparation based on the mechanochemical method is a rapidly expanding field of solid-state science [1]. This processing involves high-energy collisions of the milling media and reactant powders, resulting in pulverizations, phase transformations and chemical reactions during intensive milling. As a consequence, chemical reactions, which would normally require higher temperatures to occur due to separation of the reacting phase by the product phase, can occur at lower temperatures in a ball milling without any external heating. By selecting proper conditions such as suitable chemical reaction paths, mechanochemical processing can be used to synthesise nanocrystalline particles dispersed within a soluble salt matrix [2–5]. Moreover, the morphology of the products can be improved by heat treatment prior to the removal of the salt matrix by washing [2–5].

Newly, a procedure was developed in which the high-energy ball milling process is combined with a subsequent treatment in molten salt. An important property of molten salt is promotion of the selective growth of certain crystallographic planes, which leads to the appearance of highly anisotropic particles in the reaction products [5]. For example, a combination of both methods gives a new and simple approach for the synthesis of one-dimensional $\text{Na}_2\text{Ti}_6\text{O}_{13}$ nanobelts [5].

In this work, the mechanochemical synthesis of nanostructured oxide powders such as TiO_2 , SnO_2 , VO_2 , Al_2O_3 , Mn_2O_3 and $\text{Na}_2\text{Ti}_6\text{O}_{13}$ with unique morphology has been investigated by using the transmission electron microscopy (TEM).

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DETERMINATION OF PARTICLE SHAPE AND SIZE DISTRIBUTION OF MODEL TYPES OF NANOMATERIALS

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At present great attention is given to study of preparation and properties of various nanomaterials usable in many applications. They are utilized in varied fields of human activity – e.g. in electronics, medicine, paint industry etc. Except detailed chemical structure, such nanoparticle properties as shape and size distribution are fundamental to the given application. To measure these parameters various methods are used, e.g. transmission electron microscopy (TEM), atomic force microscopy (AFM), acoustic spectrometry, methods based on the light scattering and X-ray disc centrifuge system.

All above-mentioned methods were used in this work to characterize particles of two selected model types of nanomaterials – colloidal silica and sodium montmorillonite. Silica represents a material with spherical particles. Tabular shapes are typical for montmorillonite materials.

Experiments proved that methods used to measure particle size distribution based on the light scattering require very diluted dispersions. But, on the other hand, these conditions can affect the particle size distribution due to agglomeration or deagglomeration of the particles. For these reasons methods working with concentrated suspensions, without a great dilution, are more suitable to get correct results for such colloidal systems, for example acoustic spectrometry and X-ray disc centrifuge system. To obtain information of the shape of particles TEM and AFM methods were used.

Type of stabilization of silica influenced behavior of colloidal solutions during dilution (particle size and zeta potential changes). Bigger particles (aggregates primary particles) were observed by means of AFM and TEM. Commercial sodium montmorillonite is compound from elements with different size and shapes. There are lengthwise formations, circular and pentagonal particles. All used methods give similar results. Merits and limitations of the individual methods used to evaluation of nanoparticles of various types are discussed in this work.

APPLICATION POTENTIAL OF NANOCRYSTALLINE RIBBONS STILL PENDING

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Several years ago, when soft-magnetic nanocrystalline (SMN) ribbons entered the industrial practice, a long-term rise of demand was expected. This expectation does not seem to be fulfilled. Unlike metallic glasses (amorphous), the SMN product range of major manufacturers shrunk in the last years – the only composition used in the current larger-scale production is Fe-Nb-Cu-B-Si with 15.5÷16 at. % Si. Apart from pure marketing considerations, there are certain physical properties, which impact negatively the production as well as the use of SMN materials. SMN are brittle. The use of protective boxes helps in many but not all cases. The magnetostriction of SMN should be minimized. Apart from its detrimental impact on core loss, considerable magnetostriction would promote noise generation at magnetization rotation when exploiting slant hysteresis loops (field-annealed cores). Nanocrystalline ribbons - particularly the above composition - shrink markedly (~1% of as-cast length) during structural relaxation and subsequent crystallization. Thus larger tape-wound toroidal cores, unable to relax easily the ensuing stress, need expensive special construction and post-treatment technology. Last but not least, there are still unresolved physical problems met by hardly substantiated stereotypes: oxidation and surface crystallization (as examples of macroscopic heterogeneity) is generally unfavorable, rough surface is detrimental etc. Here we took a closer look on several aspects of the last point.

It is well known that refining the domain structure helps to lower the core loss. We inspected a series of medium-size toroidal cores (1 cm height, 3 cm o.d., 10 g mass, Fe-Nb-Cu-B-Si) and compared to the now standard field-annealed Finemet core. Our cores were no-field annealed in Ar, where some macroscopic heterogeneity builds up. Although the loops are clearly different, the power loss only behaves differently in detail: the field-annealed core shows less steep induction variation, the heterogeneous core shows less steep frequency variation. Core loss at 0.3 T is 1.62 and 73 W/kg for the heterogeneous core and 1.53 and 93 W/kg for the field-annealed core at 10 and 100 kHz respectively. Whereas the transverse anisotropy of the field-annealed core promotes magnetization rotation, the heterogeneous core shows fine domain structure and supports domain wall movement. Thus the risk of magnetostrictive noise generation as well as of domain wall stabilization is lowered. The comparison of vacuum- and Ar-annealed cores showed slight but clear preferences for Ar anneal: dynamic coercivity is 5÷15% lower and, contrary to vacuum-annealed cores, the approach to saturation can be better tailored by varying the annealing duration. Thus some materials offer additional possibilities if the macroscopic heterogeneity is manipulated. Moreover, peculiar constricted loops showed after vacuum annealing just for the material with the smoothest ribbon surface.

Since 2002 there is a new class of SMN containing Co, called Hitperms. It shows great application potential but less use yet. The macroscopic heterogeneity seems to play still greater role than in Fe-Nb-Cu-B-Si. Slant loops typical of the heterogeneity are sometimes observed after vacuum annealing too. So far, it is not clear what is the principal reason of such not well reproducible behavior. Hitperms generally show a preference for surface crystallization. However it is questionable whether this effect is the basic reason. The simple action: the heterogeneity creates macroscopic forces between surfaces and ribbon interior and magnetoelastic contribution to anisotropy is the result does not seem to work in Hitperms so well as in Fe-Nb-Cu-B-Si ribbons. Thus the problem is worth of further research and encouraging results can be expected.

INDENTATION LOAD-SIZE EFFECT IN Al_2O_3 - SiC NANOCOMPOSITES

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The indentation load-size effect (ISE) in Vickers hardness of Al_2O_3 and $\text{Al}_2\text{O}_3 + \text{SiC}$ nanocomposites has been investigated and analysed using Meyer's law, proportional specimen resistance (PSR) model and modified proportional specimen resistance (MPSR) model. The strongest ISE was found for alumina. It is suggested that the smaller ISE in the nanocomposites is associated with the large thermal residual stresses and pre-existing dislocations in these materials, both of which would help the initiation of plastic deformation. Both the PSR and MPSR models described the ISE well, but the MPSR model resulted in slightly lower true hardness values for all materials investigated. There was no evidence of an effect of machining stresses on the ISE.

Keywords: nanocomposites, hardness, microstructure, residual stresses

MICROSTRUCTURES AND PROPERTIES OF EXTRUDED ALCRFE MELT-SPUN RIBBONS PROFILES.

