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APRIL 8-14, 2025

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INVITED SPEAKER

Id-918

Novel Polymer Nanocomposite Surfaces as Superhydrophobic Marine antifouling Coatings

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Abstract. Since the use of tributyltin compounds in antifouling coatings was prohibited in 2003, the search for environmentally friendly alternatives has intensified. Because of their nonstick, environmental, and economic benefits, fouling-release nanocoatings have received a lot of attention. They use physical anti-adhesion terminology to deter any fouling attachment. Superhydrophobic bioinspired surfaces have micro/nanoroughness and low free energy characteristics, which can motivate dynamic antifouling surface fabrication. Polymer/graphene nanocomposite coatings have been designed to combat biofouling adhesion with ecological and ecofriendly effects, rather than biocidal solutions. Because of their improved interaction at the filler-polymer interface for nanocomposites, graphene-based nanofillers have been used as novel class of composite materials in fouling-prevention applications. Graphene hybrid metal oxide fillers can be used as functional coating nanofillers that would release fouling and confer surface robustness were facilely created by using a straightforward one-phase ultrasonication technique. Long-term durability and self-cleaning performance are among the advantages of developing effective, stable, and ecofriendly modeling alternatives. Water contact angle, surface free energy, and water contact angles were employed to examine the superhydrophobicity and micro/nanoroughness of the coatings. The antifouling effects of the coating systems were evaluated in the laboratory using specific microorganisms. Bioinspired polymeric/graphene nanocomposites can develop efficient and eco-friendly superhydrophobic and durable antifouling coatings.

Keywords: Antifouling Coatings; Bioinspired Superhydrophobic; Fouling-Release; Graphene-Based Nanofillers; Nanocomposites.

INVITED SPEAKER

Id-923

Optimization of Heat Capacities of Wurtzite and Sphalerite Phases as a Single System and Thermodynamic Properties of Nihonium Nitride

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Abstract. The correct mathematical description of heat capacities Cp in a wide range of temperatures still needs to be solved. A fragmental description of some phases is like a vision of one part of a large mosaic picture. Having a fragmented description of some phases is like looking at a large mosaic with half the tiles missing. We propose a special mathematical model to describe Cp in a wide temperature range for two large classes of isostructural sphalerite and wurtzite phases. In this work, two independent methods were used to describe the heat capacity of III-V compounds with the structure of sphalerite [1] and wurtzite, as well as their isostructural analogs of elements of the fourth group in the solid state: 1) a semi-empirical method using a multiparameter function and 2) a method based on density functional theory. To describe the set of the isostructural experimental data Cp(T) for diamond-like or wurtzite phases in solid state as a whole system, here we used a special multi-parameter family of functions with X parameters, where X= {To, a, b, A1, Ө1, Ө2}. The X parameters, in turn, are a function of the atomic number of the element (Si, Ge, α-Sn, Pb) or half the sum of the atomic numbers of the AIIIBV binary phases of B, Al, Ga, Tl, Nh), while the element germanium has a specific point for the X parameters vs. atomic number. For each substance, the parameters are found by minimizing the discrepancy between the theoretical dependence Cp(T) and corresponding experimental data. In this case, either a break point or an inflection point attributable to germanium is observed for parameter dependencies on Ln(N). The ideal crystal is assumed to have no foreign inclusions, defects, or dislocations in the proposed model. The known heat capacities of the Al, Ga, In, and Tl nitrides were taken as the basis, and the element flerovium (114Fl) closes this group. According to the fine structure constant (α) (or the Sommerfeld constant), this group has no other elements. Consequently, the limiting value of the heat capacities of phases with a wurtzite structure falls on the element 114 (114Fl) and has a value of Cp = 30.5±0.3 J · mol-at-1 · K-1. The second method permits the description of the heat capacities (Cp) for the mentioned materials using a novel, first-principles method based on density functional theory. This method, termed the Beyond Quasi-Harmonic method, includes all anharmonic vibrations–changes in volume and phonon-phonon interactions. Our calculated values for the AIIIBV compounds with the wurtzite and sphalerite structures show good agreement between the two methods.

Keywords: Heat Capacities; Sphalerite and Wurtzite Phases; Multi-parameter Family of Function; Density Functional Theory.

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INVITED SPEAKER

Id-932

Subnanometer Clusters in Oxidative Dehydrogenation Reactions: Knobs for Controlling Catalyst Performance in an Atom-by-Atom Fashion

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Abstract. The presentation will focus on catalysis, performed under realistic reaction conditions of pressure and temperature, driven by supported monodisperse subnanometer clusters made of a handful of atoms, supported on technologically relevant oxide- and model carbon-based supports. Schematic of the oxidative dehydrogenation of cyclohexene showing possible reaction products. As an example of controlling catalyst performance at the atomic level along available tuning knobs, monometallic Co, Cu, Pd and bimetallic CuPd clusters in the oxidative dehydrogenation of cyclohexene and cyclohexane will be discussed [1-4], where the atomic precision design of mono- and bimetallic clusters allows for the fine-tuning of their activity and selectivity by varying the size and/or the composition of these atomic clusters in an atom-by-atom fashion and by the choice of support material and varying reaction conditions.

Keywords: Subnanometer Clusters; Atomic Clusters; Single-Site Catalysts; Oxidative Dehydrogenation; Cyclohexane; Cyclohexene; Oxide Support; Carbon-Based Support.

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INVITED SPEAKER

Id-938

Isolation of Nanocellulose from Oil Palm Trunk Biomass Waste using a Sustainable Approach

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Abstract. Nanocellulose from agricultural biomass has emerged as a sustainable material for various applications due to its renewable nature and remarkable properties. This study reviews the isolation of nanocellulose from oil palm trunk biomass waste through a few processing approaches. The method utilizes acid hydrolysis treatments and total chlorine-free (TCF) processes to ensure the preservation of cellulose purity and reduce environmental impact. The study also covers the isolation of cellulose nanocrystals (CNCs) from part of the oil palm trunk (parenchyma and vascular bundle tissue). The resulting CNCs exhibit high crystallinity and desirable thermal and mechanical properties, making them suitable for diverse applications such as biocomposites and advanced functional materials. This approach underscores the potential of oil palm trunk biomass as a value-added resource in sustainable material development.

Keywords: Nanofibers; Biomass Waste; Characterization; Oil Palm Trunk.

INVITED SPEAKER

Id-946

Charterization and Dye Removal Potential for Green Synthesized Cellulose-based Silver Nanocomposites

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Abstract. The contamination of water resources by industrial dyes presents significant environmental and health challenges, necessitating the development of efficient and sustainable remediation strategies. This study investigates the catalytic potential of a cellulose-based silver nanocomposite synthesized via an eco-friendly *in situ* green synthesis method for the degradation of methylene blue dye. The cellulose nanofibers used as a support material for silver nanoparticles were derived from commercial cotton through a three-step process: bleaching, alkali treatment, and acid hydrolysis. Cotton was first bleached with NaClO, followed by washing to remove impurities. Alkali treatment was performed using KOH, with subsequent washing to achieve neutral pH. The final step, acid hydrolysis, was carried out with HCl for 24 hours. The resulting cellulose nanofibers were centrifuged, followed by dialysis against distilled water for three days to neutralize the pH. The nanocomposite synthesis employed *Laurus nobilis* extract, prepared by stirring powdered laurel leaves at 60°C for 10 minutes with distilled water. The extract was mixed with $AgNO_3$ in a 9:1 ratio, and cellulose nanofibers. The reaction proceeded at 80°C for 120 minutes, followed by centrifugation and drying processes. Characterization of the nanocomposite was conducted using UV-Vis spectroscopy, Fourier-transform infrared (FTIR) spectroscopy, Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Energy-dispersive X-ray spectroscopy (EDS), X-ray diffraction (XRD), and Brunauer-Emmett-Teller (BET) analysis. The nanocomposite consisted of uniformly distributed silver nanoparticles (25 nm diameter) on cellulose nanofibers (25 nm width). FTIR results confirmed the successful incorporation of silver into the cellulose matrix. BET analysis revealed a pore size of 11.1 nm and a specific surface area of 199.85 m^2/g, attributes that enhance its catalytic efficiency.

