



THE 1st UKM - ISESCO - COMSATS INTERNATIONAL WORKSHOP ON NANOTECHNOLOGY FOR YOUNG SCIENTISTS IWYS2016

“INSPIRING INNOVATIONS”

Abstract e-Book

Main organizer: UKM

Co-organizers: ISESCO & COMSATS

In collaboration with MASS



Commercial partnerships



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Opening Remarks by Vice Chancellor of Universiti Kebangsaan Malaysia

Assalamualaikum wbt. and warm greetings.

Welcome to The 1st International Workshop on Nanoscience for Young Scientists 2016 (IWYS2016). IWYS offers a multitude of renowned international keynote speakers, invited speakers, young scientists, posters and commercial exhibition to discourse the latest developments and inventions in the fields of nanotechnology.

Nanotechnology is a tiny in scale but infinitely immense in possibility. Nanotechnology is probably the most promising field of science today. It is a fascinating field that holds promise for our future welfare and well-being for today's development. The developments in nano are captivating and understanding knowledge that provides you with interesting scientific area in physics, chemistry and biology.

The exploration of its application in the real world has to take a serious action as well as the concept. As we know, nanotechnology has applications in almost every area of life especially health, sustainable energy, electronic, processed materials and space. Most benefits of nanotechnology depend on the fact that it is possible to tailor the essential structures at the nanoscale to achieve specific properties, thus greatly extending the performance.

I would like to thank everyone that makes this workshop happen smoothly and successfully. Thanks to the following companies for their sponsorship: Bruker (M) Sdn Bhd, Gaia Science, Alpha Instrument Supplies & Services Sdn Bhd, Vistec, RGS Corporation Sdn Bhd, Interscience Sdn Bhd, Pure Dimension, Prisma Instrument, Globe Science, Ziqrah Scientific and others. In addition, thanks must be given to the organizers, UKM and co-organizers, COMSATS and ISESCO whose work hard planning this workshop. I would like to thank all participants, speakers and exhibitors that joined the workshop and have a great time!

Thank you.

Prof. Datuk Dr. Noor Azlan Ghazali
Vice-Chancellor
Universiti Kebangsaan Malaysia



Remarks by Chairman of IWYS2016

Praises to Allah for His blessings in giving the opportunity to Universiti Kebangsaan Malaysia (UKM) to host The 1st UKM-ISESCO-COMSATS International Workshop on Nanotechnology for Young Scientists (IWYS2016). This workshop is jointly organized by the Islamic Educational, Scientific and Cultural Organization (ISESCO) and Commission on Science and Technology for Sustainable Development in the South (COMSATS) in collaboration with the Malaysian Solid State Science and Technology Society (MASS). On behalf of all committee members, I would like to welcome all delegates with a hope that all may benefit from this workshop.

This workshop will bring together academicians, researchers and industry players for knowledge sharing in the various transdisciplinary areas of nanotechnology. IWYS2016 serves as a good platform for all participants to meet and to exchange ideas. The main objective of the workshop is to expose and provide valuable experiences for young researchers in nanomaterial field to keep up with the current, cutting edge and potentially leading research topics in the near future. It will also help the participants to identify potential collaboration among the participants. The topics covered by papers presented by the expert Resource Persons as well as the invited speakers and presenters reflect the current and future trends that require transdisciplinary initiatives in search of ideas and solution towards nanotechnology research development. We hope that the ensuing discussions and networking will benefit all in their future research.

I would like to take this opportunity to extend our gratitude to the generous support given by the sponsors and also thanks to the staff in the Faculty of Science and Technology, for their unfailing commitments and support towards IWYS2016. On behalf of the organizing committee, we would also like to thank all the speakers who have accepted our invitation and help make this workshop to be an interesting experience. Last but not least, my deepest appreciation goes to the committee members who have worked so hard in ensuring the success of this workshop.

Assoc. Prof. Dr. Mohammad Hafizuddin Hj Jumali
Chairman of IWYS2016



Remarks by Executive Director, Commission on Science and Technology for Sustainable Development in the South (COMSATS)

Today Nanotechnology is seen as the transformative technology, with the potential to improve every aspect of our socio-economic well-being. The research in the field of nano science and technology is making huge advances at molecular level, thus helping to improving material properties and offering new solutions for development. Establishing an effective process for identifying and understanding the broad implications of nano-technology for society could help policy-makers duly integrate it in development strategies to tap the full potential of nano-technology for economic development.

The applications of nano science and technology are extensive and can contribute in a number of areas including medicine, electronics, environment, energy, materials, food production, molecular manufacturing. Moreover, this field is increasingly forming bridges between different disciplines of science and engineering. The global market for products developed pursuing nano-science and technology was valued at US\$ 27 Billion in 2015 and is expected to grow to US\$ 75.8 Billion by 2020. The nano-technology based economy and diversification is expected to continue to grow over the next decade as technology and new discoveries in the field continue to emerge. The developed countries are prudently investing in this field, realizing the potential that nano science and technology has. It is believed that countries having the necessary critical mass in this field would spearhead another technological revolution.

A key element to preparing a country's industries to embrace the nano-technology revolution is to prepare the relevant graduates to assume key position in making and creating technologies. Nano-technology is estimated to create or impact hundreds of thousands of jobs worldwide over the next decade. Roughly six million new nano scientists and engineers will be needed worldwide in the next 5 years to serve the needs of the progress in the field. Based on similar realizations, some developing countries have established national initiatives to develop human resources and build research capacity in nano-technology.

Cognizant of the needs and challenges pertaining to the filed in member States, the significance of nano-technology, the Islamic Educational, Scientific, and Cultural Organization (ISESCO), the Commission on Science and Technology for Sustainable Development in the South (COMSATS), in collaboration with the Universiti Kebangsaan Malaysia (UKM), are organizing an International Workshop on Nanotechnology for Young Scientists (IWYS-2016), from 28th – 30th November 2016.

The objectives of the Workshop are two-fold: first and foremost, it would help highlighting the potential of nano-technology in addressing environmental concerns, meeting energy needs, and applications of bio-nanotechnology to human healthcare. Secondly, it would bring together young scientists and researchers for exchanging relevant knowledge and expertise in this field and to keep them abreast of the latest technological advances. This Workshop is expected to be a good networking opportunity among experts and young nano-scientists working in various disciplines of this important emerging field.

Mr. Fazal Abbas Maken

Executive Director, Commission on Science and Technology for Sustainable Development in the South (COMSATS)

Remarks by Representative of Islamic Educational, Scientific and Cultural Organization (ISESCO)

It gives a great pleasure to welcome you to The 1st International Workshop in Nanotechnology for Young Scientists 2016 (IWYS2016). This workshop has been initiated from the International Workshop and Conference on Nanotechnology (IWCN) which held every 2 years since 2007. IWYS features 10 resource persons, 10 invited young scientists and 7 invited speakers from 13 different countries.

Extensive research on nanotechnology has unveiled many interesting and promising materials properties for novel applications in functional materials, technology for medicine, materials for energy and environmental protection.

IWYS2016 provides a forum for international academics, researchers, practitioners and students working in the areas of nanofabrication, nanoelectronics, nanobiology, and nanomaterials to discuss new developments, concepts and practices and to identify future research needs so that this field can be brought closer to its endless potential and immense possibility.

The workshop is specifically designed to prepare the platform for researchers more aware producing novel products for the most advanced applications of science covering on nanotechnology and nanoscience. Moreover, the opportunities this brings for scientists and academia seeking new ideas in the field besides promotes networking in the nano-research area.

I welcome you all to an exciting and splendid workshop, IWYS2016. We look forward to seeing you there!

Dr. Ismail Abdel Hamid
Representative, Islamic Educational, Scientific and Cultural Organization (ISESCO)

International Advisory Board

Prof. Dr. Muhammad Yahaya	Universiti Kebangsaan Malaysia
Dr. Ismail Abdel Hamid	ISESCO representative
Mr. Irfan Hayee	COMSATS representative
Dr. Abdul Kadir Masrom	National Nanotechnology Directorate (Malaysia)

Resource Persons

Malaysia	Prof. Dr. Shahidan Radiman Prof. Dr. Misni Misran Prof. Dr. Elias Saion Assoc. Prof. Dr. Zainovia Lockman
China	Prof. Dr. Xue Qi Kun Prof. Dr. Tianyou Zhai
Japan	Prof. Dr. Seigi Mizuno
Korea	Prof. Dr. Jae-Wook Kang
Islamic Republic of Pakistan	Prof. Dr. Arshad Saleem Bhatti
Turkey	Prof. Dr. Ahmet Oral

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PROGRAM SCHEDULE
THE 1ST UKM-ISESCO-COMSATS INTERNATIONAL WORKSHOP ON NANOTECHNOLOGY
FOR YOUNG SCIENTISTS (IWYS2016)
Hotel Bangi-Putrajaya, Bandar Baru Bangi, Selangor, Malaysia
28-30th November 2016

Day 1: 28 November 2016 (Monday)

TIME	EVENT
0800	Registration
0840	Opening Ceremony
0840	Arrival of participants and guests
0850	Arrival of VIPs
0900	Arrival of UKM Deputy Vice Chancellor
0910	Du'a recitation
0915	Welcoming speech by the Dean of FST - Prof. Dr. Sahrim Haji Ahmad
0930	Speech by ISESCO representative
0945	Speech by COMSATS representative
1000	Opening speech by the UKM Deputy Vice Chancellor - Prof. Dato' Dr. Imran Ho Abdullah Montage presentation Photo session
1030	Tea & Poster Session
1100	Plenary 1 Atomic-Level Control of Two Dimensional Quantum Material Growth: From Quantized Anomalous Hall Effect to High Temperature Superconductivity <i>Prof. Dr. Xue Qi-Kun (Tsinghua University, China)</i>
1200	Keynote 1 Hybridisation : The Way Forward for Nanomaterials <i>Prof. Dr. Shahidan Radiman (Universiti Kebangsaan Malaysia)</i>
1245	Lunch
1415	Workshop 1 Fundamental Description of Metallic Nanoparticles <i>Prof. Dr. Elias Saion (Universiti Putra Malaysia)</i>
1500	Workshop 2 Flexible Organic Optoelectronic Devices using Printing Process <i>Prof. Dr. Jae-Wook Kang (Chonbuk National University, Korea)</i>
1545	Workshop 3 Low-Dimensional Inorganic Optoelectronic Nanomaterials and Micro/nano Devices <i>Prof. Dr. Tianyou Zhai (Huazhong University of Science and Technology, China)</i>
1630	Total Reflection X-ray Fluorescence Analysis of Airborne Silver Nanoparticles from Fabrics <i>Ms. Chiew Moi Yee (Bruker (Malaysia) Sdn. Bhd.)</i>
1700	Tea
1800	Visit to Putrajaya (International delegates only)

Day 2: 29 November 2016 (Tuesday)

TIME	EVENT
0900	Flow Chemistry Process for Continuous Synthesis of Silver Nanowires <i>Assoc. Prof. Dr. Chia Chin Hua</i>
	Impedance Characteristics of Optimized DSSC With Siloxane Gel Electrolyte Exhibiting Efficient Power Conversion <i>Dr. Wa Ode Sukmawati Arsyad</i>
0920	Synthesis of Nanometals by Pulsed Laser Ablation in Liquid Environmental <i>Mr. Ayman Mostafa Darwish</i>
	One dimensional ZnO Nanorods for Energy Application <i>Dr. Marjan Rajabi</i>
0940	Biosynthesis of Silver Nanoparticles Using Jordanian Olea Europea Leaf Extracts <i>Mr. Mohammad Emran Abu Othman</i>
	The Evolution of the Design, Materials, Fabrication Processes and Performances of MEMS Condenser Microphone <i>Dr. Faisal Mohd-Yasin</i>
1000	Photonic Bandgap of Low Cost ZnO Nanorods by Two-step Chemical Bath Deposition <i>Mr. Muhammad Nuri Nordin</i>
	Planar-Perovskite Solar Cells: Low Temperature Photovoltaic Behavior and Its Degradation Mechanism under Air Stability <i>Dr. Riski Titian Ginting</i>
1020	Aptamer-mediated Glucose Oxidase Conjugation on Magnetic/gold Nanoparticles for Glucose Detection <i>Dr. Yazmin Bustami</i>
	Modify Nanostructured materials by AACVD Method for Solar Cells and PEC Applications <i>Dr. Mohd Asri Mat Teridi</i>
1040	Tea & poster session
1100	Plenary 2 Growth Of Nano-Materials and Determination of Surface Structures Via Low-Energy Electron Diffraction <i>Prof. Dr. Seigi Mizuno (Kyushu University, Japan)</i>
1200	Keynote 2 Status and Trends in High Performance Magnetic Imaging using Scanning Probe Microscopy (SPM) <i>Prof. Dr. Ahmet Oral (Middle East Technical University, Turkey)</i>
1245	Lunch
1415	Workshop 4 Defects in wide band gap semiconductors for potential use in light sources <i>Prof. Dr. Arshad Saleem Bhatti (COMSATS Institute of Information Technology, Pakistan)</i>
1500	Workshop 5 Acyated Chitosan Stealth Liposomes <i>Prof. Dr. Misni Misran (Universiti Malaya)</i>
1545	Workshop 6 One Dimensional Electronic Oxides Nanomaterials: Nanowires and Nanotubes for Environmental Applications <i>Assoc. Prof. Dr. Zainovia Lockman (Universiti Sains Malaysia)</i>
1630	Atomic scale Correlative Surface to Bulk Characterization <i>Tay Khoon Yang (Hi-Tech Instruments Sdn. Bhd.)</i>
1700	Tea

1930	Dinner
1930	Arrival of participants and guests
2000	Arrival of VIPs
2015	Du'a recitation
2020	Welcoming speech by Chairman of IWYS 2016 - Assoc. Prof. Dr. Mohammad Hafizuddin Hj Jumali
2030	Speech by International Advisory Board Representative (UKM) - Prof. Emeritus Dato' Dr. Muhammad Yahaya
2040	Presentation of souvenir to Co-organizers IWYS2016 Best Poster Award Photo session Dinner
2230	End of event

Day 3: 30 November 2016 (Wednesday)

TIME	EVENT
0900	Electronic Modification of Palladium Nanoparticles with Single Atom Boron Interstitials <i>Dr. Abdul Hanif Mahadi</i>
	Development of Nano Crystalline Hydroxylapatite and Bio-composites from Novel Sources for Bio-medical Applications <i>Mr. Md. Rakibul Qadir</i>
0920	Carrier Relaxation in Mn Doped ZnS Nanowires Studied by Temperature Dependent Photoluminescence Spectroscopy <i>Mr. Liaquat Aziz</i>
	The Charge Transfer Kinetics of Au-NPs-MWCNTs Modified Glassy Carbon Electrode Surrounded by E-coli <i>Dr. Shahid Mehmood</i>
0940	Obtaining of Hydrophobic and Hydrophilic Surface in Plasma AR/CH ₄ Medium <i>Mr. Zhunisbekov Askar</i>
	The Role of Graphene in Dye-Sensitized Solar Cell <i>Dr. Norasikin Ahmad Ludin</i>
1000	Application of Gamma Radiation in Graphene Oxide Reduction and G/metal Oxide Nanocomposite Synthesis <i>Assoc. Prof. Dr. Irman Abdul Rahman</i>
	Amino Acid Based Vesicle as Potential Radiosensitizer <i>Assoc. Prof. Dr. Faizal Mohamed</i>
1020	Effect of Post Annealing Temperature on Photonic Bandgap of ZnO Nanorods Grown by Chemical Bath Deposition <i>Dr. Wan Maryam Binti Wan Ahmad Kamil</i>
	Effect of Annealing Strategy on Improved Photoactivity of Cuprous Oxide Nanowire Prepared Using Facile Fabrication Strategy for Solar Water Splitting <i>Dr. Lorna Jeffery Minggu</i>
1040	Tea & Poster Session
1100	Scientific Writing Workshop <ul style="list-style-type: none"> Impactful Writing <i>Prof. Dato' Dr. Roslan Abd Shukor</i> Dealing with Editors and Reviewers <i>Prof. Dr. Sarani Zakaria</i>
1245	Closing Ceremony <ul style="list-style-type: none"> Closing Speech by Chairman of IWYS 2016 - Assoc. Prof. Dr. Mohammad Hafizuddin Hj Jumali Speech by ISESCO representative Speech by COMSATS representative Closing montage
1300	Lunch
1430	Excursion (Melaka)

Event	Venue
Welcoming Opening Ceremony Dinner Plenary Keynote Workshop	Grand Ballroom
Registration Tea Poster Session	Grand Ballroom Foyer
Lunch	Cempaka
Oral presentation (parallel session)	Grand Ballroom and Dahlia 3 (level 2)

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Atomic-Level Control of Two Dimensional Quantum Material Growth: From Quantized Anomalous Hall Effect to High Temperature Superconductivity

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Abstract

Molecular beam epitaxy (MBE) has been well-known as a powerful technique for preparing semiconductors and heterostructures. Combining MBE with two surface sensitive tools--scanning tunneling microscopy (STM) and angle resolved photoemission spectroscopy (ARPES), can even push its power to an unprecedented level in material quality control. We apply MBE-STM-ARPES to topological insulators and high T_c superconductors, which have recently attracted extensive attention. We show how quantized anomalous Hall effect could be achieved by atomic-level control of energy-band-engineered and magnetically doped topological insulators with MBE-STM-ARPES. We then show the discovery of interface enhanced high temperature superconductivity in FeSe/SrTiO₃ heterostructure using the same approach. Implications on exploring other quantum phenomena such as Majorana fermions and on searching for new high temperature superconductors will be discussed.

Acknowledgement

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Growth of Nano-materials and Determination of Surface Structures via Low-energy Electron Diffraction

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Abstract

The surface properties of materials are becoming increasingly important with the development of nanoscience and nanotechnology. The first step in understanding the properties of materials is the determination of their structures. The surface structure is sometimes quite different from the bulk structure, and has considerably more variety than three-dimensional crystals. A low-energy electron beam (20–500 eV) is one of the best candidates for a probe of surface, because it is extremely surface sensitive and the electrons have a suitable wavelength of 0.3–0.05 nm that is comparable with atomic size. Therefore, low-energy electron diffraction (LEED) is one of the most powerful tools for determining surface structures. We have been studied several structures on metal and semiconductor surfaces, and also tried to develop a new LEED apparatus using field emission to improve its spatial and reciprocal-space resolutions.

In this presentation, our recent studies of growth of silicon oxynitride (SiON) layer on SiC(0001) surface in ultra-high vacuum are reported. Previously we have reported the epitaxial growth of the dangling-bond-free SiON layer on SiC(0001) [1]. This interface is not only abrupt but also has no dangling bond in the unit cell. It has a chemical composition of $\text{Si}_4\text{O}_5\text{N}_3$, and exhibits a substantial band gap of 9 eV at the surface. The $\text{Si}_4\text{O}_5\text{N}_3$ layer was obtained by H_2 etching followed by N_2 treatment at 1360 °C in atmospheric pressure. Because control of the numbers of Si and C atoms is difficult in the atmospheric pressure conditions, there exist residual Si and C atoms and those oxides on the surface. These residual materials would lower the electronic properties for the application toward MOSFET. In this study, we tried to prepare the $\text{Si}_4\text{O}_5\text{N}_3$ layer in a UHV chamber to eliminate the residual materials. As a result, we obtained a new surface structure with a chemical composition of Si_2ON_3 by NO treatment of Si-adsorbed SiC(0001) surfaces [2]. Finally, we could obtain the targeted $\text{Si}_4\text{O}_5\text{N}_3$ layer in UHV.

Keywords: Low-energy electron diffraction; Surface structure determination; Ultra-high vacuum; Silicon carbide; Silicon oxynitride layer.

Acknowledgement

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Hybridisation: The Way Forward for Nanomaterials

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Abstract

We review some aspects of hybridisation in nanomaterials e.g graphene with other carbon allotropes, plasmonic-excitonic coupling in nanoparticle aggregates, coupled magnetic plasmons in metamaterials and vibron-phonon hybridisation in dielectric nanostructures. Some examples of nanotechnology applications e.g hydrogen production and solar cell are given from our own work. The future prospect of hybridisations in magnonics and spintronics as well as in nanocomposites (mainly conducting polymers) are also pointed out as a research roadmap with a bright future. This is especially encouraging with the increasing number of prospective 2-dimensional platform ranging from molybdenum sulphide to silicene and phosphorene and other single-layer atomic structures.

