STEMa2022

3rd International Conference on Science and Technology of Emerging Materials

4 - 6 August 2022
Pattaya, THAILAND

Book of Abstracts

International Conference on Science and Technology of Emerging Materials 2022 (STEMa2022)

August 4-6, 2022

Holiday Inn, Pattaya, Thailand

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Asst.Prof.Dr. Wanichaya Mekprasart College of Materials Innovation and Technology, KMITL
Dr. Khattiya Chalapat College of Materials Innovation and Technology, KMITL

Message from the President of King Mongkut's Institute of Technology Ladkrabang (KMITL)

On behalf of King Mongkut's Institute of Technology Ladkrabang (KMITL), I would like to express a warm welcome to **the International Conference on Science and Technology of Emerging Materials 2022 (STEMa 2022)**. This conference is the 3rd STEMa conference that was postponed from the year 2020 due to the COVID-19 pandemic. For this year, STEMa conference is back onsite and will be held on 4 – 6 August at the Holiday Inn, Pattaya with COVID-19 prevention measures. This conference provides an academic forum for materials science, nanotechnology, and engineering community. It serves as an opportunity for Thai and oversea researchers, lecturers, students, and young scientists as well as those who are interested in material science to discuss and exchange scientific progress and also to develop and strengthen the collaboration network among the research community.

I would like to give special thanks to the organizers and to all speakers and participants. From the success of the previous STEMa conferences, I wish high success to the STEMa 2022 and sincerely hope that this event will provide an inspiring experience and benefit to all participants.

Sincerely yours,

Associate Professor Dr. Komsan Maleesee
President (Acting)
King Mongkut's Institute of Technology Ladkrabang (KMITL), Thailand

Associate Professor Dr. Komsan Maleesee
The President (Acting) of King Mongkut's Institute of Technology Ladkrabang (KMITL)

Message from the Dean of College of Materials Innovation and Technology, King Mongkut's Institute of Technology Ladkrabang (KMITL)

It is my honor to welcome you to the International Conference on Science and Technology of Emerging Materials (STEMa2022), which is held on August 4 – 6, 2022 at Holiday Inn, Pattaya, Thailand. This is our 3rd international conference after STEMa2018. The STEMa conference is devoted to the advancement of scientific research and communication of materials science, nanotechnology, engineering, and other related fields. This conference is for the scientists, scholars, engineers, and students from universities, research institutes, and industries to present ongoing research activities. This allows for the free exchange of ideas and challenges among the conference participants.

On behalf of the organizing committee, we would like to welcome participants from all over the country and worldwide to participate in STEMa2022. We are looking forward to meeting you at the conference.

Sincerely yours,

Assistant Professor Dr. Wipoo Sriseubsai
Dean of College of Materials Innovation and Technology,
King Mongkut's Institute of Technology Ladkrabang (KMITL), Thailand

Assistant Professor Dr. Wipoo Sriseubsai
The Dean of College of Materials Innovation and Technology,
King Mongkut's Institute of Technology Ladkrabang (KMITL), Thailand

Overview:

International Conference on Science and Technology of Emerging Materials 2022 (STEMa2022) will be held at Holiday Inn, Pattaya, Thailand, during August 4-6, 2022. The STEMa2022 conference is organized by College of Materials Innovation and Technology, King Mongkut's Institute of Technology Ladkrabang (KMITL). The conference will focus on current developing material science and engineering.

Key Topics:

- Advanced Functional Materials (AMF)
- Biomaterials and Carbon-based Materials (BCM)
- Computational Materials (COM)
- Energy and Environment Materials (EEM)
- Materials Fabrication, Characterisation and Manufacturing (MFM)
- Materials for Health Science (MHS)
- Nano-Materials and Applications (NMA)
- Optical and Electronic Materials (OEM)
- Sensors, Sensing Materials and Related Devices (SSM)
- Sensors, Sensing Materials and Related Devices (SSB)

Venue:

Holiday Inn, Pattaya, Thailand

Oral Presentation:

51

Poster Presentation:

52

Organizer:

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King Mongkut's Institute of Technology Ladkrabang
1 Chalongkrung Rd., Ladkrabang, Bangkok, 10520 THAILAND
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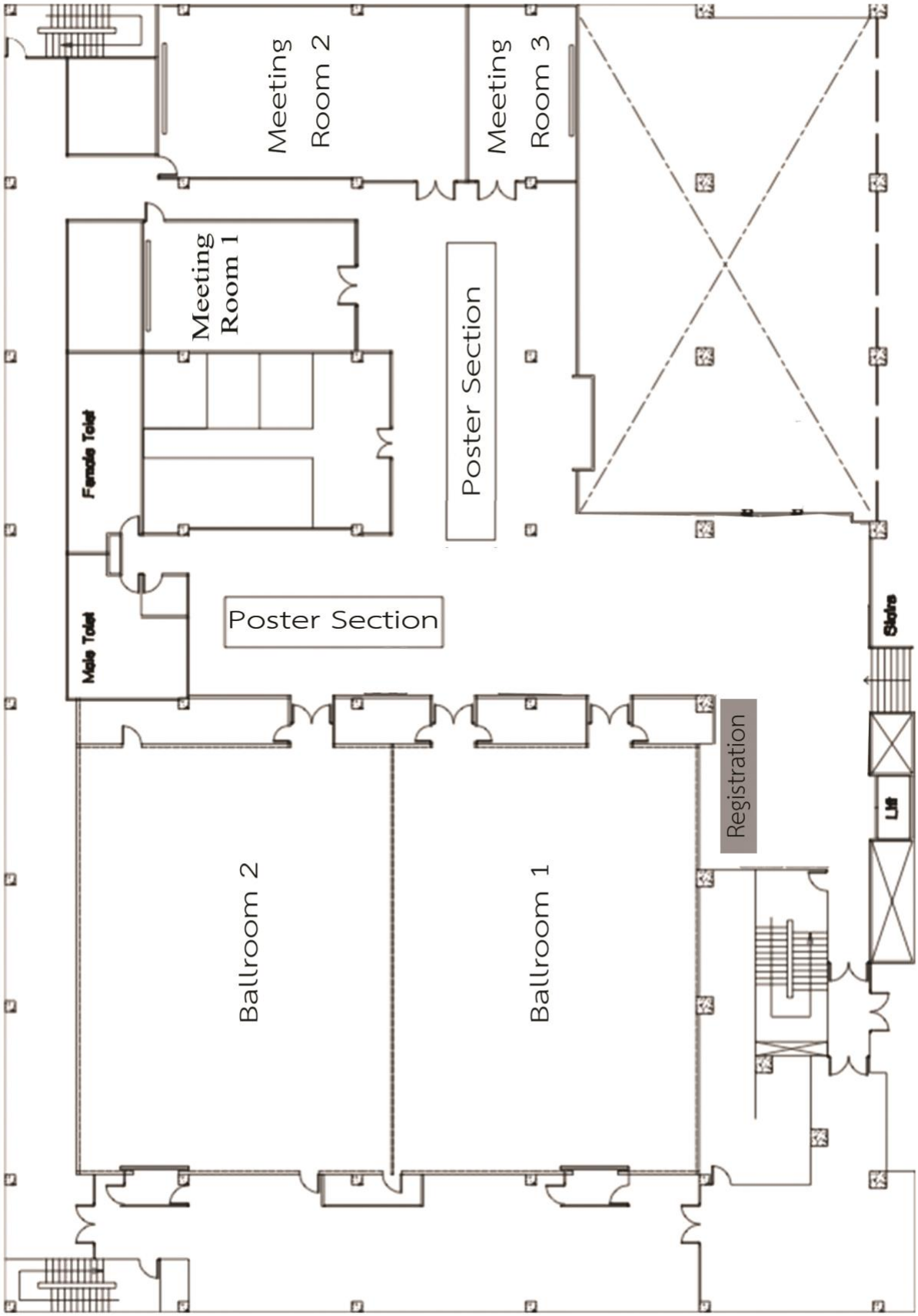
Floorplan:


Meeting Room 2
Meeting Room 3
Meeting Room 1
Poster Section
Female Toilet
Male Toilet
Poster Section
Registration
Ballroom 2
Ballroom 1

Thursday, 4 August 2022

Time	Activity
14.00-18.30	***Registration***

Friday, 5 August 2022

Time	Activity at Ballroom 1 and 2
08:30-09:10	*Registration*
09:10-09:40	*Welcome and Conference Opening/ Group photo*
09:40-10:00	*Coffee Break*
10:00-10:45	***Keynote Presentation I (Online)*** *by* *Prof. Dr. Morinobu Endo* *(Shinshu University, Japan)* *“ Carbon Nanotubes: Mass Production and Applications for Sustainability”*
10:45-11:30	***Keynote Presentation II*** *by* *Dr. Adisorn Tuantranont* *(National Science and Technology Development Agency, Thailand)* *“ Graphene Technology for Energy Storage Devices”*
11:30-12:00	*Special Talks*
12:00-13:00	***Lunch***

Friday, 5 August 2022 (P.1)

Time	Ballroom 1	Ballroom 2	Meeting room 1	Meeting room 2	Meeting room 3
13:00-13:15	**Optics & Electronics I (OEM I)**	**Energy&Environment I (EEM I)**	**Sensor & Sensing Materials I (SSM I)**		**Bio-Carbon Materials (BCM)**
13:15-13:30	**Invited I:** **Prof. Dr. C.K. Jayasankar** *"Compositional Dependence Spectroscopic Studies of Dy^3-doped Glasses for Optical Device Applications"*	**Invited I (Online):** **Prof. Balaji Rao Ravuri** *"Variation on Long Term Electrochemical Stability of Sodium–Vanadium Glass and Glass-ceramic Anode Half-cell Network Mixed with ZnO"*	**Invited I:** **Asst. Prof. Dr. Theerakiat Kerdcharoen** *"Digitalization of Smell: Development of Chemical Sensors from Lab to Startup Business"*		**Invited I:** **Assoc. Prof. Dr. Dheerawan Boonyawan** *"Nightingale®: a Novel Source for Plasma-Driven Biocatalysis"*
13:30-13:45	**Invited II:** **Asst. Prof. Dr. Piyachat Meejitlaisan** *"Broadband 1.53 μm Emission Characteristics of Er^{3+} Doped Alkali Oxyfluorophosphate Glass for Fiber Optic Communication Material"*	**EEM-OR01 (Ab-ID015):** *"Effect of Processing Parameters on Dielectric, Ferroelectric and Energy Storage Properties of Nd_2O_3 Modified BNT-based Lead-free Ceramics"*	**SSM-OR01 (Ab-ID069):** *"The Sensitivity Improvement of Electrochemical Non-enzymatic Glucose Sensor by Means of Solar-radiation on Gold Nanoparticles-decorated Iron Oxide Nanorods"*		**Invited II:** **Assoc. Prof. Dr. Pakorn Opaprakasit** *"Functional Materials from Responsive Polymeric Hybrid Nanoparticles"*
13:45-14:00		**EEM-OR02 (Ab-ID046):** *"Biocompatible and Biodegradable Gamma Glycine Treated Bacterial Cellulose Nanofibrils Based on Hybrid Piezoelectric-Triboelectric Nanogenerator"*	**SSM-OR02 (Ab-ID091):** *"The Effect of Temperature on Carbaryl Pesticide Detection by Using Ion-Sensitive Field Effect Transistor"*	**Special Symposium I: MRS and JASTIP (13.45-17.15)**	
14:00-14:15	**OEM-OR01 (Ab-ID035):** *"Improvement of Luminescence Performance by Addition Potassium Fluoride in Li_2O-AlF_3- NaF-P_2O_5 Glass Doped with Eu_2O_3 Content for Efficient Reddish-Orange Applications"*	**EEM-EOR01 (Ab-ID080): (Online)** *"Energy Harvesting of Time-dependent Electromagnetic Field Wasted from Triboelectric Generators"*	**SSM-OR03 (Ab-ID065):** *"Photoelectrochemical Hydrogen Peroxide Detections based on Bismuth Vanadate Thin Film Prepared by Pulsed Laser Deposition System"*		**BCM-OR01 (Ab-ID036):** *"Synthesis of Nano Porous Carbon Derived from Vinasses Wastes for Trihalomethanes Adsorption Application"*
14:15-14:30	**OEM-OR02 (Ab-ID030):** *"Luminescence Behavior of Sm^{3+} Ion Doped Pottasium Aluminium Gadolinium Phosphate Glasses as Orange Laser and Photonics Applications*	***Coffee break***	**SSM-OR04 (Ab-ID072):** *"Vehicle-Theft Detection Device with Image Recognition on Google Cloud Vision"*		**BCM-OR02 (Ab-ID039):** *"Synthesis of Lignin Extracted from Black Liquor to Nano Porous Carbon Materials for Tetracycline Adsorption Application"*

Friday, 5 August 2022 (P.2)

Time	Ballroom 1	Ballroom 2	Meeting room 1	Meeting room 2	Meeting room 3
14:30-14:45	**OEM-OR03 (Ab-ID031):** *"Development Luminescence and Energy Transfer from Gd^{3+} to Sm^{3+} of Tungsten Calcium Silicoborate Glass for Orange Emission Material Application"*	***Coffee break***	**SSM-EOR01 (Ab-ID056): (Online)** *"IoT-Based Real Time pH Monitoring of University of Mindanao's Chemical Laboratory Wastewater"*	**Special Symposium I: MRS and JASTIP (13.45-17.15)**	**BCM-OR03 (Ab-ID042):** *"Bacterial Cellulose Nanopaper: Preparation, Characterization and Its Applications as Sensing Platforms"*
14:45-15:00	**OEM-OR04 (Ab-ID034):** *"A Study on Physical and Luminescence Properties of Sm^{3+} Ions Doped Li_2O:Al_2O_3:La_2O_3:B_2O_3 Glasses"*	**Nanomaterials I (NMA I)** **Invited I:** **Dr. Waluree Thongkam** *"Thailand Nanosafety and Nanotechnology Ethics Implementation"*	***Coffee break***		**BCM-OR04 (Ab-ID097):** *"The Preparation Characterization and Bioactivity Study of Bioactive Glass Nanoparticles"*
15:00-15:15	**OEM-OR05 (Ab-ID044):** *"Influence of Calcium Fluoride on the Radiative Properties of Sm^{3+} Doped Zinc Borophosphate Glasses"*		**Material Fabrication (MFM)** **Invited I:** **Dr. Tossaporn Lertvanithphol** *"Design and Fabrication of Nanoscale Plasmonic Structures for Optical Sensor Devices"*		**BCM-OR05 (Ab-ID098):** *"A Study on Conversion of Liquid Benzene Derivatives to Value-added Carbon Nanotubes Using Fe and Ni on Alumina Catalysts"*
15:15-15:30	***Coffee break***	**Invited II (Online):** **Prof. Dr. Takashi Ikuno** *"High-yield Conversion of Plastics into Carbon Nanotubes"*		***Coffee break***	
15:30-15:45	**Optics & Electronics II (OEM II)** **Invited III:** **Prof. Dr. Supon Ananta** *"Perovskite Ferroelectric Ceramics: Domain Evolution Behavior and Dielectric Properties"*		**Invited II:** **Dr. Pinit Kidkhuntod** *"X-ray Absorption Spectroscopy: The State of the Art Synchrotron-based Characterization"*	**Special Symposium II: MRS and JASTIP (13.45-17.15)**	**Materials for Health Science (MHS)** **Invited I:** **Assoc. Prof. Dr. Paul Gleeson** *"Probing Inorganic Catalytic Materials and Biological Enzymes using Computational Simulations"*
15:45-16:00		**NMA-EOR01 (Ab-ID064): (Online)** *"Direct Fabrication of Carbon Nanotube Wirings on Plastic Films Using a Laser Thermal Transfer Method"*			

Friday, 5 August 2022 (P.3)

Time	Ballroom 1	Ballroom 2	Meeting room 1	Meeting room 2	Meeting room 3
16:00-16:15	**OEM-OR06 (Ab-ID033):** *"Investigation of Manganese Oxide (Mn_2O) Doped in Calcium Sodium Borosilicate Glasses for Photonics Materials Application"*	**NMA-EOR02 (Ab-ID060): (Online)** *"Improvement of Output Power of Triboelectric Generators by Adding TiO_2 Particles into PDMS Films"*	**MFM-OR01 (Ab-ID019):** *"Design and Fabrication of Flexible Thermoelectric Generator: An Experimental and Simulation Study"*	**Special Symposium II: MRS and JASTIP (13.45-17.15)**	**MHS-OR01 (Ab-ID017):** *"Effects of Ag-doped Content on Antimicrobial Activity and Substrate Color of Chromium Thin Films Deposited by DC Magnetron Sputtering"*
16:15-16:30	**OEM-OR07 (Ab-ID025):** *"X-ray Source Using Pyroelectric Crystals under UV Laser Irradiation"*	**NMA-OR01 (Ab-ID047):** *"Flexible Bacterial Cellulose–Titania Nanotubes Composite for Wireless Motion Sensor"*	**MFM-OR02 (Ab-ID057):** *"Effect of Copper Percentage in Copper Tungsten Electrode on Ti_6Al_4V by Electrical Discharge Machining"*		**MHS-OR02 (Ab-ID048):** *"Analysis of Asbestos Contamination Found in Talc Powder Products Marketed in Thailand Using X-ray and Infrared Spectroscopies"*
16:30-16:45	**OEM-OR08 (Ab-ID106):** *"Giant Dielectric Properties of (Sn/Ta) Co-doped TiO_2 Ceramics"*	**NMA-OR02 (Ab-ID061):** *"The effect of Annealing Treatment on WO_3 Thin Film Prepared by Reactive DC Magnetron Sputtering for Photo-electrochemical Water Splitting Application"*	**MFM-OR03 (Ab-ID068):** *"Role of Sb Species on Electrical Properties of Sb-doped ZnO Prepared by Pulsed Laser Deposition"*		
16:45-17:00	**OEM-OR09 (Ab-ID010):** *"Investigation on Optically Ultraviolet Response of Low-dimensional ZnO Structures Prepared by Chemical Processes"*	**NMA-OR03 (Ab-ID062):** *"Surface Modification on ZnO Nanorod as a Template Substrate for ELISA Technique and Dengue Virus Detection Application"*	**MFM-OR04 (Ab-ID084):** *"Production of Elastomeric Fibers from Natural Rubber Latex by Electrospinning"*		
17.00-17.15		**NMA-OR04 (Ab-ID083):** *"Hydrothermal Fabrication of Nanosheets on Electrospun Titanium Dioxide Nanofibers"*	**MFM-OR05(Ab-ID102):** *"TOPSIS Based Selection of Optimal Parametric Combination during Laser Surface Texturing of Zirconia Ceramic"*		
17:00-18:30	***Poster Session I (All sessions)***				
19.00-21.00	***Conference Banquet***				

Friday, 5 August 2022 (P.4)

Special Symposium on "Materials for Environment Applications" during 13.45-17.00 at Meeting Room 2

