Book of Abstracts

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Committee of the ICNSNT- 2015

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MESSAGE FROM PROF. K.M. NALIN DE SILVA

CONFERENCE CHAIR – ICNSNT 2015

Welcome to the 2nd Annual International Conference on Nanoscience and Nanotechnology.

It is my great pleasure to invite the community of research scientists, academics and postgraduate students to participate in the 2nd Annual International Conference on Nanoscience and Nanotechnology to be held in Colombo, Sri Lanka during 2-4 September 2015. It has been a real honor and privilege to serve as the Chair of this conference. First International Conference on Nanoscience and Nanotechnology 2014 was successfully completed with more than 60 participants from 19 countries. TIIKM has brought together a rich diversity of authors and speakers from various universities and industry covering more than 16 countries to share ideas and new perspectives on a wide range of topics related to nanoscience and nanotechnology.

The conference focuses on many areas through the Keynotes Speeches, Invited Talks, and Technical Program. This year we have carefully selected few areas such as Textile & Apparel, smart agriculture, energy, water purification, nanobiotechnology, computational nanoscience, and nanotechnology safety & policy. The conference will be organized by the experienced local organizing committee at TIIKM. There will be a significant participation by researchers from local universities and industrial organizations and the potential for collaboration and cross fertilization across borders would be substantial, especially due to the fact that Sri Lanka has already started the nanotechnology programme through a national nanotechnology initiative by setting up Sri Lanka Institute of Nanotechnology (SLINTEC), a world class fifty acre nanotechnology and science park comprising nanotechnology center of excellence equipped with state of the art equipment for nano characterization.

As the Chair of the conference I am requesting you to submit an abstract and participate in the ICNST 2015. Extended versions of selected papers from the conference will be published after peer review. I am confident that these experienced local organizers TIIKM will make the ICNST 2015 an unforgettable event for all the participants. I would also like to invite you to attend this most enjoyable gathering of scientists belonging to the universities and industries from many countries across the globe.

Prof. K.M. Nalin de Silva
Professor of Chemistry / University of Colombo,
Science Team Leader / Sri Lanka Institute of Nanotechnology,
Sri Lanka.

MESSAGE FROM PROF. MORINOBU ENDO

KEYNOTE SPEAKER - ICNSNT 2015

It is my great honor to send this message to the ICNSNT 2015 and to be a member of the scientific committee organized by the International of Knowledge and Management TIIKM during 2-4 September 2015 at Colombo, Sri Lanka.

Nanoscience and nanotechnology (NS&NT) are very important fields for engineering in the 21st century, in both developed and developing countries, as fundamentals of knowledge and technology as well. NS&NT are very different from conventional science fields, such as chemistry, physics, biology, because at the nanolevel these fields are totally fused and there is no boundary anymore. So, from such new fields of NS&NT, we can expect innovations that will contribute to the sustainability of human beings in the current century.

I hope that the present conference can promote the development for such an important and advanced field of NS&NT in this country and at the global level.

Prof. Morinobu Endo
Department of Electrical and Electronic Engineering, Faculty of Engineering,
Shinshu University, Japan.

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KEYNOTE SPEECHES

[01]

NANOTECHNOLOGY IN AGRICULTURE: NANOPARTICLES AS A PLATFORM FOR ENHANCED PLANT UPTAKE OF NITROGEN

Nilwala Kottegoda [1], Chanaka Sandaruwan [2], W. M. G. I. Priyadarshana [3], Asitha Siriwardhana [4], U. A. Rathnayake [5], B. A. D. Madhushanka [6], A. R. Kumarasinghe [7], Damayanthi Dahanayake [8] , Veranja Karunaratne [9], Gehan A. J. Amaratunga [10]

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ABSTRACT

Worldwide, urea remains the most widely used nitrogen fertilizer contributing to global food security. However, 70–80% of urea is lost during fertilization. Therefore, solutions for increasing its plant availability while reducing adverse effects to the environment caused by eutrophication and increase in greenhouse gases are of major importance in the context of maintaining both global food security and environmental sustainability. A urea coated hydroxyapatite nanoparticle platform for slow release of nitrogen in soil is introduced. In field trials carried out for rice the nanocomposite allows the amount of urea used to be reduced up to 50% compared to the standard amount while maintaining a better yield.

[02]

THE FUTURE OF SMART TEXTILES

Nadeeka Tissera [1], Ruchira Wijesena [2], K. M. Nalin de Silva [3]

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ABSTRACT

The incorporation of science and technology into fabrics has given birth to a new variety of textiles and clothing known as smart textiles and interactive clothing. These textiles to cater high technological area are termed as technical textiles. Until recently the clothing was primarily used for two purposes; for covering our bodies and visually identifying ourselves from others. However in the face of developing technologies in the world the use of textile as a high technology material has seemed growing in a rapid rate. New fields in textile have appeared over the last few years, centering on technical performance properties rather than their aesthetic or beautiful character. The textile industry has taken a giant step from being a supplier of cloths to become a positive force in the development of society through technologically advanced textiles. According to industry experts, smart textiles and interactive apparels will be one of the main fashions for the future. Textile research has advanced in many different areas and due to the special properties of materials at the nanoscale, nanotechnology inspired functionalization can play a key role in almost all of these fields. Wearable electronics will be a key area of research, leading to clothes that can take an ECG or become cool at extreme temperatures. Many people are familiar with wearable electronics due to the existing products such as Nike fuelband, Fitbit and Apple Watch. Most of these applications are wrist mounted, however more and more sensors will be appeared in clothing, distributing in different parts of the body and will become invisible. With the aim of being one of the leading destinations in globe for catering the high performance textile industry, SLINTEC textile team engages in building expertise and IP through advanced research in Nanotechnology to bring practical solutions to problems faced by the local textile industry through industry focused research and developments. At SLINTEC we focus on interesting functionalities such as self-cleaning ability, odor removal ability, superhydrophobicity, UV blocking ability, IR reflectivity, moisture management, wearable electronics, etc.

[03]

EXTREMELY LOW-COST ALTERNATIVES FOR THE OXYGEN REDUCTION CATALYST OF FUEL CELLS

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ABSTRACT

Fuel cells are devices capable of converting chemical energy change of the net reaction caused by the oxidation half reaction of a fuel that is taking place at the anode and the reduction half reaction of oxygen that is taking place at the cathode ($-\Delta G_{reaction}$) to electrical energy (nFE_{cell}). Fuel cells have become enabling energy technology for the world's energy portfolio. They offer clean energy more efficiently and constantly when compared to energy production by combusting gasoline and other fuels. Fuel cells, therefore, have the potential to replace the internal-combustion engine in vehicles and provide power in stationary and portable power applications because they are energy-efficient, clean, and fuel-flexible. They are alternative power sources for remote stations and places where grid supply is not available. The both oxidation half reaction of a fuel and reduction half reaction of oxygen demand highly expensive catalysts such as Pt and Pt/Rh, respectively, making the cost of fuel cells prohibitively expensive. Researchers, over the past two decades, have done extensive research programmes to reduce the costs of these catalysts and research has been carried out in four different strategies, viz., lowering the platinum group metal content by catalyst engineering particle morphology and crystal structure, alloying platinum with less expensive base metals such as Co, Mn, Ni and others, developing novel supports such as non-carbon supports and alternative carbon structures and researching non-platinum catalysts. We have been pioneered in developing non-platinum catalysts for the oxygen reduction half reaction of fuel cells by developing extremely low-cost catalysts based on nanocomposites of montmorillinite clay (MMT), electronically conducting polymers such as polypyrrole (PPY) and the reduced form of the oxidising ion. We describesystems such as Fe(II)/Polypyrrole/MM, Ag/Polypyrrole/MMT, Pd/Polypyrrole and Polypyrrole/Porphyrine structures and metalated Porphyrine structures, all of which show promising results for oxygen reduction and stand as substantially low-cost alternatives to currently used Pt-Rh catalyst for oxygen reduction half reaction of fuel cells. As such, fuel cell power can be harnessed at reasonably low cost in the near future for the environmentally benign greener power production.

Keywords: Low-cost oxygen reduction catalyst, Polypyrrole, Montmorrilonite, Irion(II), Silver, Palladium, Nanocomposite, Fuel Cells

[04]

THE STATE-OF-THE-ART SCIENCE AND APPLICATIONS OF CARBON NANOTUBES

M. Endo

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ABSTRACT

Carbon nanotubes have been attracted lots of attention from various fields of science and technology because of their extraordinary physical and chemical performances by their intrinsic nano-sized one-dimensional nature of carbon. The most common process to synthesize carbon nanotubes is CCVD method, because this technique is very powerful for large scale producing and controlling the nanostructure, using nanosized iron particle that are dispersed on the substrate or floating reactant technique [1-3]. In this account, here at first, the current usage of carbon nanotubes in energy storage devices as one of the important component of lithium ion secondary batteries is shown. Mainly, the effectiveness of the addition of carbon nanotubes to both the cathode and anode electrode on the performance of lithium ion secondary batteries will be discussed. Secondarily, the industrial usages of carbon nanotubes as multi-functional filler in polymeric composites will be summarized, Thirdly, for successful developments of CNT's, the safety of carbon nanotubes is the most important issue [4]. By sharing the all information on risks and benefits of the materials with all the stakeholders, we are able to prove the carbon nanotubes as an safe innovative materials, by the responsible productions and uses, through the designing the safe nanostructure of CNT's.

Keywords: Carbon nanotubes, Lithium ion battery, Composite, Safety, Design safe nano

PLENARY SPEECHES

[01]

STRATEGIES FOR IMPROVING CHARGE TRANSPORT IN NANOCRYSTALLINE TITANIUM DIOXIDE BASED SOLAR CELLS

Prof. P. Ravirajan
Department of Physics, University of Jaffna, Thirunelveli, Jaffna JA 40 000

ABSTRACT

Solar cells based on hybrid Titanium dioxide (TiO_2) – organic nano-composites have been intense focused for more than two decades. Although extremely rapid progress on Perovskite-sensitized TiO_2 photoanodes was made with energy conversion efficiencies more than 18 %, there is still room for improvement through enhancing charge carrier mobilities of the nanocrystalline TiO_2 and hole transporting material.

This study focuses on enhancing the performance of hybrid TiO_2/Polymer solar cell by incorporating Multi-Wall Carbon Nanotube (MWNT) and dyes in nanocrystalline titanium dioxides and at the TiO_2/polymer interface, respectively. Both strategies significantly improve charge transport of porous Titanium dioxide and hole-transporting materials as confirmed by Time of Flight measurement. Overall power conversion efficiency of these solar cells which were incorporated MWNT and dye showed efficiency more than a factor of two in comparison with their respective control devices.

Key words: solar cell, carbon nanotube, TiO_2, polymer

[02]

APPLICATIONS OF ACTIVATED CARBON NANOCOMPOSITES IN WATER PURIFICATION

Rohini M de Silva
Department of Chemistry, University of Colombo, Colombo 03, Sri Lanka

ABSTRACT

Over 75% of our earth's surface is covered with water. But, only 2.5% of it remains as fresh water and even less than 1% of this world's fresh water is accessible for direct human uses. This is the water found in lakes, rivers, reservoirs and underground sources. Water intended for human consumption must be free from chemical substances and micro-organisms in amounts which would provide a hazard to health is universally accepted. Supplies of drinking-water should not only be safe and free from dangers to health, but should also be as aesthetically attractive as possible. Absence of turbidity, colour and disagreeable or detectable tastes and odours is important in water-supplies intended for domestic use. All people, whatever their stage of development and their social and economic conditions, have the right to have access to an adequate supply of safe drinking water. There are certain substances which, if present in supplies of drinking-water at concentrations above certain levels, may give rise to actual danger to health and thus, leads to rejection of the water as a public supply for domestic use. The present water purification technology involves distillation, deionization, ion exchange, UV irradiation, filtration, chemical treatment and reverse osmosis. However there are various draw backs in each method.