Status and Trends in High Performance Magnetic Imaging using Scanning Probe Microscopy (SPM)

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Abstract

We will give an overview of the state of the art Scanning Probe Microscopes (SPM) for magnetic imaging in the 20mK to 300K temperature range. Recent developments in cryofree cryostats and dilution refrigerators (DR) have opened a new avenue for scientists suffering from heavy Helium costs.

We shall first describe the design of High Resolution MFM which can achieve 10nm magnetic resolution. Such high resolution is possible with unprecedented $\sim 12\text{fm}/\sqrt{\text{Hz}}$ noise floor of the cantilever deflection electronics.

We shall also describe a mK-Scanning Probe Microscopes (mK-SPM) operating in Scanning Tunnelling Microscope (STM), Scanning Hall Probe Microscope (SHPM) and Atomic/Magnetic Force Microscope (AFM/MFM) mode in a wide temperature range of 20mK-300K. SHPM images of magnetic materials at 20mK will be presented.

An Oxford Instrument cryogen-free DR (Triton DR400) with 400uW cooling power and 7mK base temperature is used for the experiments. A 1W Pulse Tube cryo-cooler is integrated into the DR. After wiring and attaching the microscope we achieved 20mK base temperature. Piezo driven Stick slip coarse approach mechanism is used to bring the sample in to close proximity of the sample.

We have also designed a Fabry-Perot interferometer for our mK-AFM which has a measured $\sim 1\text{fm}/\sqrt{\text{Hz}}$ noise level @ 4K as shown in Fig.1.(a), while the shot noise limit was $\sim 0.2\text{fm}/\sqrt{\text{Hz}}$. The system uses a dielectric multilayer coating at the end of the fiber to achieve this unprecedented noise level. We tested the microscope in MFM mode with a harddisk sample and imaging Abrikosov vortices in BSCCO as shown in Fig.1.(b)-(c). We hope to improve the noise levels further and achieve better than 5-6nm resolution for mK-MFM.

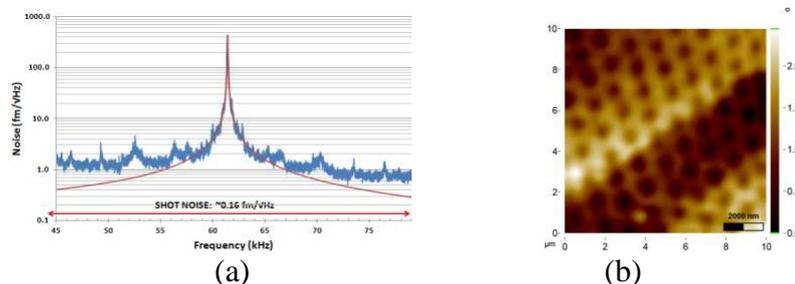


FIGURE 1. (a) Noise floor of our interferometer (b) MFM image of Abrikosov Vortex Lattice in BSCCO at 4K.

A novel method for excitation of Atomic Force Microscope (AFM) cantilevers by means of radiation pressure for imaging has been developed for the first time. Piezo excitation is the most common method for cantilever excitation. However, it has quite a few drawbacks like causing spurious resonance peaks and non-ideal Lorentzian curves. The force exerted by the

radiation pressure is quite weak but sufficient to excite the cantilever to tens of nanometers for imaging in vacuum, as the Q increases to few thousands. An amplitude modulated fiber coupled 1.31 μ m laser is used to excite the cantilever at its resonance and detect the position for MFM imaging as shown in Fig.2.

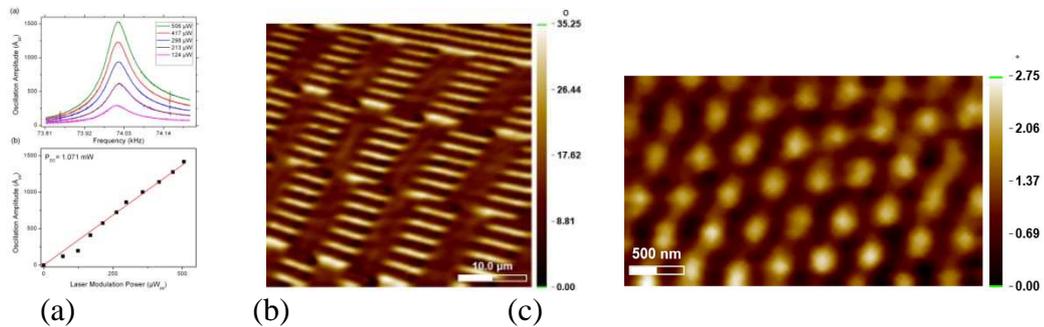


FIGURE 2. (a) Calibration of AFM cantilevers using radiation pressure (b) MFM image of Hard disk at 4K (c) MFM image of Abrikosov Vortex Lattice in BSCCO at 4K.

We shall also give a brief overview of recent trends in room temperature magnetic force microscopes(MFM) and atomic force microscopes(MFM).

Fundamental Description of Metallic Nanoparticles

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Abstract

Metal nanoparticles (MNPs) are clusters of atoms of metallic elements with dimensions of the order 1-20 nm. They are formed from a wide variety of metal-metal bond crystallines ranging from the s-block metals (such as Ag and Au NMPs), p-block metals (such as Al and Ga NMPs), and both d-block and s-block metals (such as Ru and Pt MNPs). The fundamental geometrical and electronic structures are discussed and the applications of MNPs are reviewed. When UV-visible light interacts with MNPs the energy is absorbed in two possible events. First, the free surface electrons or plasmons of MNPs might oscillate collectively in resonance with the electric field of incident electromagnetic light, which in turn polarized the particles. This classical physics description proposed by Mie theory (1908) is known as the localized surface Plasmon resonance (LSPR). Secondly, the conduction electrons of MNPs experience intra-band quantum excitations upon absorbing the incident photon energy of light. This quantum physics description mimics the photoelectric effect (1905) and Compton scattering (1923) in bulk metal, a well-established phenomenon of light absorption on metal surface. Both the classical and quantum descriptions of light interaction with MNPs are examined.

Flexible Organic Optoelectronic Devices using Printing Process

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Abstract

Flexible organic optoelectronic devices such as organic solar cells (OSCs), perovskite solar cells (PSCs) and organic light-emitting diodes (OLEDs) require transparent conducting electrodes (TCEs) having high flexibility, transparency, and conductivity fabricated on plastic substrates. Most of transparent materials suffer from the classic trade-off between optical transmittance and electrical conductivity. Thicker layers afford higher conductivity, but this increase comes at the expense of optical transmittance and vice versa. In this talk, we will present the development of all-printed flexible TCEs by using solution-processed materials such as metal mesh, silver nanowire, and PEDOT:PSS. These electrodes used to fabricate flexible OSCs, PSCs, and OLEDs that exhibited performances similar to that of devices fabricated on glass substrate. Moreover, the flexible devices did not show degradation in their performance even after being bent to a bending radius of ~1mm. In addition, we will present our recent results related to (i) cellulose-paper based transparent electrodes and its device applications, (ii) high performance PSCs with excellent stability, and (iii) fiber-shape organic devices.

Low-Dimensional Inorganic Optoelectronic Nanomaterials and Micro/nano Devices

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Abstract

Low-dimensional inorganic nanostructures have drawn great scientific and technical interest due to their interesting fundamental properties and possibilities of utilization in novel promising opto-electronical devices with augmented performance and functionalities. We have been carrying out a systematical study on the low-dimensional inorganic optoelectronic materials and micro/nano devices, including the ration design, structure and optoelectronic property relationship, and high-performance optoelectronic devices of low-dimensional organic materials. Some new result achieved in our group will be presented including (1) Developed several novel methods to synthesis inorganic nanomaterials with controlled size and morphologies through controlling the kinetics, thermodynamics and crystal engineering; (2) Investigated their optoelectronic properties including flexible optoelectronic devices, optimizing optoelectronic properties, and in-situ optoelectronic measurements.

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Defects in Wide Band Gap Semiconductors for Potential Use in Light Sources

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Abstract

Very recently, wide band gap semiconductors have received a great deal of attention due to optically active defect states in the energy band gap, high dielectric dielectric constant and applications in electronic and photonic devices. Some of these materials are ZnS, ZnO, TiO₂, In₂O₃, etc., and some of potential applications are in transparent electronics and displays, TiO₂ is one of the most suitable material for photocatalysis. The talk will be focused on tuning of intrinsic defects by creating extrinsic defects and tailoring of optical properties of these materials for potential use in tunable light sources. Another emerging area in these materials is the exciton-plasmon interactions. Some initial experimental results will be shared on the interaction of surface plasmon modes of Au with bound excitons in ZnS and ZnO to demonstrate quenching and amplification of emitted light.

Acylated Chitosan Stealth Liposomes

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Abstract

The use of liposomes as drug delivery carriers has extensively been investigated and clinically used as an effective of drug delivery system owing to what liposomal system could offer such as controlled-release, prolonged drug circulation time, decrease drug metabolism including reduced drug toxicity, increased efficacy and also can be modified to specific use such as for specific delivery to target sites. One of the major concern for such system is to minimize mononuclear phagocyte system uptake that currently being tackled by using PEGylated phospholipids to give the “stealth” property. However, such system incurred higher cost to the existing expensive liposomal technology. In this seminar, a much cheaper liposomal model was prepared by using oleic acid (OA) liposomes coated with non-PEG/non-phospholipid acylated chitosan to provide the similar stealth effect. The acylated chitosans were prepared by using water-soluble low molecular weight (LMW) chitosan (10 and 25 kDa). The coating of the acylated chitosan layer on OA liposomes was confirmed by its microscopic images and physicochemical properties, such as zeta potentials and hydrodynamic size of the liposomes. After surface modification, we have also observed enhanced rigidity of liposomes structure and decrease in the average particle size as compared to the unmodified OA liposomes. The decrease in the liposomes average diameter was also accompanied with an increase of their average zeta potentials, indicated that successful coating on the surface of OA liposomes. Some on-going liposomal delivery systems will also be shared for discussion.

One Dimensional Electronic Oxides Nanomaterials: Nanowires and Nanotubes for Environmental Applications

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Abstract

Over the past 30 years, considerable number of methods to synthesise oxide with one-dimensional (1-D) nanostructures nanowires and nanotubes have been elaborated and reported. Various synthesis schemes such as templated and oxidation (thermal or anodic) have resulted in nanotubes or nanowires of uniform dimensions and arrangement. In here, several methods of synthesis will be described aiming at understanding the materials science governing the process formation of the nanostructures given a method selected. Then the characteristic of electronic oxides like TiO_2 , ZnO , Fe_2O_3 , ZrO_2 and WO_3 will be discussed focusing on the electronic properties which are useful for environmental applications; either to be used in energy devices or as nanomaterials that combat pollutants. Characterizations equipment used to learn the characteristics of the nanomaterials will be presented. Reasons for using nanostructured materials will then be discussed. Questions that remained to be answered would be the effectiveness of the utilization of 1-D structure for the applications stated above, how to incorporate nanomaterials in existing devices and whether nanomaterials induce secondary pollution. Moreover, the understanding of scientists generally on the major differences between bulk materials and those in nanoscale or the practical reasons for choosing 1-D nanomaterials for applications stated will be discussed. The workshop participants are expected to take part in the discussion.

Flow Chemistry Process for Continuous Synthesis of Silver Nanowires

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Abstract

One dimensional (1D) silver nanowires (AgNWs) with high aspect ratios and crystallinity have been receiving wide attention owing to their excellent plasmonic, optical and chemical properties, as well as high electric and thermal conductivities (Zhang et al. 2008). These properties make AgNWs a suitable candidate in various applications, such as catalysis (Zeng et al. 2015), transparent conductive films (Menampambath et al. 2015), sterilization (Scheon et al. 2010), and surface enhanced Raman spectroscopy (Dasari & Zamborini 2016). Polyol method is among the most widely used processes in synthesizing AgNWs (Coskun et al. 2011). However, most of the synthesis of AgNWs was performed using batch reactor system. Continuous flow chemistry has received increased interest in the synthetic organic chemistry community over the past decades due to many advantages derived from its small size and flow nature (Yoshida et al. 2011). In this study, AgNWs were produced using polyol method with the aid of a flow chemistry reactor. Biphasic segmented flow was created throughout the reaction using two immiscible liquids to create high internal mixing and minimize diffusion (Fig. 1). Reaction parameters studied, including temperature of reactor heater, flow rate, NaCl and molecular weight of PVP.



FIGURE 1. Segmented flow of reaction for the continuous synthesis of AgNWs.



FIGURE 2. AgNWs collected from the outlet of the flow reaction system.

Keywords: Continuous; flow chemistry; silver.

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Electronic Modification of Palladium Nanoparticles with Single Atom Boron Interstitials

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Abstract

Palladium nanoparticles has been widely used as heterogeneous catalyst for various reactions in particular hydrogenation of organic compounds. The popularity of Pd nanoparticles as catalyst is due to its high reactivity to these reactions and also its feasibility to be synthesised to small and high surface area nano-sizes. They also have an economic benefit as a cheaper alternative to platinum without compromising the catalytic performance. However, traditional Pd nanoparticles on a support material usually lack in selectivity control, especially in reactions that can produce multiple side products. For fine chemical application, other than activity, selectivity is utmost importance to ensure the production of high yields economically. Various techniques have been used to improve the selectivity of Pd nanoparticles which includes modifying support materials, incorporating additives, morphology control and alloying with other metals.

In this study, we have developed a modification of the catalytic properties of Pd nanoparticles by inserting light element boron into the Pd interstitial lattice sites at facile and low temperature conditions. Pd is well-known for having hydrogen atoms in its interstitial lattice which has been identified as β -hydride phase. The incorporation of B atoms into the Pd interstitial sites were performed by adding $\text{BH}_3\cdot\text{THF}$ as B precursor to pre-formed Pd/C and heated to 200°C under N_2 atmosphere. The thermal treatment was required due to the high activation energy of B insertion into the Pd interstitial sites which resulted in Pd lattice expansion, suggested by X-ray diffraction (XRD) (Figure 1).

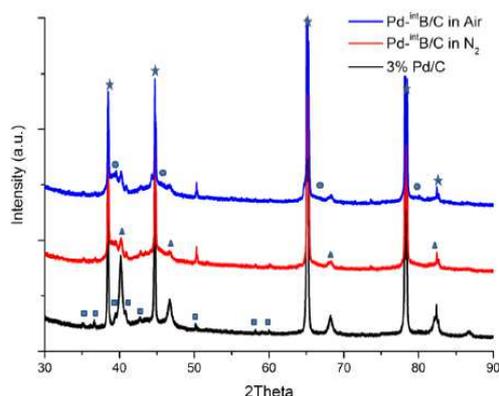


FIGURE 1 XRD profiles showing the fcc Pd (111), (200), (220) and (311) peaks for: i) Pd/C (black); ii) $\text{BH}_3\cdot\text{THF}$ in N_2 (red); iii) $\text{BH}_3\cdot\text{THF}$ in air. Stars: Background peaks from the Al sample cell. Squares: Peaks from the carbon support. Triangles: metallic Pd peaks. Circles: $\text{Pd}^{\text{int}}\text{B}$ peak.

From Figure 1, the XRD profile of 3% Pd/C (black) corresponded to the lattice parameter of 3.889Å, which is a typical lattice parameter for face-centred cubic Pd. Heating treatment in under N₂ (blue) resulted in the shift of the Pd peaks into lower 2θ angles which corresponded to the lattice parameter of 4.026Å, a 3.2% Pd lattice expansion. Further XRD characterisation using synchrotron radiation and profile refinement indicated that the Pd fcc lattice structure was retained but with an increase in lattice parameter. The increase in lattice parameter also agreed with Extend X-ray absorption fine structure (EXAFS) measurements. Temperature programmed reduction (TPR) measurements of Pd-^{int}B/C showed the absence of the β-hydride peak at 80°C which was an indicative of B atoms blocking the interstitial sites.

The catalytic performance of the Pd-^{int}B/C was tested with several key reactions in fine chemical synthesis and compared with the corresponding unmodified Pd/C. One example is the partial hydrogenation of chloro-nitrobenzene (CNB) to ortho-chloroaniline (o-CA) without hydrodechlorination which produces aniline (AN). This partial hydrogenation reaction represents an important class of chemical transformation in the industrial production of dyes, pharmaceuticals, polymers, herbicides and pesticides.

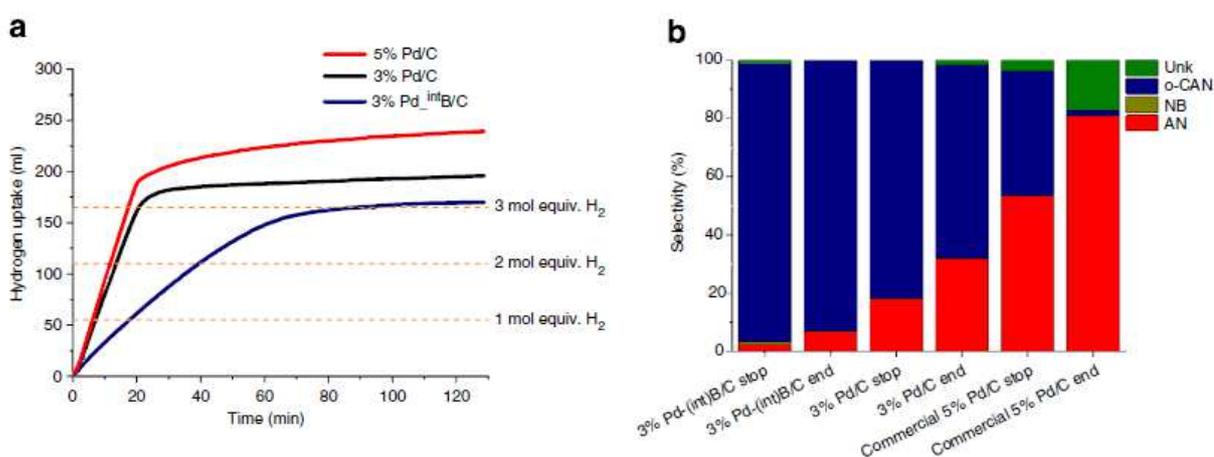


FIGURE 2 Catalytic results of the hydrogenation of o-CNB reaction. (a) H₂ uptake curves for hydrogenation of o-CNB on: (i) commercial 5% Pd/C (red); (ii) non-modified 3% Pd/C (black); (iii) 3% Pd-^{int}B/C (blue). (b) GC results in the hydrogenation of o-CNB. Stop: sample collected before rate change in the H₂ uptake. End: sample collected at the end of H₂ uptake.

Figure 2a shows the hydrogen uptake curves for 3% Pd-^{int}B/C (blue) compared with unmodified 3% Pd/C (black) and commercial 5% Pd/C (red) under industrially applicable conditions. Based on the gradient of the H₂ uptake curves, commercial 5% Pd/C showed the highest initial rate which might be due to its low particle sizes compared with unmodified 3% Pd/C. Furthermore, the slowest initial rate was observed for 3% Pd-^{int}B/C which suggested the loss of surface area upon B addition. However Figure 2b shows that the selectivity towards o-CA was the highest with Pd-^{int}B/C. The increase in selectivity for the Pd-^{int}B/C was attributed to the change in absorption strength of the Pd nanoparticles caused by the electronic modification of the Pd d-band structure by B interstitial atoms as shown by Density Functional Theory (DFT) calculations.

Keywords: Heterogeneous catalysis; palladium nanoparticle; boron interstitial; green catalyst.

Acknowledgement

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Carrier Relaxation in Mn Doped ZnS Nanowires Studied by Temperature Dependent Photoluminescence Spectroscopy

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Abstract

ZnS is a wide band gap semiconductor and has a band gap in UV (3.73 eV). The intrinsic defects in ZnS are responsible for emission in blue (440 nm) and green (520 nm) due to S and Zn vacancies, respectively. However, when doped with Mn in suitable quantity, the concentration of intrinsic defect states can be tailored. In addition, Mn introduces very strong broad emission band in red (600-650nm). Temperature dependent photoluminescence spectroscopy was employed to study the relaxation mechanism of excited carriers in the presence of varied intrinsic and Mn related defects. The results have demonstrated Berthlot type behavior of defect states, which are critical for light amplification processes. The effect of Mn concentration on relaxation processes will also be presented.