The catalytic degradation of methylene blue, carried out in the presence of $NaBH_4$, achieved complete dye removal within 1 hour, with reaction monitoring up to 120 minutes. The nanocomposite exhibited excellent reusability, maintaining catalytic efficiency across three cycles. This study demonstrates that the cellulose-based silver nanocomposite is a promising, environmentally friendly, and cost-effective material for the treatment of wastewater contaminated with industrial dyes, offering a sustainable alternative to conventional methods. Its scalable synthesis and high reusability make it a potential candidate for industrial wastewater treatment applications, while future research could focus on optimizing its catalytic efficiency for a broader range of pollutants and exploring its performance in real-world environmental conditions.

Keywords: Nanocellulose; Silver Nanoparticle; Nanocomposite; Dye Removal; Green Synthesis.

INVITED SPEAKER

Id-948

Recent Advances in Mechanochemical Preparation of Ternary Cadmium Chalcogenides

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Abstract. Semiconducting nanomaterials like CdS, CdSe, and CdTe, are essential in up-to-date electronic devices [1]. In particular, CdS and CdSe have gained research interest due to their favorable optical band gaps of 2.44 eV and 1.74 eV, respectively. Recently, the research interest has shifted from binary to ternary materials due to their adjustable band gap range [2]. Various preparation methods, like hydrothermal, microwave, and sonochemical synthesis, were used for the synthesis of those kinds of compounds so far. The mechanochemical approach, developed in the 1970s for the fabrication of nickel- and iron-based superalloys for applications in the aerospace industry, has proven to be a convenient solid-state processing technique in which the precursor powders are exposed to repeated welding, fracturing, and re-welding in a high energy ball mill. The method is nowadays widely used in the processing of advanced materials. Our group has previously reported on the mechanochemical synthesis of copper and cadmium chalcogenides (CuS, $CuSe_2$, Cu_7Te_5, CdS, CdSe, and CdTe) [3] as well as the mechanochemical preparation of Al_2S_3, Al_2Se_3, Ga_2S_3, and Ga_2Se_3 [4]. Recently, nickel tellurides with various stoichiometries have been prepared by the mechanochemical method [5]. In the current contribution, we present the recent advances in the mechanochemical synthesis of ternary and quaternary cadmium chalcogenides with the general formula CdS_xSe_y as well as $CdS_xSe_yTe_z$. Similar to ternary cadmium chalcogenides, $CdS_xSe_yTe_z$ is utilized in photovoltaics due to its ability to absorb a broad spectrum of sunlight, as well as in light-emitting diodes for its high photoluminescence. The syntheses were performed using a planetary micro mill, where the time required for efficient synthesis was determined. The as-prepared compounds were characterized by multiple methods, including X-ray powder diffraction (pXRD), differential scanning calorimetry (DSC), dynamic light scattering (DLS) and zeta-potential measurements. The transmission electron microscopy (TEM) images and the energy dispersive X-ray spectroscopy (EDX) spectra confirm the composition of the products and reveal a clustered agglomerate structure of the nanosized ternary and quaternary cadmium chalcogenides nanoparticles.

Keywords: Nanomaterials; Ternary Cadmium Compounds; Sulfides; Selenides; Mechanochemistry.

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INVITED SPEAKER

Id-950

Magnetic Nanocomposites for Biomedical Applications and Electromagnetic Interference Shielding: Influence of Synthesis Methods and Conditions on Magnetic Properties

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Abstract. The presentation will focus on magnetic nanocomposites studied in our group for applications in biomedicine and electromagnetic interference (EMI) shielding. An overview will be provided of the essential requirements that materials synthesized for such applications must meet. In this context, the desirable physical properties — including magnetic, morphological, structural, and optical characteristics — will be described.

Examples of specific nanocomposites investigated will include magnetically doped oxide semiconductors, nanocomposites incorporating semiconductor oxides and transition metal oxides/ferrites/transition metal hydroxides, as well as graphene oxide decorated with transition metal oxides, magnetically functionalized carbon nanotubes. The influence of synthesis methods on the magnetic properties of these materials —covering paramagnetic, ferromagnetic, superparamagnetic, antiferromagnetic behaviors — will be discussed.

Additionally, we will demonstrate how factors such as crystallite size, magnetic dopant concentration/magnetic phase content in nanocomposites, and surface functionalization impact magnetic properties. Special attention will be given to the critical role of surface and size effects, as these are key determinants of the unique magnetic behaviors observed in nanoscale materials. The presentation will address strategies for optimizing these materials for specific applications. Finally, we will highlight the importance of detailed structural characterization, emphasizing the need to go beyond standard characterization techniques to identify the origin of particular magnetic behaviors accurately.

Keywords: Magnetic Nanoparticles; Oxide Semiconductors; Graphene Oxide; Carbon Nanotubes.

INVITED SPEAKER

Id-957

Zeolitic Imidazolate Framework (ZIF-67) as A Superior Platform for Electrocatalysts in Oxygen Evolution Reaction – Strategies Overview

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Abstract. This contribution investigates the potential applications of metal-organic frameworks (MOFs) in the oxygen evolution reaction (OER) during electrocatalytic water splitting. The study concentrates on three different strategies for modifying a zeolitic imidazolate framework based on cobalt centers (ZIF-67), a type of MOF.

The first method involves subjecting ZIF-67 to low-temperature thermal treatment (at temperatures of 150 - 300°C). The most effective sample (ZIF-67 200) demonstrates an overpotential of 318 mV and a Tafel slope (TS) of 105 mV/dec during the OER. The electrocatalytic performance is improved compared to the unmodified ZIF-67, owing to the presence of cobalt species on the surface, which promotes favorable OER reactions, along with an optimized pore structure and a higher number of exposed active sites. The second method involves functionalization of ZIF-67 with nickel salt (using nickel(II) nitrate hexahydrate at concentrations in the range of 0.0001 to 0.1 M). The most effective sample in terms of electrocatalytic performance (ZIF-67 0.001Ni) shows an overpotential of 299 mV and a TS of 94 mV/dec, attributed to the formation of active nickel dimers (Ni2+) with superparamagnetic properties and an enhanced specific surface area (SSA). The last approach to modify ZIF-67 is realized via carbonization (at temperatures of 650, 750, and 850°C). The most effective sample (CZIF-67 750C) achieves an overpotential of 288 mV and a TS of 69 mV/dec. The improved electrochemical properties result from a surface enriched with Co3O4 islets and the highest electrochemically active surface area (ECSA). In conclusion, it is evident that MOFs hold significant promise as a platform for enhancing electroactivity in this complex but crucial reaction in energy conversion system.

Keywords: Oxygen Evolution Reaction; Electrocatalysis; Zeolitic Imidazolate Frameworks.

INVITED SPEAKER

Id-959

Towards Enhancement of Photoactivity of G-CN Based Catalysts in Hydrogen Evolution Reaction Irradiated by Solar Light

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Abstract. The research presents the potential of the catalysts based on exfoliated graphitic carbon nitride (ex-gCN) and its composites for photocatalytic hydrogen evolution. Different strategies of modification were verified: liquid-phase exfoliation of bulk graphitic carbon nitride by means of sugars, thermal treatment of ex-gCN at high temperatures in H_2, formation of composites with mesoporous titanium dioxide spheres, and with MXene. Detailed physicochemical characterization of the obtained catalysts gave an insight into the mechanism of the photocatalytic hydrogen generation reaction in the presence of the proposed catalysts. The most efficient strategy was observed in the composite based on gCN and $Ti_3C_2T_X$. Here, the calcination temperature significantly influenced the final product's structure. All gCN:MXene_T catalysts exhibited higher photocatalytic hydrogen generation activity than the reference materials with gCN:MXene_600 showing the highest activity of 37,660.4 μmol/g of H_2. PL, CA, and EIS analyses indicated that the high efficiency of hydrogen generation with gCN:MXene_600 is due to the reduced recombination rate of photogenerated electron-hole pairs, linked to their effective separation and transport within the material.