In the past few years, there has been a marked increase in the applications of nanocomposite materials for water purification. For instance, the use of carbon nanotubes (CNT) and various nanoparticles as filtering materials, prove that nanotechnology could potentially lead to more effective means of filtration methods. Special emphasise was drawn to the use of activated carbon as the base material for various nanocomposites. Our research is focused on various types of nanocomposites of activated carbon using nanoparticles of iron oxide, silver, zinc oxide, copper oxide, titanium dioxide, hydroxyapatite, and natural ingredients such as curcumin, etc. The research is focused on laboratory investigations and to improve the processes to achieve and improve the technology that can be commercialized.

[03]

EXPLANATION OF THE PHOTOCURRENT EFFICIENCY(Φ) ENHANCEMENTS, THROUGH THE CAN'S MODEL EQUATION FOR THE p-CuI SENSITIZED METHYLVIOLET-C_{18} (M-C_{18}) LB FILMS IN THE PHOTOELECTROCHEMICAL CELLS (PECs) And Cu/n-Cu_2O/M-C_{18}/p-CuI SOLID STATE PHOTOVOLTAIC CELLS

C.A.N. Fernando [1]

[1] *Nano-Technology Research Laboratory, Department of Electronics, Faculty of Applied Sciences, Wayamaba University of Sri Lanka, Kuliyapitiya, Sri Lanka*

ABSTRACT

Photocurrent enhancements in a dye sensitized photoelectrochemical cell (PEC) with a Cu/p-CuI/M-C_{18} photoelectrode and a dye sensitized solid state photovoltaic cell (DSSC) with Cu/n-Cu_2O/p-CuI/M-C_{18}/p-CuI are studied by controlling the formation of dye aggregates of (Methylviolet-C_{18}) M-C_{18} Langmuir-Blodgett (LB) films on the p-CuI layer. LB films of M-C_{18} are deposited under biasing conditions during the LB film deposition process on p-CuI, Cu/n-Cu_2O/p-CuI and conductive glass plates with the three-electrode configuration set up coupling to the LB trough. LB films prepared under positive biasing conditions enhance the photocurrent quantum efficiencies for both PECs and DSSCs controlling and minimizing the formation of dye aggregates. The electrolyte used for LB deposition and photocurrent measurements is (10^{-2}M) Fe^{2+}+ Fe^{3+} (10^{-2}M) and (10^{-2}M) NaH_2PO_4-Na_2HPO_4, pH=6 buffer solution. Maximum photocurrent quantum efficiencies (Φ_{max} %) obtained are ≈22% for PECs and ≈ 20% for DSSCs, where the M-C_{18} LB film deposition applied potentials +0.3V versus Ag/AgCl. The mechanism of the photocurrent enhancement is discussed through the CAN's model equation, $\Phi = ADo - BDo^2$, where $A-=k_1k_2/F$, $B=Ik_1^2k_2[2k_6/F^3 + k_2k_4/k_3^2X^2F^2]$, $F=k_2+k_5Y+k_7+k_1I[1+k_2/k_3X]$. Experimental evidence for the formation of the aggregates of M-C_{18} LB films for the negative applied potentials and suppression of the aggregates with positive applied potentials are presented from absorption spectra, AFM pictures and fluorescence measurements of the samples. Conversion efficiency obtained is ≈ 2.5%, Voc ≈ 750mV and Isc ≈ 5.8mAcm^{-2} for DSSC fabricated with +0.3V versus Ag/AgCl applied deposition potential of M-C_{18} LB films.

[04]

GRAPHENE APPLICATIONS AND 3D PRINTING

S.G.M de Silva

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ABSTRACT

Current production methods of graphene are discussed. With the features of each production method explored, attention is given to production methods. Their application specific considerations such as impurities, flake size, functionalization. Based on present capabilities, Specific applications are explored with the view of gaining an understanding of higher order functionality. The second part of the presentation will consist of exploring 3D printing as a key application of the graphene material. With the unique properties available to graphene, over other conductive materials, we present an understanding on how graphene, 3D printing symbiosis could evolve over the next few decades.

ORAL PRESENTATIONS

[01]

PRETREATMENT OF CONTAMINATED WATER BY ELECTROCHEMICALLY PRODUCED NANOSTRUCTURED FLOCS

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ABSTRACT

Contaminated water is usually represented with multiple contaminations containing both dissolved organic and inorganic compounds (metallic ions). Such contaminated water cannot be treated by single method thus pretreatment process needs to be applied. This contribution represents a pretreatment method for dissolved metallic ions removal by electrochemically produced nanostructured flocs. Flocs were produced by electrochemical coagulation (electrocoagulation) and characterized in terms of their textural properties as well as their performance in removal efficiencies. Method of electrocoagulation is based on electrochemical dissolution of "sacrificial" electrode and formation of solid porous particles that adsorb dissolved inorganic pollutants. Two electrode materials (iron and aluminum) were used and their performances were directly compared. It was shown that aluminum nanostructured flocs are stable in wide range of inputting current densities while character of iron flocs is changing with higher current densities. Aluminum flocs revealed higher removal efficiencies in removal of dissolved metallic ions than iron electrode at all followed parameters.

Keywords: electrocoagulation, water treatment, nanostructured flocs, iron electrode, aluminum electrode

[02]

MODIFICATION OF FUNCTIONAL NANOMATERIAL FOR PHOTOCATALYSIS

Morozova M. [1], Dytrych P. [2], Solcova O. [3]

[1, 2, 3] *Institute of Chemical Process Fundamentals of the CAS, v. v. i., Czech Republic*

ABSTRACT

The applications in the area of photo-electrochemistry require an excellent charge separation and electron transport. The requested material properties can be achieved by various methods, nevertheless, the most common way is doping of the semiconductor material by metallic or non-metallic compounds. Moreover, not only foreign elements must be used as a material for doping. In this study the effect of the rutile nanoparicles on structural and photo-electrochemical properties and photo-induced activity of the mixed anatase/rutile thin films in various ratios was studied. Modification of the TiO_2 crystal structure by the rutile crystallographic form allows the systematic tuning of the surface area, the porosity, and the particle size, etc. Thin TiO_2 layers were prepared by the sol–gel method using a reverse micelles system as a molecular template and were deposited on the conductive ITO substrate by a dip-coating technique. Pure anatase or mixed anatase/rutile phase were obtained during the calcination step as a result of the selected temperature. The positive influence of the presence of rutile particles in the thin layer on the photo-induced properties was verified by photo-electrochemical experiments. It was found that the mixed crystallographic phase of anatase and rutile can exhibit much higher photo-induced activity than pure form due to the better photo-excited charge separation, lower recombination and improved electron-transfer rate.

Keywords: sol-gel, thin layer, TiO2, anatas, rutile, photo-induced properties

[03]

NANOTITANIA OXIDE FOR WATER PURIFICATION

O. Solcova [1], Y. Maleterova [2], L. Spacilova [3], M. Morozova [4], F. Kastanek [5]

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ABSTRACT

Nowadays, photocatalysis has been applied as a promising technique for the wastewater decontamination and/or purification. It is well established that titanium oxide and related nanostructure materials in the presence of UV light (in dependence of condition also in the presence of visible-light) can create very active species that are able to restore and preserve a clean environment by decomposition of the harmful organics. Endocrine disruptors represent the group of chemical substances disrupting the hormonal indication of vertebrates and thereby they could encroach on the organism function. To the group of endocrine disruptors belong surfactants, softeners, fungicides, insecticides and some kinds of medications and hormonal contraception. They are commonly presented not only in the waste water but also in the natural water. Endocrine disruptors are persistent to degradation by common chemicals as well as biological and photolytic processes. The necessity of finding the alternative solutions leads to development and use of the new technologies. Photo-catalysis using semiconductor particles have found increasing interest to solve the endocrine disruptors remove problems. This study is focused on verification of the specially designed pilot plant photocatalytic reactor carried out upon illumination in the UV-light based on results with various concentrations of endocrine disruptors in the two types of laboratory reactors; batch and plug flow arrangement.

Keywords: titanium dioxide, endocrine disruptors, water purification, pilot plant photoreactor, photocatalysis, photolysis

[04]

HEXAGONAL CuS NANOPARTICLES FROM A NEW COPPER(II) DITHIOCARBAMATE PRECURSOR AS AN EFFICIENT PHOTOCATALYST FOR DETOXIFICATION OF CONGO RED

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ABSTRACT

Dyes used in textile industries impart color to the textile fibers through their excellent binding ability. The fixation efficiency typically ranges between 60-90% [1]; therefore, the effluent from the dyeing process will contain unfixated reactive dyes. The color and toxicity caused by these dyestuffs may have a detrimental impact on water quality, and hence the effluent requires appropriate treatment before it discharged to the environment. Dyes even in low concentrations effect the aquatic life and food web. Since many organic dyes are harmful to human beings; their economical and effective removal from effluents becomes environmentally important. These toxic dyes enter human body via food web, and can cause serious ailments. Therefore, the removal of dyestuffs from industrial wastewater has encouraged dynamic research activities in the development of several treatment technologies. The use of photocatalysis that decompose organic contaminants into harmless species is imperatively needed for the preservation of sea food quality. So a new hexagonal shaped CuS nanoparticle (NPs) with average size of 35.39 nm have been synthesized by solvothermal decomposition of bis-(4-benzylpiperidine-1-carbodithioato)copper(II) using octylamine as a solvent. These NPs are efficient photocatalyst and can 100 % degrade Congo red in 50 min. In this talk, mechanism of CuS NPs synthesis and kinetics of Congo red degradation will be discussed.

Keywords: CuS NPs; Mechanism; Dye degradation

[05]

SYNERGISTIC EFFECT OF PHOTOCATALYTIC OZONATION IN PHENOL DEGRADATION

Achisa C. Mecha [1], Maurice S. Onyango [2], Aoyi Ochieng [3], Maggy N.B. Momba [4]

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[4] Department of Environmental, Water and Earth Sciences, Tshwane University of Technology, RSA

ABSTRACT

Advanced oxidation processes (photocatalysis and ozonation) have shown tremendous potential in water and wastewater treatment. However, their major challenges are that photocatalysis is a relatively slow process whereas ozonation leads to the formation of by products that may be more harmful. This study demonstrates how simultaneous photocatalytic ozonation resulted in the negation of these challenges. Metal doped (silver, copper and iron) titanium dioxide (TiO_2) nanoparticles were prepared and the effects of metal dopants on the structure, properties and photocatalytic effectiveness of the catalysts were investigated. The morphology, composition, crystalline structure, surface area, particle size, functional groups and light absorption were characterized. The photocatalytic ozonation activity of the catalysts was evaluated by the degradation of 100 ppm phenol in aqueous solution using Ultraviolet radiation coupled with ozonation. The results showed that metal dopants were successfully introduced into TiO_2 particles and the light absorption of the metal doped TiO_2 samples was red shifted relative to the un-doped sample. Photocatalytic processes on their own degraded 100 ppm phenol in approximately 7 h, however, when these processes were combined with ozonation, the reaction time reduced from 7 h to 2.5 h (64 % reduction). Ozonation alone resulted in formation of by products which were absent when photocatalytic ozonation was employed. Total organic carbon results indicated that photocatalytic ozonation achieved over 99% mineralization of phenol. The novelty of the study is that it shows that photocatalytic ozonation is a fast and efficient technique for the treatment of bio-recalcitrant water contaminants.

Keywords: phenol, photocatalytic ozonation, titanium dioxide, water treatment

[06]

SOLAR-LIGHT-INDUCED PHOTOCATALYTIC ACTIVITY OF PHTHALOCYANINE/TITANIUM DIOXIDE COMPOSITES

Elzbieta Regulska [1], Danisha Marie Rivera-Nazario [2], Marta Eliza Plonska-Brzezinska [3], Luis Echegoyen [4], Joanna Karpinska [5]

[1, 3, 5] *University of Bialystok / Institute of Chemistry*

[2, 4] *University of Texas at El Paso / Department of Chemistry*

ABSTRACT

Titanium dioxide (TiO_2) is a semiconductor which shows a huge potential in different fields mostly due to its photocatalytic activity. This is the reason why it is widely used in the chemical, engineering, medical, cosmetic and electronic industry. As TiO_2 possesses 3.2 eV energy band-gap its excitation requires ultraviolet light, which lowers the efficiency of the catalytic photodegradation process. Therefore, a variety of methods have been attempted to enhance TiO_2 photocatalytic behavior. The present work aims to prepare a TiO_2-based visible-light-sensitive photocatalysts. Symmetric phthalocyanines with Zn(II), Cu(II) and Co(II) in metallic centre were prepared and applied during sol-gel synthesis of TiO_2 for that purpose. Following methods were applied for the complete characterization of the prepared composites: SEM, TGA, DSC, Raman microscopy, IR and UV-VIS diffuse-reflectance spectroscopy. Photocatalytic effect was examined by investigating the quercetin degradation. Solar simulated light was used as an irradiation source. Absorbance changes were monitored by UV-VIS spectrophotometry. Kinetic profile and parameters were estimated using this method too. Decomposition intermediates were studied by LC-MS/MS technique. Phthalocyanine modified TiO_2 demonstrated an increased photocatalytic activity when compared to pristine TiO_2. It was concluded that sensitizers decrease the electron excitation energy, thereby improve the photocatalytic performance by causing an increase in sensitivity under visible light irradiation.

