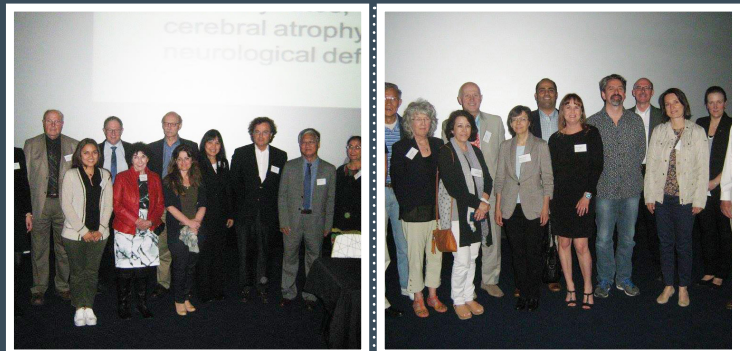


POSTERS

Abstracts



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FRACTAL NATURE MATERIALS ANALYSIS WITHIN THE NEW AND ALTERNATIVE ENERGY SOURCES

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Important priorities of the modern material science faces the lack of energy and incline towards new and alternative energy sources. The electronic and other ceramics have complex fractal correction based on three different phenomena: ceramic grains have fractal shape as a contour in cross section or a surface, there is the so-called "negative space" (pores and inter-granular space), there is a Brownian fractal motions inside the material in the form of micro-particles flow (ions, atoms and electrons). These factors, make the microelectronic environment as peculiar electro-static/dynamic combination. The stress is on inter-granular supermicro-capacity in function of higher energy harvesting and storage. Fractal theory allows micro-capacitors with fractal electrodes. This is based on the iterative process of interpolation, compatible with the model of grains itself. In this paper, we recognized fractal nature within the wind, solar, electrochemical and other energy and its storage on the way to fractals and energy correlation.

Biography

Mitic obtained his B.Sc. degree 1982 in Material science at the University of Nis; M.Sc. degree 1990 in Material science at the University of Belgrade and Ph.D. in Material science at the University of Nis. In 1995 he got position of research scientist at the Institute of Technical Sciences of the Serbian Academy of Sciences and Arts; 1999 Mitic was promoted to senior (higher) scientific associate at the Institute of Technical Sciences of the Serbian Academy of Sciences and Arts – elected into the Center for Multidisciplinary Studies, University of Belgrade - main research field: Electronic Ceramic Materials.

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DEGRADATION MECHANISMS OF BISPHENOL A POLYCARBONATE (BPA-PC) IN LED-BASED PRODUCTS

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This paper aims studying the main reason of ageing of optical materials used in LED-based products. Solid state lighting (SSL) and more specifically LEDs, are known to be a revolutionary invention in the lighting industry and are expected to completely replace traditional less efficient light sources. A solid-state lighting system is composed of an LED chip with electronic driver(s) integrated in a package that provides optical functions, thermal management and/or other functions. White LEDs are multipart systems. Apparently, each of these components can break and induce failure. Optical degradation of white LED products is mainly due to the aging of the encapsulants/lens. Optical degradation of the products is mainly due to the ageing of BPA-PC encapsulants under Thermal exposure and light radiation. In this study, BPA-PC plates are aged at different temperatures and light intensities. The results show that increasing the exposure time leads to the discoloration, loss of optical properties, decrease of light transmission, and increase in the yellowing index (YI) of BPA-PC plates leading to a reduction of light intensity and even early failure before the expected lifetime of the instrument. Reliability models such as Arrhenius and Eyring equations are used to predict the life time of the samples at different time. In order to prevent the ageing of BPA-PC a graphene monolayer has been successfully coated on one side of a bisphenolA-polycarbonate (BPA-PC) plate, it is shown that graphene monolayer considerably increases the lifetime of LEDs mainly by shielding them against exterior degradation reasons such as moisture and oxygen. This method has excessive potential to improve the reliability of not only LED-based products but also many other microelectronics packaging and components, in which moisture and oxygen are the key causes of failures.

Biography

Maryam Yazdan Mehr did her PhD at Delft University of Technology from 2011 to till 2015, associated with Professor Zhang and Professor van Driel in the ECTM group at TU Delft. During her PhD, she worked on Organic Materials Degradation in Solid State Applications. During this project, the reliability and degradation of LEDs was for the first time studied from both materials and system perspective. One of the greatest achievements in this project was developing a high accelerated ageing test methodology. The set-up and the concept are now being used by Philips Lighting. So far, she has published almost 16 journal papers, more than 10 conference papers, and a book chapter. After her PhD, she applied for an HTSM grant as a Post-doc and it was granted in 2016. In June 2017, she started her Post- doc project entitled Reliability of Optical Materials in LED-based Products under Harsh Environments in the group of Professor Zhang at TU Delft.

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SELF-CENTERING CAPACITY OF SUPERELASTIC SHAPE MEMORY ALLOY FIBERS IN MORTAR

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This study investigated the effects of geometric parameters, diameter and crimped length, of superelastic shape memory alloy (SMA) fibers on their pullout displacement recovering capacity. For this purpose, three diameters of 0.5, 0.7 and 1.0 mm and two different crimped lengths of 5.0 and 10.0 mm were considered for short fibers to be fabricated, with a length of 30 mm, employing NiTi SMA Wires. The superelastic SMA wires had similar stress-strain behaviour and temperature characteristics of phase transformation. As previous studies indicated that the spear-head end provided greatest anchoring action compared with other types of end shapes, to provide anchoring action during the pullout test, fibers were crimped at the end part and spear-head end was created. To conduct pullout tests, mortar specimens with compressive strength of 84 MPa were prepared with a square shape at the top and dog-bone shape at the bottom to be fixed in the grip. The embedded length of each fiber in the mortar specimen was 15 mm. The pullout test was performed with displacement control to obtain monotonic or hysteretic behaviours. The results showed that pullout displacements were recovered after fibers slipped. The superelastic SMA fibers with larger diameters showed better pullout displacement recovering capacity. All fibers showed the flag-shaped behaviour, and the fibers of 1.0 mm showed the clearest flag-shaped behaviour. It was also observed that the length of fiber cramping did not affect the pullout resistance of the superelastic SMA fibers.

Biography

Eunsoo Choi is a Professor in Hongik University, Seoul, Korea. He received his BS and MS from the Hanyang University in Seoul, and his PhD from the Georgia Institute of Technology, Atlanta, GA. His research fields include the Application of Shape Memory Alloys for Civil Engineering Structures and Seismic Retrofits for Reinforced Concrete Structures.

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PREPARATION OF 3D GRAPHENE WITH MICROWAVE-HYDROTHERMAL ASSISTANCE FOR ULTRAHIGH PERFORMANCE OF CAPACITIVE DEIONIZATION

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Capacitive deionization (CDI) is a prospective desalination technology, which can be operated at low voltage, low temperature and potentially consume low energy for brackish water desalination. To obtain the optimal electrosorption, an electrode should possess high electrical conductivity, large surface area, good wettability, highly mesoporous structure which provide efficient pathways for ion distribution. In this study, a 3D structure graphene was fabricated using hydrothermal method which is assisted with microwave treatments to form 3D rGO (Gr-Mw-Hyd). Physical characterizations such as SEM, TEM, Raman, FTIR, XPS, XRD, and BET have been used to study the physicochemical properties of the samples. Among them, the Gr-Mw-Hyd samples have excellent specific capacitance (189.2 F/g) and ultrahigh electrosorption capacity (28.5 mg/g) for the desalination of ca. 500 mg/L NaCl. This may be attributed to the fact that Gr-Mw-Hyd samples have lower resistance and higher conductivity than other samples which are fabricated by only using hydrothermal method without microwave assistance (Gr-Hyd) and traditional reflux method (Gr-Reflux). Therefore, the prepared Gr-Mw-Hyd samples may be one of promising electrode for CDI in the practical applications.