Time	Activity
13.30-13.45	Registration for onsite and online participants
13.45-14.00	Welcome and Workshop Opening/ Group photo
14.00-14.20	**Speaker 1 Prof. Dr. Keiichi N. Ishihara** (Kyoto University) *"The Mechanism of Z-scheme in Photocatalytic Degradation of Dyes"*
14.20-14.40	**Speaker 2 Dr. Anis Natasha Shafawi** (Online) (Universiti Sains Malaysia) "*Bi_2O_3 Particles Decorated on Porous g-C_3N_4 Sheets: Enhanced Photocatalytic Activity through a Direct Z-scheme Mechanism for Degradation of Reactive Black 5 under UV–Vis Light*"
14.40-15.00	**Speaker 3 Dr. Nonni Soraya Sambudi** (Online) (Universiti Teknologi PETRONAS) "*Photoreduction of CO_2 by Using f-CQDs/TiO_2: Preliminary Study*"
15.00-15.20	**Speaker 4 Assoc. Prof. Dr. Bridgid Chin Lai Fui** (Online) (Curtin University, Malaysia) *"Catalytic Pyrolysis of Oil Palm Wastes for Bio-oil Production"*
15.20-15.40	*Coffee break*
15.40-16.00	**Speaker 5 Assoc. Prof. Dr. Sorapong Pavasupree** (Rajamangala University of Technology Thanyaburi (RMUTT)) *"Applications of Nano-materials from Thai Minerals"*
16.00-16.20	**Speaker 6 Asst. Prof. Dr. Wanichaya Mekprasart** (King Mongkut's Institute of Technology Ladkrabang (KMITL)) *"Photocatalytic Performance of $BiVO_4$ Photocatalyst Incorporated with Different Metal Dopants"*
16.20-16.40	**Speaker 7 Assoc. Prof. Dr. Pakorn Opaprakasit** (Thammasat University) *"Towards A Circular Economy: Chemical Upcycling of Postconsumer Polymeric Products for Functional Materials"*
16.40-17.00	**Speaker 8 Dr. Siwarutt Boonyarattanakalin** (SMS Group Thailand) *"TAPIOPLAST®: The Functional Thermoplastic Starch Resin for Bioplastic Applications"*
17.00-17.10	*Q&A, Group discussion and Closing symposium*

Saturday, 6 August 2022

Time	Ballroom 1	Ballroom 2	Meeting room 1	Meeting room 2
08:30-09:30	*Registration*			
09:15-10:30	***Poster Session II*** ***(All sessions and Online poster)***			
10:30-10:45	*Coffee break*			
10:15-10:45			**Computational (COM)** **Invited I (Online):** **Prof. Dr. Siriporn Jungsuttiwong** *"Encouraging Metal-free Catalyst Reactivity with a Synergistic Effect on Phosphorus and Nitrogen co-doped Graphene for Catalyzed co-oxidation Reaction"*	
10:45-11:00	**Sensor&Sensing Materials II (SSM II)** **Invited II (Online):** **Prof. Dr. Toru Aoki** *"TlBr Single Crystal Growth and Device Process for Radiation Detector"*	**Special Session: Biomedical Applications** **(09.45-12.00)**	**Advanced Functional & Nanomaterials II (AFM) & (NMA II)** **Invited I (Online):** **Prof. Dr. Andrej Kuznetsov** *"Disorder Induced Ordering in Materials: Discovery of a New Nanoscale Process Resulting in Macroscopic Transformations"*	**Energy&Environment II (EEM II)** **Invited II (Online):** **Prof. Dr. Puangrat Kajitvichyanukul** *"Pesticide Removal from Environmental Media Using Physico-chemical and Biological processes"*
11:00-11:15				
11:15-11:30	**SSM-OR05 (Ab-ID009):** *"Gas Sensors Based On Tellurium-Filled Carbon Nanotubes"*		**AFM-OR01 (Ab-ID020):** *"Design and Construction of Lanthanide Coordination Polymers for Highly Performance Catalysts in CO_2 Cycloaddition Reactions"*	**EEM-OR03 (Ab-ID086):** *"Mercury Removal Efficiency of Disulfide- and Thiol-functionalized Lanthanide Coordination Polymers"*
11:30-11:45	**SSM-OR06 (Ab-ID022):** *"Study of Novel Neutron Detector Using Vertical Type BGaN Semiconductor"*		**NMA-OR05 (Ab-ID104):** *"Comparison of TOPSIS, ARAS and MOORA MCDM Techniques in Optimization of Photochemical Machining Process"*	**EEM-OR04 (Ab-ID107):** *"Synthesis and Characterization of 2-Dimensional ZSM-5 Catalyst Using C22-6-6Br2 Template"*

Saturday, 6 August 2022 (P.1)

Time	Ballroom 1	Ballroom 2	Meeting room 1	Meeting room 2
11:45-12:00	**SSM-OR07 (Ab-ID023): (Online)** *"Comparison of X-ray Penetration Image Contrast between CdTe and TlBr Detectors"*	**Special Session: Biomedical Applications** **(09.45-12.00)**	**NMA-OR06 (Ab-ID109):** *"Functional Magnetic Polymeric Nanoparticles and Their Applications in Medical and Industrial Applications"*	**EEM-OR05 (Ab-ID108):** *"Cobalt-based Catalysts Supported on Urea-Modified Sheet-Like ZSM-5 for Hydrodeoxygenation of Fatty acid Methyl Esters"*
12.00-13.30	*Lunch*			
13.30-14.30	***Closing Ceremony and Award***			
14.30-15.00	*Coffee break*			

Online Poster Program in Poster session II on 6 Aug 2022

Time	Poster ID	Abstract ID	Title
09.45-09.53	BCM-EPO01	11	Adsorption of Heavy Metals through Bio-calcium Oxide Derived from a Golden Apple Snail Shell for Heavy Removal from Contaminated Water
09.53-09.01	BCM-EPO02	12	Synthesis, Scrutiny and Applications of Calcium Carbonate ($CaCO_3$) from Cockle Shell Waste for the Adsorption of Heavy Metals in the Water
09.01-09.09	NMA-EPO01	2	Chemical Sterilization of the Culture Medium for in Vitro Culture of Dendrobium Hybrid Using Biogenic Silver Nanoparticles
09.09-10.17	MFM-EPO01	32	Lateral Capillary Interactions of Two-Dimensional Self-Assembly Aggregates on Liquid Film

Saturday, 6 August 2022

Time	Ballroom 2
	Special Session: Biomedical Applications ***Chairman: Assoc.Prof.Pattarapong Phasukkit, Co-chairman: Assist.Prof.Nongluck Houngkamhang (King Mongkut Chaokhunthahan Hospital: KMCH)***
09.45-10.15	**Invited speaker : Dr. Chaiyanut Jirayupat (Online)**
	"Breath Odor-based Individual Authentication by an Artificial Olfactory Sensor System and Machine Learning"
10.15-10.30	**SSB-OR01 (Ab-ID076): Kuson Tuntiwong**
	"Biomechanical Pattern of Canine Distalization in The Miniscew Position: A Finite Element Analysis"
10.30-10.45	**SSB-OR02 (Ab-ID081): Shantanu Agnihotri**
	"A Simulation Based Performance Analysis of Field-Effect Transistors for Biomedical Sensing"
10.45-11.00	**SSB-OR03 (Ab-ID085): Popphon Laon**
	"Deep Learning and Artificial Intelligence for Electrophysiology Mapping and Signal Analysis"
11.00-11.15	**SSB-OR04 (Ab-ID087): Solos Punkabutra**
	"The Interrelationships Between Low Alpha and Musical Frequencies"
11.15-11.30	**SSB-OR05 (Ab-ID088): Sarut Puangragsa (Online)**
	"Technical Aspect of 3D Printing in Gynecological Brachytherapy"
11.30-11.45	**SSB-OR06 (Ab-ID089): Kamonchat Apivanichkul**
	"The Performance Improvement of Deep Learning in Automatic Femur Segmentation using External Feature Addition"
11.45-12.00	**SSB-OR07 (Ab-ID090): Nongluck Houngkamhang**
	"Antibody Conjugated Gold Nanoparticles for Lateral Flow Immunoassay"

Advanced Functional Materials		
Abstract ID	**Poster ID**	**Title**
66	AFM-PO01	Phase Structure, Microstructure and Electrical Properties of $(LiNb)^{4+}$ Substituted on B-Sites of $Bi_{0.47}Na_{0.47}Ba_{0.06}TiO_3$ Ceramics
		Anupong Luangpangai, Bhoowadol Thatawong, Nipaphat Charoenthai and Theerachai Bongkarn
70	AFM-PO02	Low-Temperature-Sintering of Modified $(K_{0.44}Na_{0.52}Li_{0.04})(Nb_{0.84}Ta_{0.10}Sb_{0.06})O_3$ Solid Solution Prepared via the Solid-State Combustion Technique
		Chittakorn Kornphom, Pichittra Thawong, Suprakorn Khiwoon, Naratip Vittayakorn, Theerachai Bongkarn
73	AFM-PO03	Effect of La Substitution on Phase Formation, Microstructure, and Electrical Properties of Lead-free $BaTi_{0.91}Sn_{0.09}O_3$ Ceramics
		Wiwat Pattanakasem, Sasiporn Prasertpalichat, Pathit Premwichit, Naratip Vittayakorn, and Theerachai Bongkarn
79	AFM-PO04	Phase Evolution and Electrical Properties of $0.85[0.94Bi_{0.5}Na_{0.5}TiO_3$-$0.06BaTiO_3]$-$0.15[Na_{0.73}Bi_{0.09}NbO_3]$ Ceramics Synthesized via the Solid-State Combustion Method
		Wiwat Pattanakasem, Surirat Yotthuan, Pakornkiat Hongsamsibjed, Tawat Suriwong, Natthapong Wongdamnern, Naratip Vittayakorn, Theerachai Bongkarn

Biomaterials and Carbon-based Materials		
Abstract ID	**Poster ID**	**Title**
4	BCM-PO01	Fabrication, Characterization, and Properties of Nanoscale Hydroxyapatite Particles Derived from Natural Materials
		Pharatree Jaita and Parkpoom Jarupoom
50	BCM-PO02	Nanoporous Carbon from Hemp Waste via Pyrolysis Process Assisted Microwave Activation
		Korn Sukphunphoncharoen, Chaimongkol Thawonthae, Chonlawat Akalamongkonleart, Napat Kaewtrakulchai, Pramote Puengjinda, Gasidit Panomsuwan, Nuwong Chollacoop, Tawat Suriwong, Weerawut Chaiwat, Atthapon Srifa, Worapon Kiatkittipong, Suttichai Assabumrungrat, Patcharaporn Weerachawanasak, Sutee Chutipaijit, Anuchit Jaruvanawat and Apiluck Eiad-Ua

Abstract ID	Poster ID	Title
51	BCM-PO03	Effect of Pre-carbonization on Porous Structure of Nanoporous Carbon from Biomasses for Phenol Red Removal
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Keynote Speakers

Carbon Nanotubes
~Mass Production and Applications for Sustainability~

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Abstract

Carbon nanotubes (CNTs) have been contributing to various fields of technology because of their unique properties owing to their intrinsic nano-sized and one-dimensional natures of carbon. The most common process of carbon nanotubes formations is Catalytic Chemical Vapor Deposition(CCVD) method for multi-walled, double-walled and single-walled structure, because of the adequateness for large scale production and nanostructure controlability. Especially, the CCVD method using the nano-sized iron partiles has been most common for both of substrate and floating systems of catalyst [1-4].

Our world is facing many emmerging issues such as global warming, constant shortage of water and exaution of netural resources. Carbon nanotubes have the enough high potential to contribut for such solutions. Here, the current and future applications of carbon nanotubes relating to sustainability will be shown, especially on lithium ion battery[5,6], conducting wire[7] and water treatment membrane[8,9]. Also, for further successful development of CNTs, the safety of carbon nanotubes is important[10-13]. Sharing all the information on risks and benefits of the carbon nanomaterials with all the stakeholders is essential. By responsible productions and uses and also design of the safe nanostructure based on accumulated CNTs science, we are able to promote further the applications contributing to the sustanability..

Keywords: Carbon Nanotubes, Applications, Lithium Ion Battery, Reverse Osmosis Membrane,

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Graphene Technology for Energy Storage Devices

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Abstract

Graphene is an allotrope of carbon consisting of a single layer of carbon atoms arranged in a two-dimensional honeycomb lattice. Graphene in 2D and 3D structure has received increasing attention due to its unique physicochemical properties including high surface area, excellent conductivity, high mechanical strength, flexibility and ease of functionalization and synthesis and low cost material . Graphene has recently applied in the area of energy storage applications both in battery and supercapacitor. In our research lab at NSTDA, electrochemical-exfoliated 2D graphene and Hummer-made reduced Graphene Oxide (rGO) are widely used for enhancing energy density and cyclability performance in various types of batteries and supercapacitors such as 3D hollow graphite nanotetrapods by Vapor Phase Transport and In-situ Chemical Vapor Deposition/Etching which is used to fabricate 3D graphene for high-performance Lithium-Sulfur batteries based on 3-D graphene foam structures. In this talk, both 2D and 3D graphene and other carbon nanomaterials are used to enhance performance by electrode composition, coated separator and enhanced electrolyte in both lithium-based and beyond-Lithium-based energy storage devices including Lithium-Sulfur battery, Zinc ion battery, Sodium ion battery and high energy density supercapacitors.

Keywords: Graphene, Energy, Battery, Supercapacitor.

Special Talks

Introduction of Research and Industry-Academia Cooperation of Shizuoka University

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Abstract

In this presentation, research promotion and industry-academia cooperation activities in Shizuoka university (SU) will be introduced. Based on the concept to develop new research domain using SU expertise in various research fields, the Headquater for Promotion of Interdiciplinary Domain Research in was established in 2011. In the 3rd midterm plan (from 2016), SU is focusing 3 fields of research, such as Photonic Application and Imaging Science, Environmental and Energy Sciences, and GreenBio Science. We are further supporting researches through cooperation among those 3 fields of research and the development of new research domains. SU is conducting the world's leading researches in specific fields, however, we have a mission to contribute the local community. The Organization for Innovation and Social Collaboration is directed to play an important role in developing the local community and the university by establishing strategies of collaboration between industry and the university. As well as research and technology transfer activities, the Program for Building Regional Innovation Ecosystems supported by MEXT will be described.

Invited Speakers

Nightingale®: a Novel Source for Plasma-Driven Biocatalysis

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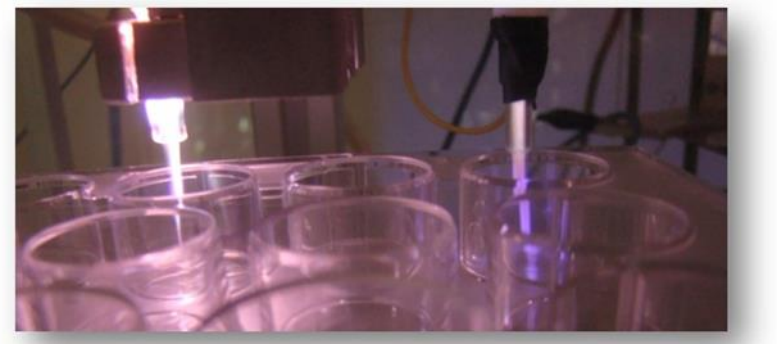
Abstract

A cold atmospheric pressure plasma (CAPP) has been facilitated for a variety of applications in plasma bioscience. However, the challenge is its potential to supply a highly oxidizing agent, inorganic form; hydrogen peroxide, H_2O_2 in biocatalysis.

This study was performed using "**Nightingale**" an IEC standard/CE-certified, low-temperature air plasma device to provide significantly higher H_2O_2 production rates and better handling of larger reaction volumes. Nightingale was able to operate with plasma exposed power at 0.28, 0.43, and 0.62 W. The Plasma Activated-Lactated Ringer's Injection (PA-LRI) and Plasma Activated- Capsaicin loaded Nanoemulsion (PA-CNE) were activated using plasma power at 0.62 W wth exposure time 1 to 5 min for PA1-LRI to PA5-LRI, and 5 and 10 min for PA-CNE. The UV-VIS spectrophotometer was used to detect the amounts of H_2O_2, NO_2^- and NO_3^- in PA-LRI and PA-CNE within 3 min after the solutions were activated by plasma. Besides, using plasma-treated buffer, no side reactions with other plasma-generated species were detected.



In typical treatment, PA-LRI and PA-CNE were immobilized, transferred to a rotating bed reactor. The concentration of H_2O_2 in PA1-LRI to PA5-LRI accounted at 24.12, 62.35, 96.18, 136.47 and 159.12 µM, respectively. While NO_2^- and NO_3^- drastically raised 86.96, 163.04, 243.48, 293.48 and 376.09 µM, and 180.65, 264.68, 336.29, 399.19 and 536.45 µM, respectively. Furthermore, in PA-CNE, with plasma exposure time 5 and 10 min, 294.12 and 735.29 µM (H_2O_2), 2,173.91 and 2,173.91 µM (NO_2^-) and 806.45 and 1,612.90 µM (NO_3^-), were accumulated respectively. Overall, the Nightingale presents a promising plasma source for plasma-driven biocatalysis.

Keywords: Cold atmospheric pressure plasma, Biocatalysis, oxidizing agent, H_2O_2

Functional Materials from Responsive Polymeric Hybrid Nanoparticles

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Abstract

Responsive polymeric hybrid particles are of great interest in various applications. The materials are powerful tools for encapsulation and controlled release of different active compounds. These can specifically respond to environmental changes, such as temperature, photoirradiation, ultrasound, magnetic field, pH, redox species, and biomolecules. In our laboratory, various polymeric hybrid particles have been developed, and their potential applications are assessed. Degradable/ biocompatible nano-, microspheres, with solid or hollow structures and adjustable morphology, have been prepared from poly(lactic acid-*co*-glycidyl methacrylate) copolymers. These particles, with tunable structures and properties, are suitable for cosmetic and biomedical applications, e.g., sunscreen products or essential oil-encapsulated products. Temperature-sensitive gating nanoparticles have been fabricated using a cationic ammonium methacrylate copolymer, Eudragit®RS100. The particles are decorated with poly(N-isopropyl acrylamide) as gatekeepers, which serve as thermal triggers for drug release at the body temperature range. Magnetic polymeric nanoparticles (MPNPs) embedded into poly(styrene-*b*-acrylic acid) particles have been prepared. The materials possess a high surface-area-to-volume ratio, surface modifiability, and magnetic separation ability. The formulated MPNPs acted as a nanosorbent for various cations, especially $Ca^{2+,}$ with a removal efficiency of 92%. The MPNPs can be effectively reused for up to 4 cycles, which is suitable for reusable antiscalants. In addition, chitosan polyampholyte (CPA) nanoparticles have been synthesized by selective oxidation of primary hydroxyl of quaternized chitosan employing TEMPO+ solutions generated by a "mild" halogen-free process. The materials show high-scale prevention and antibacterial activities, promising as environmental-friendly bio-based antiscalants.

Keywords: Responsive materials, Polymeric hybrid particles. Chitosan, Drug delivery, Magnetic nanoparticles.

