Session: Materials for energy and environment (EE)

EE-P01 - EE-P30

EE-P01 (Poster)

Progressive and stable synaptic plasticity with attojoule energy consumption by the interface engineering of a metal/ferroelectric

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In the era of “big data”, the cognitive system of the human brain is being mimicked through hardware implementation of highly accurate neuromorphic computing by progressive weight update in synaptic electronics. Low-energy synaptic operation requires both low reading current and short operation time to be applicable to large-scale neuromorphic computing systems. In this study, we implement an energy-efficient synaptic device comprising a Ni/Pb($Zr_{0.52}Ti_{0.48}$)O_3 (PZT)/0.5 wt% Nb-doped $SrTiO_3$ (Nb:STO) heterojunction with a low reading current of 10 nA and short operation time of 20–100 ns. Ultralow attojoule operation up to 5.5 aJ at a synaptic event, which is significantly lower than the energy required for synaptic events in the human brain (10 fJ), is achieved by adjusting the Schottky barrier between the top electrode and ferroelectric film. Moreover, progressive domain switching in ferroelectric PZT successfully induces both low nonlinearity/asymmetry and good stability of the weight update. The synaptic device developed here can facilitate the development of large-scale neuromorphic arrays for artificial neural networks with low energy consumption and high accuracy.

Keywords: Energy efficiency, Low reading current, Short operation time, Linearity, Symmetry, Variability, Neuromorphic computing

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EE-P02 (Poster)

Silver nanoparticles synthesis using chromolaena odorata (L.) Extract in thermosensitive polymer solutions and evaluation of wound healing capability

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Trauma wound is an inevitable health issue in life. Many researchers have endeavored to develop multifunctional materials to enhance wound healing after injury. Chromolaena odorata (L.), a plant with fresh leaves and decoction, is widely used in Vietnam and tropical countries to treat soft tissue wounds, burns, skin infections, and periodontal diseases. Silver nanoparticles (AgNPs) (which were synthesized in the herbal extract solution) and Pluronic polymer (which plays roles in enhancing healing and protecting the colloidal nanosilver and active components from medicinal plant extracts) were used to create a thermosensitive polymeric nanocomposite solution that can form a multifunctional hydrogel film on the wound surface. Phytochemical analysis was performed to determine the total phenolic, flavonoid contents, and the iron reduction capacity of the CO extract responsible for reducing and capping the biosynthesized CO-AgNPs by using the Folin–Ciocalteu method, the aluminum chloride colorimetric method, and the Oyaizu method, respectively. Antimicrobial and antioxidant activities of the SR extract and CO-AgNPs were tested using the Kirby-Bauer and DPPH methods. The synthesized products were characterized using different techniques, such as UV−visible spectroscopy, dynamic light scattering (DLS), Fourier transform infrared (FTIR) spectroscopy, X-ray diffraction (XRD), and transmission electron microscopy (TEM). The results proved that both ultrasound-supported ethanol CO extract and CO-AgNPs have high efficiency in antimicrobial and antioxidant activities, but CO-AgNPs show superiority. Furthermore, the multifunctional hydrogel system was evaluated, and the results show that the products have high efficiency in antibacterial activities and anti-inflammatory regulation.

Keywords: Antibacterial activity, thermosensitive hydrogel, Chromolaena odorata, silver nanoparticles, wound healing.

EE-P03 (Poster)

Construction of highly condensed Cu_2O/CuO composites on Cu sheet and its photocatalytic in photodegradation of hazardous colouring agent rose bengal

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Binary copper oxides with different copper ion oxidation states including cuprous Cu_2O and cupric CuO have already been successfully synthesized by the simple and highly repeatable grow-up technique from the modified copper Cu sheet. By controlling the annealing time and temperature, the copper oxide (CuO, Cu_2O) composites were hierarchically formed on Cu surface. All obtained samples were characterized using X-ray diffraction (XRD) spectroscopy and scanning electron microscopy (SEM). The results showed that the modified Cu sheets after annealing in air yielded the mixture of CuO and Cu_2O phases. The obtained Cu_2O/CuO composites have been used as active photocatalysts to decolourize the 10 ppm dyes rose bengal solution with the degradation efficiency of 73% over a period of 3 h under UV-A irradiation after three uses. These results make them attractive as reusable photocatalytic materials in form of flat sheet. The other testing conditions as pH values and oxidant agent (H_2O_2) was carried out. It was observed that the photodegradation achieved up to 96% with the presence of H_2O_2.

Key words: CuO, Cu_2O, film-based photocatalyst, reusability, stability, photodegradation.

EE-P04 (Poster)

Chemical Expansivity and Oxygen Transport in Oxide Perovskite Ceramics

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Oxygen transport membranes are necessary to create portable gas reformers. A dense oxide layer with mixed electronic and ionic conductivity (MEIC) performs efficiently for selective diffusion of oxygen but they are mechanically unstable due to their chemical expansion under oxygen partial pressure gradients in working conditions. Various designs to circumvent this instability were proposed but they may affect functionality. As a measure of the membrane's functionality, oxygen flux needs to be measured for comparison, but direct measurement methods require complex equipment.