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The study describes properties of AlCr5Fe0,85 (at.%) alloy produced by powder metallurgy route. The rapidly solidified feedstock alloy was prepared by melt-spinning from temperature of 1290°C and at rotation speed of 43m.s⁻¹. The as-spun ribbons were disintegrated by cryo-chopping and then directly extruded at 450°C into the profiles of 6mm diameter. Microstructure of as-spun ribbons consisted of α -Al grains with embedded nano-metric quasicrystalline Al₄₅Cr₇ and Al_{84,6}Cr_{15,4} phases. Hot-extrusion yielded sound compacts and accommodated no major structural changes in comparison to as-spun ribbons. Compacts showed room temperature ultimate tensile strength of 555MPa, yield strength of 497MPa and ductility of 2%. Long-term structural stability of compacts up to 300°C, with no major structural changes and changes in mechanical properties, was proved. Thermal stability was accompanied with high mechanical properties of compacts tested at 300°C, where ultimate tensile strength of 302MPa, yield strength of 266MPa and ductility of 3% were confirmed. Further increase of annealing temperature to ~370°C led to slight increase of Al₄₅Cr₇ phase amount on expense of Al_{84,6}Cr_{15,4} phase. From ~420°C quasicrystalline phase started to transform into crystalline Al₇Cr what was followed with strength and ductility reduction. The excellent thermal stability of compacts was a consequence of very slow diffusivities and low equilibrium solubility of Cr and Fe in solid Al. High strength along with reasonable ductility of compacts was given by supersaturated α -Al, fine nature of α -Al grains and strengthening effect of nano-metric homogenously distributed quasicrystalline phases. Found features of presented AlCr5Fe0,85 predetermine this material for service at elevated temperatures, with superior performance to any conventional Al alloy. Furthermore, good formability of AlCr5Fe0,85 at elevated temperatures along with short-term structural stability enables consolidation of melt-spun ribbons at low extrusion pressures. That makes potential up-scaling of presented procedure feasible.

DEBYE TEMPERATURE OF NANOCRYSTALLINE ALUMINIUM BASED ALLOYS

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Aluminium based nanocrystalline alloys of nominal composition $Al_{90}Fe_7Nb_3$ and $Al_{94}Fe_2V_4$ were studied by Mössbauer spectroscopy. The characteristic Debye temperature was derived from the measurement of the recoil-free fraction and thermal shift at room and liquid nitrogen temperature. The frequency modes of atomic vibrations were determined. Characteristic temperature calculated from f-factor was lower than those fitted from second order Doppler shift. This indicates the presence of different frequency modes for amorphous and nanocrystalline state. Comparing results of $Al_{90}Fe_7Nb_3$ and $Al_{94}Fe_2V_4$ samples, masses and force constants play also additional role. Low values of Debye temperatures, softening of local modes at low temperature indicate on the low temperature anharmonicity in nanocrystalline state.

COEFFICIENT OF FRICTION VS. SURFACE ROUGHNESS IN NANOCOMPOSITE WC-C COATINGS

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Friction behavior and the coefficient of friction (COF) in thin PECVD WC-C coatings on steel substrates have been investigated using ball-on-disc method and the results were correlated with the surface roughness and deposition conditions. Steel substrates were prepared with five different levels of surface roughness which was controlled using conventional profilometer and AFM. Roughness values of the coatings were compared with the initial roughness of the substrates. Structure of the coatings was investigated by transmission electron microscopy (TEM) and the level of residual stresses was measured by grazing incidence X-ray diffraction (GIXRD). TEM and microdiffraction confirmed nanocomposite structure of the coatings and GIXRD revealed the presence of high compressive stress in the coatings. COF values obtained from tribological tests were correlated with surface roughness. The analysis suggests that the effect of surface roughness is accompanied by the effect of residual stresses.

Co-SUBSTITUED NANOPERM-TYPE ALLOYS STUDIED BY SYNCHROTRON RADIATION

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Nanocrystalline metallic alloys represent a new class of materials the physical properties of which can be tailored not only by the help of their chemical composition but also by varying the size of crystalline grains, their morphology, and structural composition. The size of structural elements dominantly influences mechanical, optical, electrical, and/or magnetic properties. Thus, structural transformations belong to principal mechanisms that considerably affect macroscopic physical properties of these materials. In order to understand their macroscopic features it is inevitable to know their microstructure as well as physical consequences of structural transformations. We have investigated the kinetics of crystallization of a NANOPERM-type metallic glass in which part of Fe atoms was substituted by Co. The study was performed by *in situ* diffraction of synchrotron radiation upon rapidly quenched $(\text{Fe}_{1-x}\text{Co}_x)_{76}\text{Mo}_8\text{Cu}_1\text{B}_{15}$ alloy with various amounts of Co ($x = 0, 0.25, 0.5$). As-quenched ribbon-shaped samples about 10 mm wide and 20 μm thick were prepared by the method of planar-flow. They were exposed to continuous heat treatment in a vacuum with temperature increase of 10 K/min up to 800 °C. During annealing, diffractograms that extend over the principal reflection of a bcc-FeCo lattice were collected every 10 s. The experiments were performed with monochromatic synchrotron radiation (7 keV) at the BESSY KMC-2 synchrotron line in Berlin. An influence of Co on the temperature of the first and the second crystallization T_{x1} and T_{x2} , respectively was found. With increasing Co-substitution we have observed a reduction of T_{x1} and T_{x2} at each side of the ribbon. We have also confirmed that the crystallization process starts in all samples at lower T_{x1} and T_{x2} at the wheel side of the ribbon in comparison with the air side. The wheel side of the ribbons was in direct contact with the quenching wheel during the production whereas the air side was exposed to the surrounding atmosphere. Quantitative analysis of the diffraction patterns was performed by deconvolution of the principal reflection into two components, Lorentzian and Gaussian. The former represents (nano)crystalline bcc-FeCo phase while the latter corresponds to the amorphous residual matrix. From the relative areas of the Lorentzian component, an increase of volume crystallization was observed as a function of annealing temperature and Co content. We have observed evolution of the bcc-FeCo phase towards better structural arrangement characterised by a minimum at the temperature dependence of lattice parameters. The closest value of the lattice parameter to that of bcc-Fe (0.2866 nm) was observed for $x=0.5$ (0.2876 nm). This indicates that Co atoms apparently expel molybdenum from the bcc lattice. Temperature induced lattice expansion was observed by increase of lattice parameters.

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STRUCTURAL ANALYSIS OF SEMICONDUCTING QUANTUM DOTS BY TRANSMISSION ELECTRON MICROSCOPY.

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The quantum dots (QD) are single crystalline cells of a semiconductor material. They must be under 100 nm in size in all three spatial dimensions. The quantum dots nucleate spontaneously under certain conditions during [molecular beam epitaxy](#) (MBE) and Metal-Organic Vapour Phase Epitaxy (MOVPE), when a material is grown on a substrate to which it is not lattice matched. The resulting [strain](#), produces coherently strained islands. This growth mode is known as [Stranski–Krastanov growth](#).

This special small structures has unique optical and electrical properties, that are different comparing to the same bulk material. The interesting is, their emission of photons under excitation, which are visible to the human eyes as light. The wavelength of photon emissions depends on their size and not on the material which is QDs made. Or the quantum dots which consist of a host semiconductor material and some magnetic atoms which co-determine transition temperature (Curie temperature).