Encouraging Metal-free Catalyst Reactivity with a Synergistic Effect on Phosphorus and Nitrogen co-doped Graphene for Catalyzed co-oxidation Reaction

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Abstract

P and N co-doped graphene (PN_xC_y-G with x = 1, 2, 3 and y = 0, 1, 2) is designed to enhance graphene reactivity with a synergistic effect of the P and N atoms for the CO oxidation reaction, focusing on the influence of the N dopant concentration on graphene. The calculated results indicate that increasing two or three coordinated N to P can facilitate charge transfer from the surface onto O_2 molecules. However, the adsorbed O_2 molecule breaks apart on PN_3-G surface, affecting CO oxidation performance. Furthermore, PN_2C_1-G exhibits excellent catalytic activity towards the oxidation of CO via the ER mechanism, which catalyzes CO oxidation with the rate-determining step of only 0.26 eV for the first and 0.25 eV for the second oxidation at 0 K. Additionally, the catalytic oxidation of PN_2C_1-G via Eley-Rideal mechanism prefers to occur at room temperature (298.15 K), with a rate-determining step of 0.77 eV. The reaction rates at 298.15K is calculated to be 5.36 $x10^{16}$ mol s^{-1}. The rate constants are obtained according to harmonic transition state theory, which could be supportive for catalytic oxidation of CO on the experiment.

Keywords: CO oxidation, P and N co-doped on graphene, DFT

Variation on long term electrochemical stability of sodium – vanadium glass and glass-ceramic anode half-cell network mixed with ZnO nanocrystals

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Abstract

The long term electrochemical stability of Zn_{20}-0h glass anode half-cell [$(37.5Na_2O\text{-}62.5V_2O_5)_{80}$ mixed with 20 mol% of ZnO nanocrsytals and Zn_{20}-15h glass-ceramic anode half-cell [heat treated for 15h at its crystallization temperature 'T_c'] is reported. The 1st charge and discharge capacities of Zn_{20}-15h glass-ceramic anode half-cell dominates the corresponding glass sample (pre heat treatment). At a specific current of 50mA/g for the first 250 cycles, the current increased from 50 mA/g to 400mA/g, measured at 1C for both Zn_{20} and Zn_{20}-15h half-cell systems. However, charge capacity for Zn_{20}-15h half-cell systems relatively increased to 421 mAh g-1 compared to Zn_{20} half-cell and which is 384 mAh/g even after 3000 cycles. The cycle-dependent reaction mechanism of Zn_{20}-15h glass-ceramic anode half-cell systems is analyzed in the light of ex-situ XRD profiles and electronic structure profile.

Keywords: Powders; Solid state reaction, Impedance, Glass ceramics, Batteries

Pesticide Removal from Environmental Media Using Physico-chemical and Biological Processes

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Abstract

This work demonstrated the capability of (a) biochar adsorption and (b) cell-immobilized biochar for water remediation of some selected pesticides The characteristics of biochar were analysed by SEM, BET, and FTIR. The adsorption isotherms for investigated pesticides were followed the Langmuir isotherm with the maximum adsorption capacities as of 16.6, 41.7, 29.9, and 39.3 mg g^{-1} for atrazine, 2,4-D, dichlorvos, and pymetrozine, respectively. The chemical bonding (π-π electron donor–acceptor interaction, hydrogen bonding, and hydrophobic interaction) between biochar and pesticides is the major mechanisms for biochar-facilitated water remediation for all investigated pesticides. The biochar has been further used as the supported materials for cell-immobilization. The *Pseudomonas putida* was immobilized onto coconut fiber-derived biochar. The FTIR spectrum analysis revealed that the main adsorption mechanism of bacteria and biochar relates to the interaction between cell surface proteins and the functional group on biochar. The efficient performance of cell-immobilized biochar in removing paraquat from contaminated water was described in this work. The cell-immobilized biochar using the covalent bonding method and adsorption method exhibited superior pesticide (paraquat) removal capacity with 30–35% increases in efficiency compared with simple biochar. Both biochar adsorption and cell-immobilized biochar exhibited a high removal performance to be the promising technology in pesticide removal from water contamination.

Keywords: pesticide, biochar, degradation, biodegradation, adsorption

Design and Fabrication of Nanoscale Plasmonic Structures for Optical Sensor Devices

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Abstract

This work explores the design and fabrication of plasmonic nanostructures at OEC laboratory, NECTEC, based on the physical vapor deposition (PVD) technique. The conventional magnetron sputtering and glancing angle deposition (GLAD) technique were used to fabricate the non-periodic plasmonic nanostructure. Combined with nanosphere lithography, the periodic nanostructure arrays, i.e., nanohole and nanodot arrays, could be prepared. The non-periodic and periodic nanostructure arrays were studied, and discussion on the electromagnetic (EM) enhancement between the plasmonic nanostructures (hot-spot region) from spectroscopy analysis combined with numerical electromagnetic field simulation. The localized surface plasmon resonance (LSPR) peak wavelength and large hot-spot region can be controlled by the geometry of plasmonic nanostructure, which enables us to formulate a set of design rules for achieving high sensitivity plasmonic sensors. Finally, we demonstrate the function of the optical sensors with the surface-enhanced Raman scattering (SERS), surface-enhanced fluorescence (SEF), and (LSPR) sensors for chemical and biological sample analysis. The results indicated that our plasmonic nanostructure was a promising chemical-bio sensor that can be applied to the country's economy. In addition, our cost-effective plasmonic nanostructure fabrication platform could be applicable for industrial production.

Keywords: Plasmonic nanostructures, LSPR, SERS, SEF

X-ray Absorption Spectroscopy: The State of the Art Synchrotron-based Characterization

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Abstract

The investigation of the local geometric and electronic structure of probing element in bulk samples is the most extensive field of application in X-ray Absorption Spectroscopy (XAS). XAS consists of two main regions which are X-ray Absorption Near Edge Structure (XANES) and Extended X-ray Absorption Fine Structure (EXAFS). The former region is used to explain the local geometry and oxidation states of selected element in a sample whilst the latter one is used to address the local structure around probing element in samples. In my talk, the introduction of XAS and applications of synchrotron-based XAS on advanced functional materials such as energy materials, Li-ion and K-ion battery and catalysts will be introduced in order to understand the structure and function relationship of these materials.

Keywords*:* X-ray absorption spectroscopy (XAS), XANES, EXAFS, structure and function

Probing Inorganic Catalytic Materials and Biological Enzymes Using Computational Simulations.

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Abstract

We report the application of computational models to study the catalytic ketonization of acetic acid to acetone in the zeolite ZSM5.[3] of the zeolite ZSM5 to explore the catalytic conversion of acetic acid to acetone. Biomaterials processing has become increasingly important in the chemical industry and the identification and optimization of processes to facilitate biomass conversion is recognized as being necessary. We investigate the relative energetics associated with the formation of plausible intermediates, including acyl-zeolite complexes, enols, acylium cation, ketenes, anhydrides, and β-keto acids, that could connect acetic acid from the observed product, acetone. Computation of the many potential stationary points formed within ZSM5 allow us to identify the most probable mechanism connecting the reactant to products. We also describe the application of computational chemistry methods to design, and subsequently synthesize, inhibitors of phosphodiesterase 5 (PDE5), an important enzyme on the cyclic guanosine monophosphate (cGMP) / nitric oxide signaling pathway. The binding mode of our previously reported lead compound to PDE5[4, 5] was predicted using 3D ligand-based similarity methods to inhibitors of known binding mode, combined with a PDE5 docking and molecular dynamics based-protocol, each of which pointed to the same binding mode. Chemical modifications were then designed to both increase potency and solubility of the chemotype. New compounds containing a quinazoline core displayed IC_{50}s ranging from 0.10-9.39 μM while those consisting of a purine scaffold ranging from 0.29-43.16 μM. We identified **25** with a PDE5 IC_{50} of 0.15 μM, and much improved solubility (1.7781 mg/mL) over the starting lead. Furthermore, it was found that the predicted binding mode was consistent with the observed SAR validating our computationally driven approach.

Keywords: PDE5 Inhibitors, Zeolite Catalysis, QM/MM, Molecular Modelling, DFT.

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Thailand Nanosafety and Nanotechnology Ethics Implementation

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Abstract

Nanotechnology is one of the technologies that drives the development of industry and manufactures products. As nanotechnology develops, nanosafety also has to develop together to ensure the sustainable development of nanotechnology. Thailand prioritizes nanosafety and is developing a National Nanosafety and Ethics Strategic Plan from 2017 to 2024 to ensure the safety and sustainability of nanotechnology development. However, implementing the strategic plan requires cooperation between various stakeholders. To put nanosafety knowledge into practice in society, The Nanosafety Network for Industry is being developed under the terms of a memorandum of understanding with nine organizations divided into three groups: technical support institutes, regulatory bodies, and user groups (industry). The network's aim is to increase awareness of the importance of nanosafety, develop mechanisms for growing understanding of industrial standards, encourage all stakeholders to participate in nanosafety activities, and foster networking among stakeholders. Nanosafety is required at every stage of the supply chain, from manufacturing to the finished product. It should consider the worker's safety during the production process as well as the safety of the product itself. Finally, at the end of the product's life cycle, waste treatment and environmental safety are important considerations. Through a network of alliance organizations, the National Nanotechnology Center (NANOTEC) supports nanosafety guidelines and nanotechnology national standard information for industry, academia, and the general public through a variety of activities. The network's goal is to raise awareness of nanosafety's importance, provide mechanisms for better understanding industrial standards, encourage all stakeholders to participate in nanosafety activities, and stimulate networking among stakeholders. Nanosafety is necessary at every step of the supply chain, from manufacturing to finished product. It should take into account both the safety of the workers and the safety of the product itself during the manufacturing process. Finally, waste treatment and environmental safety are crucial considerations towards the end of a product's life cycle. The National Nanotechnology Center (NANOTEC) provides nanosafety guidelines and nanotechnology national standard information for industry, academia, and the general public through a network of partner organizations through a number of activities. Furthermore, it is crucial to communicate nanosafety to the international community in order to share and exchange ideas on nanosafety standards and regulations from Thailand's perspective.

Keywords: Nanosafety, Network, Standard, Industry.

High-yield Conversion of Plastics into Carbon Nanotubes

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Abstract

In recent years, marine pollution has been increasingly severe. Eight million tons of plastics are disposed into the ocean every year. It is predicted that the amount of plastics in the ocean will exceed the amount of fish by 2050 on a mass basis. From the viewpoint of upcycling, we are trying to convert waste plastics into "value-added" carbon nanotubes (CNTs). Although there have been reports on the conversion of virgin plastic into multi-walled CNTs (MWNTs) by chemical vapor deposition (CVD), the conversion efficiency η was poor (4% at maximum), and the available plastic species were few. In addition, the correlation between the plastic species and the properties of MWNTs has not been well understood.

In this study, we have newly developed a CVD system that can convert various types of plastics into MWNTs with high efficiency. This method consists of three regions: the pyrolysis region of the plastic, the sublimation region of the metal-organic catalyst, and the growth region of the MWNTs. The features of this method are that η is much higher than those reported previously (maximum η > 50%) and that a variety of plastic species can be used.

In this presentation, I will introduce the detail of the conversion method. Specifically, the relationship between pyrolysis gas species, which were characterized by infrared and mass spectroscopy, and the properties of resultant MWNTs will be presented. Furthermore, I will show some demonstrations of conversion from "real" marine debris (fishing nets, etc.) collected at beaches and inland into MWNTs with a conversion efficiency of more than 30%.

Keywords: Plastics, Carbon nanotubes, Conversion, Chemical vapor deposition

Compositional Dependence Spectroscopic Studies of Dy^{3+}-doped Glasses for Optical Device Applications

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Abstract

Rare earth doped glasses and in particular, dysprosium (Dy^{3+}) doped glasses have been extensively studied for the development and design of optical devices. A detailed investigation on optical absorption, photoluminescence (emission, excitation and lifetime) properties of Dy^{3+}-doped materials play crucial role in all these optical devices. Hence, the present work aims to study the compositional dependence spectroscopic studies of (74-x) TeO_2 + 20 ZnO + x ZnF_2 + 5 Na_2O +1 Dy_2O_3, x = 0, 10 referred as $TZNDy_{1.0}$, $T10ZofNDy_{1.0}$, respectively; $39B_2O_3$ +25 TeO_2 + $15SrCO_3$ + 10ZnO + $10ZnF_2$ + $1Dy_2O_3$ ($BTSrZofDy_{1.0}$) and 45 P_2O_5 + 19 ZnO + 15 K_2O + 10 Al_2O_3 + $10Na_2O$ + $1Dy_2O_3$ ($PZKANDy_{1.0}$) glasses have been analyzed. Absorption spectra were characterized in the frame of Judd-Ofelt model to determine essential radiative properties of $^4F_{9/2}$ luminescent level. The quantum efficiency for the $^4F_{9/2}$ state is found to be 62 % for the $T10ZofNDy_{1.0}$ glass. The peak stimulated emission cross-section ($\sigma(\lambda_p)$) for $^4F_{9/2} \rightarrow {}^6H_{13/2}$ luminescent level of $BTSrZofDy_{1.0}$ glass is found to be 77.54 $\times 10^{-21} cm^2$. The lifetime and quantum yield values are evaluated for $PZKANDy_{1.0}$ glass and the values are found to be 587 μs and 44 %. The results obtained in the present study have been compared with nearly 100 Dy^{3+}:glasses and found to be scattered behavior among various spectroscopic properties versus either Dy^{3+} ion concentration or glass composition. Therefore needs further systematic studies to establish predictive nature of spectroscopic properties for a given Dy^{3+}:glass to advance spectroscopic properties of rare earth ions for the development of novel luminescent devices.

Keywords: Spectroscopic studies, Dy^{3+}-doped glasses, Judd-Ofelt theory, white light emission, Quantum yield.

Acknowledgements: One of the authors, C.K. Jayasankar, is thankful to DAE-BRNS, Mumbai (No.2009/34/36/BRNS/3174, dt.12-02-2010) for financial support.

Broadband 1.53 μm Emission Characteristics of Er^{3+} Doped Alkali Oxyfluorophosphate Glass for Fiber Optic Communication Material

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Abstract

Er^{3+} doped alkali oxyfluorophosphate glasses were prepared by melted quenching method and characterize their optical and luminescence properties. Firstly, the chemical compositions of glasses were varied by changing of alkali fluoride (LiF, NaF and KF), whereas the concentration of Er^{3+} was fixed at 1.00 mol%. The optical absorption of KF-glasses presented the highest peak at 520 nm, and it was selected for stimulating the emission spectra. Broadband 1.53 μm emission was one prominent peak of Er^{3+} in glass and the highest emission intensity was obtained for KF-glass. Secondly, the KF-glass was prepared by variation of Er^{3+} concentration (0.1, 0.5, 1.0 and 2.0 mol%). The emission intensity of glasses increases with increasing of Er_2O_3 concentration up to 1.00 mol% and decrease for higher Er_2O_3 concentration, because of concentration quenching effect. Broadband emission was observed that it covers three telecommunication windows: S, C and L bands. The emission cross-section of 1.00 mol% of Er^{3+} doped alkali oxyfluorophosphate have been evaluated using McCumber theory. All results point out that Er^{3+} doped alkali oxyfluorophosphate glass could be useful for fiber optic communication material.

Keywords: Alkali oxyfluorophosphate glass, Erbium, Fiber optic communication Material, McCumber theory

Perovskite Ferroelectric Ceramics: Domain Evolution Behavior and Dielectric Properties

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Abstract

Progress in new generations of ferroelectric-based devices production and designing new ferroelectric materials relies on deep understanding the structure-property relationships. One of the exciting discoveries in the ferroelectric ceramics on the nanoscale research was the visualization of local domain structures through piezoresponse force microscopy (PFM) via the detection of electromechanical response at surfaces. Hence, an opportunity for direct imaging of insight into these materials is possible. So far, to evidence ferroelectricity, the existence of domains with different orientation of polarization and hysteresis switching between the opposite domain states by electric fields have to be verified. It is well-demonstrated that domain structures and their evolution behavior play an important role in the electrical properties of ferroelectric ceramics. Being one of the classic nonPb-based perovskite ferroelectrics, $BaTiO_3$ is of interest as a component in commercial capacitors for over century. Appropriated amount of conductive gold nanoparticles are expected to generate better dielectric properties of the materials via ferroelectric domain switching mechanism. In this work, using eco-friendly $Au/BaTiO_3$ as nanometal/ferroelectrics model system for perovskite ferroelectric ceramics, the dielectric contribution of the domain evolution behavior is investigated via PFM technique. Furthermore, the origin of dielectric loss has been attributed to domain wall migration in electric field. Because of the sustaining trend of further miniaturization and ever increasing volume capacities, the situation changes or even disrupts. In addition, the interpretation that PFM data is sufficient to indicate the dielectric behavior or potential artifacts has been extensively questioned. The obtained PFM results will be discussed in terms of their domain topology, phase shift and amplitude.

Keywords: Perovskite Ceramics, Ferroelectric Domains, Piezoresponse Force Microscopy.

Digitalization of Smell: Development of Chemical Sensors from Lab to Startup Business

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Abstract

Chemo-sensory system is an essential part of the living organism ranging from the smallest bacterial cells up to the most complex neural systems as presented in human. In fact, the sense of smell especially in mammalian species (i.e., dogs and human) occurs at the nanoscale. By transduction of the chemical interactions between the odor molecules with the receptor proteins into electrical signals, smell perception including recognition and memory would be possible. At present, nanoscience of smell attracts a great interest from both academic and industry, particularly in terms of artificial olfaction. Technological applications of artificial noses (aka electronic nose) are vast: for examples, quality assurance of foods, beverage and agricultural products, health-care diagnostics, environmental monitoring, security systems etc. In this lecture, the development of electronic nose from the discovery of sensing materials to the fabrication of chemical sensor array up to the integration into various forms of electronic nose systems, such as portable, handheld and wearable devices, will be presented. We have explored numerous sensor materials based on different sensing mechanism, i.e., metal oxides, porphyrins/phthalocyanines, carbon nanotubes and conductive polymers, in order to span the applications in broad areas. In addition, techniques of hybridization between the sensor materials as well as transduction principles have been examined, leading to enhanced functionality and flexibility of the new electronic nose systems. Especially in this lecture, real-world applications of our electronic noses to assess the quality of foods, diagnose cancer, determine the health status of individual and monitor the environmental conditions will be demonstrated. Development of a startup business based on this research will be provided in this lecture.

Keywords: chemical sensor, electronic nose, smell, artificial sense.

TlBr Single Crystal Growth and Device Process for Radiation Detector

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Abstract

TlBr crystals have been studied as optical crystals in the past and also as radiation detector detector application due to their high X-ray and γ-ray attenuation properties, but in the radiation detectors, good properties were obtained due to carrier migration problems at that time. In recent years, radiation detectors with good characteristics as γ-ray detectors have been produced using TlBr in several research groups. In this study, in order to use TlBr as a semiconductor detector in high energy X-ray and γ-ray region, the growth of single crystals and device processes such as cutting and polishing cleaning processes and electrode formation were studied. The resulting devices were evaluated using energy-spectrum measurements of γ-ray detector, carrier concentration and mobility from Hall effect measurements and photon counting method, along with I-V and C-V characteristics. The influence of impurities on the operating radiation detector characteristics was clarified together with the characterization of physical properties such as electron diffraction, neutron diffraction, X-ray diffraction, and Photoluminescence by other researchers.