R code was used to calculate a membrane's oxygen diffusivity from measurements of its chemical expansion. Oxygen diffusivity measures how fast oxygen moves inside the material under a gradient in oxygen potential, related to oxygen flux. By measuring the membrane's expansion and contraction due to step changes in oxygen partial pressure, the oxygen diffusivity can be approximated. It is noticed that the accuracy of this approach is sensitive to the precision of the chemical expansion measurements.

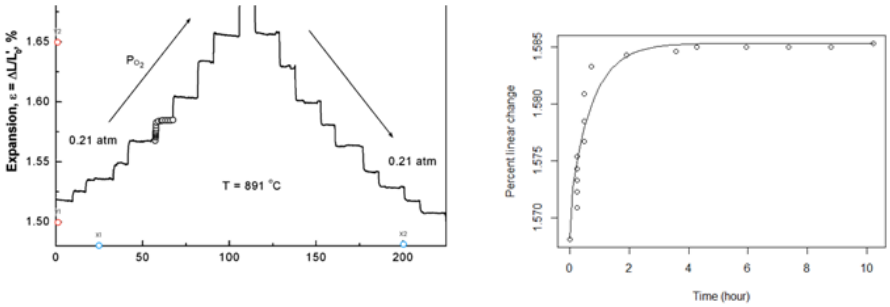

FIG. 1. Digitalized data of sample expansion when exposed to partial pressure changes of oxygen (left) and the resulting curve when fitted in R [1].

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EE-P05 (Poster)

Zr and Hf-based Metal-Organic Frameworks Used as Efficient Heterogeneous Catalysts for the Synthesis of Heterocyclic Compounds

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Zirconium- and Hafnium-based metal-organic frameworks (Zr- and Hf-MOFs), which are constructed by a diversity of coordinated clusters, were shown to be highly effective heterogeneous catalysts for many reactions. Herein, we demonstrate strategies for designing, functionalizing, tailoring, and synthesizing defective 12-connected and 6-connected Zr- and Hf-MOFs used as reusable catalysts. These synthesized materials were fully characterized by several techniques, including powder X-ray diffraction, N2 sorption isotherms, acid-base titration, and thermal gravimetric analysis to determine their features regarding structural defect, porosity, acidity, and stability. In the catalytic studies, the combination of Brønsted and Lewis acidic of these MOFs was efficiently applied for synthesizing heterocyclic bioactive compounds such as benzoxazole, benzimidazole, benzothiazole, and quinazolinone. MOFs with Zr6 or Hf6 nodes could identify a significantly enhanced yield in Brønsted acid catalyzed reactions by using the wide opening spaces structures and inherent high density of active sites. The catalysts can be used for a broad substrate scope and recycled several times without a significant loss in their activity.

Keywords: Zr-MOF, Bronsted acid MOF, Heterocyclic reaction, Benzoxazole derivatives, Quinazolinone

EE-P06 (Poster)

Modeling inductance of a coil dipping in solution

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Self-inductance of a coil depends on dipping environment. The measured values vary slightly for vacuum, air and pure water [1-4] in large ranges of both temperature and applied frequency. However, for particular cases of solutions of salts such as NaCl, $FeCl_3$ etc., the measured inductance depends significantly on both temperature and frequency. In this article we show that the dependance of a coil's inductance on frequency and temperature when dipping in a salt solution may be derived from the mobility and relaxation time of ions at given concentration. The fit to measured data is demonstrated for the NaCl and $FeCl_3$ solutions of concentrations from 0.1 to 1.0 *mol/l*. The results show that for each given kind of ion at given concentration there is a specific frequency where the inductance is zeroed, and another one where it is maximum. This enable sensing separability of ion and its concentration in liquid water due to measurement of coil's self-inductance.

Keywords: Inductance, Coil, Ion, Solution, Soil, Magnetic Response

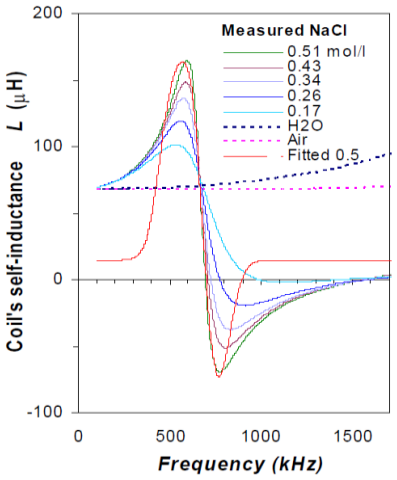

FIG. 1. Measured and fitted data for NaCl solution at various concentrations.