This work was financially supported by the National Science Centre, Poland (projects 2012/05/N/ST5/01479 and 2014/12/T/ST5/00118).

Keywords: photocatalysis, titanium dioxide, phthalocyanine, composite

[07]

NANOTECHNOLOGY IN THE DISINFECTION OF DRINKING WATER

Thomas Prevenslik [1]

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ABSTRACT

Perhaps half of the world population drinks water that is contaminated by human or animal waste because electrical power for disinfection by boiling is not always available. In nanotechnology, QED induced UV-C radiation using nano-coated half sphere drinking bowls (100 mm diameter x 50 mm high) that fit into the palm of the hand disinfect drinking water using only body heat alone without the need for electrical power. QED stands for quantum electrodynamics. QED disinfection is a consequence of quantum mechanics that precludes atoms under the TIR confinement in the nano-coating from having the heat capacity to increase in temperature upon the absorption of body heat. TIR stands for total internal reflection. Provided the nano coating has a higher refractive index than that of the bowl, the body heat is conserved by QED inducing the creation of UV-C radiation at wavelength $\lambda = 2$ nd, where n and d are the refractive index and thickness of the coating. For a silicon dioxide nano-coating on the aluminum bowl having n = 1.54 and 1.09, UV-C at 254 nm is produced with a coating thickness d = 83 nm. EPA guidelines require a minimum UV-C dosage of 16-38 mJ/cm^2 to remove pathogens from water. With the human producing body heat = 6 mW/cm^2, the water is held in the bowl for at least 7 seconds. On-going UV-C tests are reportred.

Keywords: QED, UV-C disinfection, quantum mechanics, drinking water, body heat

[08]

GREEN SYNTHESIS OF BIOPOLYMER ENCAPSULATED GOLD NANOPARTICLES FOR THE EVALUATION OF IT'S ENHANCED BIOCHEMICAL POTENCY

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ABSTRACT

Gold nano particles (AuNPs), possessing very low biochemical potency, were functionalized by a bioactive polymer through ultrasound assisted green process. The synthesis was carried out by reducing Au^{III} to Au^{0} in presence of aqueous solution of chitosan, a biocompatible, biodegradable and nontoxic biopolymer in an ultrasonic bath. Nonbiopolymer (PVA) stabilized AuNP was also synthesized using the same protocol. The synthesized nanomaterials were further characterized by UV-Vis spectrophotometer, TEM, SEM, DLS techniques. Zeta potential measurements, Mass spectrometry studies were also carried out. Biochemical potency of both the biopolymer stabilized and nonbiopolymer stabilized AuNPs was evaluated and compared in terms of antiparasitic (antifilarial), antibacterial and antifungal activities. The synthesized biopolymer/AuNP composite material was found to be much more efficient than the nonbiopolymer/ AuNP composite material against pathogenic bacteria, fungus and filarial parasite. The particles were found to be strongly interactive with the principle cellular bio-molecule (viz. DNA) and protein, which might be the reason of their bioactivity. Particularly against parasites, the synthesized AuNPs were able to induce apoptosis through increasing the level of key regulator of cell death and fragmentation of genomic DNA. Molecular level studies, which were carried out by Circular Dichorism (CD) spectroscopic analysis, showed the interaction of AuNPs with principal biomolecules (DNA & Protein). That interaction changes the structure of DNA and protein which might be the reason behind their biochemical activity.

Keywords: AuNP/polymer nanocomposites, chitosan, antifilarial activity, CDspectroscopy

[09]

MICROWAVE ABSORBING PROPERTIES OF POLYANILINE/MWCNT/THT NANOCOMPOSITES

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ABSTRACT

Microwave absorbing structures typically contain material with properties that allow electromagnetic (EM) waves to breach into regions where the electrically and magnetically fields losses. Polyaniline/ multi walled carbon nanotubes/ triethylamine hydrothiocyanate (THT) composite were synthesized using in situ polymerization at different weight ratios. The spectroscopic characterization of the process of formation of PANI/MWCNT/THT composites were studied using Fourier transform infrared spectroscopy, an ultraviolet-visible spectrophotometer, powder X-ray diffractometer, Scanning electron microscope and Impedance/ material analyzer. To solve the problem of narrow absorption band and small absorption strength of dielectric loss material polyaniline (PANI), this PANI/MWCNT/THT nanocomposites work turns to increase the strength of the magnetic loss and the impedance matching by changing the morphology of PANI. The microwave absorbing properties of PANI/MWCNT nanocomposites with doped THT different amounts were investigated by measuring complex permittivity, complex permeability and reflection loss. The results showed the significant microwave properties, which achieving a large absorption over a wide frequency range, especially for higher frequency values.

Keywords: microwave absorption, PANI-CNT nanocomposites, Polyaniline

[10]

DEVELOPMENT OF BROAD SPECTRUM NANO WATER PURIFICATION SYSTEM

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ABSTRACT

Nano-membrane Water Purification Filtering system designed for removing from water various organics, microbes, viruses and most metallic ions, heavy metal ions with two or higher valence while retaining part of the sodium, potassium, calcium and magnesium ions, etc. Along with the advantages such as low membrane cost and low operating costs, with respect to the requirement of removal of heavy metals from water, Nano-membrane filtration is the most appropriate method to adopt for heavy metal removal. Since other filtration methods such as, microfiltration and ultrafiltration does not remove any multivalent ions, which includes heavy metals reduction as well. Also another commonly used filtration method is reverse osmosis, which has a mechanism that will not only remove heavy metals but will also remove monovalent ions and all the multivalent ions too. Therefor reverse osmosis will remove beneficial minerals from the drinking water. Long time use of such filtration method for drinking water will lead to mineral deficiency in the consumer, unless minerals are added externally to the drinking water after filtration, which adds cost complexity. Heavy metals and heavy metal complexes such as Cadmium, Mercury, Barium and Arsenate have reported to show of more than 80% of percentage reduction after the Nano filtration process. Nano water purification system has the capability of efficient removal of pesticide residues, organic pollutants and microbes via the filtration process. Nano membrane is also used as a membrane softener for water softening purpose.

Keywords: Nano-filtration, heavy metal removal, drinking water, water softening

[11]

NANO-ENRICHED GRANULAR ACTIVATED CARBON AS A WATER FILTER MATRIX WITH HEAVY METAL ADSORPTION

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ABSTRACT

Among the vast majority of water filter materials that are commonly used, Granular Activated Carbon (GAC) is marked as the favorite of most. Its high potency in adsorption of dust, rust, objectionable colors and odors earns it the aforementioned status. But considering the water purification grounds, the more the adsorption abilities towards heavy metal contaminants, better it'll be as the suitable candidate. Current study was carried out to enhance the heavy metal ion adsorption ability of virgin GAC by the incorporation of nano Hydroxyapatite (HAP) and Curcumin: whose presence imparts an antibacterial effect to the composite. Preparation of the nanocomposite was done by following an in-situ precipitation method under basic conditions to obtain nano-hydroxyapatite and curcumin coated on GAC (HAP/C/GAC). The effect of these two coatings on enhancing the metal ion sorption of GAC was assessed taking Pb^{2+} as the marker heavy metal ion. The comparative studies were accomplished using neat GAC and HAP/GAC. Investigations indicated that the sorption ability of HAP/C/GAC is similar to HAP/GAC and superior to virgin GAC. Virgin GAC's adsorption data were more compliant with Langmuir Isotherm model whereas the two nanocomposites showed compliancy towards Freundlich Isotherm model.

Keywords: Adsorption, heavy metal ions, Activated Carbon, Hydroxyapatite, Curcumin

[12]

ANTIFUNGAL MECHANISM OF BIOGENIC SILVER NANOPARTICLES OF *ASPERGILLUS FOETIDUS*

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ABSTRACT

The biosynthesis of silver nanoparticles (AgNPs) has been carried out by using the extracellular filtrate of the fungal strain, Aspergillus foetidus. The synthesized nano particles have been characterized following different biophysical techniques. The results obtained from the studies of antifungal activities of AgNPs were found to be of utmost significance. Growth of A. foetidus both in liquid and solid CD media have been monitored in presence of the nanoparticles (0-40 ppm). Medium free dry biomass of the fungi was collected and emphasis has been laid on the assay of catalase activity, lipid per oxidation, thiol and protein content estimation and leakage of thiol, protein content. Growth of fungi in the presence of AgNPs was significantly inhibited in a dose dependent manner. Adherence of AgNPs on the fungal strain was realized by field emission scanning electron microscopy, and energy-dispersive X-ray spectroscopy, which indicated presence of silver nanomaterials in the surface of fungal mycelium. The growth of the fungus was found to be remarkably decreased with the increase in concentration of AgNPs and a considerable change in the activities and contents of all of the biochemical parameters considered indicated a plausible mechanistic mode of action of biosynthesized AgNPs establishing its antifungal activity.

Keywords: Silver nanoparticles, Aspergillus foetidus, FESEM, catalase, lipid peroxidation

[13]

NANOMEDICINE IN CENTRAL NERVOUS SYSTEM (CNS) DISORDERS: A PRESENT AND FUTURE PROSPECTIVE

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ABSTRACT

Aim: For the past few decades central nervous system disorders were considered as a major strike on human health and social system of developing countries. Cognitive and neurological impairments are insidious in brain dysfunction that affects memory, learning ability, emotions and some physical abnormalities also. In this review, we highlighted on meaningful advances of nanotechnology and their use as pharmaceutical weapons in different CNS disorders.

Method: Numerous animal and in vivo studies have been conducted on nanomedicine, which advocates potential therapeutics in CNS disorders. We reviewed the PubMed database to identify experimental studies of different nanomaterials, conducted on several CNS disorders. We didn't include nanotechnology application in brain imaging and genetic modification research.

Result: Nanotechnology based drug delivery has a very potent role in the treatment of CNS disorders, i.e. Parkinson disease, Alzheimer's disease, stroke, TBI, tumor, epilepsy and multiple sclerosis.

Conclusion: Although impressive advancement has been made via innovative potential drug development, but their efficacy is still moderate due to limited brain permeability. To overcome this constraint, nanotechnology based drug delivery methods provide a powerful tool in CNS therapeutic intervention. Due to its small size and biofunctionalization characteristics, nanomedicine can easily penetrate and facilitate the drug through the barrier. But still, understanding of their toxicity level, optimization and standardization are long way to go.

Keywords: Nanotechnology, CNS disorders, brain permeability

[14]

FACILE SYNTHESIS OF HYDROXYAPATITE/ IRON OXIDE NANOCOMPOSITE TO BE USED AS A DRUG CARRIER

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ABSTRACT

Hydroxyapatite (HAp) is known to have a similar composition to bone and teeth. It is an inorganic calcium phosphate ceramic which has been widely used for many biological applications like bone tissue engineering, bone reconstruction and in drug delivery because of its known biocompatibility and biodegradability. In most of the reported work the synthesized hydroxyapatite nanoparticles had a nanocrystalline nature with a needle shape. However this study has involved the facile creation of low crystalline HAp as an alternative to these methods. Moreover a magnetic core of iron oxide nanoparticles (IONPs) has coupled to this system in order to increase the targeted delivery by using an external magnetic field. As synthesized HAp coated on IONPs characterized using Scanning electron micrographs (SEM), Fourier Transform Infra-red spectroscopy (FT-IR) and X- ray diffraction (XRD) revealed both HAp and IONPs has been formed during the synthesis. Later the drug encapsulation efficiency was studied using paracetamol as a model drug. Varying concentrations of the carrier was incubated with a fixed concentration of the drug with time and the amount loaded was measured using UV visible spectroscopy (UV-Vis). Several systems having different degree of crystallinity were studied for their capability to bind with the drug molecules. Therefore the main objective of this work was to increase the surface adsorption of drug molecules by lowering the crystallinity and the particle size of HAp nanocarrier which could be ultimately delivered to the targeted site using its magnetic property.