Keywords: TlBr, Radiation detector, X-ray imaging device

Breath Odor-based Individual Authentication by an Artificial Olfactory Sensor System and Machine Learning

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Abstract

In the digital age, cyber security is a critical issue in a global society so biometric authentication has become a frontier technology for increasing the security levels of digital privacy. Although physical information-based techniques based on fingerprint and face recognition are mainly utilized for biometric authentication, the competition between the biometric authentication techniques and ones for hacking them is rapidly growing neck and neck. Human scent analysis/sensing is a new class of biometric authentication techniques using chemical information. Since human scents such as exhaled breath and percutaneous gas have a strong genetic basis, their chemical composition profiles are inherently different among individuals and therefore can potentially be utilized for individual authentication. Among human scents, exhaled breath is known to have thousands of volatile organic compounds (VOCs) and allows us a facile and non-invasive sampling. Moreover, the breath odor is consumed once it is utilized, which may reduce the risk of long-term presence attack. Thus, breath odor sensing has great potential to realize a secure individual authentication.

In this research, we aim to demonstrate the feasibility of breath odor sensing-based individual authentication using an artificial olfactory sensor system. A 16-channel chemiresistive sensor array was utilized for detecting various VOCs contained in breath odor. The acquired sensing responses from 20 persons under fasting condition were analyzed by machine learning with a neural network algorithm and the identification accuracy of individual authentication was evaluated. The result shows a high mean accuracy of over 97% for classification and highlights the impact of the number of sensors on the accuracy and reproducibility.

Keywords: Breath odor, Artificial olfactory sensor, Biometric authentication.

Advanced Functional Materials

Design and Construction of Lanthanide Coordination Polymers for Highly Performance Catalysts in CO_2 Cycloaddition Reactions

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Abstract

To develop efficient catalysts for CO_2 cycloaddition reactions, three new series of lanthanide coordination polymers of 3,3′,5,5′-azobenzenetetracarboxylic acid (H_4abtc) were designed and synthesized, including $[Ln^{III}(Habtc)(H_2O)_2]\cdot 2H_2O$ (Ln = Sm^{III}, Eu^{III}, Gd^{III}, Tb^{III}, Dy^{III}, Ho^{III}, Er^{III}, Tm^{III}), $[Ln^{III}(Habtc)(H_2O)_4]\cdot 3H_2O$ (Ln^{III} = Eu^{III}, Gd^{III}, Tb^{III}, Dy^{III}, Ho^{III}, Tm^{III}, Yb^{III}) and $[Eu^{III}_2(Habtc)_2(H_2O)_6]\cdot 2.75H_2O$. Catalytic performances of $[Eu^{III}(Habtc)(H_2O)_2]\cdot 2H_2O$ and $[Eu^{III}(Habtc)(H_2O)_4]\cdot 3H_2O$ were evaluated based on the cycloaddition reactions of CO_2 with epichlorohydrin. Influences of several catalytic conditions, differences in nucleophile sources and monosubstituted epoxides the catalytic performances have been studied. Depending on the molar ratio of the epoxide and the catalysts as well as the reaction temperature and time, exceptional TON and TOF values of 2,778 and 694 h^{-1} for $[Eu^{III}(Habtc)(H_2O)_2]\cdot 2H_2O$ and 2,870 and 718 h^{-1} for $[Eu^{III}(Habtc)(H_2O)_4]\cdot 3H_2O$ could be achieved with satisfying conversion and selectivity of ca. ≥99% and ≥87%, respectively. Correlation between catalytic performances and structures of the materials are discussed. Both materials were also shown to be robust over ten cycles of catalysis and work-up process.

Keywords: Coordination Polymers, Metal Organic Framework, Lanthanide, Catalysis, Carbon Dioxide.

Phase Structure, Microstructure and Electrical Properties of $(LiNb)^{4+}$ Substituted on B-Sites of $Bi_{0.47}Na_{0.47}Ba_{0.06}TiO_3$ Ceramics

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Abstract

Lead-free $Bi_{0.47}Na_{0.47}Ba_{0.06}Ti_{1-x}(LiNb)_xO_3$ ($BNBT_{1-x}LN_x$) ceramics (with x=0-0.04) have been fabricated by the solid-state combustion method. The influence of x on the phase structure, microstructure and electrical properties was investigated. A pure perovskite structure was obtained from all specimens. The results of XRD pattern exhibited the coexistence of rhombohedral and tetragonal phases in all samples and the tetragonal phase increased with increasing x, which was analyzed by Rietveld refinement method. The morphology of $BNBT_{1-x}LN_x$ obtained by SEM exhibited irregular polyhedron grain shape and anisotropic grain growth. Density and average grain size values decreased from 5.84 to 5.54 g/cm^3 and 1.7 to 0.9 µm when x increased from 0 to 0.04, respectively. The grain size distribution was narrower by increasing x. The electrical properties remarkable decrease when increasing x, which was related by the increasing tetragonal phase.

Keywords: $BNBT_{1-x}LN_x$, Phase Formation, Microstructure, Dielectric, Ferroelectric.

Low-Temperature-Sintering of Modified $(K_{0.44}Na_{0.52}Li_{0.04})(Nb_{0.84}Ta_{0.10}Sb_{0.06})O_3$ Solid Solution Prepared via the Solid-State Combustion Technique

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Abstract

In this study, the effect of sintering temperature (1000-1100ºC for 2 h) on phase formation, phase transition, microstructure and electrical properties of lead-free piezoelectric $(K_{0.44}Na_{0.52}Li_{0.04})(Nb_{0.84}Ta_{0.10}Sb_{0.06})O_3$ (KNLNTS) solid solution with 0.3wt%Bi_2O_3 + 0.4wt%Fe_2O_3 + 0.2wt%CuO additive (abbreviate as modified KNLNTS) was investigated. Modified KNLNTS ceramics were synthesized by the solid state combustion technique using glycine as fuel. The modified KNLNTS powders were prepared using the calcination condition of 650ºC for 2 h. The XRD pattern of all sintered ceramics exhibited a pure perovskite phase. Using Rietveld refinement to analyze the phase formation showed that the modified KNLNTS ceramics had co-existing phases of orthorhombic and tetragonal in all sintered ceramics and the orthorhombic phase increased when the sintering temperature increased. The average grain size, T_{O-T}, T_c, P_r and E_c increased with increasing sintering temperature. At the sintering temperature of 1025ºC, the modified KNLNTS ceramic showed the best electrical properties ($\varepsilon_C \approx 6745$, $S_{max} \approx 0.274\%$ and $d^*_{33} \approx 548$ pm/V). The good electrical properties of the modified KNLNTS ceramics makes them good candidates for lead-free applications to replace Pb-based ceramics.

Keywords: Modified KNLNTS, Combustion Technique, Rietveld Refinement, Microstructure, Dielectric Properties.

Effect of La Substitution on Phase Formation, Microstructure, and Electrical Properties of Lead-free $BaTi_{0.91}Sn_{0.09}O_3$ Ceramics

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Abstract

Lead-free $Ba_{1-x}La_xTi_{0.91}Sn_{0.09}O_3$ (BLTS, x = 0.00, 0.01, 0.03 and 0.05) ceramics were prepared by traditional solid-state sintering method with calcination and sintering temperatures of 1200 ºC for 2 h and 1400 ºC for 4 h, respectively. X-ray diffraction (XRD) measurement revealed that all the BLTS ceramics had pure perovskite structures with no detectable impurity. A coexist phase between orthorhombic and tetragonal was observed and the Rietveld refinement analysis suggested that tetragonal phase increased with increasing La substitution. Furthermore, increasing the La substitution in BLTS ceramics led to a great decrease in average grain size (from 45.7 to 0.9 µm), while the density increased from 5.72 to 5.81 g/cm^3. Significant broaden dielectric anomaly and more slim hysteresis loop were observed with increasing La. This demonstrates that the ceramics transition from normal ferroelectric to relaxor ferroelectric behavior.

Keywords: Phase Formation, Microstructure, Rietveld Refinement, Hysteresis Loop, Relaxor Ferroelectric

Phase Evolution and Electrical Properties of $0.85[0.94Bi_{0.5}Na_{0.5}TiO_3$-$0.06BaTiO_3]$-$0.15[Na_{0.73}Bi_{0.09}NbO_3]$ Ceramics Synthesized via the Solid-State Combustion Method

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Abstract

In this research paper we describe $0.85[0.94Bi_{0.5}Na_{0.5}TiO_3$-$0.06BaTiO_3]$-$0.15[Na_{0.73}Bi_{0.09}NbO_3]$ (BNT-BT-NBN) ceramics fabricated by the solid-state combustion technique. The phase evolution, microstructure, dielectric, ferroelectric and energy storage properties were examined. The BNT-BT-NBN powders and ceramics were calcined and sintered between 650-900°C and 1100-1200°C, respectively, for 2 h. All samples showed a typical perovskite structure, as revealed by X-ray diffraction. The Rietveld refinement analysis on the ceramics suggested the samples sintered between 1100 and 1150°C had coexisting *R*+*T* phases, while the *R*+*T*+*C* phases were observed in the ceramics sintered ≥ 1175°C. The average grain size of the samples increased from 0.52 to 1.79 μm with rising sintering temperature. The density of the ceramics increased from 5.12 to 5.45 g/cm^3 when the sintering temperature increased from 1100 to 1150°C, and then decreased. With increasing sintering temperatures, the dielectric constant at T_s (ε_s) increased from 1727 to 2030. The dielectric constant at T_m (ε_m) increased from 1564 to 1750, upon the sintering temperature rising from 1100 to 1150°C and then ε_m declined. All BNT-BT-NBN ceramics had good dielectric temperature stability with it only changing ± 10% in the working temperature range of room temperature to ~300°C. The optimum energy-storage properties (W_{rec} = 0.214 J/cm^3 and η = 51.2%) were obtained from BNT-BT-NBN ceramics sintered at 1150°C for 2 h. This data indicates that the BNT-BT-NBN ceramics can be useful lead-free materials for high energy-storage density capacitors.

Keywords: BNT-BT-NBN, Phase Evolution, Rietveld Refinement, Electrical Properties, Combustion Method.

Biomaterials and Carbon-based Materials

Synthesis of Nano Porous Carbon Derived from Vinasses Wastes for Trihalomethanes Adsorption Application

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Abstract

Trihalomethane is a group of chemicals that include chloroform and structurally related compounds. Some industries use it as a refrigerant and solvent. This term is commonly applied to some of these substances that may be a byproduct of chlorination in water. One group of chemicals that are produced are chloroform, bromodic chloromethane, and diboromethane. Although several compounds can be chemically considered trihalomethane, these four compounds tend to make sense when the term is used. Their sum is called Total Trihalomethanes (THMs). Chloroform is the most common group and is found in all chlorinated tap water. The effects of trihalomethane have been studied extensively. The US Environmental Protection Agency (EPA) concluded that there is insufficient evidence to establish regulations regarding TTHM in drinking water. There may be a small risk of increased colon or bladder cancer if drinking water contaminated with THMs at levels in excess of 80 parts per billion (ppb) over a lifetime of humans. In this study, a solution to the THMs removal problem is presented by using vinasse waste material as a nano porous absorbent material. The vinasse waste is a large byproduct of the sugar or ethanol industry. This waste is acidic, thus affecting soil and water quality. Therefore, it is essential to dispose of this waste to prevent any environmental impact. Nano porous carbon (adsorbent) was synthesized from vinasses waste by pyrolysis carbonization and chemical activation process for THMs adsorption. The physical and chemical properties of nano porous carbon was characterized by Energy Dispersive X-Ray Spectroscopy (EDS), thermogravimetric analysis (TGA), X-ray fluorescence (XRF), infrared spectroscopy, Raman spectroscopy and Nitrogen sorption isotherm, respectively. Activation temperature at 900 °C, a 1:1 activator (KOH)- precursor ratio provides the maximum surface area of 1,018 m^2/g, which is a suitable to be applied in making an adsorbent.

Keywords: Vinasses, Nano Porous Carbon, Trihalomethanes, Chemical Activation, Carbonization.

Synthesis of Lignin Extracted from Black Liquor to Nano Porous Carbon Materials for Tetracycline Adsorption Application

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Abstract

Tetracycline is an antibiotic that suppresses the growth of bacteria, treats infections in the urinary tract, treats intestinal inflammation, bronchitis, treats dysentery, treats wounds, abscesses, pus, various inflammations due to infections. However, antibiotics have attracted extensive attention from the scientists because a variety of antibiotics have been. detected in soil, surface water, groundwater, and even in drinking water in the recent years. Antibiotics are among the most potent pollutants due to their overuse. This is because most antibiotics are metabolized and poorly absorbed by humans and treated animals, so many fractions are excreted through urine and feces into water. Therefore, it is urgent to remove tetracycline from water environment. There are several techniques used to remove tetracycline from aqueous solutions. coagulation, photo electrocatalytic degradation, ion exchange, membrane processing, and adsorption. Among them, adsorption is a widely used efficient technology, because it has the advantages of easy operation, low cost, high efficiency, and there is no risk of highly toxic byproducts. In this work, lignin from black liquor in chemical pulping processes is used as a precursor for nano porous carbon synthesis. The physical and chemical properties of nano porous carbon was investigated by field-emission scanning electron microscope (FESEM), X-ray diffractometer (XRD), thermogravimetric analysis (TGA), X-ray fluorescence spectroscopy (XRF), Raman spectroscopy, and Nitrogen sorption isotherm, respectively.

Keywords: Nano Porous Carbon; Black Liquor; Lignin; Chemical Activation; Tetracycline Adsorption

Bacterial Cellulose Nanopaper: Preparation, Characterization and Its Applications as Sensing Platforms

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Abstract

In this work, a simple method for preparation of bacterial cellulose (BC) nanopaper, characterization and its application were presented. The bare BC nanopaper was prepared by culturing of *Acetobacter xylinum* in Hestrin-Schramm (culture medium). It was purified by soaking in 5 % w/w NaOH and was then bleached with the mixture of 1 % w/w NaOH and 0.2 % w/v H_2O_2 at 80 °C. Finally, the transparent nanopaper was obtained. The nanopaper was characterized using scanning electron microscope (SEM). The SEM images revealed that bundles of cellulose nanofibrils were observed. Two applications of the nanopaper for using as both the sensing platforms and the two-dimensional (2D) microcuvettes were studied. For the first application, the gold nanoparticles (AuNPs)-BC nanopaper was synthesized for the spectrophotometric determination of hydrogen peroxide (H_2O_2). After the embedding process, color of the nanopaper was changed from milky-white to wine-red. Dropping of H_2O_2 onto the AuNPs-BC nanopaper resulted in decreasing in the absorbance of the nanopaper at 525 nm. Detection limit ($y_B + 3S_B$) of 0.79 % (v/v) was observed and this value was enough sensitive for the determination of H_2O_2 in wound cleaner and hair dye samples. For the second application, the bare BC nanopaper was soaked in the solution of fluorescein derivative that was synthesized by our laboratory. This nanopaper was then employed as 2D-microcuvtte for the fluorometric detection of trivalent chromium ion (Cr(III)) instead of using an expensive quartz fluorescent cell. In the presence of Cr(III), fluorescence intensity of the derivative, immobilized on the nanopaper, was decreased accordingly to the quenching effect (λ_{ex} 490 nm, λ_{em} 525 nm). Optimization and evaluation of the analytical performances for the second application will be presented.

Keywords: Bacterial Cellulose Nanopaper, Microcuvette, Hydrogen Peroxide, Trivalent Chromium Ion

The Preparation Characterization and Bioactivity Study of Bioactive Glass Nanoparticles

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Abstract

The nanoparticle bioactive glass compositions of 82.5-90% SiO_2 5-12.5% CaO and 5% P_2O_5 by mol were synthesized by sol-gel process. from Tetraethoxysilanes/TEOS ($SiC_8H_{20}O_4$) mixed with Calcium nitrate tetrahydrate $Ca(NO_3)_2$ and Triethyl phosphate $(C_2H_5)_3PO_4.5H_2O$. After calcine process at 700°C all composition found as the white powders, and the X-ray diffraction spectra of present the major component of amorphous phase and small peak of calcium silicate. The morphology of the glass particles were characterized by scanning electron microscope (SEM) found the round shape of the glasses particles and the average of particle size of glass particles around 350-450 nm. The bioactivity was studied by using in vitro method which soak the glass powders in simulated body fluid (SBF) solution for 10 days. The glasses found the hydroxyapatite phase very soon (at day 1) and growth rapidly. The bioactivity mechanism was depends on the ratio of SiO_2:CaO. From the synthesis process found well homogeneous nanoparticles of the bioactive glass, that could be occurred by sol-gel process. This glass composition found the high bioactivity that may be applied for the medical application.

Keywords: Bioactive Glass, Bioactivity, In Vitro Study, Glass Nanoparticle.

A Study on Conversion of Liquid Benzene Derivatives to Value-added Carbon Nanotubes Using Fe and Ni on Alumina Catalysts

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Abstract

Multi-walled carbon nanotubes (MWCNTs) were synthesized from liquid aromatic hydrocarbon benzene derivatives which can be abundantly found in industrial waste, volatile organic compounds (VOC) and biomass pyrolysis tar. In this present study, catalytic chemical vapor deposition (CCVD) method at 700–850˚C using alumina supported Fe and Ni metal catalysts Fe/Al_2O_3 and Ni/Al_2O_3 prepared by dry incipient impregnation method were used to produce value-added carbon nanotubes (CNTs) from liquid hydrocarbon source benzene (C6). Long, uniform and clear tubular bundles of good-quality CNTs were observed from both of the metal catalysts of Fe and Ni at the temperature of 800˚C. Higher CVD temperature resulted in larger diameter of CNTs. At 800˚C, Ni/Al_2O_3 showed the narrow diameter distribution of 24 nm compared to Fe/Al_2O_3 of 37 nm. However, using Fe/Al_2O_3 catalysts provided the higher carbon yield of 5.6 wt% compared to Ni catalysts of 1.2 wt%. For Raman spectroscopy results, I_G/I_D ratio represented the high graphitic carbon for both of the catalysts used. Suitable growth temperature and CVD conditions to convert liquid benzene to value-added MWCNTs were investigated. In addition, it was discovered that by increasing the molecular weight of hydrocarbon, i.e, toluene (C7) and xylene (C8) using the same CVD conditions, carbon yield had increased maintaining the same good quality of CNTs product. Doubling the amount of catalyst used also resulted in doubling the carbon yield as well. Hence, these investigated parameters are influential and can be applicable as preliminary results for producing MWCNTs from liquid aromatic hydrocarbons in industrial scale in the future.