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EE-P07 (Poster)

The Langmuir-Blodgett and Langmuir-Schaefer film of stearic acid: Preparation and characterization

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Stearic acid (SA) is one of the most common long-chain saturated fatty acids and is a surfactant capable of forming stable floating films with different nanostructures by the Langmuir-Blodgett (LB) technique. These floating layers could be transferred to different substrates to obtain solid films by LB or Langmuir-Schaefer (LS) deposition method. Films of SA are used independently and in conjunction with other substances (e.g. chitosan, poly(p-phenylene vinylene) (PPV), metallic ions, other fatty acids, proteins, vitamins, and so on) to synthesize new materials for a wide range of applications. These applications include but are not limited to electronics, chemical and biological sensors, and filters. This paper systematically reviews LB and LS films of stearic acid especially experimental parameters in prior studies as well as advancements in the application of stearic acid-based films.

Keywords: Stearic acid, Langmuir-Blodgett, Langmuir-Schaefer, thin film

EE-P08 (Poster)

Preparation, photocatalytic degradation of pollutants and self-cleaning performance of TiO_2 based-nanomaterials (TiO_2, TiO_2-ZnO, TiO_2-Au)

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Titanium dioxide (TiO_2), a non-toxic semiconductor, has garnered extensive interest due to their excellent photocatalytic, self-cleaning and antibacterial properties. Its wide bandgap with rutile phase (3.0 eV), anatase and brookite phases (3.2 eV) restricts the visible light photocatalytic applications. An effective approach to address this limitation is decorating the TiO_2 surface by plasmonic Au nanoparticles or engineering the heterostructure with ZnO metal-oxide leading to the multi-function photocatalyst. Herein, we have successfully prepared some TiO_2 based-nanomaterials (TiO_2, TiO_2-ZnO, TiO_2- Au) and investigated their photocatalytic activity and photocatalytic self-cleaning behavior. All obtained photocatalysts were prepared by chemical route (sol-gel and hydrothermal methods) and plasma jet technology. Characterization was analyzed by X- ray diffraction (XRD), Raman spectroscopy, scanning electron microscopy (SEM) technique. Ultra-hydrophilicity was assessed by measuring the contact angle. Photocatalytic properties were evaluated through the photodegradation of methylene blue (MB) and rhodamine 101 (RB) under the both simulated visible light and direct sunlight. The TiO_2-ZnO and TiO_2-Au photocatalysts are active under this condition while the pure TiO_2 in form of anatase, brookite and the anatase/brookite mixture exhibit high activity under the ultraviolet (UV) light.

Keywords: TiO2, ZnO, Au, Photocatalytic, Self-cleaning, Hydrothermal, Plasma jet

EE-P09 (Poster)

Application of SiO_2 nano-spheres embedded in polypropylene matrixfor the analytical blood filtering processes

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The human body responses to diseases or illnesses with significants, such as body-temperature elevation, oxidant-release and blood chemical level changing. As consequence, blood chemistry tests are of common processes, those are frequently performed to detect and identify a wide variety of medical conditions. In some chemistry tests, large-size blood components – usually blood cells themselves, aggregated cholesterol, lipids - might originate the positive or negative bias, which falsifies the investigation results. To minimize these interferences, this study introduced an advanced structural blood-filter using SiO_2 nanospheres embedded in a polypropylene matrix, which has the filtering pore-sizes 40 nm-smaller. The as-prepared nano blood filters were applied for calcium ion and organic filtering and let ~97% small size chemicals – calcium ions, Rohdamine B - transfer, and are suitable for blood chemistry test sampling.

Keywords: blood chemistry test, blood sampling, nano blood filter, SiO_2 nanospheres

EE-P10 (Poster)

Effects of Surfactants on Dispersion of Expanded Graphite in Polyurethane Foam

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Using surfactants is a common strategy to exfoliate stacks of graphene sheets from graphite and enhance its processability. Two commercially available surfactants, Tween 80 and Triton X-100, are used to modify expanded graphite (EG) which serves as filler for polyurethane foam (PUF). Effects of the two surfactants on dispersion of EG within the polymer matrix are testified through scanning-electron microscopy (SEM) and thermal conductivity measurements of the EG/PUF composite samples. Modification of EG with Triton-X / Tween 80 results in more uniform dispersion of the filler material inside the polyurethane matrix and increases the thermal conductivity of EG/PUF composite from 0.057 to 0.074 / 0.080 ($W.m^{-1}.K^{-1}$), respectively.

Keywords: expanded graphite, polyurethane foam, surfactants

EE-P11 (Poster)

Study and characterization of betulin encapsulated by liquid compounds to improve itssolubility in water

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Betulin is a natural compound, extracted from the bark of the birch trees, known and used for a long time because of its anti-viral, anti-cancer, antioxidant properties etc. However, like many naturally occurring bioactive compounds, it has poor solubility, which greatly limits its pharmacologically promoting effects. Many studies on betulin have been conducted, but mainly on its acid and other derivatives. In this paper, the research direction was preparation of betulin in liquid phase in order to enhance the solubility in water. The particle sizes of obtained samples were less than 100 nm and their solutions were optically clear, and they could be stable for 24 hours. In addition, the results of SEM, UV-VIS, FTIR measurements of betulin powder and liquid formulation were also reported.