Impedance Characteristics of Optimized DSSC with Siloxane Gel Electrolyte Exhibiting Efficient Power Conversion

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Abstract

This paper will present the elucidation of research result in quasi solid-state DSSC (QSS-DSSC) that utilize polymer gel electrolyte (PGE) as the replacement of liquid electrolyte. The gel electrolyte that used was a combination from hybrid gel electrolyte as the medium and imidazolium based ionic liquid as the salt. We compared the impedance spectrum of PGE based DSSC without (type-1 PGE) and with (type-2 PGE) an addition of propylene carbonate (PC), that was measured under dark and light illumination. From the measurement result in the dark condition at the bias voltage 0.7V, there was a difference from the impedance spectra of both cells, especially on the high frequency region. Unlike the type-2 PGE based DSSC with, the type-1 PGE based DSSC did not show the transmission line characteristic. This transmission line characteristic was associated with the charge carrier diffusion inside the TiO₂ nano-porous. Under light illumination, the impedance spectrums of both cells were smaller, which might cause by the accelerated interfacial charge transfer process inside TiO₂ layers. On the type-2 PGE based DSSC, the interfacial charge transfer between electrons inside TiO₂ layers with the electrolyte (R_{ct}) and the electron life-time inside TiO₂ layers before it is recombined (τ_r) were become smaller under light illumination, namely from 139,3 Ω to 40.1 Ω and from 121.5 ms to 48.7 ms for R_{ct} and τ_r value respectively. On the other hand, the R_{ct} and τ_r values of type-1 PGE based DSSC were bigger under light illumination, namely from 47.1 Ω to 52.64 Ω and from 1.9 ms to 7.9 ms for R_{ct} and τ_r values respectively. These results indicated that for the cell that using type-1 PGE, the recombination rate was increased when the cell was illuminated. This result was also in a good agreement with the photovoltaic characteristics that yields current density and efficiency values of 16 mA/cm² and 5.37% for type-2 PGE based DSSC, and 13.4 mA/cm² and 4.72% for type-1 PGE based DSSC. The current density-voltage (J-V) curves and the impedance spectrum was presented in Figure 1 and 2, while the related photovoltaic characteristics and the fitting parameters from impedance spectrum was tabulated in Table 1 and 2.

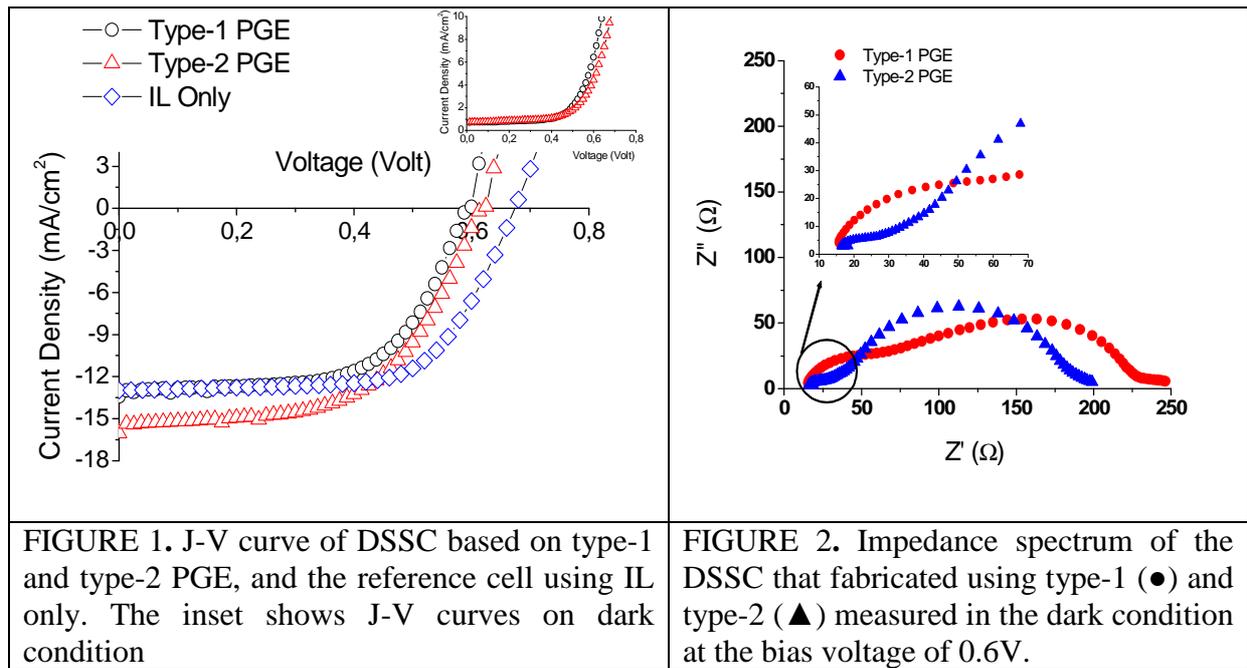


FIGURE 1. J-V curve of DSSC based on type-1 and type-2 PGE, and the reference cell using IL only. The inset shows J-V curves on dark condition

FIGURE 2. Impedance spectrum of the DSSC that fabricated using type-1 (●) and type-2 (▲) measured in the dark condition at the bias voltage of 0.6V.

TABLE 1. Photovoltaic parameters of the DSSC using type-1, type-2 of PGE, and the reference cell measured using solar simulator AM 1.5 with light intensity of 100 mW/cm².

Cell	Jsc (mA/cm ²)	Voc (Volt)	FF (%)	η (%)
Type-1 (HPG + IL ; 1:1)	13.43	0.6	58.59	4.72
Type-2 (HPG + PC + IL ; 1:1:1)	16	0.63	54.00	5.37
IL only	13	0.673	65.24	5.70

TABLE 2. Fitting parameters of the impedance spectrum of the type-1 and type-2 PGE based DSSC.

DSSC based on PGE	Measurement Condition	τ_r (ms)	Resistance Values (Ω)				
			R_s	R_{Pt}	R_t	R_{CT}	R_{dif}
Type-1	Dark	1.9	14.4	14.8	-	47.10	161.6
	Light illumination	7.9	14.3	21.3	-	52.64	22.24
Type-2	Dark	121.5	14.8	7.74	63.04	139.3	12.04
	Light illumination	48.7	41.5	7.74	12.58	40.10	48.70

Development of Nano Crystalline Hydroxylapatite and Bio-composites from Novel Sources for Bio-medical Applications

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Abstract

The author's research group investigated different aspects of a popular bio-ceramic, namely: Hydroxylapatite (HAp), a substitute material for bone and teeth in orthopedic and dentistry field due to their chemical and biological similarity to human hard tissue. In bone tissue engineering porous (HAp) is used as a filling material for bone defects, augmentation, artificial bone graft and scaffold material. Efforts have been put to adopt nano crystalline HAp in such bio-medical applications.

Local fish bone as a new source of HAp was studied to be utilized for various physiochemical properties, in order to find out the optimum conditions for HAp isolation. XRD pattern of the raw fish bone shows amorphous nature of the phosphate compounds. The XRD patterns were taken of fishbone heated at temperatures: 400°C, 700°C, 800°C, 900°C and 1000°C and analyzed by the Rietveld method.

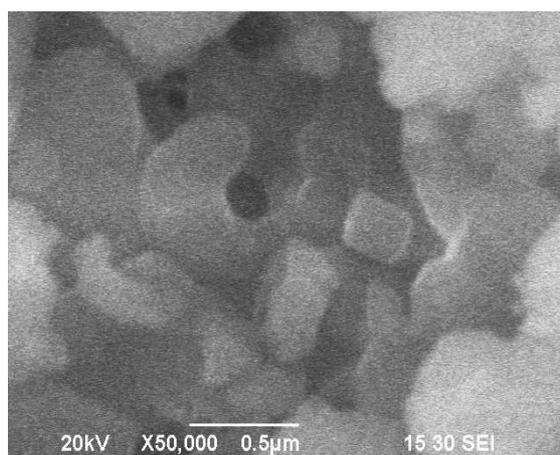


FIGURE 1. Hydroxylapatite nano particles after sintering at 1000°C for 2 hr

These diffraction patterns show a gradual increase in the degree of sharpness of peaks with increasing heat treatment temperature, indicating the extent of crystallinity of the powdered sample with the increase in crystallite size. Peaks which would indicate the thermal decomposition of hydroxyapatite into α -tricalcium phosphate and tetracalcium phosphate were not observed at any temperature up to 800° C. At this temperature also the appearance of a low intensity peak corresponding to β -tricalcium phosphate was observed. At 900°C, there were two phases-the hexagonal phase was Hydroxyapatite $[\text{Ca}_{9.868}(\text{PO}_4)_{5.586}(\text{OH})_{4.006}]$, 75.2% and the rhombohedral phase was Whitlockite $[\text{Ca}_{18}\text{Mg}_2\text{H}_2(\text{PO}_4)_{14}]$, 24.8%. With the increase in temperature the Whitlockite phase was increased. The DTA showed that the coefficient of thermal expansion (CTE) is increased with the increase in sintering temperature.

TABLE 1. Change of HAp Crystallite size from natural sources

Calcination Conditions	Calcined temp in °C	Crystallite size $B = \frac{K\lambda}{\beta \cos\theta}$ in nm
Isochronous	400(3hr)	3.67
	700(3hr)	11.23
	800(3hr)	24.58
	900(3hr)	25.45
Isothermal	1000(1hr)	25.88
	1000(2hr)	30.29
	1000(5hr)	30.95

In another study, to mimic the mineral and organic component of natural bone, nano hydroxylapatite (HAp) and gelatin (GEL) scaffolds were prepared (Hossan 2014). The raw material was first compounded and resulting composite were molded into the petri-dishes. Using Solvent casting process, it is possible to produce scaffolds with mechanical and structural properties close to natural trabecular bone. Crystallographic characterization by X-Ray diffraction and morphological characterization by SEM revealed the formation of a micro porous hydroxylapatite gelatin composite. It was observed that the pores in the scaffolds are interconnected and their sizes range from 80 to 400 μm . Since one osteoblast occupies an area of approximately 700 μm , hence the pore size of 500 μm (diameter of a spherical pore) is compatible with osteo-conduction; however the optimum pore size for osteoconduction is 150 μm . These results demonstrate that the prepared composite scaffold is a potential candidate for bone tissues engineering.

Keywords: Hydroxylapatite; nano HAp; Bio-ceramics; Bio-composites.

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Synthesis of Nanometals by Pulsed Laser Ablation in Liquid Environmental

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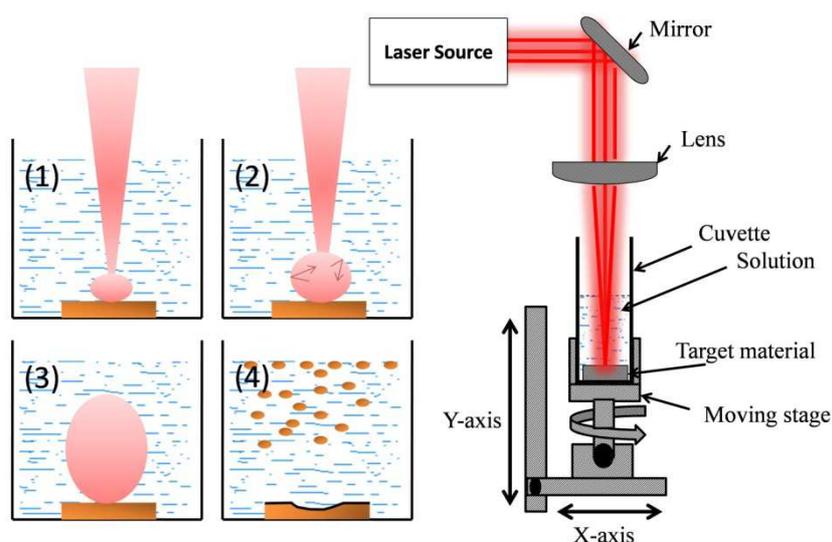
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Abstract

Pulsed laser ablation in a liquid medium is a promising technique as compared to the other synthetic methods to synthesize different materials in nanoscale form. The laser parameters (e.g.; wavelength, pulse width, fluence, and repetition frequency) and using an appropriate liquid medium (e.g.; aqueous/nonaqueous liquid or solution with surfactant) were tightly controlled during and after the ablation process. By optimizing these parameters, the particle size and distribution of materials can be adjusted. The UV-visible absorption spectra and weight changes of targets were used for the characterization and comparison of products.



One dimensional ZnO Nanorods for Energy Application

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Abstract

Vertically well aligned pure zinc oxide (ZnO) nanorods were prepared on fluorine doped tin oxide (FTO) coated glass and indium doped coated polyethylene terephthalate (PET) substrates by hydrothermal synthesis method. Dip coating and RF sputtering deposition techniques were used for deposition of ZnO seed layers on substrates before the growth of nanorods. Also, Ag- doped ZnO nanorods with different Ag content were fabricated on FTO coated glass substrates. Pure and doped nanorods were characterized by means of SEM, XRD, and room temperature photoluminescence spectroscopy (PL). The average diameters of nanorods depend on substrate and seed layer. The Ag-doping leads to a reduction in room temperature PL emission intensity of nanorods.

ZnO is a biocompatible, biodegradable, wide band gap (3.37 eV) semiconductor material with an asymmetric wurtzite crystal structure, which is responsible for its natural piezoelectric behavior. ZnO nanostructures especially vertically aligned one- dimensional nanostructures (nanorods and nanowires) have been applied in solar cells, UV photodetectors, lasers and light emitting diodes, field emission devices, sensors, and piezoelectric nanogenerators. The concept of piezoelectric nanogenerator based on ZnO nanowires, with the aim of harvesting the energy from the environment, arises from the coexistence of piezoelectric and semiconducting properties, is an exciting field of research that was first introduced by Wang et al. in 2006 [wang]. Doping is a method to improve optical, electrical, and electromechanical properties of ZnO nanorods [Jagadish]. Using elements such as Li, Sb, and Ag which acts as an acceptor (p- type) in ZnO can improve the output power of devices based on ZnO nanorods and suffering from screening effects such as nanogenerators [Lee & Shin].

In order to grow ZnO nanorods, at first, a ZnO seed layer was prepared by dip coating in a zinc acetate dehydrate solution and/or RF sputtering deposition technique on a substrate. Pure ZnO nanorods were grown by using the hydrothermal method, putting seeded substrate in a zinc nitrate hexahydrate and hexamethylenetetramine with equal molar ratio in deionized water at 95°C for 6h. Ag doping was obtained by adding the appropriate amount of silver nitrate to that solution. The morphology and crystal structure were characterized by using field emission scanning electron microscopy (Mira2 TESCAN) and x- ray diffractometer (X'Pert Pro MPD), respectively. A fluorescence spectrophotometer (Cary Eclipse) was used for PL measurements.

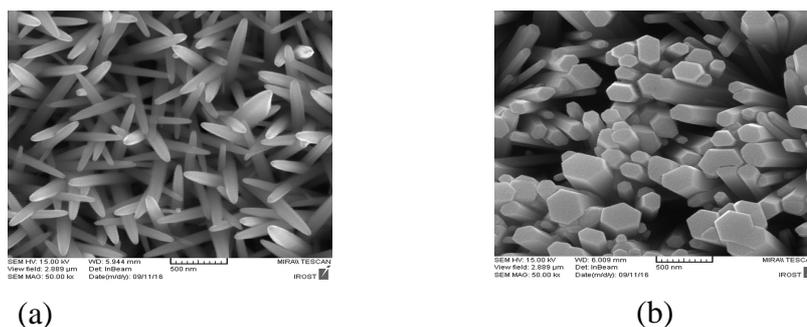


FIGURE 1. Typical top view FESEM images of pure ZnO nanorods grown on (a) FTO and (b) ITO coated PET substrates by hydrothermal synthesis method.

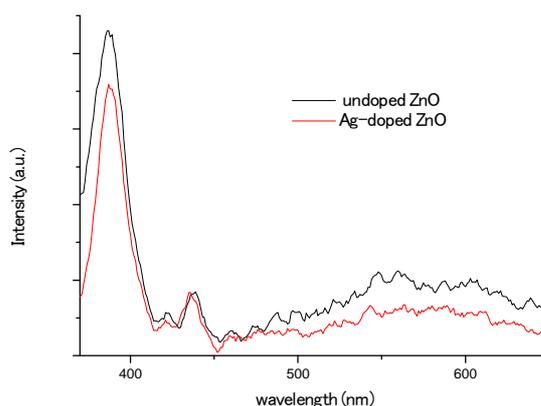


FIGURE 2. Room temperature Photoluminescence spectra of pure and Ag- doped ZnO nanorods.

The FESEM investigation of nanorods shows that the substrate material is an effective parameter. As illustrated in figure 1 (a), needle like ZnO nanorods with average diameter of 92 ± 25 nm have grown on FTO coated glass substrate, while at the same condition hexagonal rods with average diameter of 210 ± 130 nm formed on ITO coated PET. The diffraction patterns of pure and Ag- doped samples indicate that nanorods with hexagonal wurtzite crystal structure have preferred orientation along their c-axis. As observed in Fig. 2., it could be found that both pure and Ag- doped ZnO nanorods exhibit obvious PL signal with similar curve shape, demonstrating that Ag dopant did not result into new PL phenomena at room temperature. The PL spectra consists of a near band edge UV emission and visible emission bands. The intensity of the PL emission spectra is influenced by doping.

Keywords: Zinc Oxide; Hydrothermal synthesis; Doping; Photoluminescence.

Acknowledgement

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Biosynthesis of Silver Nanoparticles Using Jordanian *Olea Europea* Leaf Extracts

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Abstract

A green synthetic approach using Jordanian *olea europea* leaf extracts olive for preparing silver nanoparticles at room temperature without using toxic materials. It is environment, eco-friendly synthetic method for the antibacterial and antifungal activities. In a typical reaction procedure, 5 ml of olive leaf extracts (OLE) was added to 100 ml of 1×10^{-3} M aqueous AgNO_3 solution. The solution was stirred for 2 minutes. The reduction process Ag^+ to Ag^0 nanoparticles was followed by the color change from yellow to deep brown, the pH of solution was adjusted using 0.1N H_3PO_4 . Biosynthesis silver nanoparticles (AgNPs) were characterized by Fourier transform infrared spectroscopy (FT-IR), Atomic absorption spectroscopy (AAS) to confirm the concentration used in anti-microbiological assay, and X-ray diffraction (XRD) to confirm the biosynthesis of AgNPs. In the present work, we investigated the synthesis of stable silver nanoparticles with bio-reduction method using Jordanian *Olea europea* leaf extract and their antibacterial activity.

1. INTRODUCTION:

Silver nanoparticles (AgNPs) have become the focus of intensive research owing to their wide range of application in the development of new techniques.. Many research works are available on the biosynthesis of silver nanoparticles using plant leaves extract, such as *Chenopodium album leaf* (Dwivedi, 2010), and *Stevia rebaudiana* (Yilmaz, 2011),

2. MATERIALS & METHODS

Silver Nitrate (AgNO_3) was obtained from Sigma-Aldrich Chemicals. All glasswares were washed with dilute nitric acid HNO_3 and distilled water.

2.1. Preparation of Jordanian *Olea Europaea* Leaves Extract

Freshly leaves of Jordanian *olea europaea*, shown Figure 1, were collected and then washed several times with water to remove the dust particles and then sun dried, as seen in Figure 2, to remove the residual moisture. The extract used for the reduction of silver ions to silver nanoparticles was prepared by placing washed dried fine cut leaves in glass beaker along of sterile distilled water. The mixture was then boiled. Then the extract was cooled to room temperature and filtered with Whatman No. 1 filter paper.



FIGURE 1. Picture of Jordanian *Olea europaea* leaves



FIGURE 2. Picture of washed dried fine cut Jordanian *olea europaea* leaves

2.2. Synthesis of Silver Nanoparticles

A mixture of Jordanian *olea europaea* leaves extract and aqueous solution of silver nitrate (AgNO_3) was heated in a water bath to achieve the reduction of Ag^+ ions to Ag^0 nanoparticles. The silver nanoparticles (AgNPs) obtained by Jordanian *olea europaea* leaves

extract were centrifuged and subsequently redispersed in sterile distilled water to get rid of any uncoordinated biological materials.