Keywords: Multi-Walled Carbon Nanotubes (MWCNTs), Liquid Benzene Derivatives, Catalytic Chemical Vapor Deposition, Metal Catalysts, Growth Temperature

Fabrication, Characterization, and Properties of Nanoscale Hydroxyapatite Particles Derived from Natural Materials

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Abstract

In this research, the natural pure hydroxyapatite (HA) powder was synthesized from cockle shells and eggshells. The obtained natural HA powder showed agglomerated rod-liked crystals with a particle size ranging from 10 to 100 nm were successfully obtained. The HA were mixed and subjected to a thermal treatment up to 1100^{O}C. The pure phase ceramics were fabricated by solid-state reaction technique. The simple, ecofriendly method has high reproducibility and, at the industrial scale, offers economic benefits. To form the pure phase ceramics, the resulting powders were sinter from 1250 to 1350^{O}C and the phase composition, microstructure, and physical and mechanical properties were investigated. The microhardness increased with sintering temperature due to the modification of density, porosity, and grain size. HA ceramic sintered at 1350^{O}C provided appropriate properties for medical and dental applications.

Keywords: Hydroxyapatite, Nano Particles, Mechanical Properties

Nanoporous Carbon from Hemp Waste via Pyrolysis Process Assisted Microwave Activation

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Abstract

Nanoporous carbon have been successfully prepared by pyrolysis assisted microwave activation using hemp waste as a raw material. The pyrolysis temperature was varied at 600-900^{0}C under nitrogen flow for 1 h, while the microwave activation was performed at 450-800 W under nitrogen flow for 6 min. The physical and chemical properties of nanoporous carbon was investigated by scanning electron microscope (SEM), X-ray diffractometer (XRD), fourier transform infrared spectroscopy (FTIR), thermogravimetric analysis (TGA), and nitrogen sorption isotherm, respectively. The results have shown a significant increase of porosity and a change in nanoporous carbon structure by pyrolysis assisted microwave method. The amount of mesopores and micropores increase with increasing pyrolysis temperature and microwave power.

Keywords: Biomass; Pyrolysis; Microwave; Nanoporous Carbon

Effect of Pre-carbonization on Porous Structure of Nanoporous Carbon from Biomasses for Phenol Red Removal

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Abstract

In this work, to investigate the pre-carbonization effect on the porous structure of nanoporous carbons to removal of phenol red from wastewater, two types of biomasses were studied from cattail flower and pin bark by the one-stage and two-stage processes, respectively. The pre-carbonization temperature was varied at 300^{o}C, 400^{o}C, and 500^{o}C under partial air for 2 h, while the activation temperature was 800^{0}C under nitrogen flow for 1 h. The physical and chemical properties of nanoporous carbon was investigated by scanning electron microscope (SEM), X-ray diffractometer (XRD), fourier transform infrared spectroscopy (FTIR), thermogravimetric analysis (TGA), and nitrogen sorption isotherm, respectively. The effect of pre-carbonization temperature on the morphology, surface area and porosity, chemical functional group, and phase structure, phenol red removal of nanoporous carbon was investigated and discussed. This study identified nanoporous carbon to be a potential low-cost adsorbent from biomasses for liquid phase adsorption involving dye compounds.

Keywords: Biomass; Pre-Carbonization; Pyrolysis; Nanoporous Carbon; Phenol Red Removal

Initial Properties of the Gelatin Hydrogel Containing Sericin, and the Effect of the Electrical Potential on the Release of Sericin

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Abstract

Gelatin hydrogel containing 4% (w/v) sericin was fabricated to investigate the effect of the electrical potential on the sericin release in the systems with and without electrical potential for both positive and negative voltage at different values. Initially, the research was begun by investigating the surface characteristics, porosity, hydrophobicity, and elastic properties of the produced gelatin hydrogels. SEM images showed that the surface characteristics of the gelatin hydrogels without and with sericin were smooth, shiny, and non-porous. However, the percentage of the bulk porosity of the synthesized gelatin hydrogels can be calculated by mass comparison technique using a density balance. It was found that the porosity percentage of the hydrogel without and with sericin were not significantly different. Gelatin hydrogels without and with sericin exhibited hydrophobic properties during the first 120 second of the measurement. After that, both hydrogels became more hydrophilic. Sericin contained hydrogel had better water absorption capacity than that of non-sericin contained hydrogel. However, sericin-contained hydrogel was weaker with more flexibility than non-sericin-contained hydrogel. The sericin release from the hydrogel under a system without and with external stimulating voltage was observed. The sericin release was increased considerably with stimulating time at all experimental voltages. The optimum external voltage to stimulate the release of sericin from the hydrogel was -0.5 V. The maximum amount of released sericin was 162.38 mg, which was sufficient to inhibit the growth of infections *S. aureus* and *E. coli* that may affect inflammation and wound healing.

Keywords: Sericin, Hydrogel, Wound Healing, Biomaterials, Drug Delivery.

Rice Flour-based Amylose Nanostructure Prepared via Supercritical Fluid Carbon Dioxide Assist Ethanol Precipitation Method

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Abstract

Recently nano polysaccharide and nano amylose, have intensive attention in biopolymer-based for various develop bionanocomposites applications, such as drug delivery nanovehicles either enhance nutraceutical stability and bioaccessibility or bioactivity in biomedical, functional food, and pharmaceutical industry. Rice flour is a biodegradable and biocompatibility polymer second most natural abundant biomass material which consist of amylose helix molecules packaged in granular structures. Rice flour-based amylose nanostructure were prepared via supercritical fluid carbon dioxide assist ethanol precipitation method in this study. The obtained rice flour-based amylose nanostructures were characterized using Fourier-Transform Infrared Spectroscopy (FT-IR), X-Ray Diffraction (XRD), and scanning electron microscopy (SEM). The SEM images revealed that porous-like amylose ranged between 50 and 100 nm nanostructure morphology was successfully prepared from rice flour using supercritical fluid carbon dioxide assist ethanol precipitation-based technique. The supercritical fluid carbon dioxide condition shows no significant new bonding formation between polysaccharide and carbon dioxide, while the complex system of glucopyranose C-O environment and glycosidic C-O-C conformation, and amylose crystallinity were changed. The results suggested that this preparation method can be applied as an effective and green technique for nano polysaccharide and nano amylose production in the fields of pharmaceutical, nanomedicine, nutraceutical, food, and cosmetics sector in the future.

Keywords: Nano-Polysaccharide, Nano-Amylose, Nano-Starch, Rice Flour, Supercritical Fluid Carbon Dioxide.

Study on Nitrogen Adsorption/Desorption Isotherms of Activated Carbons Derived from Hemp

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Abstract

Activated carbon (AC) is predominantly an amorphous solid with a large internal surface area and pore volume. The usage of AC depends on their surface area, pore size distribution and chemical surface characteristics. The production of AC with desired pore size distribution and surface chemistry from low-cost precursors is an important challenge. On the other hand, Thailand has unlocked the law on hemp to be allow for the use of its components in food and industry, resulting a large amount of hemp waste. Therefore, in this research, ACs from hemp stalks were prepared by pyrolysis carbonization and chemical activation techniques. Their nitrogen adsorption/desorption isotherms were investigated. Nitrogen adsorption/desorption isotherm curves exhibit the typical IV type, implying an existence of mesopores. When the ratio of char to sodium hydroxide is 1:2.5, ACs have a maximum surface area of approximately 2600 m^2/g. The results of the adsorption isotherm show that hemp-derived ACs with a large surface area and well-developed mesoporosity are attractive materials for energy storage and adsorbents.

Keywords: Activated Carbon, Hemp, Nitrogen Adsorption/Desorption Isotherms.

Potential Utilization of Sugarcane Bagasse Ash as a Catalyst Support for Production of Carbon Nanotubes from Flare Gas

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Abstract

Sugarcane bagasse residues in sugar mill process were potentially utilized for carbon nanotubes (CNTs) synthesis via chemical vapor deposition (CVD). Sugarcane bagasse ash (SCBA) containing silica as the main composition was used as a catalyst support in this study. For the modification of carbon-free SCBA after calcination in air at 800°C for 2 h, acid leaching with 1M HCl and silica extraction with 2M NaOH could increase silica purity to 83 and 97 wt% and also enhance the surface area to 145 and 372 $m^2 \cdot g^{-1}$ in leached ash and extracted silica, respectively. However, the average pore size decreased from 12.1 nm in leached ash to 2.5 nm in extracted silica. These modified SCBA provided rather similar properties to commercial silica (187 $m^2 \cdot g^{-1}$ in surface area, 6.4 nm in pore size), which might be suitable for CNTs synthesis since they were considered as mesoporous silica. 20 wt% Fe and Ni on modified SCBA were prepared using wet impregnation with hydrothermal treatment at 160°C for 12 h prior to CNT synthesis. For CNT synthesis via CVD using methane and ethane considered as two major components in waste flare gas as carbon sources, the product yield, morphology from SEM images, and Raman spectroscopy indicated that CNTs were rarely synthesized from methane at 950°C with any types of catalyst support. However, CNTs with wider ranges in size of 40-200 nm could be produced from ethane at 950°C with higher carbon yield (32.3 wt%) and higher I_g/I_d at 4.0 when using 20%Fe/leached ash compared to 20%Fe/extracted silica with lower yield (28 wt%) and lower I_g/I_d at 2.5. In brief, with simple and low-cost modification by acid leaching of SCBA, leached ash can potentially be utilized as the catalyst support with Fe to produce uniform CNTs from alternative gaseous hydrocarbon wastes such as flare gas.

Keywords: Sugarcane Bagasse Ash, Silica, Flare Gas, Carbon Nanotubes, Chemical Vapor Deposition.

Production of Carbon Nanotubes from Liquid Benzene as a Model Compound from Pyrolysis Tar Using Sugarcane Bagasse Ash as a Catalyst Support

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Abstract

Liquid carbon sources such as eucalyptus oil, palm oil, aromatic liquid hydrocarbons and bio-oil have been recently studied for carbon nanotubes (CNTs) synthesis. In this study, benzene which is a representative of pyrolysis tar from biomass wastes such as sugarcane bagasse was used for CNTs synthesis via chemical vapor deposition (CVD). As well as sugarcane bagasse ash (SCBA) which is undesired biomass residues from combustion of sugarcane bagasse in sugar mill's steam boiler was applied as a catalyst support. Acid leaching with 1M HCl to remove impurities such as metal oxides could increase silica purity to 83 wt% and also enhance the surface area to 145 $m^2 \cdot g^{-1}$ with the average pore size at 12.1 nm. This simply modified SCBA provided rather similar properties to commercial silica (187 $m^2 \cdot g^{-1}$ in surface area, 6.4 nm in pore size). For CNT synthesis, liquid benzene was fed for 20 min by varying the reaction temperature at 700–800°C using 20 wt% Fe on acid-leached SCBA and commercial silica which were prepared by wet impregnation with hydrothermal treatment. Rather uniform CNTs with a size range of 10-70 nm could be produced from both 20 wt% Fe on acid-leached SCBA and commercial silica with carbon yields at 5.9 and 12.6 wt%, respectively, at even relatively lower temperature of 700°C. Furthermore, Raman spectroscopy analysis revealed that the value of I_G/I_D of the carbon product was 1.9 and 1.6 over acid-leached SCBA and commercial silica, respectively, which indicated high degree of graphitization. Accordingly, sugarcane bagasse residues can be potentially utilized as both carbon source and catalyst support for the production of value-added CNT products.

Keywords: Carbon Nanotubes, Sugarcane Bagasse Ash, Benzene, Pyrolysis Tar, Chemical Vapor Deposition.

Fabrication of Ceftriaxone-loaded Quaternized Chitosan Nanoparticles *via* Ionic Gelation Method

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Abstract

Ceftriaxone-Loaded chitosan-based nanoparticles have been developed for effective antimicrobial treatments. Quaternized chitosan (QCS) was synthesized by grafting chitosan with cationic glycidyltrimethylammonium chloride (GTMAC). In acidic conditions, QCS was successfully prepared with a quaternization degree of 93%, leading to a complete dissolution in water. Ceftriaxone sodium (Cef), an antimicrobial drug, was encapsulated *via* an ionic gelation method using QCS and tripolyphosphate (TPP) as a cross-linking agent. Physicochemical properties of the resulting QCS-TPP nanoparticles were investigated by particle size analysis, transmission electron microscopy, and FTIR spectroscopy. The optimum conditions for fabricating the nanoparticles were a QCS/TPP mass ratio of 5:1, pH 5.5, at ambient temperature. The obtained particles showed a spherical shape with mean particle size, polydispersity index, and zeta potential of 270 nm, 0.34, and +23 mV, respectively. FTIR spectra confirmed the cross-linked formation between amine and quaternary groups of QCS and TPP counterions by ionic interactions. The Cef/QCS-TPP nanocarriers exhibited a high encapsulation efficiency of 82% due to the hydrogen bonding between Cef and QCS-TPP, and the strong electrostatic interaction of QCS and TPP. The drug release behavior was examined *in vitro* at pH 7.4. A prolonged-release rate was achieved after 96 hours. The QCS nanoparticles cross-linked with TPP is promising as an antimicrobial drug carrier for prolonged and sustained delivery.

Keywords: Quaternized Chitosan, Tripolyphosphate, Ceftriaxone, Ionic Gelation, Encapsulation, Antimicrobial Drug

Adsorption of Heavy Metals Through Bio-calcium Oxide Derived from a Golden Apple Snail Shell for Heavy Removal from Contaminated Water

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Abstract

In this research studied the use of calcium carbonate ($CaCO_3$) from golden apple snail shells for application as an absorbent material to remove heavy metals in water sources, which replaces commercial calcium carbonate ($CaCO_3$) to reduce production costs and increase waste value. The heavy metal content (such as lead; Pb, cadmium; Cd, mercury; Hg and arsenic; As), phase formation, and physical characterization of golden apple snail shells were investigated for use as a calcium source in the production of naturally based biomaterials. The samples were calcined between 600°C and 950 °C for 5 hr. Calcined shells were grinded and sieved to select 100 micrometer size particles. The result shows that the $CaCO_3$ (calcite phase) was completely transformed into a CaO phase at 900℃, which showed that the phase transformation depended on calcination temperature and time. This study suggests that the golden apple snail shell could be an effective biomaterial for heavy removal from contaminated water.

Keywords: Calcium Carbonate, Heavy Metal ions, Adsorbent, Porosity, Microstructure.

Synthesis, Scrutiny and Applications of Calcium Carbonate ($CaCO_3$) from Cockle Shell Waste for the Adsorption of Heavy Metals in the Water

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Abstract

Cockle shells have been considered a source of calcium carbonate ($CaCO_3$), but their shells are disposed of as waste that pollutes the coastal environment. $CaCO_3$ has attracted considerable attention as an adsorbent heavy metal. To convert cockle shell waste into meaningful use for achieving a zero-waste production system, In this study, $CaCO_3$ powder was synthesized from cockle shells and then formed into a spherical ball for being a heavy metal adsorbent ball in the water. Both $CaCO_3$ powder and spherical ball are characterized using XRD, FESEM, BET, and AAS. The results showed that calcium carbonate in each shell turns into calcium oxide, increasing calcination temperature higher than 900°C. XRD patterns illustrated partial phase changing from aragonite to calcite when heating at 600-700 °C. However, the greater heating temperature to 900 °C was showed completing phase change to calcite. The $CaCO_3$ powder and ball present excellent adsorption performance for Hg, Cd, As, Pb and Cr. $CaCO_3$ ball, as a hopeful adsorbent ball, can be employed to remove the heavy metal in water for household use efficiently.

Keywords: Calcium Carbonate ($CaCO_3$), Shellfish, Cockle Shell, Absorbent and Heavy Metals

Computational Materials

Probing the Local Structure of CuO-doped $(Ba_{0.85}Ca_{0.15})(Ti_{0.90}Zr_{0.10})O_3$ Ceramics with XANES Spectroscopy Technique

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Abstract

This work aims to investigate the effects of CuO doping (0-1.0 wt%) on the local structure of $(Ba_{0.85}Ca_{0.15})(Ti_{0.90}Zr_{0.10})O_3$ (BCTZ) ceramics. These samples were prepared via the solid state combustion technique using glycine as fuel. The local structure of the samples was characterized by XANES (X-Ray Absorption Near-edge Structure) spectroscopy. The Cu, Ti *K*-edge and Ba L_3-edge XANES measurements were performed in a fluorescent mode at ambient temperature. The XANES data revealed that the oxidation state of Ba and Ti ions in all samples was +2 and +4, respectively. Comparing the experimental Cu *K*-edge XANES spectra to theoretical XANES spectra simulated by FEFF program suggested that the substitution of the Cu ions for B-site ions in BCTZ.

Keywords: BCTZ, Local Structure, XANES

Thermoelectric Prediction from Material Descriptors by Using Machine Learning Technique

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Abstract

In this work, a data-driven design of materials in the form of thermoelectric power factor is predicted by using a machine learning framework based on their composition and structure. The broad range existing materials dataset has been obtained from the Materials Project database. The electronic transport properties which is the output were collected from the relative contributed framework in Materials Project database which calculated from a Boltzmann transport theory beyond ab-initio calculations. This input dataset is governed as a material descriptor which only relies on atomic information and crystal structure without a density functional theory calculation. These material descriptors are transformed to numerical features by using an open source Matminer. These transformed datasets were trained and tested by non-linear machine learning regression models and then evaluated the performance of each model. Our results showed that an optimized random forest showed a best prediction yield as 88%.

Keywords: Thermoelectric, Machine Learning, Neural Network, Random Forrest

Accurate Band Gap Prediction of Metal Halide Perovskite Using Half-occupation Technique (DFT-1/2)

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Abstract

In this work, first-principle calculation with half-occupation technique, known as DFT-1/2, is used to perform accurate bandgap prediction of metal halide perovskite materials in tetragonal structure. The electronic structure was calculated based on non-local van der Waals-corrected density functional theory (vdW-DFT). The standard DFT with GGA approximation provided surprisingly accurate bandgap for the tetragonal phase of methylammonium lead iodide ($CH_3NH_3PbI_3$). However, this excellent performance is not transferred to other structures and other perovskite materials. The relativistic self-consistent GW (scGW) correction is generally used to predict a very accurate bandgap but this method required very high-performance computational resources. Here we report the performance of the recently developed half-occupation technique (DFT-1/2) which can solve the same band gap calculation problem with lower computational resources than a standard DFT calculation. A halide perovskite system of ABX_3 (A = CH_3NH_3, NH_2CHNH_2, B = Pb, Sn and X = I, Br, Cl) is studied using DFT-1/2 on the influence of ions and electronic structure variation. This work yields the accurate bandgap prediction by DFT-1/2 technique with a low computational cost which can be used for further complex alloying halide perovskite material studies.

Keywords: DFT-1/2, Half-Occupation Technique, Self-Energy Correction Method, Halide Perovskite Material.

Theoretical Study on Structural and Mechanical Properties of $BiVO_4$

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Abstract

In this research, the structural and mechanical properties of Bismuth Vanadate ($BiVO_4$) in monoclinic (m-BiVO4) and tetragonal (t-BiVO4) structures were investigated by first-principles calculations. The generalized gradient approximation (GGA) with the Perdew-Burke-Ernzerhof (PBE) functional was employed in the calculations. The calculated structural properties are in good agreement with the available results. For the mechanical properties, the elastic constants (Cij) were calculated. The obtained results are consistent with the previous data. The elastic constants in both crystal structures satisfy the Born criteria, indicating that m-$BiVO_4$ and t-$BiVO_4$ are mechanically stable. Moreover, other elastic properties such as bulk modulus (B), shear modulus (G), and Young's modulus (E) were analyzed from the calculated elastic constants. Furthermore, the G/B values were calculated, and the results show that both m-$BiVO_4$ and t-$BiVO_4$ are ductile material.