Keywords: Betulin, antioxidant, biological activities.

EE-P12 (Poster)

Coupling Amorphous Ni Hydroxide Nanoparticles with Single-Atom Rh on Cu Nanowire Arrays for Highly Efficient Alkaline Seawater Electrolysis

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Exploring efficient catalysts for alkaline seawater electrolysis is highly desired yet challenging. Herein, coupling single-atom rhodium with amorphous nickel hydroxide nanoparticles on copper nanowire arrays is designed as a new active catalyst for the highly efficient alkaline seawater electrolysis. We found that an amorphous $Ni(OH)_2$ nanoparticle is an effective catalyst to accelerate the water dissociation step. In contrast, the single-atom rhodium is an active site for adsorbed hydrogen recombination to generate H_2. The NiRh-Cu NA/CF catalyst shows superior electrocatalytic activity toward HER, surpassing a benchmark Pt@C. In detail, the NiRh-Cu NA/CF catalyst exhibits HER overpotentials as low as 12 and 21 mV with a current density of 10 mA cm^{-2} in fresh water and seawater, respectively. At high current density, the NiRh-Cu NA/CF catalyst also exhibits an outstanding performance, where 300 mA cm^{-2} can be obtained at an overpotential of 155 mV and shows a slight fluctuation in the current density

Keywords: Single-atom catalyst, Seawater electrolysis, cation exchange, nanowire array.

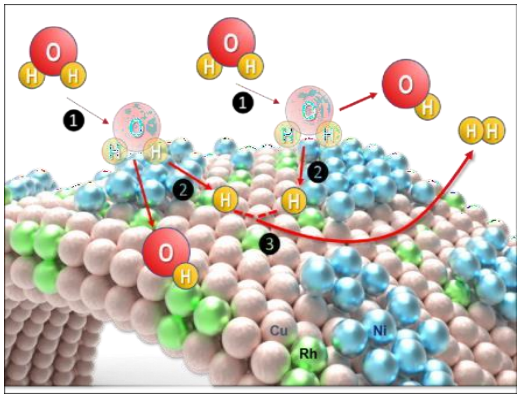

FIG. 1. Proposed mechanism to explain the enhanced HER activity of NiRh-Cu NA/CF catalyst.

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EE-P13 (Poster)

Pre-irradiation-induced grafting acrylamide onto polyvinylpyrrolidone matrix and evaluating combined copolymers with graphene oxide for high-temperature offshore oildfield application

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Crude oil will still be the primary source of energy for the economy, and an irreplaceable input material of the chemical industry, especially organic chemistry. Therefore, efficient exploitation of oil and gas is always the most critical task of the oil and gas industry, especially when, with the depletion of many large oil fields in the world, explore and exploit oil fields as far from the shore with greater depth and higher temperature (HT). Polymer solutions are widely used in oil and gas exploration and production. To meet the requirements of working effectively in the harsh conditions in offshore oilfields, thermal resistance and salt-stable in seawater with high hardness polymer solutions are required. In the present research, the irradiation-induced grafting of acrylamide (AM) onto polyvinylpyrrolidone (PVP) matrix with a number-average molecular weight (Mn) of 30000 by gamma pre-irradiation technique. Effects of the total dose, monomer concentration, reaction time, and temperature on the grafting percentage are studied in detail. It is shown that the optimum conditions for grafting are: the AM concentration of 20%, the reaction time of 7.5 h, and a total dose of 5 kGy. Then the conjugation of synthesized P(AM–NPV) copolymers on the thermostable GO nanosheets was performed to get GO-P(AM-PVP) nanocomposites. The structure of graft-polymers and GO–P(AM-PVP) nanocomposite was analyzed by Fourier transform infrared spectroscopy (FTIR), and Raman spectral analysis. The scanning electron microscopy (SEM) analyses and elemental mapping were performed to observe the composites morphology and atoms distribution of copolymers on the GO surface, respectively. The molecular weight of the polymer was determined by the Agilent Technologies Infinity gel permeation. Besides, thermal stability was analyzed using a thermogravimetric analysis (TGA). The advantages of P(AM-PVP) copolymer and GO-copolymer nanofluids in high viscosity, solubility in seawater, and stability at high White-Tiger Oligocene reservoir temperatures (> 128 °C and 135 °C) were confirmed by bottle tests at 128 °C and 135 °C in 31 days. These features render them suitable for EOR and other applications in HT offshore reservoirs.

Keywords: Pre-irradiation-induced grafting polymerization, nanofluid, high-temperature offshore reservoir, GO-polymer nanocomposite.