Biography

Shou-Heng Liu currently is an Associate Professor in Department of Environmental Engineering, National Cheng Kung University, Taiwan. He is the Associate Director of Sustainable Environment Research Center in Taiwan. He has published more than 65 papers in reputed journals.

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EFFECT OF GA CONCENTRATION ON ELECTRICAL PROPERTIES OF INP QUANTUM DOT LASER DIODE STRUCTURES

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The effect of Ga concentration on electrical properties of diodes with InP quantum dot lasers as an active region grown on GaAs substrates are investigated. The device structures in this study contains self-assembled InP quantum dots which were covered with $GaxIn(1-x)P$ layers have different Ga concentration varies as 0.54, 0.56 and 0.58 causing a tensile strains in the structures. This work includes important parameters of electrical properties such as series resistance, ideality factor and reverse saturation current density. These parameters are measured from the current-voltage characteristic for different structures over a wide temperature range starting from 77 K to 400 K. The series resistance shows a decrease with increasing temperature until 225 K for all studied structures and above that, the series resistance is slightly increased with temperature. Also, the series resistance for any structures at high temperatures shows slightly higher values for the structure with higher Ga concentration. The ideality factor, for the three studied structures, decrease with increasing temperature until 170 K. Above 200 K, the ideality factor is almost constant within 1.9-2.1 which implies that the effect of Ga concentration on the ideality factor does not appeared at high temperatures. However, this effect on reverse saturation current density does not exist at low temperatures but it does at high temperatures. The ideality factor at low temperatures is low in the structure with high Ga concentration. Furthermore, the reverse saturation current density is also low in structure containing high Ga concentration and only at high temperatures due to the high number of defects.

Biography

M S Al-Ghamdi completed his PhD at Cardiff University UK in 2010. Later he returned to Saudi Arabia where he got position at King Abdulaziz University, as an Assistant Professor. His research interests includes the Design and Fabrication of Semiconductor Devices Laser Diode and Studies the Optoelectronic and Electrical Properties of these Devices by Measuring their Absorption, Spontaneous, Stimulated Emission Spectra, Ideality Factor, Barrier Height and Series Resistance. The current research topics include Red Emitters Quantum Dot Laser Diode which used in Photodynamic Therapy of Cancer and also used in the Manufacture of Dual Wavelength Sources. He is a member of IEEE and OSA societies.

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SYNTHESIS OF BARIUM ALUMINOGERMANATE BY CITRATE METHOD

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Barium aluminogermanate ($\text{BaAl}_2\text{Ge}_2\text{O}_8$, BAG) is a ceramic material which is candidate for electronic applications with interesting structural and microwave dielectric properties. BAG was prepared using barium chloride, aluminium chloride and germanium oxide as reactants by citrate method. Different pH and citric acid stoichiometric conditions were employed to know their influence in the final product. Material composition was characterized by powder X-ray diffraction (XRD). Results showed $\text{BaAl}_2\text{Ge}_2\text{O}_8$ phase and secondary phases such as barium germanates-aluminates. Therefore, it was investigated distinct factors that could play an important role in this reaction system, for example, precursor's nature and their relationship with synthesis conditions in which they can promote or halted complete $\text{BaAl}_2\text{Ge}_2\text{O}_8$ phase formation.

Biography

Jesús Roberto Rodríguez Sánchez has a Bachelor's degree in Chemistry (2010-2016) and currently he is pursuing his Master's degree in Science and Technology of Materials at the Autonomous University of Coahuila, which is a part of Mexican Postgraduate Quality Program SEP-CONACYT (PNPC). Within his experience, it can be found he has participated in preparation courses that local and external universities offered. Also, he has attended several national conferences with the publication of the following works: Synthesis of $\text{TiO}_2\text{-CaSiO}_3$ composite by high energy milling, Journal CiBlyT, year XI, number 32, 2016; Effect of milling time on the crystalline size in the synthesis of $\text{TiO}_2\text{-CaSiO}_3$ composite, 2016; Synthesis and Characterization of precursor mix $0.75 \text{BaCO}_3\text{-}0.5\text{SrCO}_3\text{-Al}_2\text{O}_3\text{-}2\text{SiO}_2$ mechanically activated to form $\text{Ba}_{0.75}\text{Sr}_{0.25}\text{Al}_2\text{Si}_2\text{O}_8$. Journal CiBlyT, year XII, number 35, 2017.

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PIEZO-TRIBOELECTRIC HYBRID NANOGENERATOR FOR RAINDROP ENERGY HARVESTING

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Piezoelectric and triboelectric energy harvesting devices have been developed in the past few years to convert mechanical energy into electrical energy as renewable energy. Piezoelectric nanogenerator is a converting energy source, by changing structural polarity of material when it is applied with stress. On the other hand, triboelectric nanogenerator is a method of generating electricity because two different materials created the electrostatic charges on their surface when they are brought into physical contact, and the electricity is built up due to a potential difference when they are separated. In this work, a piezo-triboelectric nanogenerator (PTENG) has been developed for harvesting energy from raindrops. The compositions are polydimethylsiloxane (PDMS) as piezo-triboelectric surface and silver paint or an aluminium tape as electrode. In addition, the surface of PDMS films are modified into a flat surface with 3 patterns, including like a lotus-leaf, micro-pillar, and like shark-skin. Polyvinyl alcohol (PVA) is used to replicate this pattern to make negative moulds, which act as templates for fabricating PDMS films. The PDMS films are fabricated by a spin-coating machine. Furthermore, the depth profile of PVA negative mould is measured by atomic force microscope (AFM). The AFM topologies reveal that the lower molecular weight and concentration is higher efficiency for replicating structures. Hydrophobic property of PDMS films are observed by the contact angle tester machine. The results show that micro-pillars pattern give the highest value of contact angle as meaning the most hydrophobic but it is not dramatically different from others. Field scanning electron microscope (FE-SEM) is used to examine the size and shape of PDMS surface structure. Finally, the electrical output of PTENG is measured using a programmable electrometer, a digital oscilloscope and a low-noise current preamplifier.

Biography

Atissun Kittilaksanon has completed his Bachelor's degree from King Mongkut's University of Technology Thonburi, major in Materials Engineering with 1st honours. Now, he is pursuing Master's degree of Polymer Science at the Petroleum and Petrochemical College, Chulalongkorn University. He is a student under supervision of Associate Professor Hathaikarn Manuspiya, she has published more than 30 papers in the worldwide journals such as Cellulose, Biomacromolecules, and International Journal of Adhesion and Adhesive.

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SYNTHESIS AND CHARACTERIZATION OF SOLIDS WITH STRONG ACIDIC AND BASIC PROPERTIES, APPLIED AS CATALYSTS IN THE SYNTHESIS OF IONONES

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Ionones are fine compounds of isoprenoid nature of high commercial value that can be synthesized in two stages catalyzed in homogeneous phase: aldol condensation between citral and acetone catalyzed by a mineral base to produce pseudoionone (PI), and cyclization of pseudoionone catalyzed by mineral acid. This route generates operational problems and environmental pollution, which can be avoided or minimized by the use of heterogeneous catalysts. In the present work, we report the synthesis of ionones using mixed oxides (MgO-Al₂O₃, CaO-Al₂O₃, SrO-Al₂O₃, MgO-CaO-Al₂O₃ and CaO-SrO-Al₂O₃) and sulfated silica as possible catalysts. The materials were characterized by the techniques, Energy-dispersive X-ray spectroscopy (EDS), discontinuous Reception (DRX), scanning electron microscopy (SEM), DTP and nitrogen fisisorción. The reaction mixtures were analysed by GC-MS technique, obtaining PI with yield up to 79% with the CaO-Al₂O₃ oxide, while the best ion one yield was obtained using silica SBA-15 treated with 1M aqueous solution in H₂SO₄: 16% β-ionone at 60°C and 17% α-ionone at 80°C, under reflux conditions. The production of PS and retinoles during the condensation reaction suggests that it is possible to synthesize oxide materials with acid/base properties that promote ionone synthesis in a single step.