Keywords: Bismuth Vanadate, First-Principles Calculations, Structural Properties, Mechanical Properties.

Adsorption of Acetone Molecule on Graphene and Doped Graphene: A First Principle Study

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Abstract

Highly sensitive and selective gas detection for volatile organic compounds (VOCs) from the environment have been attracted develop. Acetone [$(CH_3)_2CO$], a widely used VOCs in laboratories as well as in chemical industries which is toxic to human organs. Graphene-based material is considered a potential candidate of gases sensor. However, most of the previous work focused on pristine graphene, and predicted relatively low adsorption energies in comparison with the essential requirement of gas sensing applications. In this work, to search for a high sensitivity sensor for acetone molecule, we investigated the adsorption of acetone on the intrinsic graphene comparison with N-doped graphene, P-doped graphene, and S-doped graphene. Optimized geometries, adsorption energies, and electronic structures of the acetone molecule-adsorbed on various graphene surfaces were determined using density functional theory (DFT) calculations. Result indicates that the adsorption energy of acetone on N-doped and P-doped graphene are stronger interactions than intrinsic and S-doped graphene due to the presence of the active defect sites to enhance charge transfers.

Keywords: VOCs Gas Sensor, Acetone, Graphene, Adsorption, DFT Calculations

Energy and Environment Materials

Effect of Processing Parameters on Dielectric, Ferroelectric, and Energy Storage Properties of Nd_2O_3 Modified BNT-Based Lead-Free Ceramics

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Abstract

In this research, the effects of processing parameter on physical, microstructure, dielectric, ferroelectric, and energy storage properties of Nd_2O_3 modified BNT-based lead-free ceramics were investigated. The mixture $Bi_{0.405}Nd_{0.02}Na_{0.375}Sr_{0.175}TiO_3$ or BNdNST powder was calcined at 850 °C under normal atmosphere for 3 h dwell time with a heating/cooling rate of 5 °C/min. The studied $Bi_{0.405}Nd_{0.02}Na_{0.375}Sr_{0.175}TiO_3$ ceramic was prepared by a solid-state reaction method and sintered at various temperatures from 1075 °C to 1150 °C in order to clarify the optimal sintering temperature for all properties. Phase formation of all samples was examined by the XRD technique. With increasing the sintering temperature, a phase transformation from mixed rhombohedral-tetragonal to pseudocubic phase observe. The maximum density was found to be 5.70 g/cm^3. Grain size tended to increase with increasing the sintering temperature. The electrical improvement was related with the change in densification and grain size. The dielectric, ferroelectric, and energy storage density properties were also increased with increasing sintering temperature. Based on the electrical property results, the selected sample has a potential for use as the high lead-free energy storage ceramic under low electric field and/or energy storage density applications.

Keywords: Neodymium Oxide (Nd_2O_3), BNT-based Lead-Free Ceramics, Energy Storage Density, Dielectric, Ferroelectric Properties.

Biocompatible and Biodegradable Gamma Glycine Treated Bacterial Cellulose Nanofibrils Based on Hybrid Piezoelectric-triboelectric Nanogenerator

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Abstract

Hybrid piezo-triboelectric nanogenerators (H-PTENGs) represent a new class of self-powered systems that exploit the synergy of piezoelectric and triboelectric mechanisms to improve energy harvesting efficiencies. The purpose of developing this energy harvester is to make devices that could be attached to the human body for serving as a wearable power source or self-powered sensors. Therefore, the H-PTENGs must be fully biocompatible. However, commonly used piezoelectric materials are toxic and non-biodegradable. Glycine is an amino acid found in animal protein with three distinct crystal symmetries, including alpha (α), beta (β), and gamma (γ). Among them, γ-glycine crystallizes in a non-centrosymmetric space group that leads to the piezoelectric response. In this work, we transformed α-glycine to γ-glycine via a dissolution-recrystallization process in an inorganic salt solvent (NaCl) and then embedded it in bacterial cellulose nanofibrils (BC) to form a 0-3 composite structure. As a result, the piezo-composite films are fully biocompatible and biodegradable. Structural changes in the obtained glycine powder and glycine treated BC films were analyzed using X-ray tomographic microscopy (XTM), attenuated total reflection-Fourier transform infrared (ATR-FTIR) spectroscopy, Instrument X-ray diffraction (XRD) and Scanning Electron Microscope (SEM). The results confirmed that the α phase in glycine powder was successfully induced to the γ phase and after it was deposited on the BC surface, phase transition did not occur. Furthermore, the electrical output of BC-based H-PTENG improved with the embedding of γ-glycine particles on the fiber surface. By paring the γ-glycine treated BC with silicone film, to fabricate H-PTENG, the device generated an output voltage and current of ~34 V and 17 nA, respectively. The maximum power of ~14.22 μW/cm^2 was obtained at the load resistance of 7 MΩ.

Keywords: Bacterial Cellulose, γ-Glycine, Hybrid Piezo-Triboelectric Nanogenerators

Mercury Removal Efficiency of Disulfide- and Thiol-functionalized Lanthanide Coordination Polymers

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Abstract

To compare efficiency of disulfide and thiol groups in removing mercury from aqueous medium without noteworthy influence from structural differences, a series of new $[Ln^{III}(dtba)_{1.5}(H_2O)_2]$ (Ln^{III} = Eu^{III} (I), Gd^{III} (II) and Tb^{III} (III), H_2dtba = 4,4´-dithiobenzoic acid) were synthesized and characterized. Single crystal structure of I was elucidated and is described. Using II having disulfide group as a precursor, II^{SH} containing disulfide and thiol groups was prepared though reduction with hydrazine. Experimental data confirming the preserved framework structure and the co-existing of disulfide and thiol groups in II^{SH} are provided. Robustness of II and II^{SH} over a wide range of pH (2 - 10) was then confirmed and their mercury removal performances at different pH were evaluated in terms of removal efficiencies (%*R*), equilibrium uptake capacities (q_e) and distribution constant (K_d). The dependence of these parameters on pH is reported. The best values of %*R*, q_e and K_d could be achieved at pH 10 where surfaces of the adsorbents were negatively charged; 86%*R*, 429 $mg \cdot g^{-1}$, and 6.04×10^3 $mL \cdot g^{-1}$ (II), and 98%*R*, 490 $mg \cdot g^{-1}$ and 5.08×10^4 $mL \cdot g^{-1}$ (II^{SH}). At pH 7, influences of the initial concentration of mercury on performances of the adsorbents as well as the adsorption isotherms and kinetics were examined from which the better performance of II^{SH} has been concluded. The characterization of the adsorptions by the Langmuir model and the pseudo-second-order kinetic as well as their excellent consistency with the experimental data are included. At the neutral pH, selectivity of the adsorption and negligible influences from common anions were illustrated. The better affinity between mercury and thiol group and therefore its contribution to the better performance of II^{SH} was then ascertained by computational study.

Keywords: Coordination Polymer, Lanthanide, Disulfide, Thiol, Mercury, Adsorption.

Synthesis and Characterization of 2-Dimensional ZSM-5 Catalyst Using $C_{22\text{-}6\text{-}6}Br_2$ Template

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Abstract

A process for the synthesis of 2-dimensional ZSM-5 (2D-ZSM-5) has been developed by using $[C_{22}H_{45}\text{-}N^{+}(CH_3)_2\text{-}C_6H_{12}\text{-}N^{+}(CH_3)_2\text{-}C_6H_{13}]\,Br^{2-}$ ($C_{22\text{-}6\text{-}6}Br_2$) template for application in hydroisomerization processes. The structures, properties, and efficiency of the synthesized 2D-ZSM-5 were compared to a conventional 3-dimensional structure (3D-ZSM-5) catalyst prepared by using TPABr as a template. The $C_{22\text{-}6\text{-}6}Br_2$ template was successfully synthesized, whose structure was confirmed using proton nuclear magnetic resonance spectroscopy (^{1}H NMR). The template was then used to synthesize ZSM-5 at a molar ratio of $25.18Na_2O$: $1.64Al_2O_3$: $96.77SiO_2$: $5.00C_{22\text{-}6\text{-}6}Br_2$: 12.87TPAOH: $4000.00H_2O$. X-ray diffraction (XRD) revealed the mixed phases between ZSM-5 and mordenite. The N_2 adsorption-desorption results showed a decrease in surface area and pore volume. The pore size distribution, calculated from density-functional theory (DFT) methods, was slightly increased. The plate-like structures with a thickness of 145 nm were observed by scanning electron microscopy (SEM). The synthesized materials have a high potential to improve the iso-alkane selectivity in the hydroisomerization (HI) of hexadecane.

Keywords: Hydroisomerization, 2-Dimensional ZSM-5, $C_{22\text{-}6\text{-}6}Br_2$ Template.

Cobalt-based Catalysts Supported on Urea-Modified Sheet-like ZSM-5 for Hydrodeoxygenation of Fatty Acid Methyl Esters

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Abstract

A cobalt-based catalyst system has been developed for use in hydrodeoxygenation (HDO) and hydroisomerization (HI) of fatty acid methyl esters (FAMEs) to enhance the cold flow properties and oxidation stability of biodiesel by upgrading them to long-chain hydrocarbons. A ZSM-5 zeolite structure was modified to generate a sheet-like structure with a short diffusion path by using urea as an additive. The synthesized samples were analyzed by X-ray diffraction (XRD), N_2 adsorption-desorption, scanning electron microscope (SEM), and ammonia temperature-programmed desorption (NH_3-TPD) technique. The effect of the additive and the Si/Al ratio on the structural and catalytic properties were investigated. The obtained urea-modified ZSM-5_SiAl50 sample (100SiO_2: 1Al_2O_3: 12.87TPAOH: 12.23TPABr: 160Urea: 10634H_2O) containing a Si/Al ratio of 1:1 exhibits a sheet-like structure with 8 times narrower in b-axis length, compared to a conventionally synthesized ZSM-5, as confirmed by SEM. The N_2 adsorption-desorption results indicated an enhanced BET surface area (from 229 to 537 m^2/g) with a slight increase in mesoporosity. Moreover, the addition of urea in the ZSM-5 synthesis generated the active H-form of ZSM-5 without an ion-exchange process. Heterogeneous transition metal catalysts (Co-based catalysts) system, specifically cobalt (Co) and cobalt phosphide (CoP) were selected because of their excellent performance in FAMEs hydroprocessing. After the metal impregnation, the catalysts were utilized in HDO/HI reactions at the following conditions: 300 °C under 50 bars of H_2 pressure with LHSV of 1 h^{-1}. The resulting liquid products were analyzed by gas chromatography-mass spectroscopy (GC-MS). The Co and CoP catalysts showed high FAMEs conversion of more than 90%. The main products were jet-range fuels and iso-alkanes, which possessed significant improvements in the cloud point and pour point properties.

Keywords: Cobalt Catalyst, Cobalt Phosphide, Urea, Hydrodeoxygenation, FAMEs, ZSM-5

Energy Harvesting of Time-dependent Electromagnetic Field Wasted from Triboelectric Generators

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Abstract

A triboelectric generation has attracted significant attention for energy harvest technology because of its low cost, high power output, and simple device structure. Many works, such as materials treatment and structure optimization, have enhanced triboelectric output power. However, the output power density in the recent report would be saturated and shows a limitation to increasing. To overcome the limit, we propose a new method to harvest time-dependent electromagnetic energy leaked from triboelectric generators. In a triboelectric generation, based on the Ampère-Maxwell law, a time-dependent electromagnetic field is generated between moving electrodes with surface charges formed by contact and separation of the electrodes. The spreading electromagnetic field is one of the reasons for energy loss. This study adopted a circular patch antenna to harvest the electromagnetic field. The antenna was located around our triboelectric device. The output voltage from the antenna was over 4 V. We found that our method is an excellent proposal to boost the output power of triboelectric generators. The details of our experiments will be presented at a conference.

Keywords: Triboelectric, PDMS, Harvest, Electromagnetic, Antenna.

River Snail Shell as Highly Effective Renewable Heterogeneous Base Catalyst for Biodiesel Production

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Abstract

Biodiesel production process encourages use of heterogeneous catalyst over homogeneous catalysts. The major problems associated with the use of homogeneous catalysts are its non-renewable nature, separation and washing which can be overcome by the use of heterogeneous catalysts. This study is focused on the investigation of river snail (Viviparidae) shell improved with modified activated carbon (MAC) as heterogeneous solid base catalyst for transesterification of palm oil. The waste shell was repeatedly washed to remove any organic impurities attached to it and then dried in an oven. It was calcined at a high temperature of 900 °C for 2 h in an air atmosphere. The calcined sample (calcium oxide: CaO) was obtained as white powder and mixed with MAC. The CaO/MAC (mass fraction 3:1) catalyst was characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM) and Brunauer-Emmet-Teller (BET) method. The operating parameters such as methanol to oil mole ratio, amount of catalyst, reaction time and microwave electrical power were investigated in order to optimize the reaction condition for the biodiesel production. As a result, the optimum reaction parameters found were 12:1 methanol to oil mole ratio, 2.5 wt.% of the CaO/MAC based on oil weight, 4 min of reaction time and microwave electrical power at 600 watt. After further reused for 5 times, the yield of biodiesel could still reach 90%, which indicated that the novel catalyst had a good stability and recyclability. The fuel properties of biodiesel obtained in this work were compared with the biodiesel international standards ASTM D6751 and EN14214. River snail shell can be considered as a nature based benign and resourceful material for the biodiesel production providing a new route for sustainability of fuels.

Keywords: Heterogeneous Catalyst, River Snail Shell, Biodiesel.

Effect of Barium Iron Niobate Incorporation on Energy Storage Density, and Electrical Properties of Lead-free Bismuth Sodium Titanate-based Ceramics

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Abstract

In this research, the (1-*x*)($Bi_{0.485}Na_{0.388}K_{0.097}Ba_{0.021}Sr_{0.09}$)$TiO_3$-*x*Ba($Fe_{0.5}Nb_{0.5}$)$TiO_3$ or (1-*x*)BNKBST-*x*BFNb were fabricated by a solid-state mixed oxide. The effects of BFNb adding on phase evolution, microstructure, dielectric, ferroelectric, and energy storage density properties of the BNKBST ceramics (with x = 0, 0.01, 0.02, and 0.03 mol fraction) were investigated. X-ray diffraction analysis showed that all samples exhibited a single perovskite phase. With increasing BFNb content, a phase transition from mixed rhombohedral-tetragonal to more tetragonal phase was observed. The density value increased with increasing the additive content, which resulted in the improvement of the dielectric properties. In addition, the incorporation of BFNb into the BNKBST ceramic significantly affects the ferroelectric properties. The x = 0.03 ceramic showed high energy storage properties, *i.e.* it had a high recoverable energy storage density (W_{rec} = 1.25 J/cm^3) and good energy storage efficiency (η = 86.55%) at 120 °C and E = 75 kV. These results indicated that the (1-*x*)BNKBST-*x*BFNb system can be designed for high recoverable energy storage density value via a substitution induced relaxor state and developed this material for an electric power pulse energy storage applications.

Keywords: Recoverable Energy Storage Density, Energy Storage Efficiency, Dielectric, Ferroelectric.

Synthesis of the Superlattice Material $Bi_4O_4SeCl_2$ for Thermoelectric Applications

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Abstract

The superlattice material $Bi_4O_4SeCl_2$ has an ultra low thermal conductivity (0.1 $Wm^{-1}K^{-1}$) making it is an ideal candidate material for thermoelectric application. In this work, the superlattice material $Bi_4O_4SeCl_2$ and Si composited $Bi_4O_4SeCl_2$ were synthesized by grinding powders of Bi, Bi_2O_3, BiOCl, Se and Si in stoichiometric ratios. Powders were pressed into pellets by isostatic hydraulic press. The pellets were heated to 800°C under an argon atmosphere and held for 12,18 and 24 hours. Formation of $Bi_4O_4SeCl_2$ was presented in X-ray diffraction patterns. The atomic composition was confirmed by energy-dispersive X-ray spectroscopy. The Seebeck coefficient and electrical conductivity were simultaneously determined using the four-probe DC method. The thermal diffusivity and specific heat were determined using a laser flash. Finally, thermoelectric efficiency of superlattice material $Bi_4O_4SeCl_2$ was determined.

Keywords: Bismuth Oxide Selenide Halides ($Bi_4O_4SeCl_2$), Superlattice, Thermoelectric

Synthesis and Characterization of Cu-MOF for Supercapacitor Electrodes

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Abstract

A Cu-MOF powder was synthesized by a slow diffusion approach and the as-synthesized Cu-MOF powder presented an irregular form with size ranges from 0.3-2 .3 μm. It provided the specific surface area of 11.49 $m^2 g^{-1}$, the total pore volume of 0.6 1 1 $cm^3 g^{-1}$, and the average pore size of 25.53 nm. The electrochemical properties of the as-synthesized Cu-MOF electrode, possessing pseudocapacitive behavior, displayed the highest specific capacitance of 75 F g^{-1} at a current density of 0.1 A g^{-1} and the capacitance retention of 16.6 7 % after 1,000 GCD cycles. When the electrical resistance of the as-synthesized Cu-MOF electrode was studied, it was found that the as-synthesized Cu-MOF electrode provided the series resistance (R_s) of 3.36 Ω, the charge transfer resistance (R_{ct}) of 6.42 Ω, the constant phase element (CPE) of 351.4 μF, and the diffusion resistance (W-R) of 7 Ω. Based on the results, the facile synthesis of Cu-MOF can guide the research and development of Cu-MOF electrodes.

Keywords: Metal Organic Framework (MOF), Supercapacitor, Cu-MOF, Electrode

Electrodeposited Manganese Oxide/Activated Carbon Composites as a High-performance Electrode Material for Supercapacitors

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Abstract

Composite electrodes of supercapacitors based on carbon nanomaterials and nanostructured metal oxide materials have attracted a great deal of attention because they can exhibit both electrochemical double layer and pseudocapacitive behaviors. In this work, we have successfully fabricated a manganese oxide (MnO_x)/activated carbon (AC) composite electrode using an electrodeposition technique. Firstly, the AC electrode pellets were formed by mixing of AC (90 wt%), carbon black (5 wt%), and polytetrafluoroethylene (5 wt%) and subsequently rolled into a thin sheet and punctured into 10 mm diameter-pellets. The electrode composites were then prepared by coating MnO_x onto the AC electrode by electrodeposition techniques via cyclic voltammetry mode using manganese acetate as a precursor for 5, 10 and 15 cycles. The condition of 10 cycle exhibits the maximum specific capacitance of 157 F/g at a current density of 0.2 A/g, which is approximately 3 times higher than that of the AC electrode.

Keywords: Supercapacitors, Activated Carbon, Manganese Oxide, Electrodeposition.