In this contribution we will present possibility of their structural characterisation by Transmission electron microscopy (TEM). The TEM analysis of QDs requires two techniques of preparation sample. The first preparation technique is preparation sample in the „cross-section“, which is orientated in required direction to monocrystal substrate. For characterisation of the structural correlation or relaxation QDs with the substrate or their alignment in the plane of layer, we used the technology of planar section TEM specimen. The TEM characterisation will be illustrated various QD – Si/SiGe, PbSe and InMnAs.

PREPARATION OF NANOCRYSTALLINE DIAMOND THIN FILMS BY DOUBLE BIAS ENHANCED HFCVD

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Surface morphology and crystal size is the key factor affecting the diamond thin films potential applications. In this study polycrystalline diamond thin films were prepared on mirror polished silicon substrates and WC-Co cutting tools using double bias hot filament CVD technique. Depending on deposition parameters, the size and morphology of diamond crystals varied from tenths of nanometres to few micrometers. A gas mixtures of Ar:CH₄:H₂ and CH₄:H₂ were used as the process gas. Negative substrate bias up to -220 V was applied to control the re-nucleation rate through the energy of incident carbon ions. The effect of gas composition, flow rate and substrate bias during deposition on diamond crystallite size, orientation and morphology was investigated. Raman spectroscopy and Scanning Electron Microscopy were employed to characterize the samples.

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ZVIDITEĽNOVANIE KRYŠTALOGRAFICKÝCH DEFEKTOV V GaP POMOCOU MOKRÉHO CHEMICKÉHO LEPTANIA

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Cieľom práce je štúdium vzniku štruktúrnych porúch v materiáloch skupiny III – V, následne ich vplyvmi, či už na kvalitu daného materiálu, alebo kvalitu súčiastky pre elektroniku a optoelektroniku z neho vyrobenej. Práca predovšetkým posudzuje kvalitu polovodičového materiálu gálium fosfid (GaP). Analyzovali sa materiály VGF GaP (100), LEC GaP (100) a LEC GaP (111)_B. Na základe teoretických poznatkov týkajúcich sa odhaľovania kryštalografických porúch pomocou metódy mokrého chemického leptania boli vykonané experimenty. Výsledky boli zaznamenané optickým, atómovým silovým a elektrónovým mikroskopom. Cieľom práce bolo zviditeľniť poruchy a identifikovať pravepodobný pôvod ich vzniku. V závere práce je diskusia zameraná na odhalené poruchy v mriežke VGF GaP, LEC GaP (100) a LEC GaP (111)_B.

CELL DISTRIBUTION AND CYTOTOXICITY OF MAGNETITE NANOPARTICLES IN A549 CELL LINE

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Magnetite nanoparticles (MNPs) are the subject of fast-moving developmental efforts aimed at the improvement of diagnosis and treatment of cancer. MNPs are physiologically well tolerated and biocompatible, hence they have been widely used for various biological application. In nanomedicine a great effort has been focused on development of magnetic resonance imaging contrast enhancement, hyperthermia cancer therapy, nanovectors for targeted drug delivery, increased cytostatic drug uptake and accumulation in malignant tissue. The surface of MNPs must be modified with various surfactants to prevent aggregation and make them more stable, biodegradable and non-toxic. Multiply functionalized MNPs, prepared by loading of specific ligands, antibodies, peptides and drugs may offer an exciting tool to make MNPs target-specific and increase their therapeutic benefit.

The objective of this study was to investigate the cytotoxic effect of nanospheric superparamagnetic magnetite particles (Fe₃O₄, 10 nm in diameter) in dependence on surface modifications in the human alveolar epithelial carcinoma cell line A549 after short-term (4h) and long-term (24h) exposure. Moreover, this study has examined the internalization and distribution of MNPs in A549 cells in dependence on cultivation conditions.

The MNPs were prepared by the coprecipitation of ferric and ferrous salts in an alkali aqueous medium. X-ray diffraction measurement was performed to identify the crystallographic structure of prepared MNPs and the magnetic properties were characterized by SQUID magnetometer at room temperature. Two surfactants - sodium oleate (C₁₇H₃₃COONa) and polyethylene glycol (PEG Mw=1000) were applied for coating of MNPs. Distribution of SO-MNPs (sodium oleate-coated MNPs) and SO-PEG-MNPs (sodium oleate- plus PEG-coated MNPs) has been investigated by transmission electron microscopy (TEM). Cytotoxicity of individual MNPs and surfactants was evaluated using MTT, trypan blue exclusion test (TB) and LDH.

We have determined differences in MNPs cytotoxicity in dependence on surface coating. A dose- and time-dependent decrease in viability was found in cells exposed to both SO-MNPs and SO-PEG-MNPs. Magnetite NPs coated with two surfactants were more cytotoxic than those with only one surfactant. SO surfactant possessed stronger cytotoxic activity than PEG alone. TEM clearly demonstrated the impact of serum concentration in the culture medium on the uptake of MNPs into cells. Based on the preliminary results, internalization of MNPs is probably mediated via diffusion or endocytosis. MNPs aggregates found in vesicles were identified in the cytoplasm, however not in the nucleus.

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PREPARATION AND ELECTRICAL CONDUCTIVITY OF NANOCOMPOSITES BASED ON POLYPROPYLENE AND MODIFIED CARBON NANOTUBES

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Carbon nanotubes (CNT) as nanoparticles with extraordinary electrical, mechanical and thermal properties have drawn attention in many fields of science. Also thermoplastic composites research is trying to exploit the exceptional properties of CNT for preparation of new materials [1]. However, when CNT are used as the nanofiller in thermoplastic matrices, problems appear with dispersion and agglomeration of CNT and compatibility with the polymeric matrix during the processing. One way to solve these problems is the surface modification of CNT with functional groups [2] or coating with conductive polymers [3].

In this work the surface of multiwall carbon nanotubes (MWCNT) was modified by non-covalent approach, by chemical oxidative polymerization of pyrrole with and without presence of anionic surfactant, dodecylbenzenesulfonic acid (DBSA). MWCNT were also modified solely by various types of surfactants, namely anionic surfactant- DBSA, cationic surfactant - cetyltrimethylammonium bromide and by their combination with different molar ratios.

Different power of ultrasound treatment was used to evaluate its influence on the properties of final products. The surface properties of modified particles were determined by X-ray photoelectron spectroscopy and scanning electron microscopy. The electrical conductivity of unmodified MWCNT particles treated by ultrasound, and also MWCNT modified by polypyrrole (PPy) and surfactants was measured.

Nanocomposites with polypropylene (PP) matrix containing 1 to 5 wt.% surface modified MWCNT were prepared by melt mixing. For comparison of the properties also unmodified MWCNT were used as filler. Electrical conductivity of samples depends on filler type and content, in addition, the phenomena of charge transport in composites below and above the percolation threshold were studied.