Keywords: Hydroxyapatite, Iron oxide, drug-carrier, low crystalline, magnetic

[15]

IRON DOPED CNTs FOR HYPERTHERMIA

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ABSTRACT

Iron is one of the best elements for magnetization with electromagnetic radiation. It can be used as a tool for medical diagnosis and treatment. Electromagnetic heating of iron nanoparticles and ferro-fluids can be successfully used for non-invasive thermal ablation of cancer cells. Different types of electromagnetic waves have been used so far. For thermal ablation of cancer cells the used radio frequency should fall within the industrial, scientific and medical scope as well as the interaction with human body should be limited to minimum. Generally, the application of radio frequency energy fields for medical treatment is justified by deep tissue penetration.

The highly Fe doped CNTs (Fe-CNTs) as the carriers creating magnetic fluid will be presented. An excessive catalyst injection method using electrical furnace and microwave plasma reactor will be proposed. This way is possible to grow the Fe filled CNTs on a moving surface in continuous synthesis process. This allows producing uniform carpet of the Fe-CNTs carriers. Then the targeted therapies which can be effective if the carriers are able to distinguish the difference between cancerous and healthy cell's physiology are considered.

Keywords: Iron, Carbon Nano Tubes, Hyperthermia

[16]

THERMAL METHODS OF IRON DOPED CNTs SYNTHESIS FOR MEDICAL APPLICATION

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ABSTRACT

Carbon nanotubes and nanotechnology can be used in medicine in many different areas. There are: lab-on-chip, nanorobots, blood purification, tissue engineering, drug delivery systems, cancer treatment. In modern medicine there are several methods of cancer treatment such as: chemotherapy, radiation, surgery, palliative care and alternative medicine. It is also possible to use of carbon iron filled nanotubes for non-invasive thermal ablation of cancer cells. These nanotubes can be attached to the diseased cells and then heated in a radio frequency field. These treatments allows the destruction of cancer cells. There are many methods for carbon nanotubes synthesis The most common are CVD, PECVD, laser ablation, arc discharge method and many others. Iron doped CNTs, can be obtained e.g in CVD and PECVD methods. In article a new application of microwave plasma system for CNTs synthesis will be presented. Also a continuous system for carbon nanotubes on metal strip will be proposed. The first result of hyperthermia of this iron filled CNTs in RF field will be described.

Keywords: Carbon Nano Tubes Synthesis, RF Heating

[17]

PREPARATION OF SILVER NANOPARTICLES DECORATED CHITIN NANOFIBERS

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ABSTRACT

In this work we report a facile, one step method for preparation of chitin nanofibers decorated with silver nanoparticles. The chitin nanofibers were prepared from processing of crab shells to progressively remove protein, mineral and colored compounds, followed by ultra-sonication to assist fibrillation of chitin strands. Then the chitin nanofibers were decorated with silver nanoparticles using silver nitrate as the silver precursor. The prepared material is characterized using array of analytical equipments including, UV-Vis, FT-IR, XRD, Fluorescence spectrophotometry, AFM and TEM. It was observed that the chitin nanofibers were fibrillated in to its most basic dimension (5 – 15 nm) and form aggregates upon silver nanoparticle decoration. The average particle size of the formed silver nanoparticles are in the range of 40 -60 nm. UV-Vis, revealed strong plasmonic absorption behavior of prepared composite material. Possible formation and interaction mechanism is given.

Keywords: chitin nanofibers, silver nanoparticles surface, modification, crab shell chitin

[18]

DEVELOPMENT OF MEDICAL TEXTILE USING NANOTECHNOLOGY

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ABSTRACT

Microencapsulation can be defined as a process used to develop micro scale capsules, which consist of an inner core material and an outer wall material, that can be used as carriers or storing vesicles for active ingredients of interest. In the pharmaceutical field most of the drug treatments are required to maintain the optimal therapeutic range over a desired period of time. In the case of Arthritis pain and other localized inflammations, transdermal dosage forms like ointments, creams and gels are common in practice to subside the pain and inflammation. These transdermal applications are accompanied with draw backs such as strong smells, stickiness and frequent applications. Most importantly, the frequent application of transdermal dosage forms can cause unwanted side effects due to over dosage. Application of microencapsulation technique has attracted a much attention in pharmaceutical industry due to its control releasing ability. Also it helps to protect the efficacy of active ingredient. The objective of this research was to develop a medicinal cloth using methyl salicylate microcapsules with analgesic properties in order to investigate the slow releasing ability of methyl salicylate. Complex coaservation method with gelatin and gum acacia combination as the wall materials was used to encapsulate methyl salicylate. Releasing of methyl salicylate was monitored using UV- visible spectroscopic method. Produced methyl salicylate microcapsules were then incorporated into cotton cloths via modified pad-dry cure method. The presence of microcapsules in cotton fabrics and their morphology were detected using scanning electron microscopy (SEM). The releasing pattern was monitored using UV/Vis spectrophotometer.

Keywords: microencapsulation, methyl salicylate, complex coaservation, sustain release, medicinal textile

[19]

BIOMECHANISITIC APPROACH FOR CONTROLLED Au AND Ag NANOPARTICLES BIOSYNTHESIS

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ABSTRACT

Nanobiotechnology has recently gained much importance mainly because of its multidisciplinary involvement. Till date in biological synthesis of gold nanoparticles (AuNPs) and silver nanoparticles (AgNPs) large number of biological entities were exploited.

The present works summarize the extracellular synthesis of AuNPs and AgNPs by using Purpureocillium liacinus at room temperature. The UV-Visible absorption spectra showed a significant absorption around 520-540 nm and 420-440 nm, indicating the presence of AuNPs and AgNPs respectively. A peak around 280 nm in extracellular filtrate attributed to the aromatic amino acids of the proteins involved in the process. Fourier-transform Infrared Spectroscopy (FT-IR analysis) also confirmed the involvement of protein molecules in the synthesis of NPs. These NPs are thus capped with proteins which enhance their stability and solubility. Energy dispersive X-ray Spectroscopy (EDX analysis) of NPs recorded strong signals of respective metal atoms. Total extracellular filtrate mediated NPs synthesis showed mixed population for AuNPs with spherical, rod shaped, triangular shaped, pyramidal shaped particles lying in the range of 20-40 nm and for Ag semi-quasi spherical particles having average size of 60- 80 nm were obtained. In order to study the total molecular mechanism proteinaceous and non proteinaceous parts of the extracellular filtrate were separated and checked for the controlled synthesis of AuNPs and AgNPs. Both the proteinaceous and non proteinaceous parts were found to be involved in the AuNPs and AgNPs synthesis.

Thus, this fungus-mediated molecular mechanism study could be very useful in cost-effective, environmental-friendly synthesis of controlled, beneficial Au and Ag NPs.

Keywords: Molecular mechanism, biosynthesis, gold nanoparticles, silver nanoparticles

[20]

TECHNOLOGICAL AND ECONOMIC ASPECTS OF MICROALGAE TREATMENT FOR BIOFUELS

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ABSTRACT

Microalgae have increasingly gained research interest as a source of lipids for biodiesel production. The wet way processing of harvested microalgae was suggested and evaluated with respect to the possible environmental impacts and production costs. This study is focused on the three key steps of the suggested process; flocculation, water recycling and extraction of lipids. Microalgae strains with high content of lipids were chosen for cultivation and subsequent treatment process. Ammonium hydroxide was tested as the flocculation agent and its efficiency was compared with chitosan. Determined optimal flocculation conditions for ammonium hydroxide enable the water recycling for the recurring microalgae growth, which was verified for the use of 30, 50 and 80 % recycled water. For extraction of the wet microalgae hexane, hexane/ethanol and comparative chloroform/methanol systems were applied. The efficiency of hexane/ethanol extraction system was found as comparable with chloroform/methanol system and it seems to be promising owing to its low volatility as well toxicity and mainly the low cost. The wet way processing of the harvested microalgae for biodiesel production seems to be the low cost promising biotechnological application with the minimal environmental impact. Moreover, biorafination methods also enable production of high valuable products hardly obtainable by other ways. Thus, isolation of these unique products can significantly improve economy of the whole biorafination process which is important mainly for central Europe climatic conditions.

Keywords: microalgae, biofuels, flocculation, recycling, extraction

[21]

ENHANCEMENT OF POWER TRANSFORMER OPERATION SECURITY FOR SAFETY OF ENERGY CONVERSION

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ABSTRACT

Nowadays, considerable effort has been devoted in order to understand a failure of the relatively new oil-filled transformers, which can cripple the energy system. The cause of failure is a short circuit in the dielectric isolation. This effect is attributed to the so-called "corrosive sulfur". Corrosive sulfur is defined as various forms of organic sulfur compounds which may cause failure in oil insulated power apparatus due to deposition of copper sulfide on the conductors and in the insulation paper. Dibenzyl disulfide (DBDS) has been found to be the leading corrosive sulfur compound in the insulation oil.

This work is focused on finding an effective way to decontaminate such oils. Commonly used transformer oils were purified by sorption technique and by extraction into polar aprotic solvents such as acrylonitrile (AC), dimethyl sulfoxide (DMSO), N-methyl-2-pyrrolidone NMP or dimethyl formamide (DMF). Moreover, three types of nanoporopus sorbents (two natural Bentonites from different locations and one activated alumina) were applied for oil purification by sorption technique. The key physico-chemical and chemical properties of transformer oils containing corrosive sulfur were defined. Therefore, viscosity at 40°C, density at 20°C, contact angle, group composed of transformer oils, distillation curve by simulated distillation, content of sulfur compounds in the oil samples by mass spectrometry (GC/HRMS) and gas chromatograph with chemiluminescence sulfur detector (GC SCD) were determined in two types of real transformer oil.

Keywords: transformer oil, corrosive sulfur, sorption, polar aprotic solvent

[22]

OLIGO-3-HEXYLTHIOPHENE DERIVATIVES FOR DYE SENSITIZED AND HYBRID TITANIUM DIOXIDE / POLYMER SOLAR CELLS

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ABSTRACT

This work examines the performance of a series of conjugated oligo-3-hexylthiophene (oligothiophene) derivative dyes, with conjugation length from one to five thiophene units (SM1− SM5) in both hybrid and dye sensitized solar cells. The UV-Vis-NIR spectral measurements of dye dipped nanoporous TiO_2 electrodes shows that the dyes have a strong absorption peak in UV region with a blue shift in peaks with reducing conjugation length. All five dyes were tested for hybrid and dye sensitized solar cells with their respective cell structures. UV-VIS-NIR and external quantum efficiency data reveal that dye mainly serves as interface modifier in thin hybrid TiO_2/ polymer solar cells while light harvesting materials in DSSC. Dye with five thiophene units (SM5) showed a promising 3.5 % efficiency with a short circuit current density (J_{SC}) of 8 $mAcm^{-2}$ under AM1.5 conditions (1 sun, 100 $mWcm^{-2}$). Both short circuit current densities and open circuit voltage are increasing with increasing conjugation lengths of dyes. Devices with SM1 and SM2 possess a very low conversion efficiency which is less than that of the self-excitation of TiO_2 electrode. A dipole effect on the surface of TiO_2 nanoparticles due to SM1 and SM2 can explain the scenario.

Short circuit current density and open circuit voltage of the hybrid devices with dyes are increasing with increasing conjugation lengths of dyes. Devices with P3HT as hole conductor and MoO_3/Ag as top contact exhibited a J_{SC} of 2.81 $mAcm^{-2}$ with an V_{OC} of 0.85 V which yielded an overall efficiency of over 1.3 % under AM1.5 conditions (100 $mWcm^{-2}$). The improved efficiency in hybrid devices with SM5 could be attributed to the involvement of P3HT hole-conducting polymer in free carrier generation as confirmed by the external quantum efficiency spectra.