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EE-P14 (Poster)

Synthesis of Cobalt sulfide nanopowders for non - enzyme Urea sensors

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Cobalt sulfide nanopowders were successffully synthesized by microwave asissted method. The structure, mophorlogy, Raman scatering and electrochemical properties were investigated. The results show that the cobalt sulfide had morphology of nanoprims with mesoporous structure. The cobalt sulfide were applicated in dection of urea. The sensing performance for urea was determined by changing the oxidation potential peak of 120 mV. The cobalt sulfide had a linear range from 1 mM to 8 mM corresponding to the urea concentration in blood. The sensitivity of proposed sensor was quite good (7.5 $\mu AmM^{-1}cm^{-2}$) compared to results from previous publications. The results presented here demonstrate the potential of the application for urea detection.

Keywords: Cobalt sulfide, electrochemical sensor, microwave asissted method,dectermination of urea

EE-P15 (Poster)

Evaluation of antioxidant capacity by in vitro methods for some biologically-active naturalcompounds

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Natural compounds with antioxidant propety have amazing potential in the pharmaceutical industry. This field attracts a lot of research groups to focus on discovering, examining their biological properties and putting them into applications. Therefore , it is important to quantify the antioxidant capacity of such compounds as a way of pre-sorting before drug development. In this paper, different in vitro assays including DPPH, ABTS and CUPRAC are used to determine and evaluate the antioxidant capacity of several natural compounds such as curcumin, taxifolin, melanin…etc.

Keywords: in vitro, DPPH, ABTS, biological activities.

EE-P16 (Poster)

Nanostructured stable floating layers and Langmuir-Schaefer films of 5,10,15,20-tetraphenylporphine

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Porphyrins are macroheterocyclic organic compounds that are of particular interest to researchers around the world because of their wide application potential in many fields such as sensor fabrication, electrochemical catalysis, photodynamic therapy (PDT), antibacterial materials, energy conversion materials... Not only that, porphyrins are applied not only in solution form but also in thin films. Porphyrins are surfactants that can easily form stable monolayers and multilayers by the Langmuir–Blodgett method. In this study, we investigated the conditions affecting the LB film formation of 5,10,15,20-tetraphenylporphine (H_2TPP) such as concentration, initial surface coverage degree, compression speed, and other factors. The obtained films were investigated for their optical properties, film structure morphology, wettability, and film durability under UV irradiation. Thereby identifying the passport of (H_2TPP) film fabrication and orientation of their application in the fields of electrochemical catalysts, antibacterial, and sensors.

Keywords: porphyrin, Langmuir-Blodgett, Langmuir-Schaefer, floating layers

Acknowledgement. This work in the part of the films formation and study was supported by the grant of the RSF (20-12-00175), ISUCT, and Ministry of Science and Higher Education of the Russian Federation (FZZW-2020-0008) in the part of synthesis of the compound.

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EE-P17 (Poster)

Sensitive Detection of Rhodamine B (RhB) in Condiments using Surface-Enhanced Raman Scattering (SERS) Silver Particles as Substrate

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The design of efficient substrates for surface-enhanced Raman spectroscopy (SERS) for large-scale fabrication at low cost is an important issue in chemical analysis. In this research, a facile large-scale preparation of SERS substrates for the determination of Rhodamine B (RhB) at the excitation wavelength of 532 nm based on silver nanoparticles (Ag NPs) has been developed. The morphology, structure, and properties of as-prepared AgNPs are characterized using ultraviolet-visible (UV-Vis) spectroscopy, field emission scanning electron microscopy (FE-SEM), and X-ray diffraction (XRD), respectively. It was found that different morphologies of the roughened Ag nanoparticles could be obtained under controlled conditions. The fabricated SERS sensor showed high sensitivity and good signal reproducibility. These Ag NPs show a broad range of tunable SERS enhancement factors ranging from 102 to 108 using rhodamine B as a probe molecule with the minimum detection limit of RhB was 10-10 M. The method showed that the proposed method was sensitive, convenient, low-cost, large-scale production of SERS substrates and feasible for the determinationof RhB in condiments.

Keywords: SERS substrates, Rhodamine B, enhancement factor, condiments, silverparticles

EE-P18 (Poster)

Effect of glycerol, gelatin and stearic acid on physical and mechanical properties of native cassava starch thin film

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Single-use plastic waste, with the decomposition time up to thousands of years, is a critical issue of modern consumerism. The development and production of eco-friendly biofilms could be a long-term and more sustainable solution to this problem. In this research, we study the formation of a bio-degradable, thin film from cassava starch, an abundantly available material in tropical countries. By adjusting the starch film casting conditions, such as the proportion of glycerol, gelatin, stearic acid, casting mass, temperature and film incubation time, starch films with different thicknesses, water absorption, and moisture content can be obtained. The morphological properties of the investigated films were observed by using a scanning electron microscope. The dependence on the fabrication conditions of tensile strength, solubility in water, thermal stability, hydrophobicity, and time of film degradation of the different starch films was investigated. Our findings could support the development of cassava starch-based biofilms for use in packaging and protection technology.

Keywords: cassava, starch film, glycerol, gelatin, stearic acid.