Materials Fabrication, Characterization and Manufacturing

Design and Fabrication of Flexible Thermoelectric Generator: An Experimental and Simulation Study

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Abstract

In this study, thermoelectric generator (TEG) is successfully fabricated, which exhibits excellent flexibility and remarkable power output, capable of high-temperature operation up to 200 °C. The flexible thermoelectric generators (f-TEGs) can be easily manufactured through connecting an inorganic-semiconductor-based high-performance thermoelectric device to a stretchable substrate. The semiconductor elements connected in series with a copper sheet and silicone rubber with low thermal conductivity were inserted between the semiconductor elements. Finally, f-TEGs were covered by electrical insulating layers with high thermal conductivity. The thickness of the coper sheet and the different insulating layers were studied. To evaluate and optimize the performance of the generator, a three-dimensional steady-state model is constructed, and a systematic study of the design parameters is performed based on the finite element method. Finally, the f-TEGs with a size of 5×5 cm^2, containing 98 thermocouples were fabricated. The f-TEGs device is capable to operate at temperatures up to 200 °C in ambient conditions (atmospheric pressure: 1 atm and relative humidity: 50 ± 5%). Together with exceptional stability and flexibility, the produced f-TEGs exhibits thermoelectric performance values with open-circuit voltage V_{OC} = 1.198 V, short-circuit current I_{SC} = 0.108 A and internal resistance f-TEGs = 754.2 Ω at ΔT = 100 K, generating a maximum output power (P_{max}) of 129.176 mW. The proposed f-TEGs device is easily scalable, enabling large-scale manufacturing opportunities towards highly efficient and high-operating temperature.

Keywords: Flexible Thermoelectric Generators (f-TEGs), Electrical Insulating Layers, Finite Element Method (FEM).

Effect of Copper Percentage in Copper Tungsten Electrode on Ti6Al4V by Electrical Discharge Machining

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Abstract

This objective of this research is to determine the optimal parameters for electrical discharge machining of titanium alloy Ti6Al4V by copper tungsten electrodes with 70% and 80% of tungsten were compared in the experiments. The experimental studies were conducted varying current, pulse on time and duty factor. The settings of machining parameters were determined by using Taguchi experimental method L-18 orthogonal arrays method. The level of importance of the machining parameters on the MRR is determined by using analysis of variance (ANOVA). The optimum machining parameter combination was obtained by using the analysis of signal-to-noise (S/N) ratio. An (CuW 20-80%) electrode gives more material removal rate than that of by an (CuW 30-70%) electrode. The optimal parameters are 30 amperes of discharge current, 50 microsecond of pulse on time and 40% of duty factor.

Keywords: EDM, Copper Tungsten, Taguchi, Ti6Al4V.

Role of Sb Species on Electrical Properties of Sb-doped ZnO Prepared by Pulsed Laser Deposition

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Abstract

Reliability and repeatability of p-type ZnO are indispensable for ZnO optoelectronic devices. The development of practical ZnO optoelectronic devices has been obstructed by the difficulty to achieve reliability, repeatability, and low resistivity of p-type ZnO. The main reason behind the difficulty is presenting n-type conductivity of ZnO because of its intrinsic defects that act as a donor. To achieve reliable p-type ZnO, two main research perspectives have been applied efforts; the first one is the fabrication of ZnO in an oxygen-rich environment (O-rich condition) to suppress intrinsic defects, which have low forming energy in Zn rich conditions. The second perspective is the doping method by substitution Zn site with antimony (Sb) into ZnO. However, we cannot contribute the p-type behaviors in SZO to substitution O by Sb, simply. In this work, the crucial role of antimony (Sb) on electrical properties of sb-doped ZnO prepared via pulsed laser deposition was demonstrated by varying the weight percentage of Sb_2O_3 in ZnO:Sb_2O_3 target. The substrate temperature was fixed at low temperature (200 °C). The SZO thin films turned from n-type to p-type conductivity at Sb_2O_3 over 2 wt.%. The film prepared at 2 wt.% showed the highest p-type conduction with the conductivity of 2.91 $\Omega^{-1}.cm^{-1}$ and the hole concentration of $3.03x10^{19}$ cm^{-3} at room temperature. The Sb^{5+}_{Zn} and Sb^{3+}_{Zn} are responsible for n-type conductivity at low-level Sb doping while the complex defect Sb_{Zn}-$2V_{Zn}$ contributes to p-type conductivity of SZO thin films at Sb_2O_3 over 2 wt.% in the target. The formation of p-type conductivity with the high hole concentration at low substrate temperature in this film is closely related to the suppression of oxygen-related defects. The energetic pulsed laser could turn the Sb^{3+} species to Sb^{5+} species resulting in the distinctive Sb^{5+} species in the low-level Sb doping. The ablation species ratio in the plasma plume is altered by increasing the Sb_2O_3 wt.% in the target, as a result, the Sb^{3+} species is dominant than the Sb^{5+} species at a higher Sb doping level.

Keywords: Antimony Doped ZnO, Complex Defect, Sb Substitution, Oxygen-Rich Condition

Production of Elastomeric Fibers from Natural Rubber Latex by Electrospinning

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Abstract

Elastomeric fibers can be utilized in various applications. This work aims to prepare elastomeric fibers from natural rubber latex by electrospinning. Three types of rubber latexes (concentrated latex with high ammonia, compounded latex, and pre-vulcanized latex) were used and compared. The viscosity of the latexes, the electrical conductivity of the latexes, and electrospinning conditions (e.g. applied potential and feed rate) were studied and optimized. Morphological appearances of the obtained fiber were investigated by scanning electron microscopy (SEM), while the tensile mechanical properties were investigated by a universal testing machine. The result showed that fibers could not form by electrospinning from the concentrated latex with high ammonia, but many connected beads were found instead. For the pre-vulcanized latex, the number of beads was found to reduce and the beaded fibers could be successfully produced.

Keywords: Elastomeric Fiber, Electrospinning, Natural Rubber Latex

TOPSIS Based Selection of Optimal Parametric Combination during Laser Surface Texturing of Zirconia Ceramic

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Abstract

The present research delas with selection of optimal parametric combination during laser surface texturing of zirconia ceramic. The experiment was based on L16 Taguchi design of experiment taking average power, pulse frequency, scanning speed and transverse feed as process parameters. Ra and Rz was considered as performance criteria. Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) has been utilized to determine the optimal parametric combination. The result shows that the TOPSIS can be a suitable method for determining the best parametric combination in order to achieve the higher value of surface roughness. The optimal level for achieving higher value of surface roughness was found to be average power (20 W), pulse frequency (15 kHz), scanning speed (2mm/s) and a transverse feed (0.04mm)

Preparation and Electrical Properties of Compositionally Modified $Ba_{0.85}Ca_{0.15}Zr_{0.10}Ti_{0.90}O_3$ Ceramics by $LiNbO_3$-doped

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Abstract

The barium calcium zirconate titanate based (Ba,Ca)(ZrTi)O_3 or BCZT ceramics is interested for electro-ceramic industry. Due to the high sintering temperature (i.e., > 1400 ˚C) of BCZT, mass production of this compound would require much energy and electricity. This research therefore attempted to improve the BCZT ceramic fabrication process by adding $LiNbO_3$ (LN) in this system and investigate its properties. In this work, the preparation of (1-*x*)BCZT-*x*LN ceramics at x = 0.00, 0.01, 0.02 0.03, 0.04 and 0.05 were carried out. All samples were sintered at 1400 ˚C for 4 h. It was found that, with increasing the LN content, the density and corresponding microstructure were improved. The XRD pattern of BCZT-LN ceramics indicated that the pure tetragonal phase. The dielectric constant of x = 0.01 showed the maximum value of 12000. The Curie temperature (T_c) apparently shifted to lower values with the corresponding increase in the room temperature dielectric constant. This study showed that the sinterability of BCZT ceramics could be improved while their physical and electrical properties could be tunable by addition of LN compound.

Keywords: Ferroelectric Properties; Dielectric Properties; Lead-Free Ceramics.

Morphology and Structure of Iron and Copper Alloy Synthesized from High-energy Ball Milling

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Abstract

This study prepared a bimetallic alloy of copper and iron particles using high-energy ball milling. The influence of milling and annealing times on the morphology, composition, and structure of alloy powder was explored by several characterization techniques. The physical properties (size, color, and agglomeration) of the particles were observed via a digital camera and scanning electron microscope. Energy-dispersive X-ray spectroscopy was used to determine elemental distribution and ratios between iron and copper in this alloy. The crystalline structures were identified by X-ray diffraction (XRD). In addition, the as-prepared alloy was pressed with different pressures to form rectangular alloy rods. The results show that the size and color of this particle were changed with the milling time. The milled iron and copper particles for 42 h presented a black color. The copper and iron atoms were uniformly dispersed in the alloy. Furthermore, an increase in annealing time caused a decrease in the copper fraction of alloy. The XRD study reveals both powders were transformed into the dominant structure of bimetallic alloy after milling for 30 h. Lastly, the appropriate pressure for alloy formation was 140 kg/cm^2.

Keywords: High Energy Ball Milling, Iron, Copper, Bimetallic Alloy.

Phase Transition, Thermal Expansion and Electrical Properties of BNLT-BT Ceramics Near the Morphotropic Phase Boundary

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Abstract

Lead free ceramics based on bismuth sodium lanthanum titanate ($Bi_{0.4871}Na_{0.4871}La_{0.0172}TiO_3$: BNLT) and barium titanate ($BaTiO_3$: BT) were prepared by a modified two step mixed-oxide method. Effects of BT content on the phase transition, thermal expansion behaviour, mechanical and electrical properties of lead-free BNLT-BT ceramics were studied. The Burn's temperature and local polarizations were estimated from the thermal expansion data. Various aspects of understanding the polarization behaviour and other effects in this system have also been investigated and discussed. The 0.96BNLT-0.04BT ceramics have shown the d_{33} value of 135 pC/N. The coercive field (E_c) and reamanent polarization (P_r) were found to be 24 kV/cm and 9.0 μC/cm^2, respectively. This may be useful in future development of the multifunctional lead-free materials in electronic applications.

Keywords: Thermal Expansion, Dielectric Properties, Ferroelectric Properties, Electrical Properties

Deposition and Characterization of MoNa Thin Films by Pulsed DC Magnetron Sputtering with Two-step Approach

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Abstract

The sodium-doped molybdenum (MoNa) thin films were deposited on a glass slide and silicon wafer substrate by pulsed DC magnetron sputtering with a two-step approach. A two-step sputtering technique consists of sputtering MoNa film at a low argon flow rate (L_{Ar}; 10 sccm), subsequently increasing the Ar flow rate (H_{Ar}; 30 sccm). The effect of the deposition time ratio between L_{Ar} and H_{Ar} on the structural, optical transmission, and electrical properties of the prepared MoNa thin films have been investigated and characterized by grazing-incident x-ray diffraction (GIXRD), field-emission scanning electron microscope (FE-SEM), UV-Vis-NIR spectrophotometer and Hall measurement. The results indicate that the two-step sputtering allows good electrical properties and uniform MoNa thin films with a thickness lower than 60 nm and 0.023 Ω·cm.

Keywords: MoNa Thin Films, Pulsed DC Magnetron Sputtering, Electrical Property.

Optimization of Oxygen-plasma Treatment to Enhance Raman Signal on Ag Nanorod-SERS Substrate

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Abstract

In this work, the increasing efficiency of Ag nanorod-surface enhanced Raman scattering (SERS) substrate by physical vapor deposition with glancing angle deposition and surface modification by oxygen plasma treatment was investigated. The conditions of the oxygen-plasma treatment process were optimized to obtain the highest Raman signal including the power of light, exposure time and operating pressure. The field emission scanning electron microscope (FE-SEM) and Raman spectrometer were used to characterize the morphology of the surface and the Raman signal from the developed Ag nanorod-SERS substrate. The results showed that the optimal conditions for the oxygen-plasma treatment are 50 W of power, 10 min of exposure time and 2.5 mT of operating pressure which provide increased surface roughness. The oxygen-plasma treated Ag nanorod-SERS substrate is tested with 10-5 M of R6G and provided a higher Raman signal compared to the untreated SERS substrate. The optimization of oxygen plasma parameters will be further investigated to improve the Raman signal.

Keywords: Oxygen-Plasma Treatment, Ag Nanorod, Surface-Enhanced Raman Scattering

Lateral Capillary Interactions of Two-dimensional Self-assembly Aggregates on Liquid Film

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Abstract

Two-dimensional (2D) self-assembly aggregates were produced by floating polystyrene microspheres on a glycerol-water liquid substrate. The 2D aggregated morphologies were classified by the fractal dimension. Lateral capillary interaction in the 2D aggregates was examined which the relevant attractive forces were the van der Waals force, lateral capillary force, and capillary bridging force. The strength of 2D networks was principally dependence on the interparticle forces of this self-assembly aggregates on liquid film. The van der Walls forces were considered as contingent variable involved the aggregation processes. The forces between two similar spheres in air-liquid interface were more attractive than in liquid-liquid interface. The short separation distance and the larger particle size gave higher the van der Waals forces than the long-range distance and the smaller particle size. The lateral capillary force and the capillary bridging force on liquid interfaces had been studied to observe the effect of 2D aggregation. The lateral capillary force was miniscule when the particle size was smaller than approximately 20 µm in diameter. In addition, the calculation obtained from the study of capillary forces indicated that the capillary-bridge force between two particle spheres depended on the particle size. This force between similar particles was greater than the van der Waals force and the lateral capillary force. The lateral capillary interaction in this study was less than 1 kT, which was much smaller than the calculated van der Waals interactions. Thus, less significant relationship of the lateral capillary interaction appeared between small particles. In conclusion, the capillary bridging force was too large compared to the van der Waals force.

Keywords: Lateral Capillary Interactions, 2D Self-Assembly Aggregate, Capillary Bridging Force, Air-Liquid Interface, Liquid Film.

Materials for Health Science

Effects of Ag-doped Content on Antimicrobial Activity and Substrate Color of Chromium Thin Films Deposited by DC Magnetron Sputtering

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Abstract

Silver ions (Ag+) have promising as an excellent antimicrobial agent to inhibit microbial growth on sanitary metal ware. In this study, different Ag-doped chromium thin films have been deposited on nickel-plated brass substrates by DC magnetron sputtering technique. This technique is suitable for metal film coating with high deposition rate and scalable to mass production. The different Ag-doped films were the atomic ratio of 6%, 8%, 10% and 13% by confirming with the energy dispersive electron spectroscopy measurement. The sputtering condition is a sputtering power of 100W, a gas pressure of 1.1*10-2 mbar and sputtering time of 15 mins. The Ag-doped chromium thin films were capable to deliver Ag+ ions into bacterial cell and contribute to Reactive oxygen species (ROS) activity in bacteria's cell. The antimicrobial activity and efficacy were determined by standard testing (JIS Z 2801: 2000). The antibacterial performance was calculated from %inhibition antibacterial of Ag+ ions in the bacterial solution (S.aureus and E.coli) during 24 hrs. The results show that the Ag-doped chromium with 10%, has inhibition efficiency of 99.98% (E.coli) and 96.33% (S.aureus). The water contact angle testing showed hydrophobic behavior with the angle over than 90 degrees. The optical color of the Ag-doped films was characterized by UV-Vis spectroscopy (CIE testing). The film colors have significant changed as the ratio of Ag doping is increased. The total color difference (ΔE) was 16 – 20 positive away from reference substrate and the Ag doping mainly impacted to +L* (Lightness).

Analysis of Asbestos Contamination Found in Talc Powder Products Marketed in Thailand Using X-ray and Infrared Spectroscopies

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Abstract

It is reported that talc powder contributes to being contaminated with asbestos fibers, which influence certain types of diseases such as asbestosis and mesothelioma. Commercial products such as cosmetics, pharmaceuticals, paints, plastics, papers, and construction materials contain talc powder. Talc is used by the personal care industry in talcum powder as an adsorbent or deodorant for diaper rash prevention by the cosmetic industry in other types of powders and blushes. Moreover, it is also used primarily in pharmaceutical industry as a glidant to improve powder flow in tablet compression. In this work, samplings of commercial cosmetic and pharmaceutical talc powder are selected from various products marketed in Thailand. Their microstructure and chemical composition are characterized using scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy (SEM-EDS) and proton-induced X-ray emission spectroscopy (PIXE). The like-asbestos structure is present in some samples. Silica and magnesia are the major components in the form of functional groups corresponding to the absorption band in the range of 3700 – 3600 cm^{-1} confirmed by IR spectra. Iron oxide, calcite, alumina, potash, and soda also have found in some samples. It is also suggested that there are possible some samples that have asbestos contamination.

Keywords: Talc, Asbestos, Cosmetics, Pharmaceuticals.

Nano-Materials and Applications

Flexible Bacterial Cellulose – Titania Nanotubes Composite for Wireless Motion Sensor

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Abstract

Wireless applications have been constantly developed to meet the needs of consumers for convenience. This research focuses on developing wireless sensors based on environmentally friendly materials that can be used in daily life as motion sensor. Herein, bacterial cellulose (BC) and titania nanotubes (TNTs) composites were prepared with TNTs loading of 0.5%, 3%, and 10%. The morphology and structure of composited films were analyzed by scanning electron microscope (SEM) and X-ray diffraction (XRD), respectively. It is found that BC nanofibers served as the matrix while TNTs were dispersed on the surface. This is accompanied by the preservation in crystal structure of both components. We applied the composites as a wireless sensor which were incorporated onto a glove to detect the finger movement via change of the resistance. Three Kirigami patterns were investigated, with the optimized one showing resistance of 47 ohm. The dielectric properties and the performance of wireless sensors were also evaluated. The sensors made of 10%TNT/BC showed the sensitivity of 183.48, %accuracy of 97.63%, and %stability of 44.04%.

Keywords: Wireless Application, Wireless Sensor, Bacterial Cellulose, Titanium Dioxide Nanotubes, Kirigami.

The Effect of Annealing Treatment on WO_3 Thin Film Prepared by Reactive DC Magnetron Sputtering for Photo-electrochemical Water Splitting Application

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Abstract

In this work, the WO_3 thin films were fabricated by reactive DC magnetron sputtering, and thermal annealed at 400 °C for 2 h under air, high vacuum and low vacuum. After annealed treatments, the morphology and crystallinity of WO_3 thin film were observed using FE-SEM, GI-XRD and Raman spectroscopy. The optical properties were analyzed by UV-Vis spectroscopy. The results showed the decreasing of film thickness at different annealing condition. In addition, it was also affected the crystalline structure at diffraction plans (200) and (002). The transmittance of WO_3 thin films revealed that the annealing treatment at high vacuum led to the lower transparency. Furthermore, the WO_3 thin film annealed under air presented the highest performance of PEC efficiency. Therefore, this approach could an alternative strategy for photoelectrochemical (PEC) water splitting application.

Keywords: WO_3 Thin Film, DC Magnetron Sputtering, Photoelectrochemical Water Splitting.