Biography

Rodrigo González is currently pursuing PhD in Chemical Sciences, has completed Master's degree in Semiconductor Devices and a degree in Chemical Engineering. He has worked as a Science Teacher in different institutions and participated in international congresses as Japan or Mexico.

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SYNTHESIS AND CHARACTERIZATION OF CARBOXYMETHYL CELLULOSE FROM WASTE NATA DE COCO

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In this study, the waste nata de coco, food industrial residue of the production of commercial nata de coco, was used as alternative cellulose source because of not only inexpensive source but also ability to be modified. The utilization of cellulose has been getting attention due to their spectacular properties such as bio-renewability, ubiquitous availability in a variety of forms and low cost. In addition to cellulose, cellulose derivatives which are produced by chemical modification of cellulose are also extensively used in many areas. Carboxymethyl cellulose (CMC) is the most widely used cellulose derivative for various applications such as textiles, paper, detergents, foods, drugs, and cosmetics. In the present study, the cellulose extracted from waste nata de coco was then modified to CMC by etherification process using sodium hydroxide (NaOH) and monochloroacetic acid (MCA) for being used as a food stabilizer. To achieve the optimal conditions for the CMC production, the concentrations of NaOH and MCA, reaction time, and reaction temperature were optimized. The degree of substitution (DS) was analyzed with respect to the reaction conditions using a chemical method. Structural information and chemical composition of cellulose and CMC were obtained by using Fourier transform infrared spectroscopy (FTIR). The surface morphology and crystallinity were studied with field emission scanning electron microscopy (FESEM), and X-ray diffraction (XRD), respectively. From the results, the obtained CMC were good water soluble with optimal DS of 0.7 to 0.8, which exhibited their potential for food industrial applications.

Biography

Lalita Narkyos has received her BSc degree in Chemistry, Chulalongkorn University (Second class with Honours). Chemistry program at Chulalongkorn University greatly developed her skills and also improved her character such as hardworking, punctual and assiduous. However, she realized the necessity of polymer industries which directly influenced economy because polymer is the main composition in various objects and also several new innovations. Therefore, she has furthered her study by studying MSc in Polymer Science at the Petroleum and Petrochemical College, Chulalongkorn University. Her research is on cellulose which is a biopolymer and is able to be used in various applications. Her research focuses on using the alternative source of cellulose which is of industrial wastes and modification of that cellulose for food application.

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IMPROVING MOLECULAR WEIGHT OF NATURAL OIL-PLASTICIZED PLA BY CHAIN EXTENDER

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Poly lactide (PLA) is biodegradable thermoplastic polyester with potential to replace conventional petrochemical-based polymers. Plasticized PLA is often found in many uses to avoid brittle fracture. In this work, cashew nut shell liquid (CNSL), a natural oil mainly consisting of cardanol (a phenolic lipid), was used as a plasticizer. In order to avoid its bleeding from the PLA bulk, it was added as an initiator during bulk ring-opening polymerization of lactide such that it was immobilized onto the PLA chains. The immobilized CNSL-plasticized PLA obtained from the synthesis has rather low molecular weight. Adding this natural oil at fixed content of 3% wt can reduce molecular weight of PLA. From Gel Permeation Chromatography (GPC) results, molecular weight of the (3% wt) immobilized CNSL-plasticized PLA were 3.93×10^{-4} g/mol, compared to 4.32×10^{-4} g/mol of the synthesized PLA. A chain extender, hexamethylene diisocyanate (HDI), is then added and varied from 1, 3, 5, 7% wt to further enhance the molecular weight of the (3% wt) immobilized CNSL-plasticized PLA. The maximum molecular weight of 5.03×10^{-4} g/mol is obtained by adding 5% wt HDI. From melt flow indexer (MFI) results, this immobilized CNSL-plasticized PLA has the lowest melt flow index value of 51.4g/10 mins which means that it has the highest molecular weight. Also, the immobilized CNSL-plasticized PLA with various HDI contents were subsequently investigated for their chemical structures by Fourier-transform Infrared Spectroscopy (FT-IR) and found that the characteristic ester absorption band appeared at 1691 cm^{-1} according to -C=O adjoining to -NH . From nuclear magnetic resonance (NMR) results, the chemical shifts at 3.2 ppm and 4.1 ppm were observed and assigned to the unit of HDI in PLA chains. Moreover, differential scanning calorimetry (DSC) results showed that increasing HDI content made T_g and T_m move toward lower temperature as a result of long chain alkane unit of HDI.

Biography

Supanut Kitphaitun has completed Bachelor's degree from King Mongkut's Institute of Technology Ladkrabang, a major in Nanomaterials Engineering with 1st honours. Now, he is pursuing Master's degree of Polymer Science at the Petroleum and Petrochemical College, Chulalongkorn University. He is a working under supervision of Prof. Rathanawan Magaraphan.

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STUDY ON MANUFACTURE OF NANOFIBERS USING BIODEGRADABLE POLYESTER MATERIALS

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Medical biodegradable polyester materials are high value-added materials that can generate US\$ 300 million in the world market. Medical biodegradable polyester materials are easy to control the molecular weight and composition ratio and physical properties through physical and chemical modification. In this study, in order to produce functional polyester nanofibers with improved productivity and uniform diameter, poly lactic acid-co-glycolic acid (PLGA), medical biodegradable polyester materials, was electrospun to produce nanofibers established production technology. In order to produce PLGA nanofibers of uniform diameter, electrospinning conditions were established in consideration of variables such as solvent, concentration, viscosity, voltage, TCD etc. As the concentration of the spinning solution decreased, the diameter of the fibers became thinner, more pores were observed and uniform nanofibers could be produced at a concentration below 5% w/v. In addition, by applying multi nozzle to the electrospinning nozzle, productivity increased and manufacturing of nanofiber with improved water pressure resistance was able to be manufactured.

Biography

Lee Hee-dong is currently working at Korea Institute of Industrial Technology. He is engaged in R&D related to dyeing process automation, smart factory, smart wearable wear and low-energy eco-friendly dyeing. Especially, he is conducting various researches related to biomedical materials.

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FABRICATION AND CHARACTERIZATION OF RHODAMINE DYE BASED COLORIMETRIC TEXTILE SENSOR FOR ACIDIC GAS DETECTION

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The growth of chemical industries has increased probability of accidents related to dangerous chemicals. Various chemicals produced in chemical industries, such as hydrochloric acid, hydrofluoric acid and methyl isocyanate are extremely toxic, causing severe damage to human body. In particular, gaseous chemicals are more dangerous due to their high diffusion rate and colourless spread. Therefore, it is necessary to detect and visualize gaseous chemical leaks quickly so that workers can easily recognize it. In this study, to detect hazardous gaseous strong acids immediately with naked eyes, we synthesized halochromic rhodamine dye and fabricated colorimetric textile sensors by incorporating the dye into textiles. The rhodamine dye was applied to nylon6 and polyester fabrics in the way of dyeing and printing and the acidic gas sensitivity of textile sensors were tested with 300 ppm of hydrochloric acid. Both of the dyed or printed fabrics showed fast and reversible color change under acidic condition. From these results, the fabricated textile sensor can be promising candidate as a strong acid gas detector useful for a wide range of application.

Biography

Young Ki Park has completed his MS from Dankook University. He is the Researcher of Korea Institute of Industrial Technology, Smart Textiles R&D group. He has published more than 6 papers in reputed journals.