EE-P19 (Poster)

Size sorting and hydrophilic functionalization of fly ash from a thermalpower plant toward to latent fingerprint development

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Fly ash is formed during the coal- fired combustion followed by the heat generation for industrial activities, such as thermal power plants, cast-iron manufactures or cement production. This residual by-product is considered as solid waste, which might cause air pollution and water contamination. To minimize the harmful effect of fly ash to the environment, collecting methods and application procedure have been introduced in recent decades. In this study, fly ash dust from Thuy Nguyen thermal power plant is collected, size classified to 5 μm smaller in average and then surface-functionalized with amine functional groups targeting to the latent fingerprint developing application. It was experienced that there are more than 20 % of fly ash from Thuy Nguyen thermal power plant was collected and conformed to the requirements for fingerprint developing powder, which dedicate a valuable use of this solid waste.

Keywords: Fly ash, thermal power plant, latent fingerprint development

EE-P20 (Poster)

Active colloidal photonic arrays of $Ag@Fe_3O_4$ nanoparticles as colorimetric sensing platforms for on-site environmental and food safety monitoring

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With rapid developments in industry and agriculture, as well as the high-consumption lifestyle, human beings are facing a massive environmental crisis. Besides, food-borne diseases, food contaminations are attracting a lot of attention due to repeated episodes of adulterated and unsafe food practices. The existence of very small amounts of toxic pollutants, such as heavy metal ions, organic compounds, bacteria, etc. can induce ecological risk and irreversible damage to people. Therefore, fast, real-time, visual, sensitive, and selective determination of toxic pollutants is significant. Although spectroscopic techniques have been widely used for the determination of various analytes with high sensitivity and selectivity, they are expensive, time-consuming, and required trained operators. Colorimetric method as an alternative has attracted tremendous attention recently due to its easy fabrication, quick detection, high sensitivity, and naked-eye sensing. Here, we aim at fabrication and investigation of a novel colorimetric sensing platform of active colloidal photonic arrays for rapid, visual, low-cost, and sensitive detection of a wide spectrum of organic molecules and inorganic ions. A novel magnetic-assisted assembly is introduced to fabricate active colloidal photonic arrays on various substrates. The use of Ag@Fe3O4 nanoparticles not only produces enhanced color saturation and sensitivity but also can offer an approach to magnetically purify/enrich samples.

Keywords: structural color, photonics, colorimetric sensor, on-site monitoring, Ag@Fe3O4

EE-P21 (Poster)

Preparation and characterisitics of SnO_2 nanomaterials by Jouleheating effect

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SnO_2 nanostructures have been prepared using the thermal oxidation reaction with the Sn metal by a self resistive heating effect. The morphology and microstructure of the prepared SnO2 nanoproducts are characterized by means of scanning electron microscopy (SEM), Xray diffraction and Raman spectrum. In addition, the possible growth mechanism of the SnO_2 nanoproducts is also discussed.

Keywords: SnO_2 nanowires; Joule heating; current; thermal oxidation.

EE-P22 (Poster)

Cu-doped effect on structural and optical properties of ZnO nanoparticles towards the application of maize growth

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Agricultural application-oriented Cu-doped ZnO nanoparticles were synthesized by co-precipitation method. Effect of Cu doping ratio on the structural, morphological, and optical characteristics of the nanoparticles was systematically examined with respect to pure and 1-5 % wt. doping concentrations. X-ray diffraction showed that the nanoparticles had a wurtzite crystal structure of pure ZnO, but the CuO phase appeared interspersed with the ZnO phase when changing the Cu concentration. Scanning electron microscopy micrographs revealed that the nanoparticles were granular with a relatively uniform size, of which the typical sizes were in range of 40 nm to 130 nm, once the concentration of Cu varied. The X-ray spectrum of energy-dispersive energy confirmed a uniformity of Cu element distribution. The ultra-violet emission peak of 380 nm appeared for the pure ZnO, and reduced to 374 nm for the Cu-containing nanoparticles. As a result, the Cu-doped ZnO nanoparticles utilized as nano-fertilizers brought a new impact into the growth of maize at the concentration of 100 ppm.

Keywords: CuO, ZnO, nanoparticle, co-precipitation, maize

EE-P23 (Poster)

Preparation and characterisitics of CuO nanowires by Joule heatingeffect

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Nanomaterials have been well known for their enhanced properties compared with their bulk counterparts. Among widely studied nanomaterials, copper oxide (CuO) nanowires has attracted much interest thanks to its diversity applications in various fields. In this research, CuO nanowires were prepared by thermal oxidation via a self heating process. The effect of heating current, annealing time on morphology and structures of the products were investigated. The study contributes a novel method for fast and convenient synthesis of CuO nanowires, which can be easily scale up for mass production.

Keywords: CuO nanowires; Joule heating; current; thermal oxidation.