Keywords: Dye sensitized solar cell, Hybrid solar cell, 3-hexylthiophene derivatives, TiO_2

[23]

THE EFFECT OF Co ADDITION TO Pt-Sn/C NANOCATALYST FOR ETHANOL ELECTROOXIDATION

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ABSTRACT

Carbon supported bimetallic Pt-Sn and trimetallic Pt-Sn-Co catalysts were synthesized by Bönnemann's colloidal precursor co-reduction method. Electrochemical characterization of the catalysts regarding their onset potentials, activities and current densities towards ethanol oxidation were determined by linear sweep voltammetry. The relationship between the catalyst structure and catalyst activity of was evaluated by various microscopic and spectroscopic characterization techniques such as X-ray diffraction (XRD), High resolution transmission electron microscopy (HR-TEM), Energy dispersive X-ray analysis (EDX), and in-situ Fourier transform infrared spectroscopy (FTIR). It was found that the catalytic property of Pt-Sn/C for the ethanol oxidation is favorably altered in the presence of Co. To understand the benefits of Co in the structure of Pt-Sn/C, HR- TEM and EDX spectroscopy techniques was very helpful since the particles with different phases such as SnO_2 species can be clearly observed from high resolution images. The change in the Pt lattice due to the addition of Co and to interaction between Pt and Co, both of which favors C–C bond cleavage in the ethanol molecule, while the CO-intermediates formed during breaking of C–C bond were removed by the SnO_2 surface species.

Keywords: Pt-Sn, Pt-Sn-Co, nanocatalyst, SnO_2, ethanol oxidation, catalytic activity

[24]

THE EFFECT OF THE ELECTRICAL DOUBLE LAYER ON THE ACTIVATION ENERGY OF ION TRANSPORT IN CONICAL NANOPORES

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ABSTRACT

The activation energies associated with ion transport (K^+ and Cl^-) in conical glass nanopores are investigated as a function of applied voltage, pore size and electrolyte concentration. The apparent activation energies for electrolyte transport through a conical glass nanopore with a negatively charged surface differ from the bulk value. Finite element simulations with the Poisson-Nernst-Planck model semi-quantitatively predict temperature-dependent electrolyte transport in conical glass nanopores. The simulations highlight that the concentration of ions inside the nanopore changes with temperature; this change can be used to calculate the deviation in apparent activation energy for electrolyte transport compared to bulk solution. At the microscopic level, higher temperatures result in a greater entropic relaxation of the ions within the double-layer, altering the potential profile within the pore. The study provides useful insights into ion transport in porous electrodes used in high performance batteries, supercapacitors and solar cell applications.

Keywords: Nanopore, Activatin energy, Electric double layer, Finite element simulations

[25]

SIMULATION OF SYNTHESIS, CHARACTERIZATION, INTEGRATION AND EVALUATION OF DOPED SINGLE-WALLED HELICALLY COILED CARBON NANOTUBES IN RECTENNAS

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ABSTRACT

This paper presents the simulation protocols for the synthesis, doping with three classes of dopants (metals, oxides and perovskites), integration and performance evaluation of single-walled helically coiled carbon nanotubes (SWHCNTs) as components of a rectenna. The simulation on the synthesis of the HCNTs is via on-substrate chemical vapor deposition (CVD) involving the pyrolysis of a hydrocarbon over a transition-metal catalysts (Fe, Co, Ni) at high temperatures (Liu and Zhao; 2013). The doping is simulated via wet chemical method, with electron-donors and –acceptors. The physical and morphological properties of the HCNTs can be characterized via Raman spectroscopy and atomic force microscopy (AFM) (Choi and Lee: 2014), while combined fluorescence and Raman scattering measurements are to be used for optical properties. Individual nano-tubes can be isolated as demonstrated by O'Connell et al. for nano-tubes manufactured by the high-pressure Co chemical vapor deposition (HiPCo) process. Moreover, heterogeneous integration of HCNTs via Dielectrophoretic (DEP) assembly, DEP assembly is a simple, low cost, and wafer scale process which is compatible with CMOS technology (Dokmeci, et al: 2008) and also, the SWHCNTs lying on a substrate form numerous hetero-junctions by contacting with the underlying n-Si (Chen, et al: 2013, in addition to nano-lithographic procedures despite being slower, do offer a convenient contacts/junctions/circuit fabrication. The integrated doped SWHCNTs can be evaluated in terms of effectiveness (frequency ranges) and efficiency (percent of signal as rectified output), as components of a nano-rectenna

Keywords: helically coiled carbon nanotubes, chemical vapor deposition, nano-lithography, nano-rectennas

[26]

$MgTiO_3$ AS AN ANODE MATERIAL FOR Li-ION RECHARGEABLE BATTERIES

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ABSTRACT

Lithium Ion Rechargeable Batteries are considered one of the most mature candidates for the electrification of transportation and renewable energy integration due to their long lifetime, high density and low environmental impact. However there is an increasing attention on the cost and the limited lithium supply for large scale energy storage applications. It is believed that the current lithium batteries could further improved and developed 30% - 40% more. Titanium based oxides have attracted much attention because of their low price, environmental friendliness, good cycling performance and most importantly high safety, which is derived from the high insertion voltage. $MgTiO_3$ is one of the most common and commercially available dielectric powders and has been used in electronics application. The properties of a material are determined by its phase composition, which in turn depends on the preparation method. For this study, $MgTiO_3$ particles were synthesized by using both the wet-chemical Pechini method and solid-state ball milling method. The subsequent characterization carried out using XRD and SEM, where electrochemical testing as an anode material was performed with Li metal electrodes in half cells. The potential associated with lithiation were to be 1.14V and 0.76V Vs Li/Li^+ with an initial discharge capacity of 103 mAh/g at C/10 rate for wet synthesized $MgTiO_3$. Lithiation potential for balled milled $MgTiO_3$ was observed to be 1.3V Vs Li/Li^+ with an initial discharge of 63 mAh/g cycled at C/10 rate.

Keywords: Magnesium titanate, anode, lithium, batteries, rechargeable

[27]

MULTIWALL CARBON NAOTUBES FOR EFFICIENCY ENHANCEMENT OF HYBRID TiO_2/POLYMER SOLAR CELLS

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ABSTRACT

Composites of conjugated polymers with nanostructured metal oxides are promising material combinations for cost-efficient solar cells. However, the performance of these cells based on these structures is limited by several factors, including interfacial charge recombination,[1] narrow spectral response of the polymer[2] and poor transport of the dissociated charges in the active layers.[3,4]

This work focuses on strategies to incorporate commercially available Multiwall carbon nanotube (MWNT) in the active layer either by dipping the nanocrystalline TiO_2 electrodes in an ethanolic suspension of MWNT or by mixing MWNT and TiO_2 nanoparticles in a co-solvent for improving the performance of the hybrid polymer/TiO_2 solar cells. Both approaches improve the overall power conversion efficiency by more than a factor of two, mainly due to the significant improvements in short circuit current density and the fill factor. This is attributed due to the enhanced electron lifetime and reduction of recombination. An optimized device with MWNT showed efficiency of 1.47 % under AM 1.5 conditions (100 mW cm^{-2}, 1 sun).

Keywords: solar cell, carbon nanotube, TiO_2, P3HT, exciton

[28]

ACID INTERCALATION OF SRI LANKAN VEIN GRAPHITE TO PRODUCE EXPANDED GRAPHITE BY CHEMICAL OXIDATION

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ABSTRACT

Expanded graphite is a functional carbon material which is useful in many industrial applications such as in rechargeable batteries, fire resistant, flame retardant etc. The objective of this study was to synthesize expandable graphite using highly crystalline Sri Lankan natural vein graphite. The Sri Lankan vein graphite have been categorized into four structurally distinct varieties, namely; shiny slippery fibrous (SSF), needle platy graphite (NPG), coarse flake of radial graphite (CFR), coarse striated of radial graphite (CSF). NPG and SSF were used to continue the study considering their high initial purity of around 99.9%. Chemical oxidation, thermal expansion, ultra- sonication have been reported as capable methods to prepare EG. For this study chemical oxidation was investigated to produce expanded graphite via intercalation of strong acids such as H_2SO_4, H_3PO_4 and strong oxidants such as $KMnO_4$, $K_2Cr_2O_7$, CrO_3 and H_2O_2. The developed samples were then characterized using Fourier transform infrared (FTIR), X-ray diffraction (XRD), D.C (or d.c.) electrical conductivity and scanning electron microscope (SEM) for surface morphology studies. The XRD phase analysis revealed the possibility to expand the inter layer distance of both the SSF and NPG in the range of 0.3-0.9 nm, depending on the oxidizing agent used for the oxidation process. The FTIR analysis confirmed the formation of functional groups such as O-H, COOH, C=O, C-H and C=C during the oxidation process of above two verities. The electrical conductivity measured by the d.c. four probe technique showed a decrease in conductivity by a factor of 10^{-3} when converting graphite into expanded graphite.

Keywords: Intercalation, expanded graphite, chemical oxidation, inter layer distance

[29]

EFFECT OF POLYANILINE EMBEDMENT ON NON-ISOTHERMAL CRYSTALLIZATION KINETICS OF PVDF

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ABSTRACT

Poly (vinylidene fluoride) (PVDF) – Polyaniline (PANI) blends of two different composition were synthesized by chemical polymerization of aniline in a mixture of PVDF and dimethylformamide (DMF).The percentage of PANI as a filler within PVDF was estimated by TGA analysis. Results show that 3.5% and 9 % PANI was synthesized within two different samples. The non-isothermal crystallization behaviors of pure PVDF and its blends with PANI were investigated at different cooling rates (Φ) between 2° and 30°C / minutes by differential scanning calorimetry (DSC). It was observed that the crystallization peak temperature decreased to lower temperature and the exothermic trace became wider when cooling rate increased for PVDF and its composites with PANI. The PANI caused a decrease in crystallization peak temperature and initial crystallization temperature. In addition, the modified Avrami and Mo methods were used to analyze the non-isothermal crystallization kinetics. The results showed that the crystallization rate raised with an increase in cooling rate, however, the PANI embedment within PVDF matrix retarding the crystallization of PVDF. Here it was also observed that the crystallization of the Pure PVDF and PVDF /PANI blends samples used in this work appeared to take place through two stages namely classical primary and secondary crystallization processes. And the nucleation mechanism of PVDF was changed from three dimensional spherical growths to solid-sheaf growth at the primary crystallization stage due to PANI embedment and for secondary stage the mechanism was same (one-dimensional growth) for all samples.

Keywords: Poly (vinylidene fluoride) (PVDF), Polyaniline (PANI), Crystallization Kinetics, Nonisothermal Crystallization, Half Crystallization Time, Jeziorny and Mo methods.

[30]

FABRICATION CHALLENGE OF QUANTUM DEVICES BY MIST CVD WITH HIGHLY-CONTROLLED FLUID TECHNOLOGY UNDER ATMOSPHERIC PRESSURE

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ABSTRACT

Quantum devices, such as quantum well (QW) and topological insulator (TI), have been actively developed for next generation devices recently. Now, molecular beam epitaxy (MBE) and metal organic chemical vapor deposition (MOCVD) are mainly employed for fabricating high quality thin film of quantum devices [1]. This is because the influences of side reaction and disturbance cannot be ignored in non-vacuum process compared with vacuum process. Generally, precursor flow and ambient temperature have to be carefully controlled in order to obtain uniform and high-quality thin films in non-vacuum process. Thus, we have developed a novel CVD process using mist, based on an idea that mist which has both features of gas and liquid is suitable for control of precursor flow and ambient temperature [2]. As results, recently, high-performance oxide TFT with an IGZO/AlOx stack in no way inferior to that prepared by vacuum process has been successfully fabricated by mist CVD. Also, multiple quantum well α-Fe2O3/α-Ga2O3 on sapphire substrate has been successfully fabricated by mist CVD. We would like to report in detail and discuss them in the meeting.