2.3. Characterization of Silver Nanoparticles

Biosynthesis silver nanoparticles (AgNPs) were characterized by Fourier transform infrared spectroscopy (FT-IR), Atomic absorption spectroscopy (AAS), and X-ray diffraction (XRD).

2.4. Antibacterial Studies

Antibacterial activities of the biosynthesized silver nanoparticles against *Listeria monocytogenes*, *Shigella*, and *Staphylococcus aureus* were determined using the agar diffusion assay method. Silver nitrate (AgNO_3) was taken (Perez, 1990) as a control. The plates were examined for evidence of zones inhibition.

3. RESULTS AND DISCUSSION

3.1. Fourier Transform Infrared Spectroscopy (FT-IR)

FT-IR spectrum of the olive leaf is shown in Figure 3. The olive leaf displays a number of absorption peaks, reflecting its complex nature. The peak IR bands in Figure 3 observed at 3410 and 1732 cm^{-1} in dried olive leaf are characteristic of the O-H, and C=O groups stretching modes for the OH and C=O groups possibly of oleuropein. The medium band at 1624 cm^{-1} corresponds to amide I arising due to carbonyl stretch in proteins. The strong peak at 1076 cm^{-1} corresponds to C-N stretching vibration of the amine. The peak near 700 cm^{-1} is assigned to CH out of plane banding vibration of substituted ethylene systems -CH=CH. In the case of nanoparticles, a large shift in the absorbance peak with decreased band intensity was observed, implying the binding of silver ions with hydroxyl and carboxylate group of the extract (Khalil, 2012).

3.2. XRD Analysis of Synthesized Silver Nanoparticles.

A comparison of our XRD spectrum with the standard confirmed that the silver particles formed in our experiments were in the form of nanocrystals, as evidenced by the peaks at 2θ values of 38.02, 43.58, and 64.32, and 77.22 corresponding to (111), (200), (220) and (311), respectively Bragg reflections of silver as illustrated in Figure 4. The average particle size of silver nanoparticles synthesized by the present green method calculated using Debye-Scherrer equation⁽¹⁾ was 10 ± 1 nm.

$$D = K\lambda / \beta \cos \theta \quad (1)$$

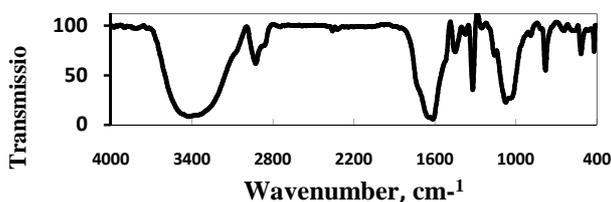


FIGURE 3. FT-IR of Jordanian *Olea Europaea* Leaves

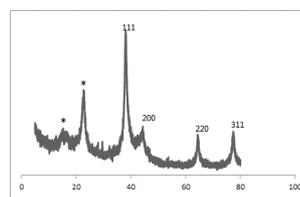


FIGURE 4. XRD Pattern of Synthesized AgNPs

3.3. Antibacterial Activity Study of Silver Nanoparticles

Biosynthesized silver nanoparticles showed excellent antibacterial activity against *Shigella*, *Listeria* and *S. aureus*. The diameter of the zone of inhibition around the antibiotic disc with silver and without silver nanoparticles against the test strains is shown in Table 1.

TABLE 1. The antibacterial activity of AgNPs synthesized using Jordanian *olea europaea* leaves extract

Name of the bacterial sps	Zone of inhibition	
	AgNPs	Reference drug
<i>Shigella</i>	9.5	17
<i>Staphylococcus aureus</i>	10	19
<i>Listeria monocytogenes</i>	20	20

3.4. Atomic Absorption Spectroscopy (AAS) Analysis

Silver ion concentration was analyzed by AAS which showed the conversion of Ag⁺ into Ag nanoparticles.

4. CONCLUSION

From the present study we prepared AgNPs using Jordanian *olea europaea* leaf extract with eco-friendly and convenient green method. Also we conclude that AgNPs possess very good antibacterial activity which makes them a potent source of antibacterial agent.

Keywords: Silver Nanoparticles; Olea Europea Leaves Extracts; Antibacterial Activity.

Acknowledgement

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Obtaining of Hydrophobic and Hydrophilic Surface in Plasma AR/CH₄ Medium

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Abstract

Nowadays the wettability of surfaces is a decisive factor in many applications. Control of the hydrophobic or hydrophilic property is a key aspect for microelectronics, light industry, etc. The wettability of the surface generally depends on two factors: surface chemistry and surface roughness. If to use both parameters properly, it is possible to develop superhydrophobic surfaces with a contact angle close to 180°, with very small grazing angle (lotus effect).

In this work, first we got superhydrophobic surfaces using a simple one-step process, based on polymerizing carbonaceous nanoparticles in plasma and deposition on silicon wafer. Nanoparticles arising in plasma polymerization process are typical example of plasma polymers, i.e. materials, which in difference to conventional structured polymers, are not consisted of repeating units. In addition, we researched how wetting characteristics was changing when proceeded in different plasma environments. Experiments have shown that the superhydrophobic surfaces can be converted into superhydrophilic surfaces in means of various plasma processing methods.

Figure 1 shows a schematic diagram of the experimental installation based on a high-frequency (HF) capacitive discharge method. This installation is used for vapor deposition of nano- and microparticles and it consists of a working chamber (1), a HF generator (2) with a self-consistent device (3) and with a measuring unit for determining the value of self-displacement (4). Inside the chamber two electrodes are located: primary electrode (5), to which high frequency alternating voltage is supplied, and power electrode(6), which is grounded. Thus, a high-frequency discharge ignition of plasma within the chamber is formed.

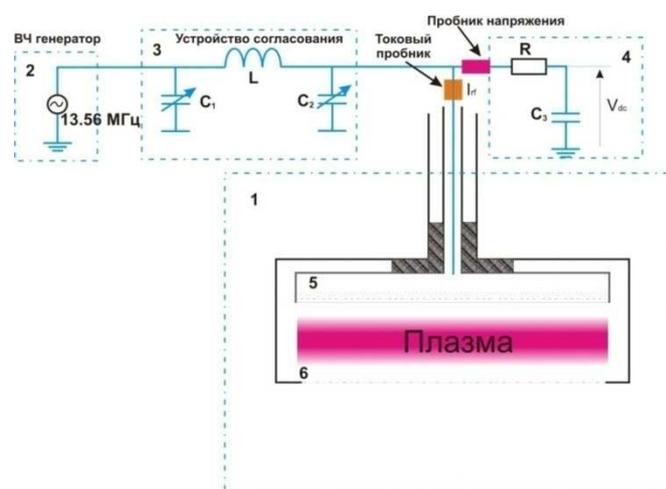


FIGURE 1. The generalized diagram of the RF discharge device

For synthesis of carbon nano- and microparticles gas mixture of methane (2%) and argon (98%) was used with various HF plasma discharge parameters.

The method of synthesis of nano- and microparticles is as follows: the working gas Ar + CH₄ is blown through the hole in glass cover. Gas passing through the mesh electrodes forms a laminar flow between electrodes, and pumped out continuously. When high voltage applied to the electrodes breakdown is arising in the gas, which cause plasma ignition, later gas is decomposed into radicals and ions under dissociation and ionization processes, and during the chemical reactions nanoparticles are synthesized. Then obtained nanoparticles are deposited on the researching surface.

In this work, we focused on the process of growth of nanoparticles and their subsequent deposition. Specific feature of this process is the negative charge of the nanoparticles. Once the particles reach a size of several nanometers, they quickly collect a negative charge (due to the high mobility of the electrons in the plasma). As a result, the particles are held in positive plasma potential, i.e. they are levitating in the discharge, where they continue to grow due to the accumulation of neutral radicals and positive ions. After the plasma turns off, particles lose the negative charge and fall down to the lower electrode. Every time plasma is turned off a certain amount of nanoparticles will fall onto the silicon substrate, which is located on the lower electrode. Thus, the number of particles on a silicon substrate depends on the number of cycles, i.e. the film's hydrophobic feature (contact angle) increases with the number of cycles (Figure 2).

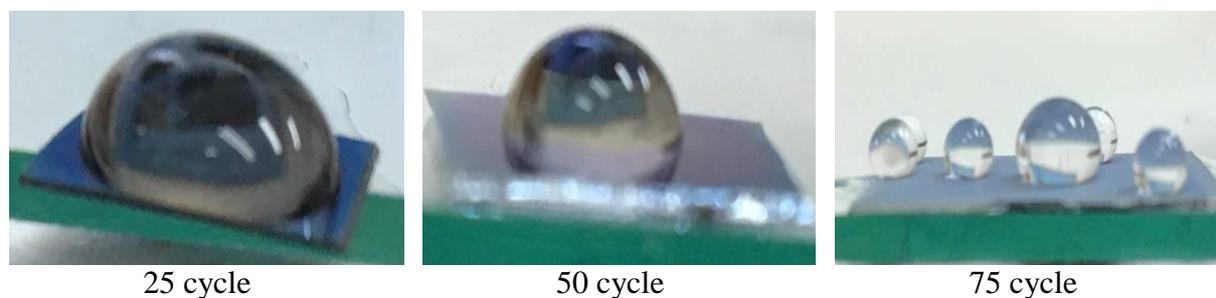


FIGURE 2. Photos of water droplets spreading into the surface of carbon-containing nanofilms in three different numbers of cycles: 25, 50, 75. The nanoparticle synthesis time in the plasma is 20 seconds.

At the next stage of research we affected film surfaces with different plasmas in order to change the chemistry of surface. In all cases plasma processing leads to essential changes of wettability. So after plasma processing surface become hydrophilic.

The experimental results show that the hydrophobic features of the film depends on the number of cycles; these superhydrophobic surfaces can be easily converted to the hydrophilic surfaces with simple plasma treatment. Depending on the processing time and the specific parameters of the plasma contact angle can be adjusted from about 160° to values below 10° . This process is accompanied by a rapid increase of the grazing angle.

The Charge Transfer Kinetics of Au-NPs-MWCNTs Modified Glassy Carbon Electrode Surrounded by E-coli

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Abstract

We present an insight into the charge transfer process of the Au decorated multiwalled carbon nanotubes (MWCNTs) when used as an immunosensor. Au nanoparticles with varied concentrations (40–100 (nM)) were functionalized on the acid oxidized MWCNTs to form nanohybrids. Electrochemical behavior of Au-NPs-MWCNTs nanohybrids decorated glassy carbon electrode (GCE) to determine the charge transfer kinetics. Both potential sweep and impedance spectroscopy analyses have suggested that the diffusion controlled processes were responsible for charge transfer at the surface of the modified electrode. Saturation in the value of rate constants k_s for 100 nM Au-NPs-MWCNTs modified GCE revealed that concentration of Au-NPs play an important role in facilitating the electron exchange between the composites and the electrode. Furthermore, the fabricated electrode exhibited a high electro-catalytic activity when *E. coli* was in the surroundings. Cyclic voltametry studies showed that both the anodic and cathodic peak currents were linearly dependent on the *E. coli* concentrations in the range from 10^4 /ml to 10^6 /ml. Finally, it was concluded that the ratio of Au-NPs in the Au-NPs-MWCNTs modified GCE described here is crucial for efficient charge transfer in *E. coli* surroundings.

The Evolution of the Design, Materials, Fabrication Processes and Performances of MEMS Condenser Microphone

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Abstract

The first prototype of a silicon-based condenser microphone was reported back in 1989 by the German researchers using bulk-micromachining process. Since then, it has come a long way. MEMS microphone has recently been commercialised and being used in smart phones by Apple, Samsung and Huawei with the compound annual growth rate of 13%. Surprisingly, there is no review paper in the literature that charts the remarkable progress of this device since its inception. Therefore, we have summarized over 90 technical papers from 1989 to 2016 that the evolution of its designs, materials, fabrication processes and performances. This talk is divided into five sections. The first part discusses the design varieties (plain, doped, perforated and corrugated) of the acoustic diaphragms from different materials (Si, SiN, polymer, metal etc). The second part talks about chamber, air gap spacer and the back plate structures. The third part deals with the air damping reduction techniques that influence the operating frequencies and the mechanical sensitivity. The fourth part summarize the trends in designing a highly sensitive, low noise and wide bandwidth MEMS condenser microphone for a variety of applications. Finally, I will discuss the collaborative work between IMEN and QMNC to develop the world's first MEMS condenser microphone employing 300 nm thick silicon carbide diaphragm with a tensile stress of 1500 MPa. The silicon carbide thin film has been epitaxially processed using the in-house LPCVD reactor at Griffith University. The targeted application is for the detection and localisation of poisonous gasses inside the underground mines. This talk would be of interest to researchers who are keen to learn about the emerging market of nanotechnology-based products.

Amino Acid Based Vesicle as Potential Radiosensitizer

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Abstract

Low concentration hydrogen peroxide (H_2O_2) is a novel radiosensitizer intended to increase the sensitivity of hypoxic tumor towards radiation delivered during radiotherapy treatment. Even though the incorporation of this agent effectively increases the therapeutic effect of radiotherapy, the delivery method of the agent via intratumoral injection causes clinical patients to experience side effects such as arterial air embolism, fibrosis, sclerosis and irritation at injection site. Hence, the main objective of this research is to study an alternative in delivering H_2O_2 radiosensitizer to target cell through the use of a recently developed vesicle system based on amino acid Sodium N-lauroylsarcosinate (SNLS). Vesicle carrying H_2O_2 was synthesized via sonication method with formulation of SNLS as primary surfactant and decanol as secondary surfactant mixed at molar ratio of 1:2 in 92 wt % of 3% v/v H_2O_2 . Characterization using polarized light microscope (PLM), Transmission Electron Microscopy (TEM), Dynamic Light Scattering (DLS), Fourier Transform Infrared Spectroscopy (FTIR) and spectrophotometer were conducted on the synthesized vesicle to study its formation, size, zeta potential value and molecular conformation as well as the encapsulation efficiency percentage (EE%) of H_2O_2 in vesicle. Cross maltese images obtain via PLM demonstrates the formation of synthesized vesicles which has a spherical morphology with size ranging 50-80 nm when characterized under TEM. The size value differs in correlation to DLS result with estimation of 252 nm as vesicle average size, deducting that vesicle synthesized are polydisperse with an index of 0.343. Based on FTIR spectrum, no chemical interaction occur between encapsulated H_2O_2 and vesicle due to unobserved changes of molecular conformation in comparison with control vesicle. Nevertheless, the encapsulation of H_2O_2 in vesicle was proven through spectrophotometric characterization with value of EE% equivalent to 75%. In term of stability, zeta potential value demonstrates that vesicle carrying H_2O_2 has a moderate stability upon synthesis and eventually declines over a period of storage time. Despite its intolerant stability during storage, it exceptionally demonstrates strong chemotherapeutic effects on cultured cancer cell via in vitro studies. However its function as a radiosensitizer agent could only be justified if conducted on hypoxic tumor via in vivo studies that will be conducted in future studies. The findings through this study demonstrated that amino acid based vesicle has the potentials to commit as a radiosensitizer carrier. The use of these vesicle might overcome the side effect of hydrogen peroxide currently faced by patients during radiotherapy treatment. However, for future implementation of these vesicle carrying radiosensitizer in clinical treatment requires further development and improvement of vesicle in terms of stability.

Application of Gamma Radiation in Graphene Oxide Reduction and G/Metal Oxide Nanocomposite Synthesis

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Abstract

Radiation nanotechnology is still practically an undeveloped field, except for some achievements in the fabrication of metallic nanoparticles under ionizing radiation. Radiation-induced processes are relatively simple, and have some advantages over common chemical methods in which they are mostly independent of high temperature, high pressure, hazardous chemicals, yield materials of high purity with narrow size distribution and can be applied to prepare various compounds. Graphene is a two dimensional nanocarbon material possessing remarkable chemical and physical properties. The high demand for graphene makes its synthesis in high volumes, especially with a relatively simple process, one of the key steps to meet various researches needs. This research aims to gauge the ability of gamma radiation to induce the reduction of graphene oxide (GO) to reduced graphene oxide (rGO). An extension of this work was to demonstrate that gamma irradiation reduction technique could also be used to produce a hybrid system of rGO-ZnO nanocomposite. For the first objective, which looks at the capability of gamma irradiation to induce GO reduction, the synthesized rGO samples which were prepared at irradiation dose ranges of 0 – 35 kGy, and characterized with fourier transform infrared spectroscopy (FTIR), UV-Vis spectroscopy, field emission scanning electron (FESEM) and energy dispersive X-ray analysis (EDX). According to the FTIR analysis, a large portion of the oxygen-containing functional group was removed after irradiation of the graphene oxide mixture. Reduction of GO was also proven using UV-Vis Spectroscopy, in which the wavelength of graphene oxide at 237 nm is red- shifted to 277 nm after being irradiated, with the peak at 292 nm (carboxyl group) disappearing in the spectrum of rGO. Morphology of graphene oxide also changed from a smooth and flat surface, to crumpled, indicating the reduction of GO. It was deduced that GO underwent reduction to rGO, induced by the irradiation. For the second objective, we endeavoured to demonstrate that the gamma irradiation reduction technique could be applied to produce a hybrid system of rGO-ZnO nanocomposite. Its effects on morphology, quantitative analysis of constituents and the chemical bonding of the produced rGO-ZnO nanocomposite were studied. Irradiation dose in the range of 0 – 100 kGy were examined to identify the optimum dose which displays the highest reduction capacity of GO to rGO sheet. FTIR spectrum shows that rGO-ZnO nanocomposite prepared at the irradiation dose of 100 kGy displayed the most significant reduction of GO to rGO, whilst still retaining the attachment of zinc oxide. It was found that zinc oxide nanoparticles were well distributed and confined in the transparent rGO sheets, as shown in the FESEM results. The mechanisms of the zinc oxide attachment and the reduction of GO which occurred simultaneously to produce rGO-ZnO nanocomposite were postulated. This work suggests that the gamma irradiation method displays promising potential towards being applied in the synthesis of rGO and rGO hybrid nanocomposites. It promises a more efficient, cost productive and simple solution towards the conundrum of graphene synthesis.

Effect of Annealing Strategy on Improved Photoactivity of Cuprous Oxide Nanowire Prepared Using Facile Fabrication Strategy for Solar Water Splitting

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Abstract

Cu₂O photocathode with free-standing nanostructure such as nanowire, nanorod, and nanotube have shown to improve photoactivity owing to enhanced photocatalytic reaction due to increase in surface active area. In this study, Cu₂O nanowire photocathode was fabricated using sequential wet chemical oxidation method and annealed under inert condition. The effect of annealing step on the transformation of precursor Cu(OH)₂ nanowire to Cu₂O nanowire is studied. The transformation undergone multistep annealing with a different ramping rate under inert condition. The highest photocurrent obtained was then compared with photocurrent generated from Cu₂O NW prepared with direct annealing strategy. With multistep annealing, the best photoelectrochemical performance was obtained from Cu₂O NW prepared at the highest ramping rate to be -5.46 mA/cm² at -0.6 V vs. Ag/AgCl under 100 mW cm⁻² light illumination power. This is 1.7 and 1.2 folds better than that obtained at the lowest ramping rate and single step annealing, respectively. The photocurrent enhancement obtained in this study was attributed to favourable morphology improving light trapping. The generated photocurrent is corresponding to applied bias potential efficiency (APBE) of 6.7 %. The abundance of Cu₂O source material, non-toxic, simple fabrication and excellent photocatalytic performance are among the attractive criteria to realize the hydrogen generation from solar water-splitting system that is cheap, clean, and efficient.

The Role of Graphene in Dye-Sensitized Solar Cell

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Abstract

Currently, graphene are getting interest for areas from nanoelectronics to biomedical engineering. This material also shows significant potential for solar energy applications such dye-sensitized solar cells. This paper highlights on the recent developments of graphene-based heterostructure for counter electrodes, photoanodes, electrolytes, and photosensitizers in the fabrication of dye-sensitized solar cells (DSSCs). DSSCs consisting of graphene composites with titanium dioxide (TiO₂), platinum (Pt), zinc oxide (ZnO), nickel oxide (NiO), dyes, ionic liquids and metals are discussed and their photovoltaic performance is compared with standard reference solar cells. Graphene–TiO₂ nanocomposites exhibit superior photovoltaic properties compared to the pure TiO₂ commonly used as a photoanode in DSSCs. Overall power conversion efficiency of graphene-based DSSCs fluctuates in a wide range, and is significantly affected by a number of factors, including the materials used for electrodes, electrolytes, photosensitizers, and solar cell configuration. The nanofabrication and processing of graphene-based materials for various forms such as quantum dots, nanofoams, nanoplatelets, aerogels, multilayers, fibers, paper, sheets, nanoparticles, and nanoflakes are also significantly influence the photovoltaic performance of DSSCs. Finally, this paper also highlights the current challenges in environmental stability and toxicity of the graphene-based materials for future commercialization.