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INTERACTION OF HUMAN SKIN CELLS WITH DIAMOND-LIKE CARBON SURFACES

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In our paper we investigate growth of HaCaT human skin cells on diamond-like carbon (DLC) layers, their adhesion and arrangement on these thin films. DLC layers exhibited after the growth by PVD method N-terminated surface. Quality of layers was investigated by Raman spectroscopy and surface morphology was characterized by scanning electron microscopy. The layers were made further active by treatment in O₂ r.f. plasma (60 sccm, 1 and 2 min, 20 Pa, 200W). Influence of plasma treatment on hydrophobic/hydrophilic properties of layer surface was investigated by contact angle measurements ($\pm 60^\circ$ for a layer without O₂ treatment). After sample sterilization (185°C, 4 hours) the skin cells were seeded with inoculum (i.e. cell density) from 1×10^4 to 1×10^5 cells per sample ($1 \times 1 \text{ cm}^2$) and grew covered with culture medium in stable surroundings in an incubator. After 72 hour incubation period the cells were fixed to the surface of the substrate and fluorescently stained. Quantity and distribution of cells were measured by fluorescent microscope; size, height and composition were investigated by optical microscope and atomic force microscope.

The results carried out indicate that cells grow in clusters in monolayer and share information about reaching the wall. They have elliptical shape and grow to approximately tens of micrometers in size. Nucleus is typically about one third to one half of cell size. Sample sterilization before the cell seeding destroys effect of O₂ termination (which was confirmed by contact angle measurement before termination, after termination and after sterilization) and therefore no selectivity in arrangement of the cells on the surface may be observed. Skin cells are resistant toward some unfavorable conditions; their avoidance of inbiocompatible resist and lower selectivity on the surface covered with resist versus surface without resist (either termination) is not observed. We discuss these results with respect to further use of DLC layers in biotechnology and bio-electronic applications.

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IMMUNOMODULATORY EFFECT OF NANOPARTICLES IN VITRO

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Nanomaterials (NPs) are currently an area of intense scientific research, due to a wide variety of potential applications in biomedical, optical, and electronic fields. We analyzed possible immunomodulatory effect of selected nanoparticles: PLGA-PEO, titanium oxide (TiO₂), iron oxide (IO), oleic acid coated iron oxide (OA IO) and silica (Si). Nanoparticles were added to the *in vitro* human peripheral blood test system in three various concentration: 0.12 µg/cm², 3 µg/cm² and 75 µg/cm² and in selected time intervals: 72h, 48h, 24h, 4h, 0h. Immunomodulatory effect was assessed using three immune methods: proliferative response of human peripheral blood lymphocytes *in vitro* stimulated with mitogens, phagocytic activity and respiratory burst of leukocytes and natural killer cell activity.

Peripheral blood lymphocytes treated with T-cell mitogen Con A and three different concentrations of uncoated iron oxide NPs showed dose dependent suppression of proliferative activity. Similar effect of the highest dose of OA IO NPs was observed also in cultures *in vitro* stimulated with Con A, PWM and antigen CD3. Moreover, clear dose-dependent decrease of proliferation of non-stimulated cells exposed to three doses of OA IO NPs was seen.

Our results showed time-dependent decreasing phagocytic activity of granulocytes in whole blood cultures exposed to all nanoparticles as well as in cultures of unexposed controls. Preliminary results indicate no differences in phagocytic activity of granulocytes exposed to PLGA-PEO, frozen TiO₂, iron oxide and oleic acid iron oxide coated nanoparticles. On the other hand, possible dose-dependent suppressive effect of freshly prepared TiO₂ and silica nanoparticles on phagocytic activity of granulocytes.

Respiratory burst of leukocytes also showed time-dependent decrease in whole blood cultures exposed to all nanoparticles as well as in cultures of unexposed controls. Preliminary results indicate no marked differences in respiratory burst of leukocytes exposed to PLGA-PEO, frozen TiO₂, iron oxide and silica nanoparticles.

No marked differences in natural killer cell activity of cells treated 24h with PLGA-PEO, frozen TiO₂ or fresh TiO₂ nanoparticles. Natural killer cells exposed 24h to iron oxide or silica nanoparticles showed slight enhancement of cytotoxicity (65%). The effect of oleic acid coated iron oxide nanoparticles expressed as decreased cytotoxicity (39%) of unexposed controls. Results are preliminary due to small number of participants. We hope that after finishing of experiments, the possible effects become more visible.

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MAGNESIUM CHIPS RECYCLING

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Manufacturing of magnesium products is connected with environmental point of view. A large amount of waste in the form of chips and discards is produced in the machining process of castings and sheets. Approx. 1/3 of magnesium used to fabricate structural products (castings and wrought products) ends as new scrap, so it is really inevitable to find ways for its efficient recycling in order to keep the use of primary Mg and thus price at reasonable level. Magnesium scrap in form of chips is material with wide distribution of chips sizes, containing fractions with micro and nano scale characteristics. This paper presents basic processing route for magnesium chips and its comparison of microstructural characteristics and mechanical properties with parental commercial alloys. Microstructural characterization was made by examination of OM micrographs and mechanical properties were determined with static tensile test.

CARBON NANOTUBE BRIDGES GROWN ON ALUMINOSILICATES BY HOT FILAMENT CVD PROCESS

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Multiwall carbon nanotubes (MWNTs) were grown on aluminosilicates, namely montmorillonite and zeolite, through anchoring on Fe nanoparticles. The starting aluminosilicates are a commercial montmorillonite and zeolite (clinoptilolite) in which the intercalated original ions were exchanged for Fe(III) ions via ion-exchange and impregnation methods. Appropriate aluminosilicate was immersing into aqueous solution of $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$ with 0,04 M concentration. The suspensions were deposited on Si wafer by sedimentation and allowed to quick dry by infrared lamp. MWNTs were synthesized by catalytic decomposition of methane on aluminosilicate layers at 600-700 °C by hot filament chemical vapour deposition process. These Fe(III) loaded aluminosilicate layers were used as catalysts. The quality and nature of carbon deposited on the aluminosilicate surface were examined by scanning electron microscopy (SEM) and Raman spectroscopy. MWNTs were obtained both on Fe-zeolite and Fe-montmorillonite. The SEM showed images of carbon nanotube bridges. The nanotubes were bridging-cross both single parts of aluminosilicates and micro-cracks, which had been formed during quick drying on aluminosilicate layers. The carbon nanotubes (CNTs) formed a three-dimensional CNTs/aluminosilicate network. The length of these nanotubes was in a range from several nm to nearly 10 μm . Diameters of the grown MWNTs were in a narrow range but the nanotubes contained also other forms of carbon. Raman spectroscopy revealed the presence of amorphous carbon on the surface of MWNTs and moreover, the position of the D and G bands are characteristic for carbon nanotubes. Consequently, the forming carbon nanotube bridges in a material can provide promising way to produce new nanocomposites with improved mechanical properties.

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INFLUENCE OF GLASS-FORMING ELEMENT (BORON) ON SURFACE CRYSTALLIZATION OF NANOPERM-TYPE ALLOYS

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We studied the formation of nanocrystalline microstructure in rapidly solidified alloys of composition $\text{Fe}_{79}\text{Mo}_8\text{Cu}_1\text{B}_{12}$ and $\text{Fe}_{76}\text{Mo}_8\text{Cu}_1\text{B}_{15}$. The crystallization was investigated *in situ* using diffraction of synchrotron radiation. Both sides of ribbon surfaces were inspected. The information about the current state of the sample's structure was recorded during heating every 10 seconds by storing a collected 2-dimensional diffraction pattern. The raw data in the form of images were integrated over a limited range of χ angles restricted by the imaging area of the 2D detector.