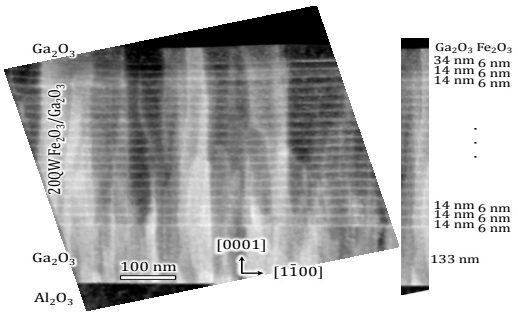

Fig. 1 STEM image of a sample which was stacked twenty times under the conditions of Ga_2O_3 and Fe_2O_3 thin film fabrication by mist CVD.

[1] A.Y. Cho, "Advances in molecular beam epitaxy (MBE)", Journal of Crystal Growth, 111 (1991) 1.

[2] Toshiyuki Kawaharamura, "Physics on development of open-air atmospheric pressure thin film fabrication technique using mist droplets; control of precursor flow", Jpn. J. Appl. Phys., Vol.53 (2014) 05FF08 (7 pages) (10.7567/JJAP.53.05FF08)

Keywords: mist CVD, open-air atmospheric pressure thin film fabrication process, quantum devices

[31]

VALIDITY OF MOLECULAR DYNAMICS IN COMPUTATIONAL NANOSCIENCE

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ABSTRACT

Over a century ago, Planck to explain blackbody radiation abandoned classical physics in favor of frequency dependent quanta of energy to give birth to the field of quantum mechanics. No longer was the heat capacity of the atom independent of the resonant frequency of the confining structure. Today, nanotechnology has renewed interest in quantum mechanics because MD simulations in computational nanoscience are based on the questionable assumption of classical physics that the atom in nanostructures has heat capacity. MD stands for molecular dynamics. In bulk materials, the continuum is simulated in MD by imposing PBC on a small ensemble of atoms, the atoms always having heat capacity. PBC stands for periodic boundary conditions. Classical MD simulations of the bulk under PBC are valid because atoms in the continuum do indeed have heat capacity. However, classical MD is invalid if applied to nanostructures that are discrete and unambiguously not periodic. Invalid MD simulations by quantum mechanics in the literature are illustrated for nanocars, linear motors, and protein folding. Valid MD simulations by quantum mechanics are presented for the stiffening of nanowires in tensile tests to allow a direct comparison of differences with invalid classical MD solutions.

Keywords: Atom heat capacity, classical physics, quantum mechanics, molecular dynamics, nanowires

[32]

ANALYZING THE MULTI-RESONANCE PROPERTY OF GRAPHENE NANOANTENNA

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ABSTRACT

The graphene nanoantenna was modeled and its properties were analyzed by finite difference time-domain simulations. The field enhancement and radar cross-section of the antenna for different chemical potentials were calculated, and the effect of the chemical potential on the resonance frequency was analyzed. It is shown that large modulation of resonance peak and intensity in log-periodic nanoantenna can be achieved via turning the chemical potential of graphene. The multi-resonance properties of the antenna have great potential for nanoscale highly nonlinear response and optical sensing.

Keywords: nanoantenna, graphene, multi-resonance, field enhancement

[33]

ONE–POT SINGLE–STEP, TEMPLATE FREE SYNTHESIS OF MESOPOROUS SPHERICAL COMPOSITE METAL OXIDE NANOPARTICLES IN SUPERCRITICAL ALCOHOLS

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ABSTRACT

Recently, size and morphology controlled metal oxide nanoparticles (NPs) received much attention due to their unique properties such as large surface area, mono disperse nature, mechanical and thermal stability and effective recovery. Physical, chemical, and electrical properties of metal oxide NPs can be effectively tuned by nano-level mixing of several metal oxides where stoichiometry, nano-structure,and morphology of NPs are important factors. Mixed metal oxide nanomaterials are prepared by many methods including sol-gel, precipitation, and template synthesis, etc. However, multi-step reactions that include calcination as well as long reaction time are usually required. Previously, we reported one-pot single-step, template free synthesis of micro/mesoporous spherical TiO_2, ZnO, ZrO_2, and CeO_2 nanoparticles called **mi**cro/**me**soporously **a**rchitected roundly **i**ntegrated **me**tal **o**xides (MARIMOs). In our method, an alcoholic solution of metal alkoxide or metal salt with carboxylic acid is heated up to a temperature above the critical point of the alcohol. In this paper, we report on the synthesis of CeO_2-ZrO_2, TiO_2-Al_2O_3, and TiO_2-ZnO MARIMO composite NPs by single-step one-pot method. CeO_2-ZrO_2 MARIMO composite NPs were synthesized by treatment of precursor solution containing a mixture of Ce^{3+}/Zr^{4+}. Homogeneous, domain and core-shell type NPs were obtained by changing the precursor, heating rate, carboxylic acid, reaction temperature and solvent, in supercritical alcohols. TiO_2-Al_2O_3 and TiO_2-ZnO hollow MARIMO composite NPs were synthesized by slow heating (5.4 °C/min) of precursor solutions containing phthalic acid and $Ti(O^iPr)_4$/$Al(O^iPr)_3$ or $Ti(O^iPr)_4$/$Zn(OCOCH_3)_2{\cdot}2H_2O$, respectively. The atomic composition of MARIMO composite NPs were controlled by changing the metal precursor mixing ratio.

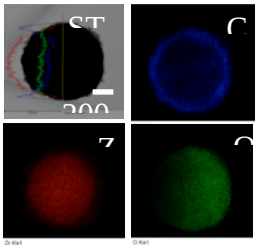

Fig. 1 EDX mapping images of ZrO_2@CeO_2 core-shell NPs.

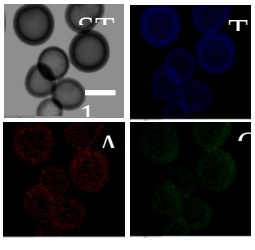

Fig. 2 EDX mapping images of TiO_2-Al_2O_3 hollow MARIMO NPs.

Keywords: one-pot synthesis, homogenous, domain, core-shell, hollow spherical nanoparticles

[34]

INTERACTION OF CERIUM OXIDE NANOPARTICLES WITH BOVINE SERUM ALBUMIN

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ABSTRACT

Adsorption of bovine serum albumin on cerium oxide was studied, the influence of various parameters was followed. The simultaneous measurements of the bovine serum albumin adsorption and zeta potential determination of the (adsorption) suspensions were carried out. Increasing of pH led to decrease of zeta potential and decrease of adsorption capacity of cerium oxide nanoparticles. The samples of nanoceria with positive zeta potential adsorbed more bovine serum albumin on the other hand, the samples with negative zeta potential showed little or no protein adsorption. The influence of temperature on adsorption behavior of BSA has been studied. The adsorption from aqueous solutions was carried out at temperatures 22, 28, 34 and 40 ^{o}C. The adsorption capacity of BSA on the ceria was found to increase with rise in temperature for all studied samples. Linear as well as nonlinear regression of experimental data confirmed that adsorption process can be described using Langmuir adsorption theory of monolayer coverage. Thus, equilibrium constant of adsorption was possible to calculate from Langmuir binding constant b. Further, from the dependence of b constant on temperature, thermodynamic parameters as enthalpy ΔH_{ads}, entropy ΔS_{ads} and Gibbs energy ΔG_{ads} were evaluated. Calculated thermodynamic parameters indicate that the adsorption of BSA on the ceria is endothermic ($\Delta H_{ads} > 0$) and non-spontaneous ($\Delta G_{ads} > 0$) process. The kinetics of adsorption fitted best to pseudo-second-order.

Keywords: cerium oxide, bovine serum albumin, isotherms, kinetic, thermodynamic

[35]

POLYCAPROLACTONE NANOFIBROUS SCAFFOLDS LOADED WITH AMIDE-AMINE FUNCTIONALISED CARBON NANOPARTICLES AND THEIR EFFECT ON 3T3 MOUSE FIBROBLASTS

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ABSTRACT

In this work, activated carbon nanoparticles (CNPs) were functionalized with amide-amine groups varying in alkyl chain lengths and the number of amine groups. Four types of composite scaffolds were prepared via sputtering CNPs into electrospun polycaprolactone (PCL) nanofibers: three of them with three types of functionalized CNPs and one with plain activated CNPs. Plain PCL nanofibers and the composite nanofibrous scaffold with plain activated CNPs were used as comparative samples. The structure of the materials was studied using scanning electron microscopy. The specific surface area of the particles and scaffolds was measured via nitrogen and krypton adsorption and calculated from Brunauer-Emmet-Teller equation. Cytocompatibility of the materials was tested using 3T3 mouse fibroblasts. Cell viability and proliferation was measured by MTT assay on days 1, 3, 8 and 14 after cell seeding. The samples were then stained using fluorescent dyes and examined via fluorescence microscopy (FM). During the FM analyses, all scaffolds containing CNPs underwent degradation when irradiated with either green or blue light, which could be used for selective degradation. However, the mechanism of the degradation has not been fully explained yet. The scaffolds with functionalised CNPs showed better cytocompatibility than the scaffold with plain CNPs.

Keywords: nanofibers, carbon nanoparticles, functionalization, cytocompatibility, 3T3, PCL

[36]

PHYTOFABRICATION OF SILVER NANOPARTICLES USING *RICCIA* SP.

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ABSTRACT

Plant-mediated synthesis is a cost effective eco-friendly method to produce silver nanoparticles (Ag NP). In this study, ethanolic plant extracts of Riccia sp. were used as the reductive source while low concentrations of $AgNO_3$ from 1- 10 mM were taken as the source of silver. Formation of Ag NP was observed by a colour change from light-green to reddish-brown and confirmed by Energy Dispersive X-ray (EDX) measurements. An absorption peak resulting from Ag NP was obtained from the UV-visible spectrum at a wavelength of 415 nm. UV-visible spectroscopic studies during 38 days after the reaction process indicated a gradual disappearance in chlorophyll peak (437.5 nm) and appearance of new peak at 400 nm due to removal of chelated Mg^{2+} from porphyrin ring in chlorophyll due to the mild acidity of the medium. Resulted Ag NP had an average size of 86 nm which was examined through the Scanning Electron Microscopic (SEM) images. Microbial susceptibility to the Ag NP was studied for all concentrations of $AgNO_3$ through the well diffusion method and a highest inhibition zone was obtained for 7 mM of $AgNO_3$.

Keywords: Riccia sp., silver nanoparticles, phytofabrication

[37]

REVIEW OF HUMAN TOXICOLOGY OF ENGINEERED NANOPARTICLES

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Research Wormhole, Canada

ABSTRACT

The increasing use of Engineered Nanoparticles in medical applications as well as other industries warrants the assessment of toxicity that can be induced by these Nanoparticles in humans. This review focuses on studies published from 2013-2015 that report toxicity of Magnetic, Ag and ZnO Nanoparticles in humans and human cell lines. This review will look at recent evidence to determine what factors greatly influence the toxicity profile of engineered Nanoparticles and which Nanoparticles can be considered safe for use in medical applications involving humans. In addition to it the review will discuss briefly the mechanisms through which Nanoparticles cause toxicity focusing on generation of Reactive Oxygen Species (ROS) and induction of Oxidative stress within cells leading to DNA damage. This review also presents a two-way simple classification system for NP-induced toxicity in human cell lines.

Keywords: Cancer cells, DNA damage, Engineered Nanoparticles, Magnetic Nanoparticles, Silver Nanoparticles, Toxicology, Zinc Oxide Nanoparticles

[38]

PEG-b-PVPA-STABILIZED MAGNETIC NANOPARTICLES FOR BIOMEDICAL APPLICATIONS

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ABSTRACT

Magnetic nanoparticles (MNP) are highly effective contrast agents in magnetic resonance imaging (MRI) (Niemirowicz et al. Adv. Med. Sci. 2012, 57(2), 196). Particles used for this purpose usually consist of a magnetic core (e.g. iron oxides) and a surface coating (primarily polymeric). A carefully designed polymer shell prevents agglomeration, prolongs the circulation of nanoparticles in the system and enhances their biocompatibility (Immordino et al., Int J Nanomedicine. 2006, 1(3), 297). A critical feature of polymer-stabilized MNPs is the nature of the link between the polymeric shell and the magnetic core. This should be as strong as possible in order to prevent dissociation of the particles after administration. Phosphonated polymers, which bind very strongly to a wide range of inorganic substrates are thus promising candidates for MNP stabilization.