Planar-Perovskite Solar Cells: Low Temperature Photovoltaic Behavior and Its Degradation Mechanism under Air Stability

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Abstract

For the past seven years, extensive efforts have been done in order to enhance the photovoltaic performance of methylammonium lead triiodide (MAPbI₃) perovskite which rise rapidly from 3.8 % to 21.0 %. However, several issue of perovskite solar cells (PSCs) are still remain unexplained particularly the low-temperature photovoltaic behavior, photocurrent hysteresis, and device stability in ambient air. In this work, the device configuration of indium tin oxide (ITO)/ZnO/MAPbI₃/Spiro-OMeTAD/Ag was used, where ZnO and spiro-OMeTAD act as electron and hole transporting layer (ETL and HTL). We found that at low temperature operating condition, the power conversion efficiency (PCE) gradually increased from 14.2 % (298 K) to 15.5 % (253 K), and simultaneously the photocurrent hysteresis is hugely suppressed owing to the enhance carrier mobility and slow ionic migration, respectively. Accordingly, PSCs have the potential for working efficiently under low operating temperature. Meanwhile, ambient air stability of PSCs was also investigated. For without encapsulation, the photovoltaic parameters undergo severe degradation and larger hysteresis upon exposure to the ambient air. The evidence of small amount iodine in the HTL causes the charge transport from MAPbI₃ to anode is hindered, consequently short circuit current density and fill factor are reduced. Additionally, the shift of iodine distribution within the MAPbI₃ layer (> 72 h aging time), further explained the correlation between the activation energy and hysteresis. The above detrimental effect can be overcome by novel encapsulation process, which exhibit excellent stabilized PCE up to 14 % and maintain hysteresis up to ~1000 h.

Modify Nanostructured Materials by AACVD Method for Solar Cells and PEC Applications

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Abstract

The application of aerosol-assisted chemical vapor deposition (AACVD) in energy research has received increasing attention in recent years. This is due to its advantageous such as low cost in manufacturing and environmental friendly for the whole process. AACVD is a unique method for the growth of thin films with excellent conformity or surface structured and allows for controllable doping levels, composite, crystallinity, thickness and particles size down to nano scale. The tailoring of thin film using AACVD method allows for enhanced performance of the functional properties of the films, whereby, the effect of the performance in solar cells and photoelectrochemical will be discussed.

Total Reflection X-ray Fluorescence Analysis of Airborne Silver Nanoparticles from Fabrics

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Abstract

Ag nanoparticles (NPs) are usually applied to consumer products because of their antimicrobial properties, which are desired in fabrics for sportswear as well as cloth used for cleaning. Hazards to human health from airborne Ag NPs may occur when the NPs are inhaled. NPs are comparable in size to macromolecules and viruses and able to penetrate deep into the lungs, e.g., the alveoli, where they may cause damage to cells and tissue due to their large surface area. In this study, aerosols released from fabrics treated with Ag NPs were collected using a low pressure Berner impactor and analyzed with total reflection X-ray fluorescence (TXRF). We found that the Ag NPs are released primarily in the form of larger particles, mainly 0.13-2 μm , probably attached to the fiber material. Using an electron micro probe, single particles could be identified. The detection of backscattered electrons suggests small spots on the particle consist of a heavier element, which most likely is Ag, although the signal in energy-dispersive X-Ray spectroscopy (EDX) was below the lower limit of detection (LOD). To achieve LODs necessary for Ag determination, Ar peaks were eliminated by a nitrogen atmosphere provided by the "Picofox-box". This enables linear calibration and quantification of Ag. The LOD was calculated at 0.2 ng (2.0 ppb). Following the TXRF and scanning electron microscopy (SEM)/EDX analysis, the aerosol samples were dissolved in nitric acid and analyzed with ICPMS to successfully confirm the results obtained by the TXRF measurements.

Atomic scale Correlative Surface to Bulk Characterization

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Abstract

Nanomaterials and nanodevices are considerably affected by atomic order structures such as growth layer thickness, atomic arrangement, crystalline defect, impurity and chemical bonding state. To characterize these fine structures, advanced analytical technologies are necessary with features of atomic resolution for surface and bulk imaging, three-dimensional, in-situ observation and pin-point sampling functions. Aberration-corrected Transmission Electron Microscope (TEM), aberration-corrected Dedicated Scanning Transmission Electron Microscope (STEM), atomic resolution (1Å) Surface Scanning Electron Microscope (SEM) and low aberration Focused Ion Beam System (FIB) are most powerful instrumentation for addressing the issues.

A high resolution image of TEM and dedicated STEM reveal directly atomic arrangements and atomic defects in the specimen. The resolution has attained sub-angstrom by combining with a self-aligning spherical aberration (Cs) probe corrector for electromagnetic lens. The atomic order elemental and chemical bonding analysis also have been enabled by Cs-corrected TEM or Cs-corrected dedicated STEM equipped with high solid angle dual EDS (energy dispersive X-ray spectroscopy) and EELS (electron energy loss spectroscopy). Moreover, a spatially resolved (SR) EELS can detect very small change of bonding state and chemical shift energy of sub electron volt on EELS spectrum. A lattice strain distribution at nanometer area is visible by nano beam diffraction method.

Three dimensional (3D) observation is available using specimen tilting series of 2D images and those 3D reconstruction image processing. FIB fabricated pillar shaped specimen and 360° rotation specimen holder are enable to an artefact-free and high-precision 3D structure analysis such as fine particles distribution, pattern edge roughness and elemental distribution in a nanometer order.

In-situ observation is very useful to investigate reaction process. Oxidation, counter diffusion and coalescence process can be demonstrated in TEM specimen chamber by using a gas injection and heating specimen holder. Simultaneous SEM and ADF-STEM imaging of catalytic reaction in a gas at elevated temperature is necessary to correlate the nano-size catalyst penetration from surface into the bulk material over time.

FIB combined with Scanning Electron Microscope (SEM) and low accelerating voltage Argon column fabricate low damage TEM / STEM specimen including an interested fine structures in a nanometer position accuracy.

Photonic Bandgap of Low Cost ZnO Nanorods by Two-step Chemical Bath Deposition

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Abstract

We wish to report the photonic bandgap (where light is confined) in low cost ZnO nanorods created by two-step chemical bath deposition (CBD) method where the glass substrates were pre-treated with two different seeding thicknesses, 100 nm and 150 nm, of ZnO using radio frequency magnetron sputtering. Then the samples were annealed at 600°C for 1 hour in air before immersed into the chemical solution. The samples once again were annealed with the same parameters as before. To observe the presence of photonic band gap on the sample, UV-Visible-NIR spectrophotometer was utilized and showed both samples exhibits a wide range of band gap between 280 nm and 400 nm, which is typical for ZnO. However, a slightly better light confinement was detected on sample with 150 nm pre-seeded substrate. Field Emission Scanning Electron Microscope (FESEM) of the samples revealed better oriented nanorods uniformly scattered across the surface when substrates were coated with 100 nm of seeding layer whilst the 150 nm sample showed a poor distribution of nanorods probably due to defects in the sample. Finally, the crystal structure of the ZnO crystallite is revealed by employing X-ray diffraction and both samples showed polycrystalline with hexagonal wurtzite structure that matched with JCPDS No. 36-1451. The 100 nm pre-seeded samples was recognized to have bigger average crystallite size than the 150 nm ones indicating a more crystalline structure. In conclusion, the 150 nm pre-seeded sample is recognized as a better candidate for future photonic applications due to its wider photonic bandgap and this widening may be attributed to more random distribution of the nanorods as observed in FESEM images as well as reduced crystallinity as observed from XRD measurements.

Keywords: ZnO; photonic bandgap; chemical bath deposition; nanostructure.

Effect of Post Annealing Temperature on Photonic Bandgap of ZnO Nanorods Grown by Chemical Bath Deposition

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Abstract

Nanostructures with wide photonic bandgap grown at low cost are desirable for fabricating photonic devices in industrial scale [1]. In this work, ZnO nanorods were grown on glass substrates in a two-step chemical bath deposition technique with seeding thicknesses of 100 nm and 200 nm. The first step involves sputtering a seeding layer of ZnO onto the glass substrate using RF magnetron sputtering at 150 W. The second step involves immersion of the substrate into a chemical bath containing 0.05 M hexamethylenetetramine (HMT) and 0.05 M zinc nitrate hexahydrate solution for 3 hours maintained at a temperature of 96 °C. Samples were then annealed at 400 °C, 500 °C and 600 °C under ambient air for an hour. The effect of annealing the structures post growth were investigated using Field Effect Scanning Electron Microscope (FESEM), Energy Dispersive X-ray (EDX), X-Ray Diffraction (XRD) and UV-Vis spectroscopy. Overall, all samples showed slight increase in size of the photonic bandgap when annealed at 600 °C. It is likely that enhanced oxygen diffusion filling the interstitial sites is responsible in increasing the width of the photonic band gap as structure imperfections has been shown to widen the gap [2]. XRD measurements revealed a decrease in grain size at this temperature (600 °C) for both seeding thicknesses calculated using the Scherrer formula. FESEM images showed an increase in ZnO nanorod diameter with increasing temperature however the sample seeded with 200 nm of ZnO showed a more closely packed population. The widest photonic bandgap was obtained from the sample with 200 nm seeding thickness annealed at 600 °C. We attribute the increase in photonic band gap to the increase in nanorod diameter as well as population density of the rods and the decrease in grain size due to interstitial oxygen diffusion. The ability to tune the photonic bandgap of low cost photonic devices and annealing at relatively low temperature; essentially at the limit for cheap glass substrates; provides potential in making useful low cost photonic devices. These samples have been used to observe random lasing behaviour which is discussed elsewhere.

Keywords: photonic band gap; low cost growth; chemical bath deposition; zinc oxide.

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Aptamer-mediated Glucose Oxidase Conjugation on Magnetic/gold Nanoparticles for Glucose Detection

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Abstract

At nanoscale, magnetic and gold nanoparticles exhibit remarkable material properties such as superparamagnetism, high plasmon field and surface functionality. Due to their versatility, biomolecules such as enzymes, antibodies and aptamers can be immobilized on these nanoparticles and provides as a useful platform for biosensing purposes. Aptamer-based nanoparticle offer a cost-effective, site-specific, good stability and performance for nanosensor application. In this study, the synergistic effect of magnetic/gold nanoparticle was manipulated for easy separation as well as for biomolecules anchor platform. The heterogeneous structure of magnetic/gold nanoparticles were produced using a simple deposition technique and was easily verified using UV-VIS spectrophotometer. Then, the aptamer which is a short synthetic oligonucleotide, was used to covalently attached glucose oxidase onto the nanoparticles surface. For nanoparticles characterization, zeta potential, TEM and EDX technique were used. For bioadsorption analysis, colorimetric detection using ABTS assay was performed. The UV absorbance measurement showed plasmon resonance changes which indicates the formation of a magnetic/gold nanoparticles and a peak broadening with the existence of immobilized enzyme. The ABTS assay showed a significant increase of absorbance with the increasing amounts of glucose. In conclusion, the development of colorimetric sensor for glucose using aptamer-based nanoparticles show a promising detection tool with rapid, simple and reliable analytical system.

Chemical Functionalization of Graphene for Lubricant Additives

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Abstract

The wide range of outstanding Graphene properties makes it a better option for application in different area of developmental interests especially the prominent functionalization into lubricant additive. In this study, a facile functionalization of Graphene oxide into promising lubricant additive was achieved at moderate conditions. The procedure involved synthesis of Graphene oxide via modified Hummer's method then functionalization with alkyne and azide compounds via click chemistry methodology over copper sulfate catalyst. Physicochemical properties of the functional potential lubricant additive were evaluated using FT-IR, XRD, TG-MS, FESEM, and NMR. To evaluate the performance of the lubricant additive, four-ball tests were performed. This determines the dispersibility and tribological properties of the functionalized Graphene in base oil. Interestingly, the organic moiety in the functionalized material was shown to improve its flexibility and stability, while Graphene provides hardness. However, the dispersed functionalized Graphene improved the tribological properties of the resulting lubricant, thereby reducing both the friction coefficient and wear by ~7%. These result suggest that the improved friction and anti-wear properties are due to functionalized Graphene (2.8 nm) and thin laminated structure as confirmed by XRD and FESEM respectively. In addition, these features offer low shear stress and prevent direct contact between metal surfaces.

Keywords: Graphene; Graphene oxide; Azide-alkyne; Click chemistry; Base oil; Antiwear; Friction.

Investigation of Corrosion on SAC 305, SAC 0307 and SAC 0307-0.03 P-0.005 Ni Solder Paste Alloys in Simulated Body Fluid (SBF)

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Abstract

The electrochemical migration (ECM) behaviour of SAC 305, SAC 0307 and SAC 0307-0.03 P-0.005 Ni has been investigated by using simulated body fluid (SBF) solution in this paper. Water drop test (WDT) was performed to compute the mean-time-to-failure (MTTF) of each sample while its electrical behaviour was examined using four-point probe test station. The microstructure of each solder paste alloy was observed using field emission scanning electron microscope (FESEM) with energy dispersive X-ray spectroscopy (EDX) to analyse the elemental composition of the solder paste alloy. X-ray photoelectron spectroscopy (XPS) was carried out to determine the dendrite phase formation. The MTTF results shows that SAC 305 has the fastest time-to-failure (TTF) due to short circuit. The corrosion susceptibility of SAC 305 is better compared SAC 0307-0.03 P-0.005 Ni. This is because of the influence of dopant incorporation on the SAC 0307-0.03 P-0.005 Ni. The four-point probe test station result reveals that SAC305 is a good electric conductor whilst SAC 0307-0.03 P-0.005 Ni is a poor electric conductor. The rate of dendritic growth was influenced by the alloying element of the solder. Therefore, SAC 0307-0.03 P-0.005 Ni have a good corrosion resistance in SBF medium.

Keywords: Electrochemical Migration; Simulated Body Fluid (SBF); Solder Paste; Corrosion.

Synthesis and Characterization of Plasmonic Nanostructures for Solar Cells

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Abstract

The research and commercial applications of metallic nanoparticles have rapidly expanded into fields like nano-scale electronics, biology, and photovoltaics due to their controllable optical and electrical properties. In thin film solar cells, particularly those based on crystalline silicon, performance is fundamentally limited due to weak absorption near the bandgap. Conventional light trapping schemes based on geometrical and diffractive optics lose their effectiveness thin-film configurations. In recent years, plasmonic scattering with metallic nanoparticles has been investigated for enhanced broadband absorption and internal scattering. Light interaction with plasmonic structures is critically dependent on their shape, separation, and physical characteristics. In this paper, synthesis of Au and Ag plasmonic nanostructures as a function of thickness and annealing temperature will be described. Optical response of plasmonic structures is investigated through broadband transmission measurements in 200-800-nm range for nanoparticles in 5-500-nm dimensions. The transmission spectra, for most part, is dominated by characteristic plasmon peaks. Appropriate configurations of plasmonic structures for conventional and thin-film solar cells will be presented.

Keywords: solar cells; plasmonic nanostructures; light trapping; transmission spectra.

Electrochemical Sunset Yellow Biosensor Based on Photocurable Polymer

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Abstract

The performance of new Sunset Yellow biosensor was investigated using electrochemical method in the form of working electrode coated with poly (Acrylamide-co-Ethyl Methacrylate)(AAM-co-EMA) membrane. Poly (AAM-co-EMA) in the presence of laccase enzyme referred as biosensor membrane was synthesized by photopolymerization. The measurements were carried out at pH 5, 0.05 M of Phosphate buffer solution added with 10 μ M of Sunset Yellow. At pH 5, biosensor has optimised condition with current peak of differential pulse voltammetry higher compared to other pH in range of 1-9. The influence of enzyme concentration, amount of biosensor mixture and accumulation time on the signal enhancement of Sunset Yellow were also discussed. As a result, the relative current value was proportional to Sunset Yellow concentrations. The linear range was observed between 0.08 – 10 μ mol/L with a detection limit (LOD) at 0.08 μ M. The proposed method was successfully used to detect Sunset Yellow in soft drinks with 99 % to 101.6 % of recovery, suggesting that determination of Sunset Yellow using this biosensor was effective and sensitive.

Keywords: Biosensor; Sunset Yellow; Laccase; Acrylamide; Ethyl Methacrylate.

Structural and Morphological Properties of Manganese–Zinc Ferrite Nanoparticles Prepared by Thermal Treatment Route

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Abstract

Manganese–zinc ferrite nanoparticles were synthesized from an aqueous solution containing metal nitrate as a precursor and polyvinyl pyrrolidone (PVP) as a capping agent by simple thermal treatment method at various temperatures from 450 to 650 °C for sintering the particles and calcination of the organic matters. The structural characteristics of the calcined Manganese–Zinc Ferrite nanoparticles have been examined by Fourier transform infrared spectroscopy (FT-IR), scanning electron microscopy (SEM), X-ray diffraction (XRD) and transmission electron microscopy (TEM). A completed calcination occurred at 500 °C and above as shown by the absence of organic absorption bands in the FT-IR spectrum and the particle size increased at higher temperatures. This method has advantages of simplicity, no additional chemicals required, a lack of by-product effluents, and environmentally friendly process.

Keywords: Thermal-treatment method; polyvinyl pyrrolidone; manganese–zinc ferrite Nanoparticles.

Nano Silicate Inhibitor Derived From Rice Husk for Corrosion Mitigation of Steel in Tap Water

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Abstract

Nanosilicate extracts from rice husk (*Oryza sativa* L.) ash (RHA) as a corrosion inhibitor for carbon steel in tap water. The nanosilicates extracted from RHA was obtained through wet chemical extraction and the extracted nanosilicates powder were analyzed using Fourier Transform Infrared Spectroscopy (FTIR) in order to identify the presence of functional groups (SiO_2) that contributed to the inhibition process. X-Ray Diffraction (XRD) characterization was conducted to identify the phase of silica from RHA. The particle size of extracted nanosilica in the range of 5-10 nm and it was confirmed through Transmission electron microscopy (TEM) and Zeta Sizer Analysis. The corrosion measurement study on the effect of nanosilicate from RHA on carbon steel sampels in tap water as corrosive media had been conducted by using weight loss method, Potentiodynamic Polarization, Electrochemical Impedance Spectroscopy (EIS), surface analysis, and adsorption isotherm study. It was proven that the maximum inhibition efficiency (IE %) obtained through corrosion measurement were up to up to 98 % of inhibition. On the other hand, the adsorption of inhibitor on the carbon steel surface was found to follow Temkin isotherm. Based on the result of Potentiodynamic polarization, it showed that inhibitors are mixed type. The results of EIS stated the value of charge transfer resistance and the percentage of inhibition efficiency increased with the increasing of nanosilicate concentration. Surface analysis on specimen that was treated with nanosilicate were smoother with fewer corrosion products compared to untreated specimen.

Keywords: Paddy rice husk; nanosilicates; corrosion inhibitor; tap water.

Using Some of Ordinary Fibers and Micro Fibers to Produce Knee Support for Women to Improve Function Performance

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Abstract

The aim of this research is for achieving better fiber of traditional fibers & high performance fiber such as (microfibers) for the production of knee support for women by improving function Performance & their fabric properties (absorption-compression-resistant fabric for explosion-pilling-air permeability & static electricity). A Constructed device at the NRC IN Cairo for measuring the knee support efficiency. The samples of research:-we produced (6) knee support with manual crochet structure with (microfiber acrylic 100%)-(microfiberacrylic-viscose50%-50%)-(micro fibers acrylic-elastic92%-8%)-cotton100%-acrylic100 %-(acrylic-cotton55%-45%). This sample has been applied in women the ages between 40-60 years old they have roughness in the knee joint, they have been using the experimental method which relies on analytical test samples produced under the research &then analyze the data & expressed. It was found that sample (100%cotton) & the sample (microfibers acrylic-viscose / 50:50 %) scored the high quality factor by using Quality Assessment by radar chart for all measuring. In questionnaire which applied in women and in practical experimental we achieved that (microfibers acrylic-viscose / 50:50 %) is the best sample for comfort wearing properties.