EE-P24 (Poster)

Corrosion evaluation of carbonate apatite-coated pure magnesiumby electrochemical measurement

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In temporary-use implant materials such as fracture fixation materials and sutures, it is ideal that they are absorbed in their body after healing of the affected area. Mg is one of the candidates for bone substitution due to its high specific strength, similar Young's modulus to that of bone, and low toxicity [1]. However, as a corrosion resistance of Mg is low, improvement of corrosion resistance of Mg has been investigated by coating with carbonate apatite (CAp), which is a hydroxyapatite (HAp) with partial replacement of phosphate ions by carbonate ions [2]. CAp is resorbed by osteoclasts, and the carbonate ions in CAp are responsible for the resorption of CAp by osteoclasts [3]. This suggests that the resorption by osteoclasts can be adjusted by changing the content of carbonate ions in the CAp coating. Therefore, it has been tried to develop a CAp coating that can adjust bone resorption by osteoclasts by changing the carbonate content in the CAp coating and moderately inhibits Mg corrosion depending on the affected area. In this study, HAp and CAp with various carbonate contents were coated on pure Mg disks and their anodic and cathodic polarization tests and impedance tests were carried out in 0.9 % NaCl (37°C) to evaluate the corrosion properties of the coated Mg. Curve fitting for the impedance spectra was performed by an equivalent circuit including the film resistance and the charge transfer resistance at the bottom of the film defects. It was revealed that the polarization resistance per film thickness increased with increasing carbonate content(FIG. 1).

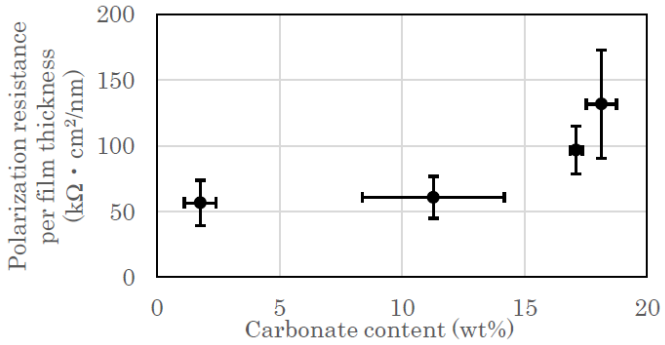

FIG. 1. Relationship between carbonate content in CAp and polarization resistance per film thickness.

Keywords: HAp, CAp, Mg, Impedance, Polarization

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EE-P25

SVM based-metal ion detection and identification in contaminated water sources

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We consider the problem of heavy metal ion detection and identification in natural water sources. Fast and accurate detection of those ions plays an important role for early treatment to protect human life and safeguard the environment. To this end, we present an experiment setup to study the characteristics of metal ions such as inductance, impedance, and phase. Then, we propose an efficient classification method based support vector machine (SVM) that exploits such characteristics as input signals. Moreover, we also propose a novel set of features based on waveform of inductance and impedance. Performance of the proposed method is validated with experiments on synthetic data.

Keywords: SVM, metal ion, detection, identification

EE-P26 (Poster)

Biodegradable periodic mesoporous phenylene and tetrasulfide-based organosilica nanoparticles for controlled release of chemotherapeutic drug

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Biodegradable periodic mesoporous organosilica (BPMO) is a class of promising nanocarriers for anticancer drug delivery due to their superior biodegradability and high drug loading capacity. In our research, we synthesized a phenylene-containing tetrasulfide-based BPMO, named P4S. Incorporating aromatic phenylene groups into the framework creates a strong interaction between nanoparticles (NPs) with aromatic rings in the cordycepin molecules. This results in a low-release profile under various conditions. In addition, the replacement of this linker slowed the degradation of nanoparticles. The biodegradability of P4S is also demonstrated in a reducing environment and the 100 nm spherical nanoparticles completely decomposed within 14 days. The porous structure of P4S has a high loading of hydrophilic cordycepin (approximately 731.52 $mg.g^{-1}$) with a slow releasing speed. The release rates of P4S NPs are significantly lower than other materials, such as liposomes, gelatin nanoparticles, and photo-crosslinked hyaluronic acid methacrylate hydrogels, in the same solution. This specific release behavior could guarantee therapeutic drug effects with minimum side effects and optimized drug dosages. Most importantly, according to the in vitro cytotoxicity study, cordycepin-loaded P4S NPs could retain toxicity against liver cancer cells (HepG2) while suppressing the cytotoxicity against normal cells (BAEC).

Keywords: phenylene silica, biodegradable, cordycepin, controlled release, drugdelivery

EE-P27

Thin films of triphenylcorrole: Fabrication methods, properties, and their potential applications in the fields of sensing and catalysis

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Corroles have been listed as redox non-innocent ligands in many metal complexes. Corroles were used as the key components in catalysis, sensing of gaseous molecules, and medically oriented research. In this study, the conditions to fabricate different desired thin films of 5,10,15-triphenylcorrole were investigated by various methods. The obtained thin films were analyzed for their spectral properties, film morphology, contact angle, and electrocatalytic ability. Some potential applications are introduced for future development of sensing, electrochemical catalysis, and photocatalyst.