Herein, is presented the synthesis of well-defined double hydrophilic poly(ethylene glycol)-b-poly(vinyl phosphonic acid) (PEG-b-PVPA) block copolymers using reversible addition-fragmentation chain transfer (RAFT) polymerization as well as the in situ formation of iron oxide nanoparticles in the presence of these copolymers. The ability of the phosphonated copolymers to bind to, and stabilize, superparamagnetic iron oxide nanoparticles is discussed.

This project has received financial support from the Ministry of Science and Higher Education, Poland, and Embassy of France in Poland, Polonium Program 2015/2016.

Keywords: polymer/inorganic nanohybrids, magnetic nanoparticles, RAFT polymerization

[39]

ADIABATIC POLARON HOPPING CONDUCTION AND GRIFFITHS PHASE IN ELECTRON DOPED $CA_{0.85}DY_{0.15}MNO_3$

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ABSTRACT

We have studied temperature and magnetic field depended resistivity and magnetization of electron doped polycrystalline $Ca_{0.85}Dy_{0.15}MnO_3$. The resistivity ρ(T) exhibits semiconducting behavior down to lowest temperature measurement 5K even on application of magnetic field. The conduction mechanism has been described through hopping model: small polaron hopping (SPH) above 118K (144K) and variable range hopping (VRH) below 40K (56K) for H = 0T (for 10T). A parallel combination of SPH and VRH has been considered to depict ρ(T) between 40K < T < 118K for H = 0T. Magnetization study shows the compound undergoes paramagnetic to ferromagnetic second order phase transition. The non-linear behavior of temperature dependent inverse susceptibility above Currie temperature has been interpreted as the formation of a Griffiths singularities arising due to the presence of magnetic ordered cluster within the paramagnetic matrix. Origin of the observed Griffiths phase has been correlated with the lattice strain at grain boundary.

Keywords: Electron-doped manganites, Hopping, Magneto-transport, Magnetization

[40]

IMPACT OF CERIUM NANOPARTICLE IN ENHANCING THE SENSITIVITY OF FRICKE GEL DOSIMETER FOR QUALITY ASSURANCE IN RADIOTHERAPY

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ABSTRACT

Gel dosimetry is gaining popularity in the field of Medical Physics that applies it as a dose measuring tool for quality assurance in radiotherapy treatment plans. Gel dosimeters are tissue equivalent and provide three dimensional information of the radiation dose absorbed, when irradiated. Since advances in technology have escalated the complexity in treatment delivery, the radiation delivered by the treatment unit requires verification before it can be administered to patients. However the sensitivity of the gel dosimeters to radiation dose is also important in this scenario. Fricke gel dosimeter has been the widely used dosimeter ever since the development of gel dosimetry in 3D form in a gelatin matrix by Gore et al. Nanotechnology has invaded every field from electronics to medicine in recent days. Since nanoparticles are promising entity in enhancing the response of gel dosimeters to radiation, the feasibility of incorporating cerium nanoparticle (25 nm particle size) into the gel dosimeter has been studied. Different concentrations of nanoparticles were prepared and added to the present recipe of Fricke gel dosimeter. Increase in response to dose was observed in the nanoparticle added gel dosimeter. However the dose response was found to be non-linear as the concentration of cerium nanoparticle was increased to 0.8 mM. The results suggest that the optimal concentration of cerium nanoparticle may be used to improve the sensitivity of the Fricke gel dosimeter. The modified Fricke gel dosimeter with cerium nanoparticle seems to be a promising tool for quality assurance in radiotherapy.

Keywords: Fricke, cerium, nanoparticle, sensitivity, dose, quality-assurance, radiotherapy, gel

[41]

COCONUT SHELL AS A CARBON SOURCE FOR CARBON NANOMATERIAL SYNTHESIS

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ABSTRACT

Carbon related nanomaterials are the subject of many research articles due their wide range of applications such as in drug delivery, gene therapy, hydrogen storage devices and in water treatment methods. Carbon nanomaterials have been synthesized using range of precursors namely acetylene, methane, carbon monoxide using metal catalysts. Most of these synthesizing method include high temperatures and requires sophisticated technologies and therefore very costly. On the other hand Granular Activated Carbon (GAC) is prepared using controlled burning of natural organic biomaterials. Of this coconut shells are the substance that use in Sri Lanka as it is commonly available waste material. In our investigation the possibility of using the waste gas, emitting during the formation of GAC, as the precursor material in synthesizing carbon based nanomaterials was studied. In this study the chemical vapour deposition method was adopted. Briefly, pieces of coconut shells were placed inside the tube furnace and were heated to 750 °C under argon gas with the catalyst of iron. The product obtained on the catalyst was purified using nitric acid and subjected to characterization. Scanning Electron micrograph shows the presence of some carbon deposits. Product formed is not amorphous and contains some crystalline nature even though could not categorized under fullerene or carbon nanotubes. Yet it is a promising experiment to use the byproduct of the GAC preparation as a precursor material in synthesizing carbon nanomaterials such as CNT with more modifications of the conditions used.

Keywords: Carbon, nanomaterials, coconut shells, chemical vapour deposition, GAC

[42]

SMALL BUT STRONG AND GREEN: MULTI WALL CARBON NANOTUBE BASED HYBRID NANOCOMPOSITE FOR AIRCRAFT APPLICATIONS

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ABSTRACT

The better mechanical properties of multiwallcarbon nanotubes (MWCNT) make them the filler material of choice for composite reinforcement. This research was to develop MWCNT-GO (Graphene Oxide) hybrid to reinforce geopolymer nanocomposite which was modified with nano inorganic material. The hybrid material consist with different compositions such as 1:1, 1:2, 1:3 and 2:1 ratios of GO and MWCNT respectively. GO was synthesized by flake Bogala graphite. MWCNT was purchased. The characterizations for the synthesized GO was done to verify the formation of GO. After addition of respective amount of GO and MWCNT in to reagent bottles separately, distilled water was added to each reagent bottle and allowed to ultrasonicate for 2 h. Then, the formed GO-MWCNT hybrid was separated and washed with water, dried overnight. Different compositions of so called hybrids were mixed separately with the optimized composition of geopolymer (GP) and nano magnesium hydroxide based composite and samples were prepared with the use of mould. Characterizations were done for the hybrid material, GO, MWCNT and GO-MWCNT hybrid modified GP based composite using TGA, SEM, XRD and FTIR. Tensile strength measuring test was carried out using Tensometer. According to the better results this can be used as a most promising processing method for mechanical reinforcement for interior aircraft applications in future.

Keywords: Multi Wall Carbon Nanotubes, Graphene Oxide, GO-MWCNT hybrid, aircraft, green

[43]

USE OF NANOTECHNOLOGY IN DEGRADATION OF PLASTIC WASTE PRODUCTS

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ABSTRACT

The environmental accumulation of plastic is a huge problem due to its low degradability. There are solutions to this problem such as reusing, recycling and use of biodegradable plastics. However, a complete solution to this problem has not yet been achieved. In this research, a nanotechnology solution has been applied. The effect of ZrO_2 nanoparticles with respect to the TiO_2 nanoparticles was studied. TiO_2 nanoparticles were synthesized by sol gel method and ZrO_2 nanoparticles were synthesized by sonochemical method. The prepared TiO_2 and ZrO_2 particles were characterized using FTIR, XRD, UV visible, EDX, SEM and TEM. Both particles were in approximately 50 nm in size. TiO_2 nanoparticles were tetragonal and in the anatase phase. ZrO_2 particles were tetragonal and nano porous. The application of these particles to polyethylene and Polypropylene were performed using nanoparticle suspensions in the THF medium. The degradation of plastic was studied by the chemical changes using FTIR and morphological changes using SEM. The concentration optimization and the time optimization were conducted in the laboratory conditions under the sun simulator. Polyethylene and Polypropylene were treated under the sun simulator as well as under the real sun light. In both treatment conditions, it was found that at 95% confidence levels, there is a significance difference in degradation of plastics. ZrO_2 nanoparticle suspension treated Polyethylene and Polypropylene showed higher degradation than the TiO_2 nanoparticle suspension treated samples.

Keywords: ZrO_2, TiO_2, sol gel method, sonochemical method, tetragonal, anatase, Nano porous

[44]

GREEN SYNTHESIS, CHARACTERIZATION AND ANTIMICROBIAL ACTIVITIES OF SILVER NANOPARTICLES USING *PTEROCARPUS MARSUPIUM* LEAF EXTRACTS

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ABSTRACT

A green synthesis route for the production of silver nanoparticles (AgNPs) using ethyl acetate and methanol extracts from Pterocarpus marsupium (PM) is reported in the present investigation. The AgNPs were synthesized by reacting PM as a reducing agent with $AgNO_3$. The qualitative and quantitative phytochemical analysis of PM leaf extracts was studied. The antioxidant studies by reducing power assay method was carried out. The synthesized PM AgNps were characterized using UV–visible spectroscopy (UV-vis), Fourier Transform Infrared spectroscopy (FTIR), powder X-ray diffraction (XRD), transmission electron microscopy (TEM) and Atomic force microscopy (AFM). The PM AgNPs were found to be about 60 nm in size, mono-dispersed in nature, and spherical in shape. The formation and the crystalline nature of the synthesized PM AgNPs were confirmed by XRD and TEM analyses. Further, these characterized PM NPs were found to exhibit significant antimicrobial activity against bacterial and fungal strains when compared with the standard chloramphenicol.

Keywords: silver nanoparticles; Pterocarpus marsupium, TEM, AFM, XRD, antimicrobial activity

[45]

POLYANILINE NANO WHISKERS GRAFTED CONDUCTIVE COTTON TEXTILES

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ABSTRACT

On spot interfacial synthesis of polyaniline (PANI) nano whiskers on cotton fabrics was carried out in this study. Polyaniline nano whiskers were synthesizesd from aniline using solvent base polymerization with the cotton fabric in the reaction medium. The grafted cotton fabric was characterized for its electricity conductive property. Aniline was polymerized using Ammoium Persulphate with different HCl acid concentration leading to acid doped polymerization of poly aniline on the cotton yarn surface. Higher H^+ concentration in the medium showed improved electricity conductive property on the grafted fabric. Cotton fabric was analyzed for its morphology using SEM and AFM which showed the presence of nano whiskers on the yarn surface. FTIR data showed the presence of functional groups of polyanilineon the treated fabric. Plasmon excitation in the near infrared region was observed using UV-Vis spectrophotometer for the PANI/Cotton fabric. XRD analysis of the treated PANI/Cotton fabric also revealed the nano whiskers of PANI presence on the cotton fabric.

Keywords: Cotton, Polyaniline, electricity, conductive, whiskers, doped

[46]

MAGNESIUM OXIDE- ACTIVATED CARBON NANOCOMPOSITES FOR GAS PURIFICATION APPLICATIONS: A STUDY OF STRUCTURAL CHARATCERISTICS AND THE SCALABLE ADSORPTION CAPACITY

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ABSTRACT

A composite of nano-magnesium oxide (MgO) and granular activated carbon (GAC) with remarkable H_2S adsorption capacity is reported here. The synthesis route follows the impregnation of nano-MgO on GAC using an in-house developed method. Further, with the objective of challenging the commercially existing H_2S scrubbers at present, several composites with the increasing MgO-concentration on the composite were prepared. The surface morphology of the nanocpmposites were characterized by the Scanning Electron Microscopy (SEM). The MgO nanoparticles were confirmed to be of the size range of 40-80 nm. Further chemical and structural details were extracted using X-ray Diffraction (XRD) and thermogravimetric analysis (TGA) techniques. The surface area and the pore structural characteristics of the nanocomposites were analyzed using the N_2-BET isotherms. The BET surface area of the nanocomposites tend to decrease slightly, with the increasing nanomaterial concentration on GAC. The pore structural data further confirmed occupation of nanomaterial by macro and measopores of GAC to a greater extent. The MgO composition on each nanocomposite was determined by the ICP-OES analysis. The H_2S adsorption capacities were tested, following the ASTM D6646 method. The composite with the highest MgO concentration has shown to have a H_2S adsorption capacity, which is comparable to those with highest H_2S adsorption capacities recorded in literature up-to-date. However, the economic feasibility, the ease of preparation and the scalability of this nanocomposite make it a superior solution for H_2S removal in large scales as well. In addition, the scalability of the H_2S adsorption capacity, which could be readily fine-tuned just by adjusting the nano-MgO composition on GAC, makes it a potential solution in many commercial applications ranging from face masks to industrial gas scrubbers.