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FABRICATION AND CHARACTERIZATION OF DIMETHINE DYE BASED COLORIMETRIC TEXTILE SENSOR FOR ALKALINE GAS DETECTION

Jee Young Lim, Young Ki Park, Woosung Lee and Yoon Cheol Park

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The accidents caused by hazardous chemicals have potential dangers everywhere in the industry. Occasionally, chemical-related accidents lead to fire and explosion, which damage not only environment but also human life seriously. Especially, accidents caused by gaseous chemicals are highly dangerous due to high spread rate and invisibility of the gas. Therefore, it is important to prevent chemical accidents in advance by detecting and treating them early in the accident. In this research, to detect harmful strong alkali gas immediately with naked eyes, we synthesized pH sensitive dimethine dye and fabricated textile sensors by incorporating the dye into textiles. The nylon6 and polyester fabrics were selected to apply dyeing and printing method respectively, and the sensitivity to alkaline gas was tested with 400 ppm of ammonia gas. Both of the dyed or printed fabrics showed definite and reversible colour change when the alkaline gas was injected directly. From the results, it should be promising candidate as a colorimetric textile sensor for alkaline gas detection.

Biography

Jee Young Lim has completed his MS from Chonbuk National University. He is the Researcher of Korea Institute of Industrial Technology, Smart Textiles R&D group. He has published more than 7 papers in reputed journals.

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MEASUREMENT OF DYEING BEHAVIOR USING PVDF'S REAL-TIME DYEING BEHAVIOUR MONITORING SYSTEM

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Microfiber is unique in drape, lustre, texture, and appearance. The market is gradually expanding not only for high-grade fabrics with soft touch like artificial suede but also for high-performance breathable and waterproof fabrics, highly hygroscopic knitted fabrics, cleaners, filters and dustproof clothing as well as industrial applications. Particularly PVDF, which is used as a waterproof material for mobile phones, is made of polyvinylidene fluoride $[\text{CH}_2\text{-CF}_2]_n$. It has a melting point of 170°C and a thermal decomposition temperature of 300°C or higher with thermoplastic resin having thermal resistance obtained by polymerization of vinylidene fluoride (1, 1-difluoroethene) with PVF2 or PVDF, so that injection and extrusion, and various moulding methods of compression are applicable. This polymer is a type of fluorocarbon resin, which is excellent in mechanical properties and can be made into a highly crystalline resin. However, the research and development of dyeability is not necessary because there is no need for a product, and information is also lacking. This study selected optimized dyeing conditions of PVDF using real-time dyeing behaviour monitoring system. The real-time dyeing behaviour monitoring system consists of a laboratory dyeing machine and a measuring device, and a real-time analysis program for dyeing behaviour. As a result of PVDF staining, it was possible to dye with various colours.

Biography

Seok Il Hong is currently working at the Korea Institute of Industrial Technology. He is engaged in R & D related to dyeing process automation, smart factory, smart wearable ware, and safety protection products. Especially, we are carrying out various studies using real-time dyeing behaviours analysis system.

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USED OF AUTOMATED SOFTWARE TOOL FOR ANALYSING AND ESTIMATING OPTIMAL PARAMETERS OF JET ENGINE PARTS PRODUCTION

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Nickel-based superalloys can be characterized by resistance to high-temperature corrosion and high-temperature creep resistance. For this reason, they are widely used in the production of jet engine critical parts. One of the commonly used materials is Inconel 625, which will be the subject of this research. For Inconel 625 processing, rotary forming can be applied, which results in axially symmetrical elements. An important property of Inconel 625 is strong strain hardening effect. To improve formability, variety of methods can be applied, including heating of the material. The purpose of the research was optimization of rotary forming process parameters of Inconel 625 to produce jet engine critical parts with high quality requirements. Scans data were processed in GOM Inspect software. For further analysis, thickness and surface deviations for all points and zones of interest were needed, as well as various statistics as extrema, standard deviation, deviation distribution, and tolerance tests. As obtaining this data manually would be extremely time consuming, Python scripting GOM API was utilized. With created scripts we automated loading, aligning, comparing of scans and CAD model, calculating measures and required statistics. Generated data was then used in multivariate optimisation for selecting optimal process parameters. Deviation statistics were modelled with regression models, predicting selected quality measures depending on trials parameters. Based on these models, overall quality function was maximised with GridSearch approach, yielding optimal parameter for the process.

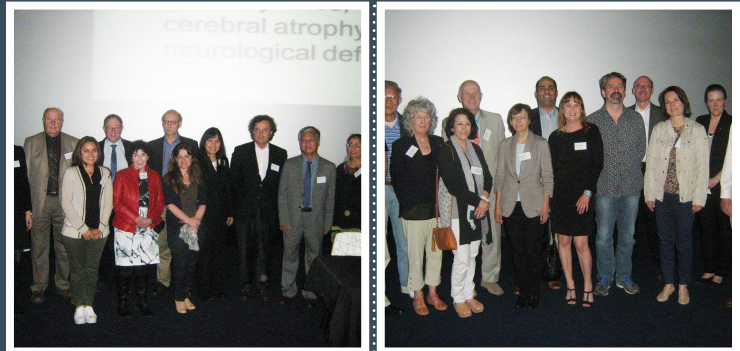
Biography

Sandra Puchlerska is pursuing her PhD at the AGH University of Science and Technology, Faculty of Non-ferrous Alloys. She has graduated in Materials Engineering with thesis about Microstructure evolution in superalloy Inconel 718 during laser heating. She is Member of the Laboratory of Production Engineering. She realized grants in the field of aluminium alloys heat treatment, metal forming of jet engines elements, investment casting of critical elements dedicated to aircraft industry. She is an author of 37 publications and conference papers. She has participated in many international conferences. Her fields of interest are Metal Forming, Superalloys, NDT, Microstructure of Nickel Superalloys, Thermovision and 3d Scanning.

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SPINODAL DECOMPOSITION DURING CRYSTALLIZATION OF SOLUTIONS

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The modern theory of phase transitions cannot explain the results of many experiments of interphase mass transfer. One reason for this is the assumption that during crystallization, the solution is in the metastable state. The purpose of this study to show that in many cases, the solution during crystallization can be an unstable state. The unstable condition leads to decomposition of the solution by spinodal scenario. The unstable solution decomposes continuously in the whole volume in this case. Experimental demonstration of spinodal decomposition of the solution is conducted video shooting process of decomposition of an aqueous solution of bromothymol blue while its crystallization. Locally, configuration thermodynamic model is used to explain the state changes of the solution during the phase transition. Spinodal decomposition of the solution explains the process of formation of a periodic distribution of the eutectic composites. The layer of the unstable solution is localized in front of the unstable interface. The unstable solution decomposes into phases, which have a composition close to the eutectic composition of the solid phases. The period of alternation of these phases is set by the period of instability of the interface. Experiments show that the formation of dendrites in the mushy zone and extremum of the component concentration during steady-state regime of crystallization close to interface also occurs in the spinodal decomposition scenario. Spinodal decomposition during crystallization solutions can be used for their separation into the eutectic phase.

Biography

Alex Guskov has received his PhD in 1982 from Physical Institute of the Russian Academy of Sciences. Later, he worked in Institute of Solid State Physics, the Russian Academy of Sciences where he investigated the Influence of Interaction of Laser Radiation and a Solid. Simultaneously he was engaged in application of technological processes in manufacture of electronic devices. Now his research interest focuses on Heat Mass Transfer during the Phase Transition.