Keywords: Graphitic Carbon Nitride; Photocatalysis; Hydrogen Generation.

INVITED SPEAKER

Id-962

Substrate-Induced Strain in Molybdenum Disulfide Thin Films Grown by Aerosol-Assisted Chemical Vapour Deposition

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Abstract. Transition metal dichalcogenides have been extensively studied in recent years because of their fascinating optical, electrical, and catalytic properties. However, low-cost, scalable production remains a challenge. Aerosol-assisted chemical vapour deposition (AACVD) provides a new method for scalable thin film growth. In this study, we demonstrate the growth of molybdenum disulfide (MoS_2) thin films using AACVD method. This method proves its suitability for low-temperature growth of MoS_2 thin films on various substrates, including glass, silicon dioxide, quartz, silicon, hexagonal boron nitride, and highly ordered pyrolytic graphite. The as-grown MoS_2 shows evidence of substrate-induced strain [1]. The type of strain and the morphology of the as-grown MoS_2 highly depend on the growth substrate's surface roughness, crystallinity, and chemical reactivity. Moreover, the as-grown MoS_2 shows the presence of both direct and indirect band gaps, suitable for exploitation in future electronics and optoelectronics.

Keywords: Molybdenum Disulfide; Transition Metal Dichalcogenides; Thin Films; Aerosol-Assisted Chemical Vapor Deposition; Strain.

Keywords: Molybdenum Disulfide; Transition Metal Dichalcogenides; Thin Films; Aerosol-Assisted Chemical Vapor Deposition; Strain.

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INVITED SPEAKER

Id-974

Metallic Nanoparticle-Additives in Greases: Electronic Spillover-Related Repulsion

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Abstract. Conditions for reducing friction and ware through greases with purely metallic nanoparticles are studied. In greases with purely metallic nanoparticle-additives, the dipole-dipole type interactions due to free electron gas spill-over, between the nanoparticles (NPs) on the one part and electric double layer (EDL) of the substrate or similar NPs on the other part exist, reducing friction and wear. The interactions of EDL with the upper hemisphere dipole (HD) and lower HD aren't fully compensated because of different distances to the dipole centres of "mass" [1].

To estimate interaction energies in this system, we introduce the approximate substrate electron density (axis *z* is orthogonal to the substrate surface, $z = 0$ is the surface plane position, n_+ is the metal core positive charge density in the *jellium* model):

$$n_S(z) = n_+ \begin{cases} 1 - 0.5\exp(\beta_S z)\,, z < 0 \\ 0.5\exp(-\beta_S z)\,, z \geq 0 \end{cases}$$

meeting the electroneutrality condition, and NP's electron density

$$n_C^-(r) \sim \begin{cases} 1 - 0.5\exp[-\beta_C(R - r)]\,, r < R \\ 0.5\exp[-\beta_C(r - R)]\,, r \geq R \end{cases}$$

normalised to NP's free electrons total charge $q_C e^-$ (q_C is number of atoms in NP of radius *R*). The energy of interaction *w* of the substrate surface with both upper and lower HDs reads

$$w = \frac{2}{3}\frac{d_{\frac{1}{2}\mathrm{MeC}}d_{\mathrm{S}}}{\varepsilon_0\varepsilon}\left(\frac{1}{z_L} - \frac{1}{z_U}\right)$$

where $d_{\frac{1}{2}\mathrm{MeC}}$ is the absolute value of MeP-dipole "half-moments" (directed „top-down" for the upper HD and "bottom-up" for the lower HD) and d_{S} is the substrate surface unit EDL dipole moment, ε low-frequency dielectric permittivity and ε_0 dielectric constant, z_L, z_U are spacings between the substrate and the lower and upper HDs respectively. If there are two similar substrates at the top and bottom and the grease with NPs in between, the interaction energy of a thick (compared to *R*) layer of NPs with both substrates is equal to

$$W \approx \frac{4}{3}\nu\frac{d_{\frac{1}{2}\mathrm{MeC}}d_{\mathrm{S}}}{\varepsilon_0\varepsilon}\ln\left(\frac{R + z^0}{R - z^0}\right)$$

where ν [m^{-3}] is the number of MePs in a volume unit, z^0 is ½ of spacing between the lower and upper HDs.

For iron substrates and lithium grease ($\varepsilon \approx 2.5$) with 1 mass% of gold NPs $Au_{147}C$, interaction energy $W \sim 10^{-3}$ J/m^2 would appear essentially weaker than energy of typical mechanical interactions in, e.g., engines and transmissions. However, among such influencing factors as MeP size and concentration, logarithmic factor and dielectric permittivity, the latter is potentially capable of producing a sharp increase in *W*. ε is very sensitive to particular factors as to island-type metal film thickness and electric field frequency [2] and under certain conditions can tend to zero thereby potentially leading to rather big interaction energies and, consequently, reducing friction and wear.

Keywords: Metallic Nanoparticle; Electric Double Layer; Grease; Friction; Wear.

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INVITED SPEAKER

Id-975

Synthesis of Nanocrystalline Cerium Oxide under Production Conditions with the Best Regenerative Activity and Biocompatibility for Creation of Wound-Healing Agents

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Abstract. The objective of the study is to develop an optimal method for the synthesis of nanosized cerium oxide powder obtained via the thermal decomposition of cerium carbonate precipitated from aqueous nitrate solution for the technical creation of new drugs for of effective wound healing in production conditions. A comprehensive interdisciplinary study was conducted, including the physico-chemical characterization of synthesized nanocerium, as well as biomedical research (in vitro and in vivo). Several modes of the industrial synthesis of cerium dioxide nanoparticles (NPs) were carried out. The synthesis stages and the chemical and physical parameters of the obtained NPs were described using transmission electron microscopy (TEM), X-ray diffraction, Raman spectroscopy, and mass spectrometry. Biomedical studies: the cell cultures of human fibroblasts and keratinocytes were cultured with different concentrations of different nanoceria variations, and the cytotoxicity and the metabolic and proliferative activity were investigated. An MTT test and cell counting were performed. The antimicrobial activity of CeO_2 variations at a concentration of 0.1–0.0001 M against *Pseudomonas aeruginosa* was studied. A study of the efficacy and safety of nanocerium application on a model of acute skin wounds in Wistar rats has been conducted. The purity of the synthesized nanoceria powders in all the batches was >99.99%. According to TEM data, the size of the NPs varied from 1 nm to 70 nm under different conditions and methodologies. The most optimal technology for the synthesis of the nanoceria with the maximum biological effect was selected. The repeatability of the results of the proposed method of nanoceria synthesis in terms of particle size was confirmed. It was proven that the more structural defects on the surface of the CeO_2 crystal lattice, the higher the efficiency of the NPs due to oxygen vacancies. The strain (microdeformations) provided the best redox activity and antioxidant properties of the nanoceria, which was demonstrated by better regenerative potential on various cell lines. The beneficial effect of synthesized nanoceria on the proliferative and metabolic activity of the cell lines involved in skin regeneration (human fibroblasts, human keratinocytes) was demonstrated. The antimicrobial effect of synthesized nanoceria on the culture of the most-resistant-to-modern-antibiotics microorganism *Pseudomonas aeruginosa* was confirmed. The optimal concentrations of the nanoceria to achieve the maximum biological effect were determined (10^{-3} M). When assessing the toxicity of nanocerium on animals of the selected concentration, nanocerium showed complete safety. On the model of wounds in rats, the use of nanocerium revealed a positive effect on wound healing, acceleration of epithelialization of the skin defect with restoration of functional elements (sebaceous glands, hair follicles). It was

possible to develop a method for the industrial synthesis of nanoceria, which can be used to produce drugs and medical devices containing CeO_2 NPs for wound regeneration.