Using this technique we were able to trace the onset temperature of primary crystallization *in situ* in each specimen. From the quantitative analysis of 1D diffraction patterns of as-quenched $\text{Fe}_{79}\text{Mo}_8\text{Cu}_1\text{B}_{12}$ alloy it was found that a considerable amount of the crystalline *bcc*-Fe(Mo) phase occupying 8% of the total volume is located at the wheel side of the ribbon. During casting, this side of the ribbon is expected to have better conditions for solidification of the melt (mainly due to higher cooling rate). However, this phenomenon occurs at the opposite side as we have expected. Contribution of the crystalline phase at the air surface of the ribbon is less than 1%. Besides *bcc*-Fe(Mo) nanocrystals, traces of tetragonal Mo_2FeB_2 phase were unveiled in the amorphous matrix in both as-quenched alloys. Indications of this phase are visible as bright spots of incomplete Debye rings in 2D patterns. Quantification of its contribution from 1D pattern would be difficult, but considering a high scattering factor of Mo_2FeB_2 phase we can clearly say that its contribution to the amount of other present phases (*bcc*-Fe(Mo) and mainly the amorphous rest) is at this point negligible. Some of these results were already presented at the NANOVED 2007 conference (in Poster P18 and invited Lecture L34), however they are essential for this comparative study.

Here, we make a comparison between two NANOPERM-type alloys with different content of glass forming element - boron. After the onset of primary crystallization at 392°C, we observe a linear increase in relative volume fraction of crystalline *bcc*-Fe(Mo) phase with the ramp of 0.64 vol.%/°C on the wheel surface of the $\text{Fe}_{79}\text{Mo}_8\text{Cu}_1\text{B}_{12}$ ribbon. It should be noted, that this surface had already some quenched-in Fe-rich nanocrystals with *bcc* structure in initial stages of structural transformation. On the air surface, the onset temperature of crystallization is located at 410°C and evolution of the principal crystalline *bcc* phase is more rapid with the ramp of 1.17 vol.%/°C. On the other hand, the differences in the crystallization behaviour at the two surfaces were almost completely eliminated in the sample with higher content of boron. Crystallization kinetics of the $\text{Fe}_{76}\text{Mo}_8\text{Cu}_1\text{B}_{15}$ ribbon is similar, with almost identical increase of crystalline fraction on both sides of the ribbon-shaped samples. Boron largely suppresses the existence of surface crystallinity in as-quenched state of the alloy, and, at the same time, stabilizes the amorphous phase. Consequently, the onset of primary crystallization is shifted towards higher temperatures.

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LIGHT EMITTING DIODE WITH 2D PHOTONIC STRUCTURE IN THE SURFACE

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We present the light emitting diode (LED) with a two-dimensional (2D) photonic crystal (PhC) structure prepared by the interference lithography in the diode surface layer. The active region of this diode includes a triple quantum well based on GaAs/AlGaAs semiconductor materials prepared by the metal-organic chemical vapour deposition (MOCVD).

Using the interference lithography based on the two beam interference method the 2D photonic structures with the square symmetry were prepared in the AlGaAs surface layer. The 2D pattern was designed by the simulations of the interference of two laser beams. The 2,2 μm period of the photonic structure was set by the appropriate geometry of two incident beams. The final structure pattern was analyzed by the atomic force microscope (AFM).

Such prepared diode was investigated by the measurement of LI dependence. The spectral measurements revealed the maximal emission at the wavelength of 850 nm originated from the triple quantum well active region. The near and far-field patterns of an emitted light were investigated using Spiricon and by the near-field scanning optical microscope (NSOM) and reflect the 2D PhC structure.

The LED diode with the 2D PhC structure shows an enhancement of the surface emission in comparison with the conventional type of LED diode without PhC structure in the surface. It was documented by the local LI-measurements from the individual emitting regions of PhC structure.

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CALIX[4]ARENES: SUPRAMOLECULAR STRUCTURES SENSITIVE TO DOPAMINE

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Calix[n]arenes are macrocyclic molecules which are characterized by cup-like cavity. This cavity is formed by benzene rings and can favorably interact with polar ligands due to the fact that the benzene has strong quadrupole moment and thus highly favored π -electron-ion interactions should be expected. Due to the affinity of calixarenes to various ligands they can be used as artificial receptors in ion selective electrodes, capillary electrophoresis and in biosensors. Among various calixarenes, those sensitive to dopamine are of substantial interest. The dopamine is neurotransmitter, which play significant role in the functioning of central nervous, renal and hormonal system. Dopamine concentration varied from 0,163 nM (blood) to 384-2360 nM (urine). Dopamine concentration in the extracellular fluid of the central nervous system is 0,01-1 μ M. Dopamine is used also in doping. Therefore detection of this compound is of high importance. At the present time the detection of dopamine is based on high performance liquid chromatography (HPLC), micellar liquid chromatography and capillary electrophoresis. Several electrochemical methods of detection dopamine were also developed. This detection is based on analysis of redox transformation of dopamine at various surfaces. However, this analysis is rather difficult due to interferences with ascorbic and uric acid.

Our approach is based on the detection of the dopamine by the quartz crystal microbalance (QCM) using transverse shear mode method. For preparation of sensing layer on a gold surface we used 25.26.27.28-tetrakis(11-sulfanylundecyloxy) calix[4]arene (calix[4]arene). We studied the kinetics of the changes of series resonant frequency, f_s , and the motional resistance, R_m , of the quartz crystal transducer. Typically we observed decrease in f_s and increase of R_m , following addition of dopamine. This suggests on increase of surface viscosity. The changes of both parameters started already at 53 pM of dopamine. The topography of the layers was investigated by atomic force microscopy in tapping magnetic mode. The images of the calix[4]arene layers in an air environment revealed smooth surface with irregular pinholes.

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TRIBOLOGICAL BEHAVIOR OF ZrO₂-CNF AND Si₃N₄-CNT NANOCOMPOSITES

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Tribological behavior of ZrO₂ and Si₃N₄ based nanocomposites with addition of carbon nanofibres and nanotubes has been studied by the pin-on-disc technique. Friction coefficients were measured and recorded, wear rates were calculated in terms of material volume loss per load and sliding distance. The wear damage was studied using optical and electron microscopy and its mechanisms were identified. In monolithic materials the dominant wear mechanism was abrasion, in composites with CNF and with higher volume fraction of CNTs (5 and 10%) fiber pull-out and lubricating by the carbon phases occurred.

NEONATAL EXPOSURE TO POLYMERIC NANOPARTICLE PEG-b-PLA INTERFERES WITH PUBERTAL DEVELOPMENT IN FEMALE WISTAR RATS

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Intentionally engineered polymeric nanoparticles (PNp) present one of the most promising approaches for CNS drug delivery as they have potential to cross blood-brain barrier (BBB) and they can exert direct actions upon the brain. On the basis of this fact, working hypothesis of our project was: "PNp could have a potential to interact with the processes of sexual brain differentiation and neurotransmission, factors of equal importance with the reproductive aspects". The purpose of *in vivo* experiments of the project was to evaluate the effects of neonatal exposure to PNp PEG-b-PLA [poly(ethylene glycol-*block*-polylactidmethyl ether)] on two endpoints, vaginal and eye opening (signs of puberty), and estrous cycle in female rats and to compare these effects to a known synthetic estrogen diethylstilbestrol (DES).