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Abstracts



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MECHANICAL INVESTIGATION APPROACH TO OPTIMIZE THE HVOF FE-BASED AMORPHOUS COATINGS REINFORCED BY B₄C NANOPARTICLES

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Fe-based amorphous feedstock powders used as the matrix into which various ratios of hard B₄C nanoparticles (0, 5, 10, 15, 20 vol%) as a reinforcing agent were prepared using a planetary high-energy mechanical milling. The ball-milled nanocomposite feedstock powders were also sprayed by means of high-velocity oxygen fuel (HVOF) technique. The characteristics of the powder particles and the prepared coating depending on their microstructures and nanohardness were examined in detail using nanoindentation tester. The results showed that the formation of the Fe-based amorphous phase was noticed over the course of high-energy ball milling. It is interesting to note that the nanocomposite coating is divided into two regions, namely, a full amorphous phase region and homogeneous dispersion of B₄C nanoparticles with a scale of 10–50 nm in a residual amorphous matrix. As the B₄C content increases, the nanohardness of the composite coatings increases, but the fracture toughness begins to decrease at the B₄C content higher than 20 vol%. The optimal mechanical properties are obtained with 15 vol% B₄C due to the suitable content and uniform distribution of nanoparticles. Consequently, the changes in mechanical properties of the coatings were attributed to the changes in the brittle to ductile transition by adding B₄C nanoparticles.

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NANOTECHNOLOGY AND THE SOLAR COLLECTORS' FUTURE

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This paper gives a comprehensive overview about the recent advances related with the application of the nanotechnology in various kinds of the solar collectors. Papers reviewed including theoretical, numerical and experimental up to date works related with the nanotechnology applications in the flat plate, direct absorption, parabolic trough, wavy, heat pipe and another kinds of the solar collectors. A lot of literature are reviewed and summarized carefully in useful tables to give a panoramic overview about the role of the nanotechnology in improving the various types of the solar collectors. It was found that the use of the nanofluid in the solar collector field can play a crucial role in increasing the efficiency of these devises. We think that this paper can be considered as an important link between the nanotechnology and all available kinds of the solar collectors. From the other side, further researches are required to study the effect of nanotechnology to enhance the solar collector industry over the next several coming years.

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WAVE SCATTERING BY MANY SMALL IMPEDANCE PARTICLES AND CREATING MATERIALS WITH A DESIRED REFRACTION COEFFICIENT

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The theory of acoustic and electromagnetic (EM) wave scattering by one and many small impedance particles of arbitrary shapes is developed. The basic assumptions are: $a \ll d$, where a is the characteristic size of particles, d is the smallest distance between the neighbouring particles, d is the wavelength. This theory allows one to give a recipe for creating materials with a desired refraction coefficient. One can create material with negative refraction: the group velocity in this material is directed opposite to the phase velocity. One can create a material with a desired permeability. Equation is derived for the EM field in the medium in which many small impedance particles are embedded. Similar results are obtained in for heat transfer in the media in which many small particles are distributed.

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IMMOBILISATION OF NI-CROWN POM FOR THE ELECTROCATALYSIS OF BROMATE AND CHLORATE IN WATER

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Polyoxometalates (POM) are versatile and attractive compounds due to their molecular and structural diversity which have a broad range of applications in different fields, such as, electronics, electrocatalysis, sensors and nanotechnology. The aim of the present research work is the immobilisation of POMs onto the surface of glassy carbon electrode (GCE) to investigate their potential applications towards the electrocatalysis. A successful immobilisation of the POMs is important for their applications; two immobilisation methods are employed in this study: the layer-by-layer and incorporation into polymeric matrixes. These methods were investigated to immobilise $\text{Ni}_4(\text{P}_8\text{W}_{48}\text{O}_{148})(\text{WO}_2)]^{28-}$ POM by using glassy carbon electrode and its electrocatalytic applications towards the chlorate and bromate. For the LBL method to build the cationic layer, a polyethylenimine (PEI) modified silver nanoparticles (AgNP's) were selected. It was found that the presence of AgNP's within the multilayer assemblies enhanced the electrocatalytic activities of immobilized POM on glassy carbon electrode (GCE) in aqueous solutions. Films were further characterized by cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS), X-ray photoelectron spectroscopy (XPS) and atomic force microscopy (AFM) was employed to determine their elemental composition and surface morphology. The possibility of the fabrication of polypyrrole films doped with Ni-substituted crown-type POMs $\text{Ni}_4(\text{P}_8\text{W}_{48}\text{O}_{148})(\text{WO}_2)]^{28-}$ was investigated on glassy carbon electrode by chronocoulometry in aqueous buffer. Amperometric sensors for the detection of bromate based on the Ni-substituted crown type POM $\text{Ni}_4(\text{P}_8\text{W}_{48}\text{O}_{148})(\text{WO}_2)]^{28-}$ was investigated with high sensitivity in a linear range of 0.1-5 mM bromate.

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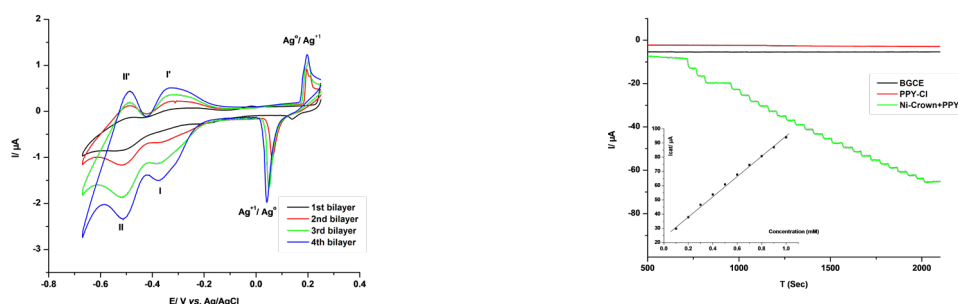


Figure1: (a) CV of a multilayer film comprised of 4-bilayers of AgNP's/ $[\text{Ni}_4(\text{P}_8\text{W}_{48}\text{O}_{148})(\text{WO}_2)]^{28-}$ in pH 2.0 buffer at a scan rate of 10mVs^{-1} . (b) Typical amperometric response of the bare glassy carbon electrode (BGCE) ($A= 0.0707\text{ cm}^2$) with in comparison of a chloride doped polypyrrole (PPY-Cl) and a $\text{Ni}_4(\text{P}_8\text{W}_{48}\text{O}_{148})(\text{WO}_2)]^{28-}$ POM+ PPY in pH 2.0 buffer up to 2 mM

CHARACTERIZATION OF THE EFFECT PRODUCED IN THE FORMATION AND MORPHOLOGY OF FUNCTIONAL NANOTUBES (IMOGOLITE) BY THE PRESENCE OF CR (III)

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Nanotubular materials are promising in terms of their potential technological applications, mainly due to their specific properties, such as their surface structure, mechanical resistance, reactivity, etc. An example of these is imogolite, a nanotubular aluminosilicate, which has been studied due to its great industrial potential, especially for its surface differentiation, with two different active sites (Al-OH and Si-OH, external and internal surface, respectively). In the search for new properties that allow extending applications of this material, incorporation of elements with similar properties has been proposed, in order to obtain structural and superficial modifications of this material, such as the reported replacement of Al by Fe and Si by Ge. In this context, in the present work, the synthesis and characterization of a new imogolite isostructure was performed, with the substitution of Al (III) by Cr (III), called Cr-Imogolite, with Al / (Al + Cr) ratio = 0.01 (Cr-Imo-1); 0.05 (Cr-Imo-5) and 1 (Cr-Imo-100), to evaluate the effect of chromium incorporated in the formation and morphology of nanotubes. The experimental procedure used is similar to that described by Denaix et al. (1999), using $\text{Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$, CrCl_3 and TEOS as reagents. The images obtained from the transmission electron microscopy (TEM) of Cr-Imo-1 and Cr-Imo-5 exhibit the presence of nanotubes like imogolite in their characteristics, however, with small variations in diameter and length, while in the micrographs of Cr-Imo-100, amorphous structures are observed. In addition, when evaluating surface behavior through isoelectric point determination (IEP), curves and IEP of the first two samples are like that reported for imogolite of, with a different behavior for Cr-Imo-100, which exhibits a considerably lower PIE. In conclusion, the chromium present in the synthesis directly affects the formation and size of the nanotube formed, depending on the percentage of substitution in the material.