Keywords: Wound Healing; Nanoparticles; Cerium Dioxide; Nanoceria; Transmission Electron Microscopy; X-Ray Diffraction; Raman Spectroscopy; Cells; Fibroblasts; Keratinocytes; Regeneration.

INVITED SPEAKER

Id-982

Hard/Soft Coupled Magnetic Nanocomposites for The Fabrication of Rare-Earth Free Permanent Magnets

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Abstract. Permanent magnets are crucial elements for the green transition as they allow storing, delivering and converting electrical energy into mechanical and vice versa, which means that improving their performance entails transforming energy in a more efficient and sustainable way. The best magnets are based on rare-earths elements, (RE). However, their status as Critical Raw Materials (CRM) has brought forward the consciousness that it is of great strategic and environmental relevance to develop alternative PMs with reduced or no amount of RE. Sr or Ba M-type hexaferrites are the most popular magnet in the market thanks to the low production costs, thermal stability, and insulating properties.[1] However, their capability to store energy, described by the energy product (BH_{max}), is much smaller than that of the high performing RE magnets (20-40 kJm^{-3} compared to up to 400 kJm^{-3}). Since ferrite magnets are constituted by multidomain grains, large improvements in their performances are expected by exploiting nanometric grains and the doping with different elements. A further increase of the performances can be obtained by realizing hybrid hard-soft nanocomposites magnetically coupled at the interface.[2] In this contribution, we present the synthesis and discuss the magnetic properties of single crystal, monodomain strontium ferrite (SrM) nanoparticles prepared by two different techniques, solid state reaction and solgel synthesis. The particles have variable average size in the 50 – 100 nm range and larger coercivity compared to commercial powders. To further improve the magnetic and morphological features of the SrM synthetized, their doping with other suitable elements (i.e. Al, Mn) was also investigated. The best obtained ferrite was employed for the fabrication of hybrid nanocomposites using, as the soft phase, iron nanowires. These latter were prepared by chemical reduction of metal salts in aqueous phase and consist of small nanoparticles assembled in a chain-like amorphous superstructure, with a mean diameter of 70-80 nm and length of 4-5 µm.

On the other hand, with the aim to obtain compact ferrite PMs with high, also preliminary alignment tests of the SrM and doped SrM nanoparticles synthetized were also performed.

Keywords: Magnetism; Nanoparticles; Nanocomposites; Permanent Magnets.

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INVITED SPEAKER

Id-983

Polymer Blend Epoxy/PVB Reinforced with BN Nanoparticles as Composite Material for Advanced Applications

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Abstract. A novel hybrid composite, integrating poly(vinyl butyral) (PVB) combined with epoxy resin as the matrix and boron nitride (BN) nanoparticles as reinforcements, has been engineered to benefit the unique synergistic effects of its components. This innovative material combines the high stiffness and rigidity of epoxy with the inherent flexibility and toughness of PVB. The selected epoxy/PVB matrix not only ensures superior processability for diverse fabrication techniques—such as molding, casting, and coating, but also significantly enhances the composite's overall mechanical performance. BN nanoparticles, recognized for their exceptional thermal conductivity and electrical insulating properties, are strategically incorporated to boost the matrix's heat dissipation capabilities without compromising its dielectric integrity. Two distinct BN nanoparticle sizes (70 nm and 200 nm) were integrated into the epoxy/PVB matrix: first the nanostructures were ultrasonically disoersed in ethanol, then the polymer components were added into it and dissolved. The suspensions with and witout nanostructures (both BN grades in 1 wt.% concentration) were cast into Teflon molds for detailed characterization. Morphological analysis using scanning electron microscopy (SEM) and nanoparticle size determination via Dynamic Light Scattering (DLS) were conducted. Mechanical performance was assessed through tensile, Charpy impact, cavitation wear, and microhardness tests, while thermal stability was evaluated using differential scanning calorimetry (DSC) to determine the glass transition temperature of both the unreinforced and nanoparticle-enhanced composites. The results have shown significant enhancement of thermo-mechanical properties upon nanoparticle reinforcement, highlighting the material's potential for advanced applications. This cutting-edge hybrid nanocomposite offers promising opportunities for use as a reinforced polymer matrix for high-performance laminated composites, in protective coatings on various surfaces, electrical insulation, aerospace, automotive industries, etc.

Keywords: Polymer Nanocomposite; Boron Nitride; Nanoparticles; Polymer Blend; Poly(Vinyl Butyral); Epoxy Resin.

INVITED SPEAKER

Id-986

Enhanced Photoelectrochemical Water Splitting by Improving Photon Capture and Charge Separation with Sea-Urchin Like Nanomaterials

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Abstract. A hierarchical sea urchin-like hybrid metal oxide nanostructure is specifically designed and successfully synthesized by depositing vertically aligned, crystallized ZnO nanorods (NRs) on the surfaces of porous TiO_2 hollow hemispheres (HHS). The HHSs, synthesized by electrospinning, facilitate light trapping and scattering. The deposited ZNRs offer a large surface area for improved surface oxidation kinetics. A thin layer of zinc titanate ($ZnTiO_3$) is formed at the interface between the TiO_2 HHSs and ZNRs, resulting in a closely coupled hierarchy structure of ZnO/ $ZnTiO_3/TiO_2$. The synergistic effects of improved light trapping, charge separation, and fast surface reaction kinetics result in a superior photoconversion efficiency of 1.07% for the photoelectrochemical (PEC) water splitting with an outstanding photocurrent density of 2.8 mA cm^{-2} at 1.23 V vs. RHE.

Keywords: Nanocomposite; Sea-Urchin; Photocatalysis; Hydrogen Production; Light Capture.

INVITED SPEAKER

Id-997

Over Two Decades of Graphene as Biomaterial

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Abstract. Graphene is one of the most controversial materials of our time. Since graphene discovery there has been much anticipation in regard to the graphene contribution to the biomaterials field. Later finds in regard to the graphene potential to improve the mechanical properties of any polymer matrix to an extent never seen before and other outstanding properties i.e. electrical and thermal conductivity, chemical stability, quenching properties, antibacterial activity has promoted graphene as the star of the biomaterials field giving the promise the change the world for the better. Conversely, concerns arisen in regard to the graphene potential toxicity, particularly at higher concentrations [1]. Soon after it was demonstrated the low cytotoxicity and membrane disruption was associated with graphene although slight pro-inflammatory differentiated macrophage profiles were noticed. After that, graphene possibilities were endless and today graphene is not just a simple nanomaterial that improves certain properties but can induce well-defined new functionalities and generate applications from tissue regeneration to optical and electrochemical biosensors and brain implants. Graphene oxide has been found to be osteoinductive and able to promote the progression of a preosteoblastic cell to a mature osteoblast and generate bone tissue when implanted in an ectopic area in vitro and in vivo models. Later discovery of 3D printing fabrication technique opened new avenues as graphene formulations and graphene-based formulations were foreseen as very promising and able to help to go beyond the limitations of the technique i.e. resolution or dimensional accuracy. Despite the efforts directed toward the development and use of graphene and its derivatives in the biomedical field, important obstacles must be addressed, however today possibilities for graphene are endless and fascinating.

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Keywords: Graphene; Biomaterials; 3D Printing; Bone Regeneration.