Newborn female Wistar rats were intraperitoneally injected daily with 20 and 40mg/kg b.w. of PEG-b-PLA, vehicle alone (deion. water) or 4µg/kg b.w. of synthetic estrogen DES (positive control) from d 4 to d 7 after birth in dose volume of 10ml/kg b.w. The endpoints related to pubertal development and reproductive function were evaluated from PND 8 - 170. In comparison with the control rats, two different doses of PEG-b-PLA significantly accelerated the onset of vaginal opening in a dose-dependent manner by 3 and 4.92 days. As we expected, positive control DES significantly accelerated the onset of puberty, vaginal opening was observed on postnatal day (PND) 10.92 as compared to the control group (PND 32.85). Concomitant statistically significant decrease of body weight at days of vaginal opening was observed in the both PEG-b-PLA groups and DES group. No effect was seen on the age of eye opening in the both PEG-b-PLA (20 and 40mg/kg b.w.), and DES groups, respectively, as compared to the control. Estrous cycles were observed in two periods (3 and 5 months of age) during 21 days. The proportion of regular cycles (4 and 5-day cycles) was reduced significantly, in parallel with a marked increase of irregular cycles in 100% animals in DES group in the both monitoring. Interestingly, the increased percentage of abnormal cycles compared to control group were also visible in the PEG-b-PLA group (20mg/kg b.w.) in the both observation periods (38% of female rats in 3 months of age and 54% of female rats in 5 months of age).

These results indicate that exposure of neonatal female rats to polymeric nanoparticle PEG-b-PLA could interfere with neuroendocrine differentiation and function, and that observed changes in endpoints related to pubertal development and reproductive function occurred due to the effect of this potential drug delivery system. Additional *ex vivo* and *in vitro* experiments are required to support our working hypothesis.

IMPORTANCE OF AFM TIP PROPERTIES FOR OBSERVATION RESULTS

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AFM - Atomic Force Microscope is a very high-resolution type of scanning probe microscope used to study surface properties of the samples. To get the surface information a sharp tip is used, a few μm in length, which is located at the free end of an elastic cantilever that is usually about $100\mu\text{m}$ long. A typical radius of the tip at the apex is from 2 to 20 nm. Interaction forces between the tip and the sample surface cause the cantilever to bend or deflect. A detector measures the cantilever deflections as the sample is scanned under the tip and it is allowing a computer to generate a map of surface topography. Detection of the cantilever bending is based on an optical principle. A laser beam from a laser diode bounces off the back of the cantilever and onto a position-sensitive photo-detector (PSPD). The advantage of this type of measurement is the possibility to measure insulators as well as semiconductors and conductors.

Our work is focused above all to surface visualization in non-contact mode. Contrary to the fact there is no contact of the tip with the surface the tip is being „wearing out”. Therefore the surface visualization is strongly influenced by tip shape and quality. Most frequently the tip shape change is expressed by tip breaking off, blunting, splitting or contamination. Lower tip quality can then lead to artefact formation. These artefacts are displayed as objects in the measured pictures, but in reality they either do not exist or have quite different shape and size. Beside by tip artefacts can be caused by scanner, image processing but also as vibration and oscillation consequence.

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SUBMICRONIZATION AND NANONIZATION OF BETA GLUCAN AND ITS APPLICATION IN BIOLOGICALLY MORE EFFICIENT FORMS

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Within the last three decades, many polysaccharides and the polysaccharide/protein complexes were isolated from mushrooms, used as therapeutic substances. The immunomodulation ability and anti-cancer efficiency belong to the most promising effects of these biopolymers; mainly glucans exhibiting these effects. Numerous species of mushrooms were identified as rich sources of beta glucans with a positive effect on the immune system of humans and animals.

Glucans are polysaccharides with a long chain. The only structural unit of the chain is glucose that is linked via the bonds in the positions 1 and 3. The most active beta-1,3-glucanes are those having shorter side chains in the position 1,6. This type beta-glucan is often marked as β -1,3/1,6 glucan. This beta conformation makes some types of beta-glucans extremely insoluble.

Nanotechnology is the creation and use of materials at extreme minute scales. These materials are of the size of 1 to 100 nanometers (nm). At these dimensions, materials exhibit different physical properties. Therefore, one of the strategies of creating new physical entities is in breaking down of crystal lattice by physical means.

To develop the method for beta-glucan nanonization we compare several processes of pre-treatment by DCSBD (Diffuse Coplanar Surface Barrier Discharge) plasma, enzymatic pre-treatment and final milling to produce pharmaceutical nano-suspensions using water as dispersion media (Figure). The aim of presented work is to compare different nanonization processes starting from crystals with size around 200 μm that were obtained after micronization using general commercial mill.

We expect that the new procedure of the pre-treatment will enhance the solubility of beta-glucan and increase its immunomodulation and anti-cancer effects. Therefore, the other aim of the study is to follow properties that affect solubility as solvation and diffusion which depend on solid and solvent chemical nature and on system conditions using swelling measurements.

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IMMUNOMODULATORY EFFECT OF NICKEL OXIDE NANOPARTICLES

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Introduction: Nanomaterials are finding growing applications in industry, biology and medicine. The clear benefits of using nanosized products in various applications are promising but detailed information related to the possible immunomodulatory effect is still limited. Our study was aimed to assess the effect of nickel oxide nanoparticles on selected parameters of systemic cellular immune response in Sprague-Dawley rats.

Material and methods : Male Sprague-Dawley rats were treated by intratracheal instillation with 1 mg of nickel oxide nanoparticles (1 mg/animal). After one month or six months, the animals were killed and blood samples were taken. The spleen was aseptically removed and placed into RPMI medium. ***In vitro lymphocyte proliferative assay:*** Spleen cell suspensions were cultured with mitogens concanavalin A, phytohaemmagglutinin and pokeweed mitogen. [3H]-thymidine was added prior to cell harvesting onto glass filter paper. [3H]-thymidine incorporation was determined by liquid scintillation counting. ***Phagocytic activity and respiratory burst test:*** Whole blood mixed with hydroxyethidine and fluorescein-labeled *Staphylococcus aureus* was used for determination of phagocytic activity and respiratory burst of cells. Measurement of phagocytic activity and respiratory burst test was performed using flow cytometry. ***Immunophenotypic analysis of peripheral blood leukocytes*** was performed using flow cytometry.

Results and conclusions

One month after intratracheal administration of nickel oxide nanoparticles to Sprague-Dawley rats, immunostimulatory effect on basal proliferative activity of rat spleen lymphocytes was shown. Proliferative activity of spleen T-lymphocytes and T-dependent B-lymphocytes *in vitro* stimulated with mitogens was moderately increased. No effect on proliferative activity of cells was seen six months after exposure.

One month after treatment of rats with nickel oxide, phagocytic activity and respiratory burst of peripheral blood cells in male Sprague-Dawley rats did not differ between groups in percentage of polymorphonuclear and monocyte phagocytosis and percentage of cells with respiratory burst. Six months after exposure, phagocytic activity of polymorphonuclear leukocytes and respiratory burst was significantly increased.