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CARBON NANOSENSORS, FROM LAB-SCALE RESEARCH TO COMMERCIALIZED PRODUCT

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Mercury contamination in water is a persistent issue due to both natural geological and anthropogenic activities. Portable, facile and affordable sensors for detection and sensing different species of mercuries are highly desirable. We report a highly effective fluorescent, solid state sensor with high sensitivity, good selectivity and excellent reversibility for Hg (II) ion. Hg (II)-responsive carbon dots immobilised polystyrene spheres were fabricated as a middle layer in double heterostructure colloidal photonic crystal film. Significant fluorescence enhancement was achieved due to doubly resonant of the modes of photonic crystals and multi beam interface inside the double heterostructure film. The amplified fluorescence enhances the sensitivity of detection, achieving a detection limit of 91 pM for Hg(II) ion, even 17 times lower than that of carbon dots solution probe. The polystyrene-based film sensor is negligibly responsive to other metal ions and can easily be recovered by rinsing with cysteine.

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HYDROGEN GENERATION AND ACCUMULATION IN STEEL AND GRAPHITE IRRADIATED IN INERT ENVIRONMENT

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In traditional power engineering, hydrogen may be one of the first primary sources of equipment damage. This problem has high actuality for both nuclear and thermonuclear power engineering. Study of hydrogen embrittlement of the irradiated steel raises the question concerning the unknown source of hydrogen in nuclear reactors. Unexpectedly high hydrogen concentrations were detected in irradiated graphite also. Consequently alloying of steel and graphite by hydrogen in nuclear reactors takes place. It is necessary to look for this source of hydrogen especially because hydrogen flakes were detected in reactor pressure vessels of Belgian Nuclear Power Plants Doel-3 and Tihange-2. As a possible initial hypothesis about the enigmatical source of hydrogen one can propose protons (hydrogen) generation during beta-decay of free neutrons in as much as protons detected by research at nuclear reactors as witness of beta-decay of free neutrons.

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THE TRANSPASSIVATION OF PURE TI IN ARTIFICIAL SEAWATER

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Ti and its alloys have been widely used in aerospace, and biomedicine, petrochemical industries because of their excellent passivity. In this paper, the passivation and transpassivation behavior of pure Ti in artificial seawater was investigated by means of volta potential, cyclic voltammetry, spectroscopic ellipsometry, Mott-Schottky analyses, SEM and XPS. The results indicated that the passive Ti surface can transform to a relatively active state around at roughly $1.4 V_{SCE}$ and then became passive again at more positive potentials up to $3.2 V_{SCE}$. Based on these experimental results, a model was proposed to interpret the transpassivation behavior around that potential.

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VANADIUM NITRIDE NANOPARTICLES ENCAPSULATED IN CARBON SHEETS FOR STABLE HIGH ENERGY LITHIUM ION ANODES

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Developing novel anode materials with improved capacity performance is essential to the development of lithium ion battery. Vanadium nitride (VN) material have been widely investigated recently as promising anode material for lithium ion battery. However, the volume expansion which would severely affect the cycling stability and cycle life is the main problem to be faced with. In the research, uniform VN nanoparticles encapsulated in carbon sheets (VN/C) for a stable high energy lithium ion anode have been successfully synthesized by a facile solution combustion method combined with a thermal treatment at 600 °C under ammonia atmosphere. The as-synthesized VN/C sample exhibits a 2D nanosheet structure, in which small VN nanoparticles encapsulated in carbon nanosheets. The unique structure not only provides a large quantity of accessible active sites for lithium ion insertion/extraction along with good conductivity and short transport path for both electrons and lithium ions, but also can effectively circumvent the volume expansion/contraction associated with lithium insertion/extraction. As anode material for lithium ion battery, the VN/C sample presents high reversible lithium storage capacity (712 mAh g⁻¹ at 0.1 A g⁻¹ after 100 cycles, 648 mAh g⁻¹ at 1 A g⁻¹ after 500 cycles), high Coulombic efficiency (~99%), excellent cycling stability and good rate capability. In addition, the approach reported in this work is also applicable to other metal nitride nanoparticles encapsulated in carbon nanosheets, which may find important applications as electrodes, catalysts, adsorbents, and sensors in many disciplines.

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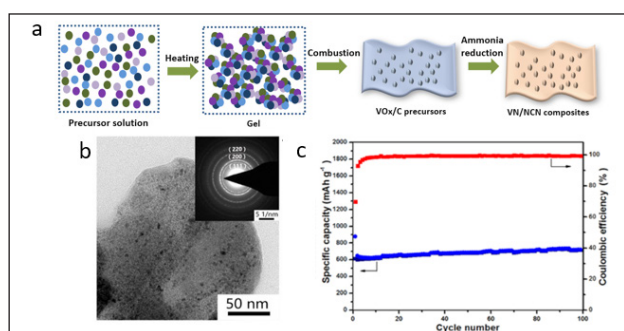


Figure 1: (a) Schematic illustration of the VN/C composites fabrication, (b) TEM images of the VN/C sample, (c) Cycling performance of the VN/C samples performed at a current density of 0.1 A g⁻¹

WIDE BAND ABSORBING SILICON BASED MATERIAL FOR ENERGY HARVESTING: FROM BLACK SILICON TO METAMATERIALS

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In this paper, we discuss novel techniques to fabricate wide band absorption material to harvest energy in different bands. The first approach is to fabricate silicon nanowires to work as black silicon in the visible range. This approach utilizes simple and efficient approach that is capable of producing wideband absorption region that covers the whole visible range and increase the absorption efficiency to reach 99% over the whole band. The fabrication process is simple, efficient with high reproducibility. The measurements show also large oblique absorption >95% up to 60 degree angle of incident. In the second approach, we propose a mid IR silicon absorber using doped Silicon/Silicon Hyperbolic Metamaterial (HMM) integrated with sub-wave length Si grating. HMMs are characterized by their hyperboloid dispersion momentum space that provides large density of photonic states. By applying sub-wavelength grating on HMM, light from free space can be coupled to high propagation wave vectors of the hyperbolic modes upon breaking the momentum mismatch restriction, leading to noticeable absorption. We are able to show that an all Si based designed HMM is capable to achieve absorption across the mid IR wavelength range reaching absorption of value 0.9. This proposed CMOS compatible Si-based absorber serves as good candidate for IR thermal harvesting application for on chips purposes.

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HIGH SENSITIVITY DETECTION BY GRATING ASSISTED SURFACE PLASMON RESONANCE SENSOR FOR IDENTIFICATION OF HAZARDOUS TOXIC CHEMICALS AND GASES

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The objective of this work is to develop and optimize the Fiber Bragg (FBG) grating based surface plasmon resonance (SPR) sensor for monitoring the hazardous toxic chemicals and gases in underground mines or any industrial area. A fully cladded telecommunication standard FBG is proposed to develop to produce surface plasmon resonance. A thin few nm gold/silver film (subject to optimization) is proposed to apply over the FBG sensing head using e-beam deposition method. Sensitivity enhancement of the sensor will be done by adding a composite nanostructured graphene oxide (GO) sensing layer using the spin coating method. Both sensor configurations supposed to demonstrate high responsiveness towards the changes in resonance wavelength. The GO enhanced sensor may show increased sensitivity of many fold compared to the gold coated traditional fibre optic sensor. Our work is focused on to optimize GO, multilayer structure and to develop fibre coating techniques that will serve well for sensitive and multifunctional detection of hazardous chemicals. This research proposal shows great potential towards future development of optical fiber sensors using readily available components such as Bragg gratings as highly sensitive chemical sensors in areas such as environmental sensing.