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ORAL PRESENTATION

Id-958

Exohedrally Functionalized Singlewalled Carbon Nanotubes in Oxygen Evolution Reaction

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Abstract. In this contribution, pristine singlewalled carbon nanotubes and SWCNTs functionalized by metal compounds such as Ni and Co by exohedral procedure route, were investigated as electrocalaysts in oxygen evolution reaction during water decomposition. The microscopic analysis shows the bundles of pristine singlewalled carbon nanotubes and decorated by a mixture of Ni and Co nanoparticles. The linear sweep voltammetry (LSV) was obtained during the OER process over SWCNTs_pristine, SWCNTs_Ni_Co, and RuO2 for comparison. Taking into account the required water decomposition potential (1.23V) each sample's overpotentials were measured at 10 mA/cm2 according to equation (2), where ERHE is the potential relative to the reversible hydrogen electrode, EWE is the potential measured directly from the working electrode against the reference electrode (e.g., MOE), and C is the constant for the reference electrode relative to the reversible hydrogen electrode. SWCNTs_Ni_Co and SWCNTs_pristine have a lower overpotential than commercially used RuO2 demonstrating overpotential equal: to 350, 373, and 376 mV, respectively. To examine the relationship between overpotential and current density over time, the chronopotentiometry (CP) method was employed. The resulting data were utilized to determine the Tafel slope (TS) and to gain insights into the efficiency of the electrocatalyst. A lower Tafel slope signifies an enhanced kinetic process, indicating that the electrocatalyst is capable of achieving the desired current with reduced overpotential. Among all studied materials, the Tafel slope of SWCNTs_Ni_Co has the lowest value of 117mV/dec. For a thorough characterization of the catalysts, an extended stability test was also conducted. Ideally, the optimal catalyst should exhibit long-term stability during operation with minimal increase in (over)potential. Consequently, potential fluctuations were monitored for SWCNTs_Ni_Co, SWCNTs_pristine, and RuO2 at different current densities: 10, 20, and 50 mA/cm², and results have been collected. SWCNTs_pristine shows excellent stability with growth in potential equal 0.0 %, 0.0 % at the first (10 mA/cm2), and second stage (20 mA/cm2) and last stage (50 mA/cm2) resulted with only 5.3% of growth. Moreover, SWCNTs_Ni_Co also shows better stability than the commonly used RuO2. Therefore, it is proved that SWCNT can serve as an efficient host for electroactive species enhancing the conductivity and stability of the system.

Keywords: Singlewalled carbon nanotubes; Electrochemistry; Oxygen Evolution Reaction.

ORAL PRESENTATION

Id-994

Doping of Laser-induced Graphene Using Polyethylenimine for Thermoelectric Applications

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Abstract. Laser-induced graphene (LIG) is a promising material known for its unique properties, including high porosity, remarkable flexibility, cost-effectiveness, high electrical conductivity, and environmental sustainability. LIG generally demonstrates p-type conductivity, which can be effectively transformed to n-type through doping with substances like polyethylenimine (PEI), amines, or other electron-donating compounds. In this study, LIG film was scraped to acquire graphene powder, which was subsequently dispersed in a terpineol/ethanol solution. By incorporating PEI along with viscosity-enhancing agent (ethyl cellulose), a viscous ink was formulated, enabling effective n-type doping of LIG with PEI, which contains abundant amine groups. This ink was printed onto glass substrates, and the doping process was confirmed through comprehensive characterization employing Fourier-transform infrared spectroscopy (FTIR), X-ray photoelectron spectroscopy (XPS), X-ray diffraction (XRD), scanning electron microscopy (SEM), and energy-dispersive X-ray spectroscopy (EDS). The findings demonstrated successful doping. Given these findings, n-type doping of LIG with PEI represents a viable strategy for enhancing graphene based-thermoelectric.

Keywords: Doping; Laser-induced Graphene; Polyethylenimine; Thermoelectric.

ORAL PRESENTATION

Id-996

Exploring the Impact of Calcination Temperature on the Morphology and Structure of LCC ($La_{0.6}Ca_{0.4}CoO_3$) Nanofibers

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Abstract. The development of ceramic nanofibers has attracted a significant interest over the recent years. Electrospinning technique enables the production of ceramic nanofibers with very small diameters, high surface areas, remarkable lengths, and small pore sizes, which qualify them for many different applications such as tissue engineering, sensors, water remediation, batteries, fuel cells etc. The fabrication of ceramic nanofibers by electrospinning involves the preparation of an electrospinning solution containing a polymer and sol–gel precursor, electrospinning of the solution to generate precursor nanofibers and conversion of precursor nanofibers into the ceramic nanofibers by calcination. Calcination temperature plays a critical role on the morphology and structure of ceramic nanofibers. In this study, $La_{0.6}Ca_{0.4}CoO_3$ (LCC) ceramic nanofibers were electrospun from a precursor solution containing polyacrylonitrile (PAN) polymer and $La(NO_3)_3{\cdot}6H_2O$, $Ca(NO_3)_2{\cdot}4H_2O$, and $Co(NO_3)_3{\cdot}6H_2O$ metal salts. The solution and electrospinning process parameters were optimized in order to obtain uniform precursor nanofibers and continuous jet formation. The nanofiber mats obtained were calcined at various temperatures (700, 800, and 900 °C) to remove the organics from the nanofiber structure and obtain LCC nanofibers. The effects of calcination temperature on the morphology and structure of the nanofibers were also examined. This study was supported by Scientific and Technological Research Council of Turkey (TUBITAK) under the Grant Number 124M101. The authors thank to TUBITAK for their supports.

Keywords: Calcination; Ceramic Nanofibers; Electrospinning; Nanofibers; Perovskites.

ORAL PRESENTATION

Id-998

Development of Laser-Induced Graphene Sensors for Hazardous Chemical Detection

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Abstract. The need for fast and accurate detection of dangerous chemicals, including explosives, is growing. To meet this need, low-cost and portable sensor technologies are being developed. In this study, laser-induced graphene (LIG) films were produced and tested for use in chemical sensing. The films were analyzed using Raman spectroscopy, X-ray photoelectron spectroscopy (XPS), X-ray diffraction (XRD), scanning electron microscopy (SEM), and Fourier transform infrared spectroscopy (FTIR). Their sensing ability was tested by measuring resistance changes when exposed to ethanol, toluene, and dinitrotoluene (DNT). Additionally, the sensors were tested with different DNT concentrations (0.1 M, 10^{-3} M, 10^{-6} M, and 10^{-9} M), showing a clear relationship between concentration and resistance change. The results show that LIG-based sensors are highly sensitive and flexible, making them a promising option for detecting explosives and monitoring environmental safety.

Keywords: Laser-Induced Graphene; Chemical Sensors; Resistance Measurement; Explosive Detection.

POSTER PRESENTATION

Id-919

Removal of Amoxicillin and Paracetamol from Water by Carbon from Peanuts Skin Waste Material

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Abstract. Recent studies show that amoxicillin (AMX) and paracetamol (PRC) are among the most frequently prescribed drugs worldwide. As a result, these substances and their derivatives inevitably end up in water systems. This is a concern for human health and the environment in general. This research investigated the effectiveness of peanut skin in adsorbing AMX and PRC from water. Pristine (PPS), carbonised (CPS) and activated peanut skin (ACPS) were produced and characterised using SEM, EDX, XRD and FTIR. The SEM images showed that the morphology of PPS is amorphous and has a high content of fatty acids. After carbonisation (CPS) and activation (ACPS), the samples had an improved surface, which is heterogeneous with well-developed pores and voids. The EDX shows that (C) and oxygen (O) are the main elements with traces of heteroatoms. The effect of initial concentration on adsorption showed that the adsorption increased gradually from 20-100 mg/L. It was observed that the removal of AMX gradually decreased with increasing temperature of the reaction mixture. This occurred with all adsorbents and confirmed that adsorption was exothermic. In contrast, the removal of PRC was enhanced by increasing the temperature of the reaction mixture. The trends for PRC confirm that the uptake is endothermic. The adsorption data were described by Freundlich and PSOM. The highest removal was observed at an initial pH of 6 and 8 for PRC and AMX respectively. The $\triangle G^o$ values were negative, indicating that adsorption was favoured and feasible for AMX and PRC on all adsorbents. $\triangle S^o$ was negative for all adsorbents, indicating that freedom at the solid-solution interface was restricted when adsorption reached equilibrium. FTIR analysis after adsorption showed that synergistic uptake mechanisms such as hydrogen bonding, Yoshida hydrogen bonding, and electrostatic and π-π interactions facilitated the adsorption of AMX and PRC. The adsorbents had adsorption capacities of 20.82, 32.76, and 35.98 mg/g for PRC and 12.36, 17.67, and 19.59 mg/g for AMX by PPS, CPS and ACPS, respectively.