Six months after exposure, phenotypic analysis of leukocytes revealed significant stimulatory effect of nickel oxide particles on expression of MHCII on lymphocytes. No effect of nickel oxide exposure on expression of markers CD3⁺, CD4⁺ and CD8⁺ on peripheral blood lymphocytes was recorded.

Our results indicate possible immunomodulatory effect of nickel oxide nanoparticles on the immune system of rats.

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PHOTOCATALYTIC ACTIVITY OF TITANIUM DIOXIDE POWDER PRECURSORS FOR HETEROGENOUS PHOTOCATALYSIS

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Heterogeneous photocatalytic oxidation reactions employing semiconductor catalysts are highly topical. Recently much interest has been devoted to titanium dioxide since it has a unique performance for photoactivated degradation of various contaminants in water or air due to generating highly reactive holes (h^+) and electrons (e^-). In works published on heterogeneous liquid phase photocatalysis, TiO_2 powder is usually employed in suspension or immobilized on various substrates, where well characterized powders are required for deposition. Considerable investigations have been also focused on improving photocatalytic activity of TiO_2 by using dopants to broaden its absorption into the visible region of the solar spectrum.

The presented study deals with cerium (IV) doped and undoped titania prepared by controlled precipitation method using urea as precipitation agent. Titania doping was carried out by Ce(IV) in two concentrations with molar ratios of 0.001 and 0.002. Sulphation and annealing were applied to the precipitates. The prepared nanocrystalline TiO_2 powders were characterized by particle size distribution (PSD), scanning electron microscopy (SEM), BET surface area, X-ray powder diffraction analysis (XRD) and photocatalytic activity.

The PSD of thermally untreated precipitates was determined employing a laser diffraction spectrometer. The nanocrystalline materials consist of aggregates with $1\ \mu m - 2\ \mu m$ in diameter. SEM observations affirmed the results of PSD. The BET surface area measurements were performed by N_2 adsorption. As expected, the surface area of the samples decreases with the rising annealing temperature. Doping with Ce(IV) shows inhibition effect on surface area reduction. Thermally untreated precipitates exhibited microporosity, while mesopores were found for annealed samples. Increased pore diameter was observed for higher annealing temperature. Anatase diffractions were found on XRD patterns for all annealing temperatures. The size of primary nanocrystallites was calculated from the full width at half maximum of the anatase diffractions and it increases with rising temperature.

The photocatalytic activity of the TiO_2 powders was assessed in the form of suspensions as the ability of phenol mineralization under irradiation by the determination of total organic carbon (TOC) decrease in an aqueous phenol solution. The photocatalytic reactions followed pseudo-zero order kinetics. The titania samples were characterized by the rate constant of phenol mineralization. The examined nanocrystalline materials show high photocatalytic activity with capability of total mineralization of the organic substance in aqueous environment.

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DETERMINATION OF Zn, Cd AND Pb BY BISMUTH-COATED MICROELECTRODE ARRAY BASED ON NANOCRYSTALLINE DIAMOND THIN FILM

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Nano-crystalline diamond thin films (NCD) are favorable materials for application in electroanalyses as a support for bismuth film deposition by electroplating or, alternatively, they can be used for heavy metals determination as a bare support. Analytical performance of the bismuth film electrodes is influenced by the properties of carbon films. Bismuth film microelectrodes have a potential to replace toxic mercury used most frequently for determination of heavy metals by anodic stripping voltammetry (ASV). Diamond thin films are characterized by excellent mechanical properties (high hardness, high elastic modulus), chemical inertness to any acids, alkaline solutions or organic solvents but, in general, their high resistivity have to be decreased by using doping element such as boron during the fabrication.

NCD films with different deposition conditions were prepared by hot filament CVD process (HF CVD). As active layer for were prepared macro (2 x 2 mm) and microelectrode array (array of 50,625 microdiscs with 3 μm in diameter and 20 μm apart) on highly conductive (0.008-0.024 Ωcm) Si(100) substrates. The areas which act as working electrodes were defined photolithographically.

We have electrochemically characterized detection of Pb^{2+} , Cd^{2+} and Zn^{2+} ions by square wave ASV and compared detection limit (LOD) and sensitivity. Surface morphology of carbon electrodes has been analyzed by scanning electron microscopy (SEM) and Raman spectroscopy. Remarkably different voltammograms were recorded after addition of 1×10^{-6} to 8×10^{-5} mol/L Bi^{3+} into an electrolyte for each type of NCD electrode, when preplated with bismuth film for 30 to 240 s at -1.3 V. We were described dependence of shifting and twining Bi^{3+} peak from 0 V to -0.1 V as a parameter for better stripping of metal.

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SYNTHESIS OF SINGLE- AND MULTI-WALLED CARBON NANOTUBES BY ARC DISCHARGE METHOD

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Synthesis of carbon nanotubes in arc-discharge reactor, recently constructed in cooperation between Danubia NanoTech, s.r.o. and KME FEI STU, is presented. In our work, the classical anodic electric arc discharge method has been implemented and refined into the fully automatic system. Among others, an automatic movement and interchange of electrodes together with the monitoring and control of the electric arc are of highest importance. By proper choice of experimental conditions, both single- and multi-walled carbon nanotubes have been successfully produced. Raman spectroscopy, NIR-optical spectroscopy, SEM and TEMs were employed to characterize the samples. The spectroscopic methods have unambiguously revealed the fingerprints of single- and multi walled carbon nanotubes and SEM and TEM pictures positively confirmed these results. In addition, some other production parameters, i.e. yield, purity, diameter distribution and length of carbon nanotubes are discussed.

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PREPARATION AND PROPERTIES OF FeCo NANOPARTICLES

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FeCo nanoparticles were prepared by chemical synthesis method from the double Fe- and Co-oxalate. The process of thermal decomposition of oxalate sample in hydrogen atmosphere was followed by high temperature X-ray diffraction and thermomagnetic measurements. The formation of α -FeCo solid solution begun at 250 °C and is finished above 500 °C. The final products were investigated using Mössbauer spectroscopy, transmission electron microscopy and magnetic measurements. The Mössbauer spectra analysis shows α -FeCo phase represented by two six-line patterns which are corresponding with surface and bulk of the nanoparticles. The hyperfine induction this components are 34.06 and 35.03 T. In addition the paramagnetic component represented by one doublet with isomer shift 0.14 mm/s and quadrupole splitting 0.49 mm/s was found. This doublet is related to superparamagnetic phase with very low content. The TEM has shown conglomerates of particles with composition about 50 at. % Fe and 50 at. % Co.

POINT OF CARE TESTING (POCT), NANOTECHNOLÓGIE A PERSONALIZOVANÁ LABORATÓRNA DIAGNOSTIKA

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Využitie nanotechnológií v rámci POCT (personalizovaná laboratórna diagnostika) predstavuje celosvetový vývojový trend. POCT využívajúce nanotechnológie predstavuje jeden z hlavných nositeľov/predstaviteľov pojmu personalizovanej laboratórnej diagnostiky. Kvalita, konektivita a regulácia sú základným predpokladom efektívneho využitia POCT v klinickej praxi. POCT má potenciál dobyť trh laboratórnej diagnostiky v nemocnici, na ambulancii, doma u pacienta, lebo sa dá poskytovať bez komplikácií, jednoducho a pohodlne: netreba ísť do laboratória, stačí kvapka krvi, výsledok je za niekoľko sekúnd až málo minút. Ďalšie špecifické benefity, ktoré v dôsledku miniaturizovanej analytickej techniky POCT poskytuje sú: zvýšená spoľahlivosť, prenosnosť, nízke náklady, implantabilita („in vivo analyzátory“).