Keywords: microfibers – knee support-high performance-medical fabric-crochet.

The Effect of Gamma-irradiation on the Morphology of Gd₂O₂S

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Abstract

Nanophosphor gadolinium oxysulfide (Gd₂O₂S) possess lots of highly potential in many applications. To synthesis this material in nanosize, a very complex method is needed. However, the nanophosphor still manage to synthesis using a very simple method which were gamma-irradiation and the hydrogenation method. The synthesis was carried out using varying doses of gamma irradiation (10 kGy to 40 kGy) and followed by fix parameters of hydrogen flow at 900°C for 1 hour. Nanophosphor Gd₂O₂S phase formation and morphological were studied using X-ray powder diffraction (XRD) and field emission scanning electron microscopic (FESEM) technique. The formation of nanosize Gd₂O₂S particle was determined by transmission electron microscopic (TEM) technique. Material elemental analysis was characterized with energy dispersive X-ray (EDX) analysis. The photoluminescence (PL) properties also investigated, when emission spectra were obtained for excitation at 479 nm, and the excitation spectra were recorded for the emission peak at 623 nm. PL properties of the sample suggests that Gd₂O₂S is a good host matrix nanophosphor.

Keywords: Gd₂O₂S; gamma irradiation; photoluminescence.

Effect of Nickel on Bimetallic Nanoalloy Catalyst for Hydrogen Generation

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Abstract

A mesoporous Fe-Ni catalyst was prepared by microwave combustion method by using glycine as a fuel to help the combustion occur in the microwave. The bimetallic catalyst prepared by our group was intend to accelerate the production of hydrogen via decomposition of formic acid. The hydrogen produced supposedly can substitute the energy source used now especially from fossil fuels to contribute to the reduction of greenhouse effect. The catalyst sample was characterized by powder X-ray diffraction (XRD), scanning electron microscopy (SEM) and N₂ adsorption-desorption isotherm (BET). From the BET isotherms, a type IV isotherm was observed, indicate the presence of mesoporous solid. XRD diffractograms of Fe-Ni have well-defined diffraction patterns with strong and sharp diffraction peaks, indicating that they are crystalline. The SEM images show the presence of voids and pores in the sample and spongy structure which also consisted of very fine crystalline. The selectivity for H₂ formation using the prepared catalyst was 94-99% for 120 minutes even at maximum conversion of formic acid and merely at room temperature.

Keywords: iron nickel catalyst; hydrogen energy; microwave combustion method; H₂ selectivity.

Surface Analysis of Bimetallic Nanocomposite and Their Performance in Carbon Dioxide Capture

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Abstract

The mixed bimetallic oxide adsorbents consist of Cu and Mg supported nitrogen-rich activated carbon from *Nypha Fruticans* biomass were characterized and measured their CO₂ adsorption. A high dispersed CuO and MgO nanoparticle on activated carbon (AC) was obtained using ultrasonic-assisted impregnation. The optimum adsorbent is 5%CuO-25%MgO/AC having good surface properties of high surface area, pores volume and low particles agglomeration. The higher content of MgO of 5%CuO-25%MgO/AC adsorbent contributes to less metal carbide formation which increases their porosity, surface area and surface basicity. From XPS analysis, it was showed some amount of nitrogen content in the adsorbent that increased their surface basicity towards selective CO₂ adsorption. The presence of moisture was accelerated the CO₂ chemisorption to form hydroxyl layer on the surfaces. The 5%CuO-25%MgO/AC adsorbent was successfully adsorbed CO₂ via physisorption and chemisorption of 14.8 wt.% and 36.2 wt.%, respectively. It was significantly higher than fresh AC which also better selectivity to CO₂.

Keywords: *Bimetallic oxides; nitrogen-rich activated carbon; carbonates; chemical adsorption.*

Investigation Near IR Absorption in Thin Crystalline Si Wafers with Randomly Etched Nano Pillars

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Abstract

Significant research has been focused on optimizing efficiency crystalline silicon solar cells with nanostructured surfaces. Light absorption is greatly enhanced by light trapping in nanostructures. The main focus of research work presented here is to enhance the broadband light absorption in randomly etched nano-pillar textures. The nano-pillars were formed through metal-assisted chemical etching (MACE) process with silver nanoparticles serving as the etch masks. Uniformly distributed nano-pillars (SiNPs) were fabricated using single step etch process. Nano-pillars were fabricated on thin (~ 150 μm) c-Si substrates by immersion into an aqueous solution of HF, AgNO₃, and H₂O₂. The NP morphology and optical response were characterized with Scanning Electron Microscope (SEM), Atomic Force Microscopy (AFM), Surface photo-voltage (SPV), and near IR transmission. The performance of growth nano-pillars on as-cut (without saw damage removal process) and planar substrate (with saw damage removed) was evaluated. Typical dimensions of the vertically-etched anisotropic Si nano-pillars were diameter ~ 80-100 nm, depth ~ 500-1000 nm, and separation ~ 300-500 nm for etching times in 5-10 minute range. Such nano-pillars exhibit almost zero reflection and are expected to enhanced efficiency of the solar cell.

Keywords: thin silicon wafers; IR absorption; Nano-pillars; Metal-assisted chemical etching.

Low Temperature Treatment on TiO₂ for Flexible Dye Sensitized Solar Cell

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Abstract

Flexible dye sensitized solar cell (DSSC) has become an interesting topic in organic solar cell energy research. The potential by replacing standard FTO coated on glass substrate with flexible substrate that can help to achieve low cost fabrication and also reduce the weight of the device. However, flexible substrate can be operated with low temperature due to their low melt point. So, the deposition of TiO₂ film can be challenging where TiO₂ need high temperature to produce a good structure. But, it has been reported that with low temperature process for TiO₂ film also can produced better efficiency of the DSSC. So, the effect of TiO₂ films with low treatment temperature on its characteristic and efficiency was studied. In this paper, we have fabricated complete cell of dye sensitized solar cell using indium tin oxide – polyethylene naphthalate (ITO-PET) plastic film with 7 ohm/sq. and annealed at 3 different low temperatures such as deposited, 50 °C and 100 °C. TiO₂ paste was deposited on top of the ITO-PET plastic substrate using doctor blade technique as photoanode part. TiO₂ powder was dissolved in distilled water with polyethylene glycol was used as binder to produce 6 M of TiO₂ paste. The characteristics of produced TiO₂ films were done using atomic force microscopy (AFM), surface profilometer and ultraviolet-visible spectroscopy (UV Vis). The performance of fabricated flexible DSSC was analyzed using I-V curve and incident photon to current efficiency (IPCE) analysis. The thickness of the TiO₂ films was measured using stylus profilometer and it was found that with low temperature annealed effect the thickness. The average thickness achieved for as deposited, 50 °C and 100 °C was 24.24, 23.40 and 19.92 μm, respectively. The UV-Vis absorbance spectra of TiO₂ films with different temperatures were recorded within wavelength range of 200 – 700 nm. However, only TiO₂ film that was annealed at 100 °C shows the absorbance spectra appeared in the shorter wavelength region. However, the performance of the dye sensitized solar cell using ITO-PEN film is quiet low where the achieved solar energy conversion efficiency was 0.5% with active area 1 cm² under 100 mW/cm².

Keywords: Flexible substrate; Low temperature; Titanium dioxide; Dye sensitized solar cell.

Study on Surface Roughness Property of TiO₂/GO Photoanode for Dye Sensitized Solar Cell

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Abstract

Dye sensitized solar cells (DSSCs), the third generation of photovoltaic are currently proposed as the alternative to the conventional silicon solar cells. This is due to its low production cost, simple manufacturing and practically under ambient condition with acceptable power conversion efficiency. Titanium dioxide (TiO₂) was the most commonly used in DSSC as photoanode for its advantages of good stability, non-toxicity, low price, etc. However, electron transportation in TiO₂ nanocrystalline film is a dynamic process of electron transportation and recombination, which directly influence the photoelectric conversion efficiency of DSSCs. The purpose of this research is to study the effect of Graphene Oxide in Titanium dioxide photoanode for the surface roughness and energy conversion efficiency. GO was synthesized by using modified Hummer's method at room ambient temperature. Three different percentage of GO were doped with TiO₂, which are 2%, 6% and 10%. The influence of GO on the photoanode structure and performance of the DSSC were studied. Atomic Force Microscopy (AFM) and Field Emission Scanning Electron Microscopy (FESEM) were carried out to analyse the surface roughness and morphological of the TiO₂/GO photoanode. The performance of DSSC device was evaluated by current-voltage (I-V) curve and incident photon-to-current efficiency (IPCE). UV-vis spectroscopy was used to measure the absorbance of the films. AFM results show the surface roughness increase by increasing the content of GO in photoanode. This result supported by increasing the porous structure in FESEM morphological figures. The highest short circuit density, J_{sc}, energy conversion efficiency, and IPCE were contributed by 6% GO in TiO₂ DSSC, with the value of 5.5%. 4.5% and 74% respectively. The performance of TiO₂/GO significantly increase compared to the DSSC device without GO.

Keywords: Dye-sensitized solar cell; Titanium dioxide; Graphene oxide; surface roughness.

Enhancement in Dye-sensitized Solar cell Properties by Incorporation of GO and CNT into Photoelectrodes

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Abstract

Dye sensitized solar cell (DSSC) are attractive as simple and low cost renewable energy source. In DSSC, photo anode plays significant role for collection and transportation of photo excited electrons from dye to external electric circuit. Poor light absorption in the infrared region of the electromagnetic spectrum is one of the factors that limits further improvements in the DSSC efficiency. The aim of this research is to improve the photon absorption by the photoanode via doping carbon materials such as carbon nanotube and graphene oxide. In this study, improvement of the DSSC has been obtained by incorporating carbon based materials into the photoelectrode. A series of DSSC with different Graphene Oxide, (GO)-TiO₂ and Carbon Nanotube, (CNT)-TiO₂ photoelectrodes were prepared via Acid-catalyzed Hummer's method of GO and Acid Treatment method of CNT. The influence of GO and CNT on the structures of TiO₂ and performance of the cells were studied. Both GO and CNT were applied into the TiO₂ with various ratios of doping concentration at (a) 1 wt%, (b) 5 wt% and (c) 10 wt%. All samples were annealed at 500 °C for 30 min. Characterizations for both GO-TiO₂ and CNT-TiO₂ nanostructures were investigated by X-ray diffraction, field emission scanning electron microscopy (FESEM), profilometer analysis and transmission electron microscopy (TEM). The DSSC devices were fabricated with 1 cm² active area. The performance of the devices was evaluated using IV curve and supported with incident photon-to-charge carrier efficiency (IPCE) measurement data. XRD patterns show that the films consist of anatase and rutile phases with decreasing crystallite sizes proportionally with the increment of both GO and CNT doping concentration. FESEM morphological figures show that the thin films were homogenously dispersed and maintained their globular structures. TEM images illustrated the internal structure design of both GO and CNT doped TiO₂ films which explained the carbon based doping advantages to the cell performance. This studies indicates that compositing of GO and CNT can effectively enhanced the open circuit voltage, short circuit current density and photoelectric conversion efficiency of the DSSC. The greatest energy conversion efficiency with 5.05 % is contributed by GO doped TiO₂ solar cell with 5 wt% doping concentration with the highest IPCE data of 82.56 %. The performance is significantly higher than the DSSC devices with the pure TiO₂ cell.

Keywords: Dye-sensitized solar cell; Titanium dioxide; Carbon nanotube; Graphene oxide.

Surface Morphology and Topology of Aluminium Nanocoating on Mild Steel Substrates for Time-Dependent Power Behaviour Characterizations

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Abstract

Nanocoating for corrosion protection has potential to attract the new market in the many industries, especially oil and gas and automotive. Nanocoating can make high quality with super properties, will fill up the uneven surface substrate at the size of nanometer compared to the normal coating only cover the substrate surface. In this work, Aluminum nanostructures coating was deposited on mild steel surface by Electron Beam Thermal Evaporator system with various value of time exposure at the deposition beam current was 60 A. Aluminium nanostructures coating on mild steel have the potential to protect the mild steel from corrosion, three times longer than a normal coating. The morphology and structure of the nanostructured films were characterized by using a field emission scanning electron microscopy with an electron diffraction x-ray spectrometer (FESEM-EDX), an atomic force microscopy (AFM) and X-ray diffraction (XRD).

Keywords: Al-nanostructures; Electron Beam Thermal Evaporator; Mild steel; Film coating.

Model Development of Monolithic Tandem Perovskite/Silicon Solar Cell by AFORS-HET Simulation

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Abstract

Recently, organic-inorganic lead halide perovskites have significant role in the photovoltaic technology due to its high efficiency, lightweight and cost effectiveness especially methyl ammonium lead (II) iodide (MALI). The MALI is an interesting material due to its strongly absorbing direct bandgap semiconductor that can act as an absorber layer for high efficiency and low cost solar cell application. The MALI has a band gap of 1.5 eV which is compatible to be paired with silicon solar cell with energy gap of 1.124 eV. Since the efficiency of silicon based technology has been stuck around 25 % for 15 years, this tandem approach is an elegant solution to improve the efficiency of Si solar cell. This paper focuses on the development of the model of device configuration for Si-perovskite solar cell by using AFORS-HET simulation. The device configuration presented that the perovskite as the top cell and silicon solar cell as the bottom cell. The thickness optimization of all sub-layer will be investigated. We obtained the efficiency of 13 % for Si bottom cell with an open circuit voltage of 0.478 V and short circuit current of 35.38 mA/cm².

Keywords: methyl ammonium lead (II) iodide; monolithic tandem; Si-perovskite solar cell; AFORS-HET simulation.

Influence of Zirconium Additive on Reduction Behaviour of Tungsten Oxide under Carbon Monoxide Atmosphere

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Abstract

Zirconium additive to tungsten oxide catalyst (Zr/WO₃) were prepared by an impregnation method. The reduction behaviour of Zr/WO₃ and WO₃ by using carbon monoxide (CO) was investigated by using temperature programmed reduction (TPR) and X-ray diffraction (XRD). The reduction characteristics of WO₃ to WO₂ were examined up to temperature 900 °C by 40% CO in N₂ as reducing agent. The experimental results shows that, TPR spectra of Zr/WO₃ catalyst slightly shift to a lower temperature as compared to the WO₃ alone where its begins reduce at 550 °C. By increasing the addition of Zr content from 3 to 10 wt % the reduction temperature of WO₃ decrease significantly. Moreover, based on the characterization of the reaction products using XRD, the addition of Zr also enhances the reducibility of WO₃. Addition of 3% Zr, only small amount of the WO₃ remaining unreduced appear compared to WO₃ alone. Whereas, by adding 10% Zr on WO₃, it was reduced to suboxide WO_{2.72} and some WO₂ phases in comparison to without addition of Zr, which still have remaining unreduced WO₃ after the reduction. The ability to enhance the reducibility involved in Zr/WO₃ may associate to the presence of tungsten zirconium, W₂Zr compound.

Keywords: carbon monoxide; tungsten oxide, tungsten; TPR; XRD; zirconium

Morphology of Microstructure of Pb-free Sn – 3.0Ag – 0.5Cu Solder Pastes added with NiO Nanoparticles

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Abstract

The Pb-free solder pastes added with ceramic type nanoparticle produces unusual nanocomposites solder pastes. Nanoparticle addition to solder materials have been demonstrated to result in increased reliability of solder joints to avoid the fatigue failure. Therefore, in this paper, (SAC305) Sn –Ag –Cu solder alloys were mixed with 0.01, 0.05, and 0.15 wt.% NiO ceramic nanoparticles to make a new nanocomposite solder pastes. The morphology and microstructures in the presence of NiO nanoparticles with the SAC305 may produces new contribution enhancing the mechanical properties in the field of microelectronic industries. The hardness values of SAC-NiO nanocomposites solder pastes are determine the strength of microstructure by using a Vickers micro-hardness tester. Conductivity and resistivity of the nanocomposites solder pastes are determine using four point probe. The morphology and the microstructure nanocomposite solder paste will discuss details in term of physical and mechanical properties.

Keywords: NiO Nanoparticle; Pb-Free SAC305; Microstructure; Conductivity.

Solution-dispersed CuO Nanoparticles as Anode Buffer Layer in Inverted Type Hybrid Organic Solar Cells

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Abstract

A solution-dispersed copper oxide (CuO) nanoparticles anode buffer layer has been investigated to improve the efficiency of inverted type hybrid organic solar cell (OSC) based on zinc oxide (ZnO)/poly(3-hexylthiophene) (P3HT) with and without an electron acceptor, (6,6)-phenyl-C61-butyric acid methylester (PCBM). The photoactive layer consisted of P3HT was spin-coated onto the ZnO nanorod arrays that were grown on fluorine tin oxide (FTO) substrate. The CuO nanopowders dissolved in 1-butanol were then spin coated onto the photoactive layer, followed by the deposition of silver (Ag) using thermal evaporation technique. The CuO anode buffer layer enhanced the holes collection at Ag as indicated by a higher short current density (J_{sc}) and a smaller series resistance (R_s). For further investigation, the effect of CuO anode buffer layer on the performance of inverted type hybrid OSC based on ZnO/P3HT:PCBM was also studied. It was found that the CuO anode buffer layer worked differently in the devices based on ZnO/P3HT with and without PCBM. In the case of device based on ZnO/P3HT, CuO anode buffer layer only served as hole transport layer but for the device based on ZnO/P3HT:PCBM, CuO also served as an electron blocking layer which could effectively reduce the charge recombination at the photoactive layer/Ag interfaces, hence enhancing the power conversion efficiency (PCE) of the device. In conclusion, both devices based on zinc oxide (ZnO)/P3HT and ZnO/P3HT:PCBM with CuO anode buffer layer exhibited two times increment in PCE compared to the devices without CuO.

Keywords: Anode buffer layer; copper (II) oxide; organic solar cells; solution-dispersed.

Characterization of Perovskite Layer on Various Nanostructured Silicon Wafer

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Abstract

Crystalline silicon (c-Si) solar cell dominates 90% of photovoltaic (PV) market. The c-Si is the most mature of all PV technologies and expected to remain leading the PV technology by 2050. The attractive characters of Si solar cell are stability, long lasting and higher lifetime. Presently, the efficiency of c-Si solar cell is still stuck at 25% for one and half decades. Tandem approach is one of the attempts to improve the Si solar cell efficiency with higher band-gap layer is stacked on top of Si bottom cell. Perovskite offers a big potential to be inserted into a tandem solar cell. Perovskite with band-gap of 1.6 to 1.9 eV will be able to absorb high energy photons, meanwhile c-Si with band-gap of 1.124 eV will absorb low energy photons. The high carrier mobility, high carrier lifetime, highly compatible with both solution and evaporation techniques makes perovskite an eligible candidate for perovskite-Si tandem configuration. The solution of methyl ammonium lead iodide (MAPbI₃) was prepared by single step precursor process. The perovskite layer was deposited on different c-Si surface structure, namely planar, textured, Si nanowires (SiNWs) and SiNW-textured by using spin-coating technique at different rotation speeds. The nanostructured of Si surface was textured using wet chemical etching process. The detailed surface morphology and absorbance were studied in this paper. The results show that the thicknesses of MAPbI₃ were reduced with the increasing of rotation speed. In addition, the perovskite layer deposited on the nanostructured Si wafer became rougher as the etching time and rotation speed increased. The average surface roughness increased from 24.600 nm to 38.329 nm for etching rate range between 5 min to 60 min at constant low rotation speed (1000 rpm) for SiNWs Si wafer.

Keywords: metal halide perovskite; nanostructured silicon wafer; perovskite layer; spin coating.