Keywords: Peanut Skin; Agriculture Waste; Paracetamol; Amoxicillin; Pharmaceuticals; Emerging Pollutants.

POSTER PRESENTATION

Id-920

One Pot Synthesis of Fe_3O_4-Chili Carbon Composite Removing Methylene Blue, Paracetamol and Nickel Ions from an Aqueous Solution

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Abstract

The presence of harmful chemicals in water is a major problem in many regions worldwide. This study aimed to develop a nanocomposite of carbonised-chili and nanoparticles to remove nickel ions (Ni(II)), methylene blue (MB) and paracetamol (PARA) from water. The material was characterised by TEM, FTIR, XRD and TGA. The uptake for PARA and MB was endothermic with capacities of 39.98 and 44.31 mg/g at pH value 7, while that of Ni(II) was exothermic at 56.06 mg/g at pH value 5. The data were described by the Freundlich and PSO models. The reusability was tested up to four cycles. In conclusion, a low-cost nanocomposite adsorbent developed from chili carbon/Fe_3O_4 exhibited excellent adsorption capacity for various pollutants, indicating the versatility and potential of the material for water treatment. The Vaal University of Technology, Vanderbijlpark, South Africa funded this work.

Keywords: Chili pepper; Nanoparticles; Sorption; Metal ions; Dyes

POSTER PRESENTATION

Id-947

Development and Characterization of A Green-Synthesized Cellulose-Based Silver/ Sodium Alginate Nanocomposite Hydrogel for Enhancing Crop Resilience to Drought Stress

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Abstract. Nanocomposite materials that integrate metal nanoparticles with biopolymers have become a key focus of research due to their multifunctional properties and potential applications in fields e.g. agriculture, biomedicine, and environmental management. These materials combine the structural and chemical versatility of biopolymers with the functional advantages of nanoparticles, creating systems that are environmentally friendly and effective. Biopolymers such as cellulose and sodium alginate (NaAlg) are particularly attractive for these applications due to their natural abundance, biodegradability, and ability to form functional networks with nanoparticles. Cellulose, a major structural component of plant cell walls, is well-suited for nanomaterial synthesis due to its high hydroxyl content, which enables strong interactions with other components. Sodium alginate, derived from marine brown algae, is widely used for its gelation and film-forming capabilities. Nanocellulose, are renewable materials with high mechanical strength and surface reactivity. Cotton, which contains approximately 90% cellulose, serves as an effective precursor for nanocellulose synthesis via chemical treatments such as bleaching, alkali processing, and acid hydrolysis. In parallel, silver nanoparticles (AgNPs) are recognized for their antimicrobial properties and are increasingly synthesized through green methods to minimize environmental impact. Green synthesis techniques use plant extracts as reducing and stabilizing agents. *Laurus nobilis* leaves, rich in antioxidants and polyphenolic compounds, are particularly effective for synthesizing stable AgNPs. Biopolymer-based hydrogels have received considerable attention for their water-retention and controlled-release capabilities, which are critical in addressing agricultural challenges such as drought. By incorporating nanocellulose and AgNPs, the structural and functional properties of hydrogels can be significantly enhanced, enabling them to serve as effective tools for improving crop resilience. In this study, a nanocomposite hydrogel, referred to as Cellulose-based Silver/Alginate Nanocomposite Hydrogel, was developed by combining nanocellulose extracted from cotton, sodium alginate, and green-synthesized AgNPs from *Laurus nobilis* leaf extract. The preparation of Cellulose-based Silver/Alginate Nanocomposite Hydrogel involved a stepwise synthesis process, beginning with the extraction of nanocellulose from cotton through sequential chemical treatments. These nanocellulose were dispersed in a sodium alginate solution to create a composite matrix. The green-synthesized AgNP solution was then added dropwise to the matrix under controlled conditions, followed by cross-linking with calcium chloride ($CaCl_2$) to form the hydrogel. The final material was dried and characterized using UV-Vis spectroscopy, Fourier-transform infrared (FTIR) spectroscopy, zeta potential analysis, and scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM-EDS).

The functional efficacy of Cellulose-based Silver/Alginate Nanocomposite Hydrogel was evaluated in greenhouse conditions, focusing on drought-stressed pepper seedlings. Initial findings indicate that Cellulose-based Silver/Alginate Nanocomposite Hydrogel enhances plant growth and development under water-deficit conditions, underscoring its potential as a sustainable material for mitigating abiotic stress in crops. By integrating biopolymer-based hydrogels with green-synthesized nanomaterials, this study highlights a promising pathway for advancing agricultural practices and addressing the challenges of climate change.

Keywords: Nanocellulose; Sodium Alginate; Silver Nanoparticle; Nanocomposite Hydrogel; Drought Stress.

POSTER PRESENTATION

Id-954

Tailoring Titanium Oxide Nanotube Arrays for High-Performance Explosive Gas Sensors

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Abstract. The development of efficient sensors for explosive gas detection requires optimized functional materials capable of high sensitivity and selectivity. Titanium dioxide (TiO_2) nanotube arrays, formed by electrochemical anodization of titanium, are promising candidates for such applications due to their high surface area, tunable morphology, and excellent chemical stability. This work presents a systematic approach using the Design of Experiment (DOE) methodology to optimize the fabrication parameters of TiO_2 nanotube arrays, specifically tailored for use as sensitive layers in explosive gas sensors. DOE provides a structured framework to analyze and optimize the influence of input parameters, such as anodization voltage, electrolyte composition, and processing time, on the resulting nanotube morphology. Through Response Surface Modeling (RSM), we aim to minimize the experimental effort while maximizing the information gained about the process. The study incorporates three types of RSM models: (i) linear models with two-level factorial designs for initial parameter screening, (ii) second-order parabolic models for detailed optimization, and (iii) advanced transcendental models for refined data interpretation and higher-order interactions. This multistage approach ensures accurate identification of the critical factors affecting nanotube formation and their subsequent performance as gas-sensing elements. The fabrication of TiO_2 nanotubes involves the electrochemical anodization of titanium in fluoride-containing electrolytes, where anodic oxidation and chemical dissolution occur simultaneously. Process optimization via DOE revealed that parameters such as voltage range, pH of the electrolyte, and anodization duration critically impact the diameter, wall thickness, and uniformity of the nanotubes. These morphological properties were further correlated with gas adsorption and sensing performance, demonstrating the material's potential for detecting explosive gases such as methane, hydrogen, and propane. Preliminary results indicate that optimized TiO_2 nanotube arrays exhibit enhanced gas-sensing properties, including low detection limits, fast response times, and high selectivity for target gases. The integration of these sensitive layers into gas sensors is underway, and their performance is being evaluated under real-world conditions. This work highlights the utility of DOE in streamlining the development of advanced materials for high-performance explosive gas sensors, paving the way for scalable and reliable fabrication processes.

Keywords: Design of Experiment; VOCs; Titanium Dioxide; Electrochemical Anodization.