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BREAKTHROUGH IN GRAPHENE STRUCTURES FOR THE NEXT GENERATION ENERGY STORAGES

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High capacity energy storage is a fundamental barrier to widespread, efficient, and cost-effective implementation of renewable energy resources. Graphite-based energy storage devices, such as lithium-ion batteries (LIBs), are the most reliable energy storage devices for portable electronics, electric vehicles (EV) and electric grid storage due to their high energy density, high power density, stability, low cost, and safety. EV technology still faces some key challenges in wide-scale development and deployment, and it is hampered by a short range and the lack of a grid-charging infrastructure. Battery anode holds the key in solving both these issues, as a way of storing energy on EVs themselves and on the evolving electricity grid. We present newly developed 3D graphene structures named incommensurate multilayer graphene (IMLG) that performs exceptional high reversible capacities up to 1600 mAh/g (430% higher of graphite) applied as an anode in LiBs cells by replacing the commercial graphite. Our study revealed a new mechanism of lithium intercalation into multilayer graphene structures with the possibility to achieve up to 1674 mAh/g capacity in finite multilayers. It appears unique physical and electronic properties of incommensurately-stacked/rotated layers enable full diffusion and reversible intercalation of large amounts of lithium within interlayer spaces. Lithium actively absorbs/desorbs on both the outer and inner surfaces of incommensurate graphene, providing highly efficient charge transfer. We also discuss the feasibility of IMLG synthesis technology and our approach to its commercialization as an advanced anode for next-generation lightweight, flexible and powerful batteries.

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SILICON TO GRAPHENE TO SILICINE: PERFORMANCE EVALUATION USING NEADF

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Non-Equilibrium Arora's Distribution Function (NEADF) is a new paradigm in performance evaluation of materials. Silicon is the king of electronics where NEADF has been applied successfully in assessment of CMOS and device nanostructures. With the award of 2010 Nobel Prize to Graphene as a perfect two-dimensional nanomaterial, the attention has shifted to layered semiconductors, including silicine and phosphorene. Bandgap engineering of layered semiconductors to nanowires, nanotubes, and nanoribbons has given new paradigms and new opportunities that will be discussed and new applications explored. It is shown that Ohm's law that is used in characterization breaks down on scaled down dimensions giving rise to velocity and current saturation as electric field exceeds its critical value. Ballistic and quantum transport arising from these scaled-down channels will be brought to light.

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WELDING OF DISSIMILAR MATERIALS

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Actually, there is an increasing industry need to join dissimilar materials. Hybrid parts made by welding of dissimilar materials such as metal to metal, polymer to polymer, metal to polymer, and metal to ceramic are nowadays in high demand because the objective is to reduce the total weight and maintaining essential physical properties. For these reasons, research works on welding of dissimilar materials is very attractive and many scientific papers have been published in this research field. The objective of this paper is to review the metallurgical aspects of the main published works on dissimilar welded materials by presenting the main joining methods used, problems faced and the future research in this area.

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ENHANCEMENT IN THE DIELECTRIC PROPERTIES OF THE PVDF-BTO NANOCOMPOSITE WITH THE EMPLOYMENT OF RGO CONTENTS

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The effect of reduced graphene oxide (rGO) contents on the dielectric and ferroelectric properties of poly (vinylidene fluoride)-barium titanate (PVDF-BTO) nanocomposites have been investigated. The nanocomposites were obtained by the polymerization of the graphene oxide (GO) into the PVDF matrix to achieve an insulator-conductor-insulator sandwich structure, and BTO was then carefully added to the composite. Four different flexible piezoelectric films were prepared by varying the rGO contents into the PVDF matrix, followed by the drop wise addition of BTO solution. For clarity, the samples were labelled as PB (PVDF-BTO-RGO 0 wt%), PRB1 (PVDF-BTO-RGO 0.1 wt%), PRB2 (PVDF-BTO-RGO 0.3 wt%), and PRB3 (PVDF-BTO-RGO 0.5 wt%). Field emission scanning electron microscopy (FESEM) analysis was carried out to check the surface morphology and to observe the uniform distribution of BTO NPs into PVDF matrix. Additionally, X- diffraction (XRD) pattern was taken in order to realize the rGO effect on the crystallinity of the PVDF. It was believed that rGO sheets may attracts the polymer chain and aligning it into one direction due to the free charges on its basal plane. Furthermore, the electrical data for the as-synthesized piezoelectric sheets was also measured. The as prepared optimum nanocomposite (PRB2) sample showed high dielectric constant (98 @ 1MHz) and relatively low loss (0.081 @ 1MHz). Furthermore, the nanocomposite exhibit energy density of 4.5 J/cm³ at an electric field of 50 MV/m, which was calculated from the P-E loop using , where E and P refer to the electric field and polarization, respectively. Considering these results, it was estimated that as-synthesized piezoelectric-ferroelectric material can be a promising building block for its application in energy harvesting and high frequency capacitors.

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DESIGN AND CHARACTERIZATION OF LAYERED SOLID FROM THE INTERCALATION OF ORGANIC MOLECULES INTO TRANSITION METAL NITROPRUSSIDES

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The design and development of hybrid materials obtained from the assembly of organic and inorganic units constitutes one of the most fertile and emerging areas within the science of materials. The wide variety of building blocks that exist has allowed the construction of a large variety of 1D, 2D and 3D structures that have received great attention for their attractive properties that have found a wide variety of applications in fields such as catalysis, energy storage, the development of electronic devices, biomedicine, and environmental remediation, among others. Lamellar materials are the result of preferential growth in two dimensions related to the electronic structure of the atoms involved. These materials can also be obtained from 3D lattices, in which growth in the axial direction is inhibited. Particularly the pentacyanonitrosilferrate $[\text{Fe}(\text{CN})_5\text{NO}]^{2-}$ anion is commonly known as nitroprusside ion, can act as a bridge unit between coordinating metal centers to give rise to a series of coordination compounds which is usually obtained as 3D solids, except phase of Cu(II) which is obtained in lamellar form. In this contribution, we used the different organic molecules as 1-methyl-2-Pyrrolidone (1m2p), Pyridine (Py) and Pyrazine (Pyz) to inhibit the axial growth of the transition metal nitroprussiate phases for the remaining metals (M = Mn, Fe, Co, Ni, Zn). In the interlayer region, organic molecules from neighbouring sheets interact through their dipole and quadrupole moments, which are forces of physical nature. As the net electrostatic interaction between neighbouring molecules is attractive, their π -clouds partially overlap, which contributes to the stability of the 3D framework through dispersive-type forces. These novel materials were separated by centrifugation, washed and then characterized by chemical analyses, XRD, IR, UV-Vis, TG, magnetic data and DSC Thermal Analysis.

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THE EFFECT OF CALCIUM CHLORIDE CROSSLINKING ON PROPERTIES OF SILK SERICIN/PECTIN/CLAY AEROGEL

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Clay aerogel is a porous solid material with an extremely low density and high surface areas. It is usually fabricated from an environmentally benign freeze-drying method and widely used for adsorbent application. One of the disadvantages of clay aerogel is its fragility, thus silk sericin and calcium chloride (CaCl_2) crosslinked pectin were chosen to improve not only the mechanical strength but also the swelling behaviour of clay aerogel. Therefore, the aim of this research is to study the effects of CaCl_2 on the properties of silk sericin/pectin/clay aerogel. The studied CaCl_2 concentrations were 0.0005, 0.001, 0.002, and 0.003 mol Ca^{2+} per gram pectin. According to the results, density increased with the addition of cations but still be in the range of clay aerogel density. The mechanical properties showed that 0.002 Ca^{2+} per gram pectin possessed the highest compressive modulus. The surface area investigated by Brunauer–Emmett–Teller (BET) method decreased as the CaCl_2 concentrations were increased. The morphology of aerogels from scanning electron microscopy (SEM) exhibited the rougher surfaces. Moreover, the observed swelling behaviour in water was less with Ca^{2+} .