Enhanced Photovoltaic Performance of CdS-Sensitized Inverted Organic Solar Cells Prepared via a Successive Ionic Layer Adsorption and Reaction Method

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Abstract

One-dimensional ZnO nanorods (ZNRs) synthesized on fluorine-doped tin oxide (FTO) glass by hydrothermal method were modified with cadmium sulfide quantum dots (CdS QDs) as an electron transport layer (ETL) in order to enhance the photovoltaic performance of inverted organic solar cell (IOSC). In present study, CdS QDs were deposited on ZNRs using a Successive Ionic Layer Adsorption and Reaction method (SILAR) method. In typical procedures, IOSCs—were fabricated by spin-coating the P3HT:PC₆₁BM photoactive layer onto the as-prepared ZNRs/CdS QDs. The results of current-voltage (I-V) measurement under illumination shows that the FTO/ZNRs/CdS QDs/P3HT:PC₆₁BM/PEDOT:PSS/Ag IOSC exhibited a higher power conversion efficiency (4.06 %) in comparison to that based on pristine ZNRs (3.6 %). Our findings suggest that the improved open circuit voltage (V_{oc}) and short circuit current density (J_{sc}) of ZNRs/CdS QDs devices could be attributed to enhanced electron selectivity and reduced interfacial charge carrier recombination between ZNRs and P3HT:PC₆₁BM after the deposition of CdS QDs. The CdS QDs sensitized ZNRs reported herein exhibit great potential for advanced optoelectronic application.

Keywords: inverted organic solar cells; ZNRs; CdS QDs; P3HT:PC₆₁BM; SILAR.

The Reduction Behaviour of Cobalt Doped Nickel Oxide in Carbon Monoxide Atmosphere

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Abstract

The reduction behaviour of 3% cobalt doped (3% Co-NiO), 10% cobalt doped (10% Co-NiO), 25% cobalt doped (25% Co-NiO) and undoped nickel oxide (NiO) by carbon monoxide (CO) in nitrogen (40%,v/v) atmospheres have been investigated by temperature programmed reduction (TPR). The phases formed of partially and completely reduced samples were characterized by X-ray diffraction spectroscopy (XRD). TPR results indicate that the reduction of Co doped and undoped nickel oxide in both reductants proceed in one step reduction (NiO → Ni) without intermediate. TPR results also suggested that by adding Co metal into NiO, the reduction to metallic Ni by using CO as reductant gaseous give less intensity to the peak. The reduction process of Co and undoped NiO become faster when CO was used as a reductant. Furthermore, in CO atmosphere, Co-NiO give complete reduction to metallic Ni at 700 °C. Meanwhile, XRD analysis indicated that the addition of different percent Co led to decrease in NiO crystallinity.

Keywords: Cobalt; Nickel Oxide; Carbon Monoxide; Temperature Programming Reduction.

Carbon Dioxide Capture by Tetradecylamine Supported on Silica Gel

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Abstract

Carbon dioxide emissions generated from fossil fuel-based power plants and other industries has reached 400 ppm in atmosphere. This negatively impact the environment, infrastructures and wildlife in particular. A lot of efforts are needed to produce CO₂ gas adsorbent in order to reduce the high CO₂ concentration. Therefore, porous silica gel (SG) is modified with amine compound for carbon dioxide capture. Calcinated silica gel functionalized with tetradecylamine (TDA) using wet impregnation has been developed as a porous media. The prepared adsorbents is characterized by x-ray diffractometry (XRD) and N₂ physisorption technique (Brunauer-Emmet-Teller analysis, BET). Appearance of 3 new crystalline peaks on 65TDA/SG diffractogram evidenced the presence of TDA molecules on the SG. Significant changes in physical properties of the adsorbents further ascertained the dispersion of TDA on the internal channels and external surface of the SG. Reactivity of porous sorbent towards CO₂ was evaluated using isothermal CO₂ adsorption by BET technique. This study shows 65TDA/SG enable to adsorb CO₂ in the highest capacity which is 23.22 cm³ CO₂ per gram adsorbent. Moreover, CO₂ adsorption consists of two type sorption which are physisorption and chemisorption.

Keywords: Tetradecylamine; Modified SG; CO₂ chemisorption.

Indium doped ZnO Nanorods for Room Temperature Optical CO Gas Sensing Application

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Abstract

Indium doped ZnO nanorods (IZO NRs) were synthesized through a facile wet chemical approach. The synthesis of IZO NRs involves two-step processes, namely seeding of ZnO nanoseeds on Fluorine doped Tin oxide coated glass substrate and growth of IZO NRs. IZO NRs sample was tested in an optical-based gas sensor operated at room temperature. The sensor response was measured in terms of absorbance variation against carbon monoxide (CO) gas using an Ocean Optics USB2000+RAD spectrometer. A remarkable improvement was observed in the CO gas sensing properties of the ZnO NRs with the Indium (In) incorporation. The improved sensing performance and accelerated sensing reaction was attributed to the band gap narrowing of the IZO NRs which eased the excitation of the photogenerated electrons onto conduction band and indirectly accelerated oxygen adsorption on NRs surface. Furthermore, the In content in ZnO NRs also increased the concentration of the oxygen-vacancy-related defect states which act as the charge trapping sites. These defects promoted the oxygen absorption on the surface of IZO NRs and enhanced its gas sensing capability. The results demonstrated that incorporation of In element in ZnO NRs exhibits a high sensitivity, fast and reversible response with rapid recovery time. IZO NRs reported herein has great potential to be used in optical CO sensing applications at room temperature. Meanwhile, a prototype optical absorbance based CO gas sensor device also presented in this work.

Keywords: carbon monoxide; gas sensor; optical; absorbance; zinc oxide.

Mesoporous TiO₂/ ZnO Nano-heterostructure for Photocatalytic Application

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Abstract

Crystalline phase transition metal oxide with controllable mesoporous architecture plays a dominant role in enhancing the performance of energy conversion and storage device. Solution based self-assembling routes for the fabrication of an orderly mesoporous heterostructure have increased the accessible morphology space as well as structural dimension. In this paper, TiO₂/ ZnO hierarchical heterostructures have been successfully synthesized by low temperature hydrothermal method. A high density and controllable morphologies of the secondary ZnO nanostructures including nanoparticle (NPs) and nanoflowers (NFs) has been tailored as a function of growth time in present work. A concise mechanism related to diffusion growth, oriented attachment and lattice matching between TiO₂ and ZnO crystal facet was discussed in details. Additionally, the photocatalytic performance of the heterostructures was also evaluated and a significant enhancement was demonstrated in the degradation of the organic pollutant and water splitting under the illumination of solar simulator, as compared to the primary bare TiO₂ nanorods. The synthetic methodology described herein promises to be an effective approach for shape-selective synthesis and assembly of metal nanoparticle with a novel structure. The nano-heterostructured materials with peculiar intrinsic properties exhibit considerable potential to address the environmental and energy issues via degradation of pollutant and water splitting applications.

Keywords: Water splitting; photocatalysts; visible light; nanoflower; Methylene Blue (MB).

Modification of Structural and Optical Properties of Zr Doped TiO₂ Nanostructures via Hydrothermal Method

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Abstract

The nanostructures of Zr dop TiO₂ thin film has been synthesized by a simple hydrothermal method within a dopant concentration in the range of $25 \leq x \leq 150$ w/w ratio. Structural and optical properties have been studied by XRD, FESEM, UV Vis and PL as a function of the Zr/Ti weight ratio. XRD results showed mixture of rutile and anatase phase for all samples except for the highest concentration (150%) that only exist in anatase phase and predominantly to the (004) plane and showed that Zr doping inhibited the grain growth. It is found that the films displays a visible luminescence band centered at about 397nm, 467nm and 621nm which are respectively ascribed to the oxygen vacancies and the intrinsic defects in TiO₂ and Zr doping. A shift of the UV absorption was observed as a hypochromic effect with bathochromic shifts which indicated a decrease in band gap of TiO₂ upon Z doping.

Keywords: Hydrothermal; TiO₂ thin film; Zr doping; nanorod.

Influence of Sputtering Pressure Variation on the Growth of ZnO Nanorods and Its Device Performance

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Abstract

Device characteristics of planar-heterojunction solar cells are known to be dependent on the nature of ZnO active layer. Therefore, the photovoltaic performance of a solar cell device is directly governed by the materials nature of ZnO seed layer. In current work, we used sputtered seed layers prepared at different sputtering pressure to grow ZnO nanorod arrays (NRA) as a replacement for conventional sol-gel derived seed layer. We investigated in details the changes induced on ZnO seed layers due to sputtering pressure variation and subsequently, the effects on the photovoltaic performance of solar cells. ZnO seed layers were deposited on fluorine doped tin oxide (FTO) coated glass using direct current (DC) magnetron sputtering technique. All seed layers were then subjected to post-annealing treatment. Using hydrothermal approach, ZnO nanorods arrays (ZNR) were grown from the seed layers prepared at different sputtering pressure. For device fabrication, P3HT polymer was spin-casted on ZNR inside a nitrogen glove box followed by the deposition of Ag electrode using DC sputtering technique. Microstructural properties and surface morphology of ZnO seed layers were characterized using XRD and FESEM, respectively. The optical absorbance of ZnO seed layers were recorded using UV-Vis Spectrophotometer. The photovoltaic performances of the solar cell devices were examined from current density-voltage (J-V) characteristic curves, measured using a Keithley 237 SMU System. It was found that the sputtering pressure variation directly affected the crystallinity of ZnO seed layer and the subsequent growth of ZNR. Simultaneously, the optical properties and the device performance of ZNR were also dependent on the sputtering pressure used. The correlations between sputtering pressure and the materials nature of ZnO seed layer and ZNR were successfully established in this study.

Keywords: Hydrothermal; surface morphology; nanorods; topography; optical band gap.

Effect of Zirconium Doping on the Reduction Behaviour of MoO₃ to MoO₂ by Using Carbon Monoxide as Reductant Agent

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Abstract

The reduction behavior of molybdenum trioxide, MoO₃ by using carbon monoxide, CO have been studied by temperature programmed reduction (TPR), X-ray diffraction (XRD), nitrogen isotherm adsorption (BET) and TEM analysis. The TPR results show that the reduction peak of MoO₃ with 20% (v/v) CO in nitrogen begins at 560 °C. Since the melting point of MoO₃ is 795 °C, reduction of MoO₃ to MoO₂ need to complete at temperature below than this. If the reduction of MoO₃ is not completed below this temperature, it will end up as a fused mass. Additional of 3% zirconium to modified MoO₃ can lower the reducing temperature of MoO₃. The TPR results show that the reduction peak of doped MoO₃ are slightly shifts to lower reduction temperature as compared with the pure MoO₃. The interaction between zirconium and molybdenum ions leads to this slightly decrease of the reduction temperature of zirconium doped MoO₃. Based on the characterization of the reaction products using XRD, it confirmed that the reduction of MoO₃ to MoO₂ by CO consists of two reduction stages, namely, Mo⁶⁺ to Mo⁵⁺ and Mo⁵⁺ to Mo⁴⁺. Reduction of pure MoO₃ to MoO₂ was a consecutive reaction with has intermediate products namely Mo₉O₂₆ and Mo₄O₁₁. However, only intermediate product Mo₄O₁₁ was form with doping of zirconium to MoO₃. It can be seen that doping with zirconium has a remarkable influence in the reduction process of the MoO₃.

DFT and Experimental Study of a Versatile Multidentate Phenantroline Bridging Ligand

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Abstract

A derivative of 1,10-phenantroline ligand, namely *N*-([1,2,4]triazino[5,6-*f*][1,10]phenanthroline-3-ylcarbamothioyl)benzamide (L3) is investigated as a bridging ligand for a bimetallic complex such as a Ru(II) photosensitizer-catalyst dyad, designed for a photoelectrochemical (PEC) water splitting reaction. The electronic and optical properties of L3 is elaborated by a DFT/B3LYP calculation along with experimental and theoretical results of the precursor ligands, 1,10-phenanthroline-5,6-dione (L1) and 3-amino-1,2,4-triazino[5,6-*f*][1,10]phenanthroline (amtp). The precursor ligands were prepared and characterised by mass spectrometry and spectroscopy techniques namely IR, UV-Vis and nuclear magnetic resonance (NMR). The challenges in developing L3 as the bridging ligand are also presented and discussed based on an energy profile of a proposed synthetic reaction which includes the energy of formation (H°_F), bond dissociation energy (E_{BD}) and activation energy (E_A). The implementation of aliphatic and aromatic acyl chlorides moieties influenced the energy barrier of the synthetic reaction to produce the derivatives of L3.

Keywords: phenantroline; photoelectrochemical; Ru(II); water splitting; DFT.

CO₂ Capture on NiO Supported Imidazolium-based Ionic Liquid

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Abstract

CO₂ capture on NiO supported imidazolium-based ionic liquid on silica known as NiO/[emim][HSO₄]/SiO₂ used as an adsorbent were investigated using gas adsorption analyzer and its desorption behavior were studied using temperature-program-desorption technique conjunction with online mass spectrometer (TPD-MS). The physical and chemical properties of the adsorbent were characterized using x-ray powder diffraction (XRD), surface area analyzer (BET method) and temperature-program-desorption analysis (TPD). Immobilization of ionic liquid on silica, [emim][HSO₄]/SiO₂ slightly decreased the surface area compared to bare silica from 266 to 256 m²/g due to the pore filling by ionic liquid. Interestingly, introduction of 10%NiO on 10%supported ionic liquid on silica, NiO/[emim][HSO₄]/SiO₂ was increased the surface area as well as pore volume from 256 to 356 m²/g and 0.14 to 0.38 cm³/g, respectively. The enhancement of surface area and pore volume was significantly increased the CO₂ adsorption performance with capacity of 48.8 mg CO₂/g adsorbent using NiO/[emim][HSO₄]/SiO₂ compared to [emim][HSO₄]/SiO₂ (27.3 mg CO₂/g adsorbent). This phenomenon might be due to the effect of NiO on ionic liquid which increased solubility of CO₂ on the surface of the adsorbent.

Keywords: Adsorption; CO₂ capture; desorption; ionic liquid; nickel oxide.

Effect of Rhodium Additive on the Reduction Behaviour of Iron Oxide in Carbon Monoxide Atmosphere

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Abstract

This study was undertaken to investigate the effect of 3% rhodium on the reduction behaviour of iron oxide by (10%, v/v) carbon monoxide in nitrogen as a reductant. The 3% Rh/Fe₂O₃ samples was prepared by impregnation method and the reduction behavior of 3% Rh/Fe₂O₃ and pure Fe₂O₃ were investigated by using temperature programmed reduction (TPR). The prepared samples and the reduced phases were characterized by X-ray diffraction spectroscopy (XRD) and structural morphology was obtained by Field Emission Scanning Electron Microscopy (FESEM). The results indicate that Rh/Fe₂O₃ shows a better reducibility compared to Fe₂O₃ with a complete reduction at 650 °C, which is 250 °C lower than Fe₂O₃. The TPR results indicate that the reduction of Fe₂O₃ proceed in three steps reduction (Fe₂O₃ → Fe₃O₄ → FeO → Fe) with Fe₃O₄ and FeO as intermediate states while for Rh/Fe₂O₃ as the TPR result showed the overlapping of second and third peak (Fe₃O₄ → FeO and FeO → Fe) at higher temperature . In addition of Rh may possibly reduce the formation of stable FeO that stable at higher temperature by accelerates the direct reduction of Fe₃O₄→ Fe so the reduction process of Fe₂O₃ become faster. The XRD pattern shows the diffraction peaks of Rh/Fe₂O₃ is more intense with improved crystallinity for the characteristic peaks of Fe₂O₃ compare to pure Fe₂O₃. No visible sign of rhodium particles peaks in the XRD spectrum that indicates the Rh particles loaded onto the iron oxide are well dispersed. The study shows that addition of Rh gives a better reducibility of iron oxide is also due to the ability of Rh to interact with CO as confirmed by the thermodynamic data with higher surface area compared to Fe₂O₃.

Keywords: Reduction; Iron oxide; Cerium; TPR; carbon monoxide; hydrogen.

Electrochemical Characterization for Supercapacitor Activated Carbon Electrode and Graphene Additive with Binder and Non-Aqueous Electrolyte

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Abstract

Graphene with its typical nano-scale characteristic properties has been widely used as an additive in activated carbon electrodes in order to enhance the performance of the electrodes for their use in high performance supercapacitors. In this study, we compare the self-adhesive carbon grains (SACGs) as activated carbon electrode (Cell-A) and SACGs added with 6 wt. % of KOH-treated multi-layer graphene (Cell-B) fabricated using 4 wt. % of Poly(vinylidene fluoride-co-hexafluoropropylene) PVDF-HFP as a binder and non-aqueous Lithium Perchlorate (LiClO_4) as an electrolyte. The supercapacitor electrodes were prepared using the paste/slurry technique. The fabricated supercapacitor cells (Cell-A and Cell-B) were characterized by electrochemical impedance spectroscopy, cyclic voltammetry and galvanostatic charge-discharge analysis to investigate the effect of graphene addition on the specific capacitance (C_{sp}), specific energy (E), specific power (P), equivalent series resistance (ESR) and response time (τ_o) of the supercapacitor cells. The results show that the addition of graphene in the electrodes changes the values of C_{sp} , E_{max} , P_{max} , ESR and τ_o from (64-96) F/g, 6.7 Wh/kg, 250 W/kg, 2.4 Ω and 5 s, to the respective values of (56-58) F/g¹, 3.3 Wh/kg, 247 W/kg, 3.1 $\Omega \text{ cm}^2$ and 25 s. This study demonstrates that the graphene addition in the electrodes has a significant effect on the electrochemical behaviour of the electrodes.

Keywords: Graphene; Activated carbon electrode; Electrochemical property; Supercapacitor; Non- aqueous electrolyte.

Optimization on Surface Passivation Layer of Homojunction Crystalline Silicon Solar Cell by Experiment and Simulation

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Abstract

Silicon nitride (SiN_x) and silicon oxide (SiO₂) films have been widely used as surface passivation and anti-reflecting coating (ARC) in crystalline silicon (c-Si) solar cells. This approach suffers from a distinct disadvantage in higher efficiency because of enhanced shunting during high (~ 800 °C) temperature rapid thermal annealing process. Therefore, a low temperature metallization process is needed. Conductive, indium tin oxide (ITO) films offer an attractive alternative principally due to their ability to form ohmic contacts at low (~ 200 °C) temperatures and high refraction index. In this article, we present a comparison study of electrical and optical characteristics of SiN and ITO film as ARC layer on homojunction solar cell by experiment and simulation by AFORS-HET. Optimization of emitter thicknesses, doping concentration and thickness of ARC layer namely SiN and ITO layer on homojunction cell were analysed with reduced internal absorption and contact resistivity to the c-Si surfaces. . Both experiment and simulation study were conducted in room temperature under ‘One Sun’ irradiation with air mass 1.5 (AM1.5). The efficiency of homojunction c-Si solar cell with ITO layer was 17.74%. The optimized thickness for ITO layer was 80 nm.

Keywords: Anti reflecting layer (ARC); SiN; ITO; homojunction solar cell; AFORS-HET.

A Study of TiO₂ Nanotubes Growth on Anodic Aluminium Oxide (AAO) Template Using Electrodeposition Method

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Abstract

Titanium dioxide, TiO₂ is a metal oxide that is commonly used in various applications such as photocatalysis, energy harvester, self-cleaning surfaces, air and water purifications. There are various methods for producing TiO₂ nanotubes such as hydrothermal, solvothermal, sol-gel, anodization and electrodeposition method. In this work, a study of TiO₂ nanotubes growth using electrodeposition method has been carried out. Hydrochloric acid, HCl was prepared using deionized water at pH 2.7 for dissolving titanium fluoride, TiF₄ powder. The final concentration and pH of the solution was 0.02M and 1.8, respectively. A commercial template of AAO was firstly sputtered with Ag using sputtering machine (600 sec). TiF₄ solution was used as an electrolyte in this work. 1.2 V potential was supplied and the deposition time was varied from 1 to 5 hours. Field Emission Scanning Electron Microscope (FESEM) was carried out to investigate effect of deposition time to the microstructural of TiO₂ nanotube arrays on AAO template. Results showed that the inner diameter of TiO₂ nanotube the wall thickness and the length were increased with the increasing of immersion time, while the outer diameter of the nanotubes followed the diameter of AAO pores.

Keywords: Titanium dioxide; nanotubes; electrodeposition method; anodic aluminium oxide (AAO).