POSTER PRESENTATION

Id-961

Ultrasonic Treatment of Cr(III) Nanocat Catalyst and Its Application in Liquid-Phase Oxidation of Undecane and Pentadecane

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Abstract. Numerous studies have demonstrated that cavitation-induced ultrasonic waves can effectively accelerate the rate of chemical reactions [1,2]. These findings were investigated through experiments on the oxidation reactions of paraffinic hydrocarbons, specifically undecane and pentadecane, in the presence of a Cr(III) nanocatalyst synthesized via chemical vapor deposition (CVD) [2,3]. The oxidation reactions were conducted using a laboratory-scale bubbling-type setup [4]. Prior to the reactions, the catalyst was treated with ultrasound (UST) using a Hielscher UP200St cavitation unit, operating at a frequency of 26 kHz. During the cavitation process, a titanium sonotrode (grade S26D7) was employed.

Liquid-phase aerobic oxidation of C_{11} and C_{15} (100 ml), in the presence of a Cr(III)nanocat catalyst pre-treated with ultrasonic treatment (Reaction temperature = 135-140^{0}C, the airflow was 100–120 l/h)

RH	Catalyst	Amount of the catalyst, mas.%	UST, min	Reaction time, hour	A.n. of oxidized product, mgKOH/g	Yield of the SFAs, mas.%	Yield of the OFAs, mas.%
C_{11}	-	-	-	12	29.3	1.1	0.2
C_{11}	Cr(III)nanoCat	0.1	-	4	57.7	17.5	19.1
C_{11}	Cr(III)nanoCat	0.05	1	4	58.0	23.7	15.4
C_{11}	Cr(III)nanoCat	0.1	1	4	78.0	21.8	26.4
C_{15}	Cr(III)nanoCat	0.05	1	4	85.7	25.9	33.7
C_{15}	Cr(III)nanoCat	0.1	1	4	129.2	22.7	28.5

SFAs-synthetic fatty acids; OFAs- oxy-fatty acids; A.n. of oxidized product – Acid number of the oxidized product (a mixture of products formed as a result of reaction oxidation: acids, oxyacids, alcohols, ketones, aldehydes, hydroperoxides and etc.)

Experimental data established that the synthesized Cr(III) nanocatalyst exhibits high catalytic activity, which is further enhanced by ultrasonic treatment. During the oxidation of pentadecane in the presence of the Cr(III) nanocatalyst, a higher yield of acids was observed compared to the oxidation of undecane. This can be attributed to the

longer hydrocarbon chain of pentadecane, which facilitates easier cleavage of C-C bonds. Ultrasound treatment generates concentrated energy in the reaction environment, thereby improving the yield of the target products, including synthetic fatty acids (SFAs) and oxy-fatty acids (OFAs).

Keywords: Cr(III) Nanocat; Undecane; Pentadecane.

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POSTER PRESENTATION

Id-984

Thermoplastic/Thermosetting Polymer Blends Reinforced with Tungsten Disulfide Nanostructures as Promising Wear and Cavitation-Resistant Coatings

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Abstract: Unique properties of multi-layer WS_2 nanostructures, including their high mechanical strength, excellent lubricating abilities, chemical inertness, and thermal stability, make them highly promising as reinforcement of polymer composites for applications in demanding environments such as aerospace, automotive, marine applications, protective equipment, and industrial machinery. WS_2, like graphite and MoS_2, possesses a layered structure that enables it to function as a solid lubricant, thereby reducing friction and improving the durability of the materials into which it is integrated. This feature might be specifically beneficial in coatings and protective layers. This research investigates poly(vinyl butyral)/epoxy layers reinforced with tungsten disulfide (WS_2) nanostructures, a novel class of coatings engineered for enhanced thermo-mechanical, wear, and cavitation resistance. Poly(vinyl butyral), PVB –a thermoplastic elastomer, and epoxy resin – a thermosetting polymer, combined together may provide a tough but flexible matrix that can absorb impact energy from cavitation bubbles. The hybrid polymer matrix (PVB/epoxy) offers resistance to chemical degradation, moisture, and corrosion. Epoxy ensures strong adhesion to the substrate, while PVB improves elasticity. WS_2 nanoparticles further enhance this property by reinforcing the matrix and reducing crack propagation. PVB/epoxy composite coatings incorporating WS_2 nanostructures were synthesized and evaluated for their thermo-mechanical and cavitation resistance properties. The coatings were prepared using a solution blending technique. PVB and epoxy resin in a ratio of 5:95 were dissolved in the appropriate solvent – ethanol, and mixed to achieve a homogeneous solution. WS_2 was ultrasonically dispersed in ethanol before the polymers were added to ensure uniform distribution of the nanostructures in the matrix. The resulting mixture was then cast into Teflon molds to form thick coatings, which were cured under controlled conditions to optimize their mechanical properties. Morphological and structural analyses, including scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDS), were conducted to assess the dispersion of WS_2 within the polymer matrix. FTIR analysis was carried out to estimate the interaction of the reinforcement with the matrix. The material's mechanical resistance was examined through microhardness measurement and the cavitation wear was assessed through ultrasonic cavitation tests, followed by damage analysis. The thermal stability of the coatings was examined using differential scanning calorimetry. The findings suggest that PVB/epoxy-WS_2 layers are promising as coatings for extending the lifespan of components exposed to high friction and cavitation environments, with potential applications in advanced composite materials, in marine and hydraulic systems, and as protection against cavitation damage in propellers, pumps, and turbines, and in general, parts subjected to high friction and erosion. Further optimization of nanostructure dispersion and optimization of desirable concentrations of WS_2 could further enhance the performance of these coatings. This work was supported by the Ministry of science,

technological development and innovations (Serbia), contracts No. 451-03-137/2025-03/200325 and 451-03-66/2024-03/200026.

Keywords: Tungsten disulfide, multi-layer nanostructures, nanocomposite, polymer matrix, mechanical resistance, cavitation wear, coatings

POSTER PRESENTATION

Id-988

Optical, Electrical and Structural Properties of Sol-Gel ZnO Nanocomposite Thin Films

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Abstract. ZnO materials are gained interest due to their non-toxicity, high abundance of Zn in nature, thermal and chemical stability. Zinc based oxides are of current research as functional material, due to a range of remarkable properties and low cost.Their optical properties (high transmittance, direct optical band gap, free exciton binding energy of 60 meV), semiconducting nature make them appropriate candidates for optoelectrinic applications, including transparent conducting oxide (TCO), transparent solar cells, sensors etc. citors etc. [1]. One fascinating application of ZnO based films is in transparent solar cells (TPV). The transparent photovoltaic cell is a solar cell, which woks by absorbing harmful UV light to generate electric power while passing the visible range light [1]. Developing heterostructure including ZnO or TiO_2 has gained tremendous research interest in TPV research. ZnO based thin films were prepared by the sol-gel spin-coated technique and annealed at temperatures ranging from 300 - 500 °C. The used substrates were glass substrates, silicon wafers and conducting glass (ITO). The sol-gel approach for depositing oxide films is versatile, efficient, cost-effective (relative low processing temperature, low-cost equipment) and it allows deposition of doped materials, controlling the homogeneity, the morphology and the thickness and crystallinity when an appropriate annealing treatment is applied. The structure, vibrational and optical properties have been analyzed in dependence on the number of layes, annealing temperatures and substrate type. The change of the work function (WF) of the samples was also determined in dependence on the technological parameters. Workfunction (WF) of the samples was measured with a Scanning Kelvin Probe (SKP5050). Kelvin probe measures the contact potential difference between a sample and tip. WF of the sample is calculated by determining the WF of the tip calibrated against a known surface. It has been found that Li or Ga doping in ZnO films maintained the hexagonal wurtzite structure arrangement, but the crystallite sizes and the lattice parameters are altered. ZnO films are transparent with slightly decreased transmittance after higher annealing temperatures. The dopants provoked the improvement of the film transparency (up to 88 %) in the visible spectral range. The optical band gaps were determined and analyzed. The work function (WF) values were found to become higher with annealing and WF values aof ZnO:Li film approached 4,85 eV. The preliminary electrical study gave encouraging results. It can be concluded that the structural, optical and morphological parameters of the sol-gel derived ZnO thin films were affected by lithium or gallium doping. The cost-effective ZnO:Li nanostructured thin films can be promising candidates for practical technological applications and transparent solar cells.