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DOES THE CAPACITY REMOVAL OF AS(V) IMPROVE WITH THE INCORPORATION OF A SECOND METAL (CU) ON FE NANOPARTICLES?

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The use of Fe⁰ nanoparticles (Fe NPs) has presented a great interest as adsorbent material. It has been extensively used for the decontamination of aqueous matrices. However, this material has some limitations when used in aqueous matrices and porous media, such as soil. To resolve these problems, the use of bimetallic nanoparticles (BNPs), specifically, FeCu BNPs had been reported, because this material has a higher reactivity, colloidal stability and removal rate compared with Fe NPs. The aim of this work was to synthesize and characterize Fe NPs and FeCu BNPs (different mass ratio of Fe-Cu), evaluating the incorporation of Cu on Fe NPs in the removal of As(V) present in aqueous matrices. The synthesis of nanomaterials was performed following the experimental procedure proposed by Wang & Zhang (1997). The change to the proposed synthesis was performed considering the simultaneous reduction of both metals, using NaBH₄ as a reducing agent. SEM images showed the formation of characteristic agglomerate of this magnetic material (Fe NPs). For FeCu BNPs, structure mix (pseudo spherical, amorphous and sheet) was observed. Besides, by XRD, peaks of Fe⁰ for both materials and Cu⁰ and oxide in FeCu BNPs, were identified. The sorption isotherm were carried out in batch system, working with 50 mg of nanomaterial and a solution of 200 mg/L As(V) (As₂O₅), 0.01 M NaCl (background electrolyte), pH 7, and stirred time of 5 hours. The Freundlich Model, which is characteristic of oxyanions that form multiple layers during the removal process, showed the best mathematical fit of the experimental data. FeCu BNPs showed better removal capacity than Fe NPs. In base on this study, the incorporation of Cu on Fe NPs, improves the removal capacity and therefore, this material can be applied as an adsorbent nanomaterial for As(V) abatement.

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DECORATING TiO₂ NANOTUBES WITH C₃N₄ FOR PHOTOCATALYTIC REMOVAL OF ORGANIC POLLUTANTS AND ANAEROBIC DIGESTION OF SLUDGE

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Herein, C₃N₄ and TiO₂ nanotubes (NTs) were considered for the synthesis of visible light active C₃N₄/TiO₂ NTs composites (with different melamine concentrations) by high temperature calcination method. The co-existence of C₃N₄ and TiO₂ NT and visible light activity was confirmed by XRD, TEM, UV-visible and PL spectroscopy. The photocatalytic performance of TiO₂ NT with 2% of melamine (precursor of C₃N₄), enhanced the degradation of 2-chlorophenol ($k = 0.0176 \text{ min}^{-1}$), where 96.6 % removal was achieved at optimum pH 7.0 and pollutant load of 30 mg/L. The application of C₃N₄/TiO₂ NTs for solubilization of rigid structure of sludge by photocatalysis released the soluble organics showing an improvement in sCOD production (4587 mg/L). Subsequently, anaerobic digestion of solubilized sludge has improved the methane production (723.4 mlkg⁻¹ VS) by 1.37 and 1.6 times compared to that in anaerobic digestion with photolytic and raw sludge, thus showing a promising applicability for biogas production from sludge.

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SILICIDE NANOWIRE ANODES ANCHORED SELECTIVELY TO THE INNER SURFACE OF GRAPHENE-BASED MICRO-TUBULAR CONDUCTING ELECTRODES FOR ULTRAFAST LITHIUM-ION BATTERIES

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As an alternative to conventional graphite anodes, higher-capacity materials (e.g., Si, Ge, and Sn) with appropriately designed nanostructures have been widely explored. However, problems associated with the unstable evolution of a solid-electrolyte interphase (SEI) on the active anode surface still remain. Considering that the SEI develops on the active anode surface before lithiation starts, most previous research focused on the novel hybrid design to prevent direct contact between electrolyte and anode materials. However, since the Li ion/etchant-permeable shell cannot permanently prevent permeation of electrolyte, these works gave rise to a dispute concerning the permeation of electrolyte and SEI development on the anode surface. In this study, we propose a new approach that prevents the formation of an SEI layer by engineering the electric potential across the electrolyte/anode interface. The silicide nanowire anodes anchored selectively to the inner surface of graphene-based micro-tubules (NiSiNWs@Gr μ Ts) were tested as a proof of concept for the proposed strategy and demonstrated unprecedentedly excellent performance during 2000 cycles at 20C with a high specific capacity (over 700 mAh/g, corresponding to 84% of the initial capacity). Moreover, the NiSiNWs@Gr μ T anodes showed superior rate capabilities with capacity retention higher than 88% at 80C (vs. the capacity at 1C).

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SOME PECULIARITIES OF ISOTOPIC MATERIALS SCIENCE

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Over of last five decades a great number of stable isotopes and well – developed method of their separation has made it possible to date to grow crystals of C, LiH, ZnO, ZnSE, CuCl, GaN, GaAs, CdS, Cu₂O, Si, Ge, α-Sn as well as graphene with a controllable isotopic composition. The use of such objects allows the investigate of not only the isotope effects in diffusion and lattice dynamics (vibrational, elastic and thermal properties) but also the influence of such effects on the electronic states via electron – phonon coupling (the renormalization of the band – to – band transition energy E_g as well as the exciton binding energy E_b). The thermal conductivity enhancement in the isotopically enriched materials amounts (C, Ge, Si) to almost 10% at room temperature and is close to a factor of six at the thermal conductivity maximum around 20K (Si-case). The change in the lattice constant is $\Delta a/a \sim 10^{-3}$ - 10^{-4} , while the change Δc_{ik} in the elastic constants amounts to several percent. Very pronounced and general effects of isotope substitution are observed in phonon spectra. The scattering lines in isotopically mixed crystals are not only shifted (the shift of LO lines exceeds 100 cm⁻¹) but are also broadened. Capture the thermal neutrons by isotope nuclei followed by nuclei decay produces new elements in a very large number of possibilities for isotope selective doping of different materials. Although the technology of isotopic materials science is still in its infancy, it is necessary underline that it has very wide applications: beginning from optical fiber technology still modern development in isotope information storage and isotope quantum computers.

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INNOVATIVE WAVE POWER GENERATOR SYSTEM USING DIELECTRIC ELASTOMER

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The wave power generation has attracted attention as one of useful utilization methods for ocean energy. However, the conventional wave generators are large, expensive, and unable to efficiently generate electric power with small amplitude waves, limiting their widespread usage. To solve these problems, we would discuss the possibilities for a wave power generator using dielectric elastomer (DE) recently developed as a novel method for harvesting renewable energy. DE is a new smart material technology with characteristics and properties not seen in other materials. The basic element of DEs is a very simple structure comprised of thin polymer films (elastomers) sandwiched by two electrodes made of a stretchable material. DEs can operate as an electrically-powered actuator. When a voltage difference is applied between the electrodes, they are attracted to each other by electrostatic forces leading to a thickness-wise contraction and plane-wise expansion of the elastomer. The use of a DE actuator in the reverse mode, in which deformation of the elastomer by external mechanical work is used to generate electrical energy, has been gaining more attention. As DE is very light, inexpensive, and easily formed into multiple layered structures, it can make a very simple and robust direct drive wave power system that is economically viable. DE has moved now from the research and development stage to the commercial domain with research and development on practical applications, and furthermore to the mass production stage.

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