Keywords: corrole, Langmuir-Blodgett, Langmuir-Schaefer, thin film, spin-coating, self-assembly

Acknowledgement. This work in the part of films fomation and study was supported by the grant of the RSF (20-12-00175), ISUCT, and Ministry of Science and Higher Education of the Russian Federation (FZZW-2020-0008) in the part of synthesis of the compound.

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EE-P28

Evaluation of Stability and *In Vitro* Anticancer Activity of Dihydroquercetin Nanoemulsion

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Dihydroquercetin (DHQ), also known as taxifolin, is a flavonoid and commonly found in many plants. Dihydroquercetin has been documented to have powerful antioxidant activity and many beneficial properties for human health, especially its ability to inhibit certain types of cancer cells. However, its low solubility and bioavailability are major obstacles to biomedical applications. Moreover, DHQ is chemically unstable and quickly degrades when exposed to alkaline conditions. In the present study, a DHQ nanoemulsion formulation was prepared by Self Nano-Emulsifying Drug Delivery System (SNEDDS) technique to overcome these disadvantages. The obtained nanoemulsion system was also evaluated for its microscopic properties, stability, and *in vitro* cytotoxic activity against some cancer cells using tetrazolium dyes (MTS assay). Measurement results showed that the DHQ nanoemulsion was successfully synthesized with typical mean droplet sizes from 9 to 11 nm, and revealed excellent stability over time. Dihydroquercetin in a nanoemulsion was more stable than its unencapsulated form. *In vitro* experiments on cytotoxic activities against A549, Hela, and HepG2 cancer cell lines indicated that the prepared DHQ nanoemulsion effectively inhibited the growth of all these cell lines with IC50 values (µg/mL) of 8.0, 20.4, and 29.5 respectively. The results of this study provide useful information on the potential use of DHQ nanoemulsion as a promising agent in cancer treatment and the development of a drug for human use.

Keywords: dihydroquercetin, nanoemulsion, anticancer, in vitro, enhanced solubility

EE-P29

A novel water-ethanol based modified inverse emulsion method for nanoparticles silica-coating in Si QDs/SiO_2 and $NiFe_2O_4/SiO_2$ core-shellsubmicron spheres synthesis.

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An immiscible hydrophilic-surface nanoparticles-containing water-soluble emulsion was created in ethanol by adding trisodium citrate (TSC) – a water-soluble ethanol-insoluble reagent – as surface activator. The formation of as-named water-ethanol based inverse emulsion was measured via light-reflection under an UV-vis spectroscope, followed by the estimation of the TSC critical micelle concentration. Under that concentration of TSC, the high pH of the hydrophilic media in the micelles generated a suitable condition for (3-aminopropyl)thiethoxysilane to react with the water and created silica spheres, those covered the nanoparticles inside. By this method, the narrow size-distribution Si QDs/SiO_2 and $NiFe_2O_4/SiO_2$ core-shell submicron spheres were synthesized, which were promising for multipurpose applications, such as biological labeling, bio-separation.

Keywords: inverse emulsion, silica-coating, core/shell particles, sub-micron spheres

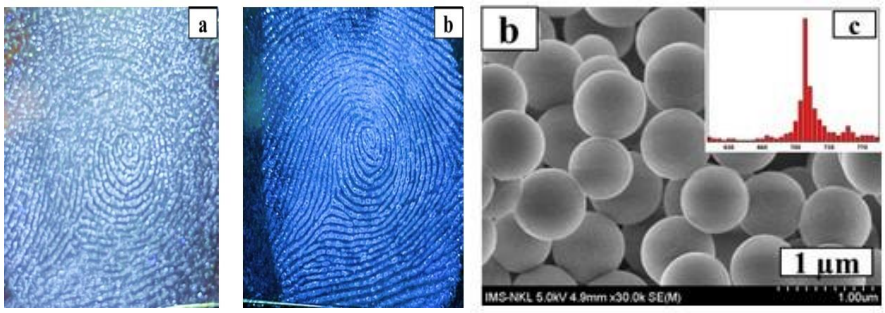

FIG. 1. SEM image of Si QDs/SiO_2 core/shell microspheres and their application in fluorescentlatent fingerprint development.

EE-P30

Arrays of $Nd_2Fe_{14}B$ clusters in PDMS background used to levitatehuman cells

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Sorting and trapping cells play an important role in fundamental cellular and biology researches. That enables the study of single-cell behaviors, which are different in comparison with a cluster of cells. Contactless handling techniques using different optical, mechanical, or magnetic phenomena have been studied for single-cell trapping. Among them, the diamagnetic force created by magnetic structures on cells is significant and stable both in time and in space. In this work, arrays of hard magnetic clusters in the PDMS background (hereafter called magnetic structure) were successfully fabricated using the magnetic imprinting method. The magnetic structure shows a proper magnetic property and the possibility to sort and trap T47D single cells via the diamagnetic levitation phenomenon at defined positions, which are both experimentally observed and theoretically calculated. The obtained results show the promise of developing a simple way to separate directly living cells.

Keywords: Magnetic structures, diamagnetic properties, single-cell trapping