Keywords: Sol-Gel; Optical Properties; Doping.

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POSTER PRESENTATION

Id-993

Effect of Microencapsulated PCM Addition on The Thermal Conductivity of Carbon Fiber Reinforced Epoxy Composites for Battery Thermal Management Systems

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Abstract. This study examines the potential of carbon fiber-reinforced epoxy composites with phase change material (PCM) additives to solve thermal management problems in batteries. The main objective of the study is to improve the thermal properties of battery systems by utilizing the high thermal conductivity, durability, and lightness of carbon fibers and the heat absorption capacity of PCM. PCMs absorb the heat generated during battery operation and provide temperature balancing, but using PCMs directly in batteries may cause problems such as leakage. To overcome this problem, PCMs operating in the range of 25-35°C are used in microencapsulated form. Composite plates with and without PCM were manufactured and subjected to thermal conductivity and thermal diffusivity tests. While the PCM addition decreased the thermal conductivity in the axial direction, it increased the thermal conductivity in the radial direction. In the isotropic measurement, it was observed that the addition of PCM decreased the thermal conductivity. This situation reveals that the thermal properties of PCM-added carbon fiber-reinforced composites are affected by the heat flow direction. The observed decrease in thermal conductivity in the axial direction across both measurement methods strongly suggests that PCM effectively absorbs and stores the released heat. As a result, it shows that PCM-added carbon fiber reinforced composites may offer potential improvements in battery thermal management.

Keywords: Phase Change Materials (PCM); Thermal; Conductivity; Battery Thermal Management; Microencapsulation; Carbon Fiber Reinforced Epoxy Composite.

POSTER PRESENTATION

Id-995

Study of the Structure of Oxyethylated Nonylphenolformaldehyde Oligomers Modified by Nitrogen-Containing Components Using Infrared Spectroscopy

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Abstract. The paper deals with the results of the studies on the possibility of carrying out modification process of oxyethylated nonylphenolformaldehyde (ONPFR) resins by nitrogen-containing compounds on the example of imidazolinamines synthesized on the basis of natural petroleum acids (NPA) and polyethylenepolyamines (PEPA) in various molar ratios -1-2-3:1. The structures of the obtained compounds and optical absorption densities of the main groups were studied using infrared spectroscopy. The spectra of the synthesized imidazolinamines, as well as the ONPFR modified by them, were recorded on LUMOS IR-Fourier spectrometer from BRUKER (Germany) in the wave frequency range of 600-4000 cm^{-1}. Spectra of imidazolinamines synthesized in various molar ratios are identical to each other with slight shifts. The spectrum showed: deformation vibrations at 1375, 1455 cm^{-1} and valence vibrations at 2816, 2853, 2921 cm^{-1} of C-H bond of CH_2 groups; deformation vibrations at 1544 cm^{-1} and valence vibrations at 3293 $cm^{-1}$of N-H bonds; valence vibrations at 1159 cm^{-1} of C-N bond; valence vibrations of C=N bond at 1644 cm^{-1}. Density of absorption bands C=N bonds and C-N bonds increase with an increase in the molar ratio of NPA:PEPAfrom 1:1 o 3:1 that proves intensity of the formation of imidazoline cycles in the chain with an increase in the amount of acid to the amine component. The spectra of imidazolinamine-modified different compositions of ONPFR are also identical with slight shifts. The spectrums showed: deformation vibrations at 1376, 1456 cm^{-1} and valence vibrations at 2872, 2923, 2955 cm^{-1} of C-H bond of CH_2 groups; deformation 1556 cm^{-1} vibrations of N-H bond; valence vibrations at 1186 cm^{-1} of C-N bond; valence vibrations of C=N bond at 1641 cm^{-1}; deformation vibrations of C-H bond of benzene ring at 829 cm^{-1}; valence vibrations at 1611 cm^{-1} of C-C bond of benzene ring; valence vibrations of O-H bonds at 3395 cm^{-1}; valence vibrations of C-O-C ether bonds at 1248 cm^{-1}. According to the analysis of IR spectra, a mechanism was proposed for the modification process.

Keywords: Oxyethylated Nonylphenolformaldehyde Oligomers; Modification; Imidazolinamines; Infrared Spectroscopy; Density of Absorption Bands; Structure.

ALL SUBMISSIONS & TOPICS

Topic	Submission
1 - 2D/Graphene	959 - Towards enhancement of photoactivity of g-CN based catalysts in hydrogen evolution reaction irradiated by solar light
	994 - Doping of Laser-induced Graphene Using Polyethylenimine for Thermoelectric Applications
	997 - Over Two Decades of Graphene as Biomaterial
	998 - Development of Laser-Induced Graphene Sensors for Hazardous Chemical Detection
3 - Nanomedicine	975 - Synthesis of Nanocrystalline Cerium Oxide Under Production Conditions with the Best Regenerative Activity and Biocompatibility for Creation of Wound-Healing Agents
4 - Nanocatalysis	932 - Subnanometer Clusters in Oxidative Dehydrogenation Reactions: Knobs for Controlling Catalyst Performance in an Atom-by-Atom Fashion
	957 - Zeolitic Imidazolate Framework (ZIF-67) as a Superior Platform for Electrocatalysts in Oxygen Evolution Reaction – Strategies Overview
	958 - Exohedrally Functionalized Singlewalled Carbon Nanotubes in Oxygen Evolution Reaction
	961 - Ultrasonic Treatment of Cr(III) Nanocat Catalyst and Its Application in Liquid-Phase Oxidation of Undecane and Pentadecane
	986 - Enhanced Photoelectrochemical Water Splitting by Improving Photon Capture and Charge Separation with Sea-Urchin Like Nanomaterials.
5 - Nanocomposites	918 - Novel Polymer Nanocomposite Surfaces as Superhydrophobic Marine antifouling Coatings
	946 - Characterization and Dye Removal Potential for Green Synthesized Cellulose-based Silver Nanocomposites

	950 - Magnetic Nanocomposites for Biomedical Applications and Electromagnetic Interference Shielding: Influence of Synthesis Methods and Conditions on Magnetic Properties
	983 - Polymer Blend Epoxy/PVB Reinforced with BN Nanoparticles as Composite Material for Advanced Applications
	993 - Effect of Microencapsulated PCM Addition on the Thermal Conductivity of Carbon Fiber Reinforced Epoxy Composites for Battery Thermal Management Systems
7 - Nanoparticles	938 - Isolation of Nanocellulose from Oil Palm Trunk Biomass Waste using a Sustainable Approach
	948 - Recent Advances in Mechanochemical Preparation of Ternary Cadmium Chalcogenides
	982 - Hard/Soft Coupled Magnetic Nanocomposites for the Fabrication of Rare-Earth Free Permanent Magnets
	996 - Exploring the Impact of Calcination Temperature on the Morphology and Structure of LCC (La0.6Ca0.4CoO3) Nanofibers
12 - Functional Nanomaterials	919 - Removal Of Amoxicillin and Paracetamol from Water by Carbon from Peanuts Skin Waste Material
	954 - Tailoring Titanium Oxide Nanotube Arrays for High-Performance Explosive Gas Sensors
	974 - Metallic Nanoparticle-Additives in Greases: Electronic Spillover-Related Repulsion
13 - Computational Nano	923 - Optimization of Heat Capacities of Wurtzite and Sphalerite Phases as a Single System and Thermodynamic Properties of Nihonium Nitride
22 - Sol-gel	988 - Optical, Electrical and Structural Properties of Sol-Gel ZnO Nanocomposite Thin Films
40 - Aerosol	962 - Substrate-Induced Strain in Molybdenum Disulfide Grown by Aerosol-Assisted Chemical Vapor Deposition