Keywords: nano composite, activated carbon, magnesium oxide, hydrogen sulfide, adsorption

POSTER PRESENTATIONS

[01]

COMPARISON OF SURFACE MORPHOLOGY OF SMOOTH VERSUS POROUS MICROFIBRES MADE FROM POLY(L-LACTIDE)

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ABSTRACT

Nanofibers prepared by electrospinning have a plenty of extraordinary properties applicable in many industrial fields. Large specific surface area is main advantage of nanofibers. Usually the surface of nano/microfibers is almost smooth. Through the process parameters it is possible to obtain porous surface of individual fibres which leads to the pronounced increase in surface area. Their morphology can be affected not only by the spinning process parameters but also by the composition of polymer solution and by the used solvents. Porous nanofibers may have a variety of uses in numerous applications because of the show even larger specific surface area compared to smooth fibers. Porous nanofibers can provide better adhesion for the cells, more rapid degradation time, etc. Porous biodegradable Poly(l-lactide) (PLLA) fibers were produced using the electrospinning method from the needle. One of the possible method to evaluate the increase of the surface area is HR-SEM image analysis. The present work demonstrates the usage of new method enabling the assessment of porosity contribution to increase in micro/nanofiber surface area.

Keywords: porous nanofibers, electrospinning, surface morphology, micro/nanofibers, structure

[02]

NEW POLYMERIC NANOHYBRIDS SYNTHESIZED VIA CONTROLLED RADICAL POLYMERIZATION

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ABSTRACT

Materials composed of polymers and nanostructures such as magnetic nanoparticles (MNP) or carbon nanotubes (CNT), due to combination of their properties (chemical/mechanical/electric/magnetic) hold significant promise for the development of many areas of science and industry (Purushotham and Ramanujan, Acta Biomater. 2010, 6, 502; Sahoo et al., Prog. Polym. Sci. 2010, 35, 837). Controlled radical polymerization (CRP) is a tool that allows precise and easy control of the chemical composition and structure of polymers. This point is essential to control some of the polymer/inorganic nanohybrids properties i.e. solubility or specific interactions (Beja et al., Prog. Polym. Sci. 2011, 36, 845). RAFT/MADIX (reversible addition-fragmentation chain transfer/macromolecular design via the interchange of xanthates) polymerization is one of the types of CRP which uses xanthates (dithiocarbonates) to mediate polymerization via reversible chain-transfer process (Destarac et al., Macromol. Chem. Phys. 2002, 203, 2281).

Herein, we present formation of polymer-CNT or polymer-MNP nanohybrids via RAFT/MADIX technique using commercially available monomers as well as synthesized bifunctional (polymerizable and complexing) ones. ‘Grafting from’ strategy of preparation of these materials is discussed.

This project is financially supported by the National Science Centre, Poland, grants no. 2014/13/N/ST5/01563 (KHM) and 2011/03/B/ST5/02691 (AZW).

Keywords: nanohybrids, carbon nanotubes, magnetic nanoparticles, RAFT/MADIX polymerization

[03]

OPTIMAL TAPERING OF SILICON RAMAN AMPLIFIERS

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ABSTRACT

We present a numerical method for calculating the optimum profile of effective mode area (EMA) that provides the largest signal gain for a given value of the EMA and pump and signal powers at the input of a silicon Raman amplifier. The implementation of the method requires numerical solution of a system of nonlinear differential equations, which contains twice as many equations as the original system describing the Raman amplification in a constant cross-section waveguide. We find the optimum EMA profile that can be realized by tapering the width of a waveguide, and show that, if the reflections at the end facets of the waveguide are neglected, then the same maximal signal gain can be achieved by a simple linear tapering of the waveguide. We also apply the developed method for optimizing the axial EMA profile of continuously-pumped silicon Raman amplifiers in the case when the reflections at the end facets are not negligible. In this case a boundary-value problem involves eight first-order coupled differential equations. In this case, we reveal that the optimized linear tapering of the waveguide is able to provide almost the same output signal power as the optimal tapering with an irregular shape.

Keywords: silicon photonics, silicon Raman amplifiers, nonlinear optics

[04]

EFFECT OF ACID ON NANOVANADIUM OXIDE

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ABSTRACT

The facile hydrothermal synthesis of two vanadium oxide nanostructure compounds (**1**) and (**2**) were synthesized using the 2:1:400 mol ratio of ammonium metavanadate (NH_4VO_3), zinc acetate dihydrate [$Zn(CH_3COO)_2{\cdot}2H_2O$] and water in the present of hydrochloric for compounds (**1**) and acetic acid for compounds (**2**) to adjust the pH of the solution to 3. The structure, morphology and composition of the as-synthesized products were characterized by field emission scanning electron microscopy (SEM), powder X-ray diffraction (XRD), thermogravimetric analysis (TGA) and differential thermal analysis (DTG) measurement and fourier transform infrared spectroscopy (FT-IR). SEM images show the nanobelt morphology of (**1**) and flower like nanobelt morphology of (**2**) with length of 3–6 micrometers in (**1**) and several tens of micrometers in (**2**) respectively. Their XRD patterns reveal the set of 1D vanadium oxide nanobelts, characteristic of (00l) reflections. Based on FT-IR, XRD and TGA results, the chemical formulae of the as-obtained nanobelt (**1**) and flower like nanobelt (**2**) are the family of $NH_4V_4O_{10}\bullet\ nH_2O$.

Keywords: hydrothermal synthesis, 1 D nanostructure, vanadium oxide nanobelt, flowerlike nanobelt, acid effect

VIRTUAL PRESENTATIONS

http://nanoconference.co/2015/virtual-icnsnt-2015/

[01]

ZINC OXIDE NANOWIRE: DEVICE FABRICATION AND OPTICAL PROPERTIES

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ABSTRACT

Zinc Oxide (ZnO) nanowires with hexagonal structure were successfully synthesized by chemical bath deposition technique. The obtained nanowires were characterized by X-ray diffraction (XRD), energy dispersive X-ray analysis (EDX) and spectrophotometer. The XRD pattern of the samples revealed that ZnO nanowire has a hexagonal crystallite structure and further showed that the crystallite size supported by Scherrer's equation increase with increasing annealing temperature (0.536 nm, 0.541nm, 0.557 nm at 100^0C, 150^0C and 200^0C) respectively. The EDX analysis revealed the elemental compositions of samples and confirmed the presence of Zn and O. The results of the optical analysis showed that ZnO nanowire has high absorbance in the ultraviolet and infrared regions with high transmittance in the visible region. The results further revealed that the absorbance of the nanowire increase with increasing annealing temperature. Its high absorbance in the ultraviolet region suggest that it can be use as solar harvester for trapping solar energy for photovoltaic panel which is capable of converting sunlight radiation directly to electricity for commercial or industrial purpose.

Keywords: Nanowire, chemical bath deposition, annealing temperature, crystallite, hexagonal

[02]

COMPARATIVE ANALYSIS OF PHYSICAL AND MECHANICAL PROPERTIES OF PATCHES FOR OPERATIONS IN GREAT VESSELS

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ABSTRACT

Materials Researched

The materials utilised in this comparative study included samples differing in their properties according to the type of weaving and porosity, with that of Lintex being warped, Sever wovern, both porous in nature, and B. Braun warped and saturated in gelatine; and according to they chemical composition, all three being polyester in nature, with that of Sever possessing a modified Lavsan finish.

Research Methods

The research scheme implemented determined the physical and mechanical, as well as morphological properties of the studied vascular patch samples, through several in vitro experiments conducted to determine the individual sample's thickness, mass, density, strength, stiffness, porosity, and surface density. These measurements were conducted in accordance with several GOST recognised parameters; and were analysed to produce statistical reliable morphometric data.

Results & Discussion

The study of the physical and mechanical properties of the studied vascular patches, ascertained that the sample produced by Lintex possesses the optimal surface density, at 0.036 ± 0.02 g / cm2; weight, at 0.03 ± 0.0009 g (similar to that of Sever); volume porosity, at 44.6 ± 0.02%; as well as rigidity.

Taking a second position come the sample produced by Sever, possessing the optimal thickness, at 253 ± 3.71 mm; and breaking strength, at 296.8 ± 0.36 N / cm. This study did not identify the sample produced by B. Braun to possess any superior properties when compared with its competitors.

Conclusion

From the results acquired, the vascular patch sample produced by Lintex was identified as possessing the greatest number of advantageous properties, which not only provide for the viability of the prosthesis; however also facilitate the integration process of these patches into the vascular wall, thereby minimising the tissue reaction of the organism to the implantation.

Keywords: vascular prostheses, vascular patch, vascular implant, polyester, polyethylene terephthalate, strength, hardness, porosity

[03]

RESEARCH OF NANORELIEF AND ADHESION FORCE OF POLYMER MEMBRANE

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ABSTRACT

One of the impotencies in abdominal surgery is adhesive disease of peritoneum, from 10.4-67% after first laparotomy, and up to 93% in second laparotomy. One of the perspectives to solve this problem is to use biodegradation polymeric membranes, that have been developed like LLC "Lintex". A very important quality of membrane is the adhesion to damaged organs. It was used the method of atomic force microscopy to solve this problem in "IPI interdisciplinary nanotechnology center" in NT-MDT Solver Next, using cantilever NT-MTD NSG01-A. In the course of a series of studies it was found that the different polymers for various methods of treating have different microtopography, and different degree of adhesion. The high level of roughness with a maximum contour deviation was found in samples of number 74 MN R (187,71 nm.) and 76 MN R (283,29 nm.). High adhesion strength was found in samples of number 70 MN R (49,37±3,21 nN.), 71 MN R (44,22±5,28 nN.), 74 MN R (64,92±7,53 nN.). After the interaction with isotonic sodium high degree of adhesion was found in a sample number 70 MN R (98,23 ±7,12 nN.), While in the number of samples 76 MN R, 77 MN R, 78 MN R, 79 MN R and the number of 80 MN R it was arisen sticking elements, indicating an increase in the degree of adhesion of the implant after contact with an isotonic solution. From the data obtained it is concluded that the degree of adhesion depends on nanorelief state of membranes.

Keywords: nanotechnology, medicine, surgery, polymer, membrane, biodegradation, adhesion, nanorelief

[04]

NUMERICAL MODELLING OF ZINC OXIDE NANOWIRE ANTI REFLECTIVE COATINGS

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ABSTRACT

Zinc Oxide (ZnO) nanowire anti-reflective coating is modelled using wave optics methods, solving the Maxwell's equation numerically using commercially available finite element software. The model is used to investigate the effectiveness of the anti-reflective coating at air-glass interface. ZnO nanowires of both uniform and tapering cross sections are investigated, and reflection coefficient is calculated for incident angles of 0-90 degrees. Simulations are done for the wavelength range 300-900 nm considering the wavelength dependent optical properties of ZnO nanowires. With average diameter of 50nm and height of 450nm the simulated nanowires confirm to dimensions of low temperature hydrothermally grown nanowires. At normal incidence, both types of nanowires can reduce the reflections to about 2% while without an anti-reflection coating reflections amount to about 5% at air-glass interface. Tapering nanowires which take in to account the graded refractive index effect due to density gradient of the nanowires are far more effective at higher incident angles. Tapered nanowires keep the reflections well below 10% for all the practical angles of incidences whereas without the anti-reflection coatings the reflections reach as high as 50%. The variation of anti-reflective properties across the wavelength range with nanowire height and nanowire density is calculated for optimizing the anti-reflective coating for a particular wavelength range. In addition to anti-reflective properties, the UV blocking property of the nanowire array is also presented. With wavelength range for which calculations are done including the absorption band of for most commonly used absorbers for organic solar cells, the simulated anti-reflection coating is very well suited for organic solar cells.

Keywords: ZnO Nanowire, anti-reflective coating, finite element method, numerical modelling