PAVING THE WAY FOR SME-FRIENDLY R&D&I PROGRAMMES

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The EU-funded project MaPEeR SME ('Making Progress and Economic enhancement a Reality for Small-to-Medium Enterprises') aims to acquire comprehensive insight into the design, implementation and impact of existing SME research and innovation programmes and initiatives at European Union (EU), national and regional level and convey it in the most appropriate way to SME stakeholders and policy-makers. The project will last two years and will involve 15 highly experienced organisations, covering the 27 EU members states plus Bosnia-Herzegovina, in order to ensure the full coverage of the EU programmes and stakeholders.

SMEs have become increasingly important in our society as providers of employment opportunities and as key players for the well-being of local and regional communities. Hence, European SMEs represent: 99.8% of all European enterprises; 67.1% of private sector jobs and at last but not least it represents more than 80% of employment in relevant industrial sectors such as metal products manufacture, construction and furniture. Thus, SMEs must be helped to thrive and being "SME-friendly" should become mainstream policy at all levels.

In this context, the European SME Experts Panel is being launched, with the participation of relevant experts, stakeholders, SMEs, Associations in order to produce recommendations towards the enhancement of Research activities to be carried out by SMEs. SMEs are in the focus of the MaPEeR SME activities, and the analysis of their needs to overcome barriers for innovations activities will ensure that the recommendations issued by the European SME Experts Panel will be well founded and will provide key solutions and recommendations to satisfy the European SMEs' requirements as well as relevant opinions concerning the suitability of the currently available Research, Development and Innovation (R+D+I) programmes and initiatives for the European SMEs. If you are interested to become member of the European SME Expert Panel, please, contact us.

A series of national and international events will involve two main target groups, namely the SME stakeholders and also the SMEs in the activities of the project by collecting their views and needs, analysing the received information and finally giving feedback to them.

The SMEs (both R+D+I orientated and non-R+D+I orientated), the EU entities, the policy makers and SME stakeholders (from Science & Technology-related Ministries, national and regional research agencies and intermediaries) are all welcomed to participate in the project activities and benefit from the results. In fact, SMEs will be the primary users of the searchable database that MAPEER will develop, including useful information on the analysed R+D+I programmes.

SUPPORT OF INNOVATION

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The sustainable growth of the Slovak economy needs cannot be guaranteed without transition to knowledge economy. It is necessary to support transfer of results from R&D institutions to industry and services enterprises. European programmes provide opportunities for using international R&D results and support their implementation in innovative enterprises. Bratislava Regional Chamber of SCCI is currently participating in two projects centrope_tt and INNOVMAT. The centrope_tt project is realized in the CENTRAL EUROPE European Territorial Cooperation 2007 – 2013 programme and the INNOVMAT project in the Slovak-Austrian cross-border cooperation programme 2007-2013.

The main goal of the centrope_tt project is to support transnational co-operations and knowledge transfer between stakeholders in the Centrope region.

The project partners establish the centrope_tt voucher to provide access to financial support for 50 transnational science to business collaborations in the bordering regions of Austria, Czech Republic, Slovakia and Hungary.

The centrope_tt voucher will start as a pilot with 50 cooperation vouchers.

This innovation vouchers helps the SME-s and R&D institutions in the CENTROPE region to develop a transnational cooperation, to enhance the knowledge transfer between the stake holders.

The scheme is funded by the centrope_tt project budget and the call for projects is launched in May 2010.

Centrope_tt voucher is available for all SMEs who are interested in expertise and direct service from knowledge providers like universities and R&D institutions. SMEs can apply for the centrope_tt voucher in the value of 5000 EUR per service.

SMEs can choose R&D providers active in universities, R&D enterprises or research centers in one of the Centrope regions. Additional information about the research institutes can be obtained by contacting the Centrope_tt regional contact points in the region of the interested SMEs. Involved regions of the knowledge providers: Lower Austria, Burgenland, Vienna (Austria); Jihomoravsky Kraj; (Czech Republic); Bratislavsky Kraj and Trnava (Slovakia), West-Transdanubian Region (Hungary).

The aim of INNOVMAT project is to create cross-border platform for technology transfer in the area of progressive materials including nanotechnology in the Vienna-Bratislava Region. Through intensive cross-border cooperation the existing material research potential will reach the European significance. Local increase in the competitiveness will overreach the regional borders and provide opportunities also for nearby regions.

Current exceptional results of material research of Vienna and Bratislava institutes are not adequately used in regional SMEs. The project will also intensify cooperation with SMEs and effective transfer of new technologies.

THE INFLUENCE OF SILVER NANOPARTICLES ON TESTES OF WISTAR RATS.

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Silver nanoparticles emerge as one of the fastest growing product categories in the nanotechnology with focus on antimicrobial activity. The aim of the study was designed to evaluate the effects of silver nanoparticles on alive organisms Wistar male rats, in testes particular.

The experiment has been performed on 46 male Wistar rats divided into three groups such that the mean animal weight within each group was similar. Nanoparticles (NPs) were administrated intravenously into the 32 rats: 16 rats obtained silver (Ag) 20 nm NPs (AgI group), and 16 obtained Ag 200nm NPs (AgII group) both in concentration 5mg/kg body weight in 300 µl saline. The remaining group of 14 rats obtained 300 µl of physiological saline (NaCl group). The biological material was sampled from half of each group 7 and 28 days after injection respectively. Testes were analysed according to standard histological techniques. Assessment was done in testes seminiferous tubules. Immunohistochemical analysis were done in seminiferous epithelium cells with antibodies: ki-67 FITC conjugated (mitosis) and active caspase 3 FITC conjugated (apoptosis). Statistical analysis (multifactor variance analysis test ANOVA) was performed using Statgraphics Plus v. 4.1 and statistical significant difference was considered at $p \leq 0.02$.

Silver nanoparticles of different particle size significantly altered mitosis and apoptosis parameters dependently on time as against to NaCl group. The more relevant result was obtained in longer time after the injection. Mitosis was decreased in both groups (Ag I and AgII groups). Apoptosis was increased in both groups also, but the more significant effect was observed in Ag I group. Histomorphometry of testes seminiferous tubule was significantly changed under the influence of 20 nm AgNPs (AgI group) which was not dependent on time in comparison to the control groups and Ag II group . In each period of time the area, circumference and diameter were diminished.

Results showed that AgNPs can influence testes, but the more significant disruption was generated by the smaller size (20nm) of nanoparticles.

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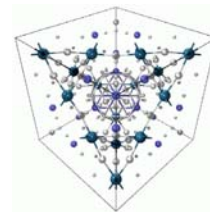
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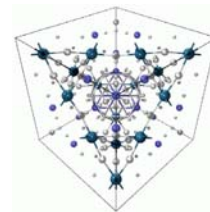
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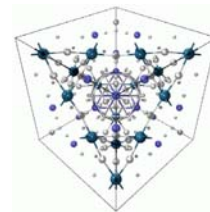
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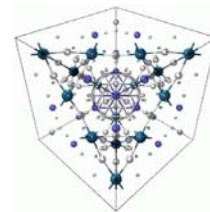
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