Simple Construction of WO₃/Fe₂O₃ Photoanode for Photoelectrochemical Reactions

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Abstract

Tungsten trioxide (WO₃) is a good candidate to serve as photoanode in photoelectrochemical water splitting reaction to produce hydrogen gas. However, due to its large band gap value (2.8 eV), it was unable to absorb visible light > 450 nm. Hence, layering it with a small-band-gap material to enhance its visible light absorption is necessary. In this work, WO₃ layer was synthesized by electrodeposition method. After annealing process, it was layered with Fe₂O₃ from different precursor solutions, i.e. Fe(NO₃)₃, FeCl₃ and FeSO₄. This process was carried out by chemical deposition method, where the WO₃ samples were immersed in a 0.01 M iron solution for 24 hours. Then, these samples were annealed at different temperatures to obtain crystalline Fe₂O₃. With a thin layer of Fe₂O₃, the light absorption of WO₃ photoanode was extended to 550 nm. Besides, most of these bilayer WO₃/Fe₂O₃ photoanodes produced a higher photocurrent density compared to pristine WO₃. The highest photocurrent density produced by WO₃/Fe₂O₃ photoanode was 1.25 mA/cm², which is two times higher than the pristine WO₃. Overall, the facile, simple and low-cost method has shown its great potential for large scale fabrication.

Keywords: bilayer; metal oxide; photoelectrochemical water splitting; chemical bath deposition.

Effect of Spin Coating Cycle on the Properties of TiO₂ Thin Film and Performance of DSSC

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Abstract

TiO₂ thin films based dye-sensitized solar cell (DSSC) were prepared by sol-gel spin-coating method. The number of spin-coating was varied, 1,2,3,5 and 7 times to get various thicknesses of TiO₂ thin film on the ITO substrate. The phase structure of anatase exists in all samples at the diffraction angle of 25.36° corresponding with the crystal plane (101). From FESEM observation, the morphological shape of all samples is agglomerate nanoparticle. The sample with higher number of spin coating has pores with its size becomes bigger at the highest spin coating number. The thickness of TiO₂ film increases with the increase of spin coating number. The absorption window increases with the spin coating number. The DSSC with 7 times spin coating number demonstrates the best power conversion efficiency (η) which is 0.699% due to the broadest absorption window and lowest R_b and R_{ct} .

Keywords: DSSC; sol-gel; spin-coating; TiO₂.

Synthesis of Reduced Graphene Oxide (rGO) and Its Application as Counter Electrode in Dye-sensitized Solar Cell (DSSC)

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Abstract

Reduced graphene oxide (rGO) was prepared by using modified hummers method as an alternative to costly platinum as a counter electrode for DSSC. The effect of weight percentage (wt.%) of GO on the morphology and performance of the DSSC has been investigated. The rGO samples were prepared with various wt.% GO, namely, 0.5, 1.5, 2.5, 3.5 and 4.5 wt.%. The FESEM images of the rGO reveal the presence of conductive and non-conductive regions represented by dark region and white strips, respectively. These rGO samples were applied in the DSSC of ITO/TiO₂/electrolyte/rGO. The DSSC using the 0.5 wt.% GO sample performed the highest photovoltaic parameters with the J_{sc} , V and η of 0.68 mA cm⁻², 0.56 V and 0.06%, respectively due to the highest electronic conductivity.

Keywords: counter electrode; DSSC; hummers method; reduced graphene oxide.

Effect of Triangular Silver Nanoplates Surface Density towards Surface-enhanced Raman Spectroscopy Enhancement Factors

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Abstract

Surface-enhanced Raman scattering (SERS) is a phenomenon that enhanced Raman spectrum signal of specific molecules as a result plasmonic effect of metal nanoparticles. The phenomenon is potentially be used as sensor to detect presence of specific molecules. This study reports the implementation of SERS silver nanoplates substrates with variation of morphologies to detect bisphenol A (BPA) using home-made SERS sensor. The substrates were prepared by depositing the silver nanoplates on quartz surface from a colloidal using a self-assembly approach. The silver nanoplates colloidal was synthesized by a direct chemical reduction technique which was successfully produced the nanoplates with the average diameter of 26 nm and the average thickness of 7 nm. A study to obtain high quality deposition of nanoplates on the substrate was performed using a pre-treatment on the quartz surface by hydroxylate process. For the thin film deposition process, a study was carried out through variation of the immersion time of the substrates in the nanoplates colloidal. It was found that the immersion times determined the size distribution and surface density of the nanoplates on the substrates. A SERS sensor system was developed; consists of light source to excite analyte molecules, a Raman probe, sensor chamber and a spectrophotometer as an analyzer system. A duplex fiber optic is used to transmit light from the source to the probe and from the probe to the spectrophotometer. The developed sensor system was used to detect BPA molecules using nanoplates substrates. The sensor was successfully to detect the BPA molecules with the highest enhancement factor of 3.81×10^4 (average SERS enhancement factor) and the lowest detection concentration of the BPA is 0.001 M. The sensor also showed a good selectivity, repeatability and reproducibility. The application of substrates with variation of morphologies showed that the sensitivity of sensor depends on the surface density of the deposited nanoplates on the substrates.

Keywords: SERS substrates; bisphenol A; enhancement factor.

AC Susceptibility and Resistance Measurement on $\text{Ni}_{0.5}\text{Zn}_{0.5}\text{Fe}_2\text{O}_4$ (NZFO) and $\text{Co}_{0.5}\text{Zn}_{0.5}\text{Fe}_2\text{O}_4$ (CZFO) Added ($\text{Bi}_{1.6}\text{Pb}_{0.4}$) $\text{Sr}_2\text{Ca}_2\text{Cu}_3\text{O}_{10}$ Superconductor

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Abstract

The influence of $\text{Co}_{0.5}\text{Zn}_{0.5}\text{Fe}_2\text{O}_4$ (CZFO) and $\text{Ni}_{0.5}\text{Zn}_{0.5}\text{Fe}_2\text{O}_4$ (NZFO) nanoparticles added to ($\text{Bi}_{1.6}\text{Pb}_{0.4}$) $\text{Sr}_2\text{Ca}_2\text{Cu}_3\text{O}_{10}$ was investigated. The two different materials were used to prepare the samples, both are magnetic nanoparticles. The amount of 0.01 wt% (CZFO) and (NZFO) were added at final heating state. The ultrafine nanosize superconductor powders were produced by co-precipitation method, these powders increased the diffusion reaction and shortened the heat treatment procedure for the sample. XRD analysis showed the Bi-2212 phase increased when added with nanoparticles of (CZFO) and (NZFO) 0.01 wt%, furthermore it was dominated by Bi-2223 phase. Results from XRD showed the peak of (CZFO) and (NZFO) was not detected.

Keywords: $\text{Co}_{0.5}\text{Zn}_{0.5}\text{Fe}_2\text{O}_4$ (CZFO); $\text{Ni}_{0.5}\text{Zn}_{0.5}\text{Fe}_2\text{O}_4$ (NZFO); ($\text{Bi}_{1.6}\text{Pb}_{0.4}$) $\text{Sr}_2\text{Ca}_2\text{Cu}_3\text{O}_{10}$; co-precipitation; nanoparticles.

Synthesis of Crystalline Perovskite-structured SrTiO₃ Nanoparticles Using an Alkali Hydrothermal Process

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Abstract

We report an experimental route for the synthesis of nanocubes of perovskite-structured strontium titanate (SrTiO₃) powder using an alkali hydrothermal process at low temperatures without further heating. Furthermore, we studied the influence of the heating time (at 180°C) on the crystallinity, morphology, and perovskite phase formation of SrTiO₃. The SrTiO₃ powder, which is formed via nanocube agglomeration, transforms into cubic particles with a particle size of 120–150 nm after 6 h of hydrothermal sintering. The crystallinity and percentage of the perovskite phase in the product increased with the heating time. The cubic particles contained 31.24% atomic content of anatase TiO₂ that originated from the precursor. By varying the weight ratio of anatase TiO₂ used to react with the strontium salt precursor, we reduced the anatase-TiO₂ content to 18.8%. However, the average particle size increased when the anatase-TiO₂ content decreased.

Keywords: perovskite oxide; SrTiO₃; TiO₂ anatase; alkali hydrothermal process.

Aqueous-alkaline Lignin Processed Graphene into Green-luminescent Graphene Quantum Dots (GQDs) as Potential Emitting Layer for Organic Light Emitting Diodes (OLEDs)

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Abstract

Organic light-emitting diodes (OLEDs) are emerging as leading technologies for both high quality display and lighting. A basic OLED structure consists of a very crucial component of active organic luminescent material sandwiched between two electrodes and Graphene Quantum Dots (GQDs) is an interesting luminescent material for OLEDs. This report describes the synthesis GQDs by the hydrothermal technique using water as a green solvent. At first, the graphene dispersion was prepared from aqueous processed graphene using alkali lignin (AL) as surfactant, a new route to produce high yield with low defect graphene sheets. The resultant graphene dispersion was then transferred to Teflon-lined auto-clave and heated at different temperature and times to obtain GQDs. The synthesized GQD was characterized using FTIR, UV-VIS, Photoluminescence, TEM and FESEM. GQD was obtained through this technique was bluish green in colour. Typical absorption peak of GQDs was observed around 230 nm in UV-VIS spectra due to the $\pi \rightarrow \pi^*$ transition of aromatic sp^2 domain. This GQD has a broad peak and emit strong PL, light centred at 380 nm and 523nm upon excitation at 230 nm and TEM images reveal the fairly uniform GQDs with a size distribution of 7-8 nm. Thus, green-luminescent GQDs are demonstrated, with a material performance that is competitive with GQDs produced by other methods.

Keywords: Low defect graphene; hydrothermal technique; green GQDs.

Device Performance of Super Yellow as Emitting Layer in Organic Light Emitting Diodes

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Abstract

Currently, OLEDs have been used commercially as we can see in a small size screen devices such as smartphone and smartwatch. However, research on OLEDs materials is a continuous effort especially focusing on searching new materials with higher external quantum efficiency (EQE) and in optimizing the fabrication process. In this work, we fabricate OLEDs devices using a commercially available super yellow (SY-PDY-132) as an emitting layer using spin-coating method. The prepared devices consist of glass layer as a substrate, indium-tin-oxide layer as anode, SY-PDY-132 as emitting layer and finally Al as a cathode. The super yellow thin film was treated through annealing treatment for 30 min after spin-coating process. We have compared the effect of concentration in terms of performance and film quality. At concentration of 3.5 mg/ml super yellow, the device produces the higher brightness and efficiency.

Keywords: emitting layer; OLEDs devices; spin-coating method; super yellow.

Humidity Sensing Properties of Amorphous Carbon Nitride (a-CN_x) by Acetylene Gas

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Abstract

Amorphous carbon nitride (a-CN_x) thin films were deposited by radio frequency plasma enhance chemical vapor deposition (RF-PECVD) using a fixed mixture of acetylene (C₂H₂) at 20 sccm and nitrogen (N₂) gases at 50 sccm. The films were deposited at different RF power of 60, 70, 80, 90 and 100 W. The deposition pressure, deposition time and substrate temperature were kept constant at 0.8 mbar, 30 minutes and 100°C, respectively. The chemical bonding of the a-CN_x thin films will be characterized using Fourier transform infrared spectroscopy (FTIR) and its sensing properties using a home built humidity sensor system. The increase of RF power is predicted to an increment of formation of double (C=N) and triple (C≡N) bonds as compared to a-CN_x deposited using methane gas (CH₄). This is due to a higher ratio of C to H atoms in C₂H₂ which is expected to exhibit a high sensitivity leading to changes in relative humidity (%RH). This might be attributed to a potential use of a-CN_x thin films as a humidity sensing material.

Keywords: electrical properties; nitrile band; pecvd.

A Review on the use of Nanofluid for Heat Transfer Augmentation in Microchannel Heatsink

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Abstract

Researches on nanofluids have been quite intensive in the past decade. The performances of nanofluids have been experimentally and theoretically investigated by various researchers across the world. In this paper, the applications of nanofluid for heat transfer augmentation in microchannel heat sink is discussed. This paper also present the effects of some important parameters such as the type of nanoparticle, concentration, and Reynolds number on the rate of heat transfer. Finally, the conclusions and important summaries were presented according to the data collected.

Keywords: Nanofluids; heat transfer enhancement; microchannel heatsink; Reynolds number.

Grain Shaped Nickel Nanoparticles Synthesized in CTAB Solution using Gamma-Irradiation

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Abstract

A facile method to synthesize Nickel nanoparticles (Ni NPs) has been developed without using harmful chemical to reduce nickel ion. Ni NPs has been synthesized using gamma irradiation in aqueous system at ambient temperature. Cetyl trimethylammonium bromide (CTAB) has been used to control oxidation during radiolysis process and help to shape the Ni NPs into spheroid. Particles synthesized were characterized by XRD, VSM and TEM. The particles formed are crystallized with fcc phase without any oxidation state. The size ranging from 20 – 50 nm and consists of special morphology of pairing spheroid. VSM analysis shows that sample has the ferromagnetic properties with value of magnetic remanence smaller than bulk due to its size.

Keywords: Nickel Nanoparticles; Gamma Irradiation; CTAB; Aqueous System.

Effect of Lanthanum Nanoparticles on Physical and Optical Properties of Zinc Borotellurite Glass System

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Abstract

The uprising of optical application in various field especially in photonic devices had made the task of enhancing optical properties of glasses a great and urgent challenges for glass researchers. Hence, through this research, the effect of lanthanum nanoparticles (La NPs) on physical and linear optical properties of zinc borotellurite glass system has been investigated. The glass samples were fabricated via conventional melt-quenching technique and the optical properties of the fabricated samples were characterized through Ultraviolet Visible spectroscopy (UV-Vis) while the physical properties were determined by applying Archimedes principle. Transmission Electron Microscopy (TEM) that was employed in this research have proven the existence of La NPs in the glass matrix. The amorphous nature of the glasses have been verified with the presence of a broad absorption band instead of sharp absorption band in the Fourier Transform Infra-Red (FTIR) spectra. As concentration of La NPs increases in the glass system, the density values increases due to the replacement of small atomic mass Te ions with bigger atomic mass La ions while the decrement of molar volume follows the theoretical relationship between density and molar volume. Optical absorbance spectra that was obtained from UV-Vis can be used to calculate the indirect energy band gap and refractive index. The decreasing high polarizability nonbridging oxygen number and rises in bridging oxygen number had led to the increasing trend in indirect energy band gap in the range of 2.70-3.20 eV as well as a decrement in refractive index values in the range of 2.48-2.34.

Keywords: borotellurite glass; lanthanum; nanoparticles; indirect energy band gap; refractive index

Synthesizing Pt Nanoparticles in the Presence of Methylamine: Impact of Acetic Acid Treatment in the Electro-catalytic Activity of Formic Acid Oxidation

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Abstract

Surfactant removal from the surface of platinum nanoparticles prepared by solution based method is a prerequisite to realize high catalytic activity for electrochemical reactions. Here, we report a possible approach combining acetic acid with thermal treatment for improving catalytic performance of formic acid oxidation. This strategy involves conversion of amine to amide in acetic acid followed by surfactant removal via subsequent thermal treatment at 85 °C. We present that this combined activation technique enhanced Pt nanoparticles in catalyzing formic acid oxidation particularly in perchloric acid solution. Pt treated in 1h of acetic acid and heat treatment of 9h shows high electrochemical surface area value (27.6 m²/g) compares to Pt without activation (16.6 m²/g). The treated samples also exhibit high current stability of 0.3 mA/cm² compares to the as-prepared (0.03 mA/cm²). We demonstrate that prolonging acetic acid treatment to 5 and 10 hours result in transformation of amine to amide in high concentrations result in low activity of electrocatalytic performance. This work demonstrates a possible technique in improving catalytic activity of platinum nanoparticles synthesized using methylamine as surfactant.

Keywords: Pt nanoparticles; methylamine; solvothermal method; formic acid oxidation.

Resonance Position and Extinction Efficiency of Single Silica Coated Gold Nanoshell

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Abstract

In this work, the plasmon resonance wavelength position for a single coated nanospheres was calculated using the extended Mie theory. Previous studies have shown that the shift of nanoshell plasmon resonance wavelength scaled by the resonance wavelength of solid nanospheres decreased as a function of thickness of shell scaled by the core radius. However, the plasmon resonance of thinner nanoshell has shown a steeper red shift than the thicker ones. In this work, the attention is focused on the size effects of core on the position of plasmon resonance wavelength. The aim of this work is to study the behaviour of resonance position for silica core – gold nanoshell for different core size and nanoshell thickness radii by using extended Mie simulations with the including Lorentz – Drude size depended dielectric function and without inclusion of size depended. The results of Mie, calculated without size effect closely matched to experimental data. The results in this work indicated that the position of plasmon resonance wavelength for the same nanoshell thickness increased rapidly with increasing core size. The result is also true for nanoshell thinner than skin depth, while for nanoshell thicker than skin depth, the plasmon resonance is damped. These observations indicate that the plasmon resonance of coated sphere resulted from the coupling of the inner shell surface of nanoshell and the outer shell surface of sphere. As such, the plasmon hybridization model can be used to describe plasmon of nanoshell. However, for small core size the spill – out effect is most effective and resulted on blue shift in plasmon resonance position.

Green Synthesis, Characterization and Optimization of Gold Nanoparticles via Sonochemistry

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Abstract

In recent years, the development of efficient green chemistry methods for the synthesis of AuNPs has become a major focus of researchers (Ahmed, Ahmad, Swami, & Ikram, 2016). Green synthesis of AuNPs by plants such as Stevia Rebaudiana leaf extracts (Sadeghi, Mohammadzadeh, & Babakhani, 2015), Garcinia Mangostana Fruit Peels (Xin Lee et al., 2016), thiolated poly (ethylene glycol) (Lee, Lim, Ha, & Choi, 2016), Dillenia Indica (Sett, Gadewar, Sharma, Deka, & Bora, 2016) and a newly isolated strain Trichosporon Montevidense (Shen et al., 2016) were reported. In this work, we will synthesis AuNPs using kappa carrageenan (k-carrageenan) as capping agents and ultrasound irradiation as reducing agent. This method is simple, efficient, economic and environmentally benign which implies huge possibilities and opportunities in real world application.

Self-catalyzed In₂O₃ Nanowires by Plasma Assisted Reactive Thermal Evaporation

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Abstract

Indium oxide (In₂O₃) nanowires grown on c-Si substrates by plasma assisted reactive thermal evaporation were investigated. These nanowires were grown by different substrate temperatures (200 and 300°C) and deposition times (5 and 30 mins). The nanowires exhibit rod-like and needle-like morphologies with tetrahedron facet shape at the sidewalls. The diameter decreases (200 to 100 nm) and length increases (950 nm to 1.5 μm) with increase in substrate temperature and deposition time. Furthermore, the increased in substrate temperature enhances the crystallinity of the nanowires while the longer deposition time showed formation of nanowire branches on the sidewalls. The reactive plasma induces the formation of In droplets which acting as a liquid medium for the self-growth of the single-crystalline (110) In₂O₃ nanowires. The self-catalyzed growth mechanism of In₂O₃ nanowires is proposed and discussed.

Keywords: Indium oxide; Nanowire; Self-catalyzed growth; Reactive thermal evaporation.

Preparation of Curcumin Nanoparticles by Using Reinforcement Ionic Gelation Technique

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Abstract

Curcumin, a polyphenolic compound present in curcuma longa has wide range of activities including anti-inflammatory properties. The potency of curcumin is limited by its poor oral bioavailability because of its poor solubility. Various methods have been tried to solve the problem including its encapsulation into nanoparticle. The aim of this study is to develop curcumin nanoparticle by using reinforcement ionic gelation technique and to evaluate the stability of curcumin nanoparticles in gastrointestinal fluid.

Curcumin nanoparticles were prepared by using reinforcement ionic gelation technique with variation of concentrations of chitosan, triphosphate, sodium alginate and calcium chloride. Curcumin nanoparticles were then characterized include particle size and zeta potential by using particle size analyzer and morphology using Transmission Electron Microscope, entrapment efficiency using UV-Vis Spectrophotometer and chemical structure analysis by Infra Red Spectrophotometer (FTIR). Furthermore, stability of curcumin nanoparticles were evaluated on artificial gastric fluid and artificial intestinal fluids by measuring the amount of curcumin released in the medium at time interval.

The result revealed that curcumin nanoparticles can be prepared by reinforcement ionic gelation technique, the entrapment efficiency of curcumin nanoparticles were from 86 to 91%. Average of particle size was 381,1 nm and zeta potential was 12,62 mV. The morphology examination showed that the curcumin nanoparticles have spherical shape. Stability evaluation of curcumin nanoparticles showed that nanoparticles were stable on artificial gastric fluid and artificial intestinal fluid. In summary, this result indicated curcumin nanoparticles were potential to be developed for oral delivery.

Keywords: curcumin; nanoparticle; reinforcement; ionic gelation; stability.

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