Surface Modification on ZnO Nanorod as a Template Substrate for ELISA Technique and Dengue Virus Detection Application

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Abstract

Rapid detection and screening of Dengue virus (DENV) by portable devices for early diagnosis of infectious diseases are essential for clinical care, surveillance activities, and outbreak control. Effective detection of dengue virus based on Enzyme-linked immunosorbent assay (ELISA) has played a major role in the protection of people from dengue shock syndrome. However, the ELISA method necessitates a high antigen concentration, which is the last stage of dengue infection and it also necessitates the use of qualified professionals. These drawbacks limit the accessibility and usability of quantitative diagnostics. The antibody-capture area of dengue virus detection based on ELISA was enhanced by integrating with Nanostructure e.g., ZnO nanorods. Nevertheless, the difference between organic-inorganic bonding affects the antibody conjugation on ZnO nanorods substrate, which influences the performance of ELISA. In this work, 3-glycidyloxypropyl trimethoxysilane (GPTMS) was modified on the ZnO nanorod surface by using the liquid-phase silanization method. The Fourier transform infrared (FT-IR) spectroscopy was employed for chemical bonding observation of GPTMS on ZnO nanorod. The result shows that the transmission broad band of GPTMS represents around 1087, 2829, and 2947 cm^{-1}, which confirm antibody can be conjugated on ZnO nanorod. The functionalization and antibody conjugate on the ZnO nanorod surface was characterized by sandwich structure ELISA. The sensitivity of a fluorescence immunoassay is directly affected by GPTMS binding and the surface-to-volume ratio of a GPTMS modified ZnO nanorod as compared to a flat surface. These results suggest that employing GPTMS functionalized on the surface of a ZnO nanorod can improve the ELISA detection performance.

Keywords: ZnO Nanorods, Dengue Virus, Enzyme-Linked Immunosorbent Assay, Fluorescence Immunoassay

Hydrothermal Fabrication of Nanosheets on Electrospun Titanium Dioxide Nanofibers

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Abstract

TiO_2 nanofibers were fabricated using electrospinning using titanium (IV) butoxide and poly(vinylpyrrolidone) (PVP) as a precursor and an assistant polymer, respectively. The concentration of PVP was studied to improve fiber formation. Calcination was performed to eliminate PVP from the as-spun fibers and form TiO_2 nanofibers. Ammonia-assisted hydrothermal was used to fabricate TiO_2 nanosheets on the obtained electrospun TiO_2 nanofibers. The hydrothermal temperature was varied from 100 °C to 160 °C. Field emission-scanning electron microscopy (FESEM) and N_2 adsorption (analyzed by the Brunauer-Emmett-Teller (BET) method) were used to investigate the morphological appearance and surface area of TiO_2 nanosheets. It was found that the morphology of TiO_2 nanosheets is influenced by the heat treatment temperature and TiO_2 nanofibers with TiO_2 nanosheets have larger surface areas compared with pristine electrospun TiO_2 nanofibers.

Keywords: TiO_2, Nanofibers, Nanosheets, Electrospinning, Hydrothermal.

Comparison of TOPSIS, ARAS and MOORA MCDM Techniques in Optimization of Photochemical Machining Process

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Abstract

Greater geometric and dimensional accuracy and better surface finish are the two crucial advantages offered by the Non-Traditional Machining (NTM) over the traditional processes. Photo Chemical Machining (PCM) is a NTM process that employs chemical etching for material removal. The applications of PCM is mostly for machining of microchannels in pharmaceutical industries, chemical industries, energy industry etc. Numerous input parameters like concentration of etchant, etching time, etchant temperature significantly affect the quality and efficiency of the machining and hence it is important that the process is optimized. Current work presents comparison of three MCDM techniques viz. TOPSIS, ARAS and MOORA to optimize the PCM process for better Material Removal Rate (MRR), Surface Roughness (SR), Undercut (Uc) and etch factor (EF). Weight of the criteria was calculated using CRITIC technique. MRR and EF are considered as beneficial criteria while SR and Uc are considered to be cost criteria. Optimum process parameters were identified to be 850 g/l Concentration of the etchant, 40 min etching time and 70 ^{0}C etchant temperature using two of the three MCDM techniques used. Also, strong correlation among the employed MCDM techniques was observed validating the results.

Keywords: Photochemical Machining, MCDM, TOPSIS, MOORA, ARAS, Non-Traditional Machining

Functional Magnetic Polymeric Nanoparticles and Their Applications in Medical and Industrial Applications

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Abstract

Magnetic polymeric nanoparticles (MPNPs), a cluster of superparamagnetic iron oxide nanoparticles (SPIONPs) embedded into a block copolymer of poly(styrene$_{27}$-*b*-acrylic acid$_{120}$) particle, were prepared *via* a facile chemically mild method. By controlling the type of solvent used for SPIONPs, the balance between the magnetic loading at a weight fraction and the polymer contents promoted the formation of well-defined MPNPs, while achieving high magnetic loading. Without the use of a surfactant or cross-linking agent, high stability of MPNPs in an aqueous medium was achieved from the contribution of long hydrophilic polyelectrolyte brush blocks containing carboxylic groups. The as-prepared MPNPs have high potential to use in different fields of medical and industrial applications. For medical applications, the MPNPs are highly responsive to an external magnetic field and can efficiently generate heat under the application of an alternating magnetic field due to high SPIONPs loading, monodispersity, and high stability. In other direction of industrial applications, the MPNPs acted as a nanosorbent for Ca^{2+} removal. Based on the electrostatic interactions between the negatively-charged polymer and the hydrated Ca2+, the resulting precipitation leads to the prevention of $CaCO_3$ (scale) formation. The as-prepared nanosorbent can be effectively reused for up to 4 cycles.

Keywords: Magnetic Polymeric Nanoparticles, Magnetic Hyperthermia Cancer Therapy, Reusable Scale Inhibitor

Direct Fabrication of Carbon Nanotube Wirings on Plastic Films Using a Laser Thermal Transfer Method

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Abstract

Carbon nanotubes (CNTs) are expected to be applied to flexible devices as next-generation wiring due to their excellent electrical properties [1]. However, most flexible substrates are not suitable for CNT growth processes with high temperatures, such as chemical vapor deposition (CVD) methods [2]. Therefore, development of CNT wiring methods using non-vacuum soft processes are needed. Researchers have developed methods of fabricating CNT wirings on plastics directly using soft processes. One of the processes is a thermal fusion of CNTs and plastics such as polyethylene and polypropylene (PP) [3]. However, in previous method, because CNTs from areas that were not heated cannot be reused, a large amount of CNTs is wasted.

We have developed a laser thermal transfer method that can directly draw multi-walled CNT (MWNT) wiring on plastic films in air and at RT. In this method, (1) MWNT/PP films is irradiated by a laser, (2) the temperature of the irradiated region is steeply increased, then (3) electrical conductive MWNT/PP composites can be formed. This method allows us to reuse MWNTs effectively because MWNT on almost entire areas expect for the irradiated region can be recovered.

In this study, we investigated the correlation between irradiation conditions of the laser (power and scanning speed) and the properties of MWNT wirings (the conductivity and line width). MWNT thin film was obtained by spraying MWNT dispersion solution (Meijo NanoCarbon, MW-I) on PP film. The MWNT thin film was then locally heated by irradiating a CW laser (405 nm wavelength) and the MWNT thin film was transferred to the PP surface. Typical scanning speed is 1-10 mm/s, and the injection current to the laser is 70-90 mA. The MWNTs were then immersed in deionized water for 15 min and sonicated to remove CNTs from areas that were not heated by the laser. Electrical characteristics of the fabricated MWNT wiring were measured, and it was found that resistance decreased with decreasing processing speed and increasing laser power. The minimum resistance was 37 kΩ/cm^2. In this presentation, we will discuss the microstructure and the electrical conduction mechanism of CNT wiring on PP films.

Keywords: Carbon Nanotube, Electrical Wiring, Plastic Films, Laser.

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Improvement of Output Power of Triboelectric Generators by Adding TiO_2 Particles into PDMS Films

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Abstract

The construction of an Internet of Things (IoT) infrastructure requires a large number of sensors. Energy harvesting, in which electricity is generated from unused energy in the environment, attracts attention as a sensor power source [1]. Among these, triboelectric devices, which are extremely simple in structure, can generate power through vibration and friction and achieve a power density (94 $\mu W/cm^3$)[2] equivalent to or higher than conventional vibration generators. On the other hand, triboelectric generators have low output power.

In principle, the output voltage depends on the capacitance of dielectric film, which is charged by contacting hetero materials. One of the methods to increase the capacitance is the increase of the dielectric constant of the film. For example, adding high-k materials such as TiO_2 particles into the dielectric film effectively increases the dielectric constant. In this study, we added TiO_2 particles into polydimethylsiloxane (PDMS) films, which is the dielectric film, to increase the capacitance. In addition, negative surface charges were fixed on the film to boost the output power.

We fabricated TiO_2/PDMS hybrid films. First, the hybrid gel was fabricated by mixing PDMS (SILPOT 184) gel with TiO_2 microparticles (FUJIFILM Wako Pure Chemicals Corporation, CAS RN®: 1317-80-2). We prepared various gels with different TiO_2 concentrations. Second, the gel was poured into a mold. Finally, the hybrid film was peeled from the mold after drying. The size of the resultant film was 50 mm x 50 mm x 0.5 mm. We characterized the electrical and geometrical properties of the films were characterized by scanning electron microscope (SEM) and LCR meter, respectively. The power generation properties were characterized using a hand-made system with an Al plate as the counter electrode.

SEM observation of the mixed film revealed that TiO_2 particles were uniformly dispersed in the PDMS film. The capacitances of the hybrid films were increased by increasing the TiO_2 content. We investigated the correlation between the TiO_2 content and the output voltage. The output voltage of the composite film increased as the volume ratio of TiO_2 increased and decreased when the volume ratio of TiO_2 exceeded 4.5 vol%. In addition, by adding negative charges into the hybrid film, the output voltages were increased. The maximum output voltage was 35 V when the volume ratio of TiO_2 was 4.5 vol%.

Keywords: Triboelectric Generators, High-permittivity Nanoparticles, Polydimethylsiloxane, Titanium Dioxide, Composite Film.

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Modification of SiO_2–TiO_2 Nanocomposite by Sonochemical Process for the Possibility in Self-cleaning Application

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Abstract

This research aims to study self-cleaning property for removing atmosphere pollutants on the substrate surface. Thus, the modification in nanocomposite material for self-cleaning property is an important challenge these days. Nanocomposite material in this work is focused on SiO_2-TiO_2 materials that synthesized with the precursors of tetraethyl orthosilicate and titanium isopropoxide by sonochemical process based on a crucial parameter of different amount of titanium ratios in SiO_2 matrix. The ratios of Si:Ti precursor were varied at 1:0.1, 1:0.3, 1:0.5, 1:0.7 and 1:1. The absorption and diffuse reflection properties of SiO_2-TiO_2 nanocomposite material were analyzed by UV-VIS-NIR spectrophotometer. Meanwhile, structural phase of SiO_2-TiO_2 nanocomposite powder was detected by X-ray diffraction technique (XRD). Chemical bonding structure in SiO_2-TiO_2 nanocomposite was analyzed by (Fourier Transform Infrared Spectrophotometer). After that, the products of SiO_2-TiO_2 nanocomposite with different Ti ratios were mixed with TES 40 WN solution and deposited on glass slides substrate by spray coating to study its hydrophilic property by contact angle method. Surface morphology of SiO_2-TiO_2 nanocomposite films was monitored by Field emission scanning electron microscope (FE-SEM). Meanwhile, the photocatalytic activity of SiO_2-TiO_2 nanocomposite films was evaluated by using aqueous methylene blue as a model atmosphere pollutant. The preliminary result confirmed that SiO_2-TiO_2 product was in form of composite powder. The contact angle of SiO_2-TiO_2 nanocomposite film was reduced with different Ti ratio in SiO_2 matrix resulting to the development of hydrophilic surface on substrate. The influence of Ti in SiO_2 matrix on self-cleaning and photocatalytic property will be improved and further discussed its mechanism.

Keywords: Nanocomposite, Hydrophilic Surfaces, Self-Cleaning, SiO_2-TiO_2**.**

Preparation of Titanium Oxide Nanoparticles Film by Air-compressed Spray Method for Supercapacitor Devices

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Abstract

In this work, the titanium dioxide (TiO_2) nanoparticles films were prepared from commercial Degussa P25-TiO_2 nanoparticles by air-compressed spray method. The properties of the prepared films were characterized by X-ray diffraction, FTIR, Raman spectroscopy, and scanning electron microscope, respectively. In addition, the prepared TiO_2 film on a metal substrate was used to fabricate the electrode of the electrochemical supercapacitor device. The electrochemical storage performance of the fabricated device was obtained by cyclic voltammetry measurement in aqueous 1 M Na_2SO_4 with an Ag/AgCl reference electrode and a platinum counter electrode. The optimum specific capacitance of the fabricated device was found at 3.014 F/g at a scan rate of 50 mV/second.

Keywords: Titanium Dioxide, TiO_2, Supercapacitor, Spray Deposition.

Behavior of PS-ZnO Thin Film Composite on Gold Layer Substrate

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Abstract

This research aimed to study the dewetting behavior of PS-ZnO thin film on silicon substrate coated by gold layer. Because an adhesion between PS thin film and silicon substrate surface is not good, heated or used PS thin film will spread out from the silicon substrate. Gold thin film, with thickness of 10 – 50 nm, fabricated by sputtering technique were added in between the PS/PS-ZnO and silicon interfaces to improve their adhesion property. There are many advantages of gold thin film due to their flexibility, malleability, strength, inertness to oxidation, and ability to conduct electricity and thermal energy. For example, gold film is sensitive to changes in the surrounding environment, making it a good platform for sensing and biosensing applications. In this research, the effects of gold layer thickness on dewetting inhibition of PS/PS-ZnO thin film were investigated. Spin-coating technique was used to create PS/PS-ZnO thin film. All surface energies were calculated by using contact angle values measured by contact angle machine. Dewetting behavior of PS/PS-ZnO thin films were induced by heating the films in vacuum oven. Optical microscope, scanning electron microscope, and atomic force microscope were used to observe the film transformation. From the results, interface modification with gold layer reveals a well-adhesion between PS/PS-ZnO thin film and silicon substrate surface. The films can suppress dewetting behavior after heating at 150 ºC for 12 hr. At that condition, the PS thin film coated on 10 nm gold layer shows the first state of dewetting, however; the PS-ZnO thin film presents a smooth surface.

Keywords: Dewetting, Thin Film Adhesion, Gold Thin Film, Polystyrene Thin Film, ZnO Additive.

Photocatalytic and Anti-bacteria Activity of Ag Nanoparticle/ZnO Composite

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Abstract

This research focuses on photocatalytic and antibacterial activities study of silver nanoparticles and zinc oxide composites prepared by a simple process. Silver Nitrate ($AgNO_3$) was used as starting precursor for the synthesis of Ag nanoparticles by a simple chemical process. The concentration of $AgNO_3$ solution was varied whereas the amount of ZnO nanopowder was fixed during the synthesis. The synthesized products with different Ag:ZnO ratios were characterized. Morphological analysis of composite materials was performed using Field Emission Scanning Electron Microscope (FESEM) and the presence of silver nanoparticles and zinc oxide was assessed by Energy Dispersive X-ray Spectrometer (EDAX). The analysis revealed that the silver nanoparticles and zinc oxide composites were morphologically in form of cuboid and rod with average particle size range of 400-600 nm. The crystal structure of the product was investigated by X-ray diffraction and their relevant optical properties were examined using Diffuse Reflectance Spectroscopy. The absorbance spectrum in the range of 400-500 nm due to characteristic surface plasmon resonance absorption of Ag suggests the existence of Ag nanoparticles decorated on ZnO particles. The photocatalytic activity of Ag/ZnO nanocomposite was assessed by decomposition of organic dyes under Xe-lamp irradiation. It was found that the Ag/ZnO nanocomposite starting with 10 ml of $AgNO_3$ exhibited superior performance to bare ZnO and others. The antibacterial abilities of the composite with 10 ml of $AgNO_3$ was also higher than the others. Further details of results and discussion will be represented.

Keywords: Silver Nanoparticles, Zinc Oxide, Composites Material, Photocatalytic Activity, Antibacterial Activity

Synthesis and Deposion of ZnO Nanoparticles on Polyester Textile in Automotive Applications

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Abstract

This project investigates the synthesis of zinc oxide nanoparticles by hydrothermal process and deposition onto polyester textile in automotive applications. This research was separated into 3 sectors. In the first section presents the synthesis of zinc oxide nanoparticle under zinc acetate precursor and various 3 different precipitant agents including: potassium hydroxide (KOH), sodium hydroxide (NaOH) and ammonium hydroxide (NH4OH), respectively. The effects of precipitant agents on size and morphology was investigated by Field Emission Scanning Microscope (FE SEM). For the ZnO characteristic were analyzed by X-ray diffraction (XRD), Fourier Transforms Infrared Spectroscopy (FTIR) and Raman spectroscopy techniques. The second section study the effect of zinc oxide nanoparticle to inhibit bacteria. The antibacterial activity of zinc oxide nanoparticle was examined by determining the inhibition zone via disc diffusion technique. The last section consider of synthesis zinc oxide nanoparticles with zinc acetate precursor and NaOH precipitant at concentration of 0.7 mg/ml by deposition on polyester textile with various dipping time at 15, 30, 45, 60, 75 and 90 minutes, respectively. The antibacterial, roughness and hydrophobic properties were studied by disc diffusion and contact angle techniques. From this result, ZnO nanoparticles also capable to antibacterial on polyester textile by dipping at optimum time with PDMS solution.

Keywords: Synthesis, Deposition, ZnO nanoparticles, Polyester, Textile.

Multi Self-cleaning Properties of Zinc Oxide Nanoparticles/Polydimethylsiloxane (ZnO/PDMS) Composite on Polyester Textile

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Abstract

Self-cleaning textile can be divided in to three categories that are physical, chemical, and biological self-cleaning. The physical self-cleaning is refer to lotus effect that relate with hydrophobic property. The chemical self-cleaning presents the degradation of color stain and other organic species or discoloration of solutions in contact with textile. The last isthe biological self-cleaning means an ability to antibacterial and kill their attached on the textiles. In this research focus on development all three self-cleaning properties on polyester textile by Zinc oxide nanoparticles/polydimethylsiloxane (ZnO/PDMS) composite. The ZnO nanoparticles was synthesized by hydrothermal process that blend with PDMS under various the concentration of ZnO nanoparticles. The polyester textile was coated by ZnO/PDMS composite solution via dip coating technique with different dipping time. The lotus effect that is dealing with roughness and hydrophobic properties were analyzed by Atomic Force Microscope (AFM) and water contact angle measurement, respectively. The chemical self-cleaning of polyester textile was examnined by photocatalytic methylene blue dye degradation with UV-Vis spectrometer. The inhibition zone of antibacterial activity was tested via disc diffusion technique. From this result was found that the polyester textile was coated by ZnO/PDMS composite can be significantly showed all of self-cleaning properties: physical, chemical and biological.

Keywords: Self-Cleaning, ZnO/PDMS, Polyester, Textile, Composite.

Enhanced Dielectric Properties of Natural Rubber Composites Filled with Chitin Nanofibers

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Abstract

Natural rubber (NR) is a promising materials as flexible polymeric matrix with its high elasticity, high tensile strength, low dielectric loss which moreover is less affected by frequency and temperature, but the low dielectric constant limits its practical application in high-performance electronic devices. Therefore, the development of NR composites for enhanced dielectric constant is highly desirable. In this study, the enhancement of dielectric properties of NR was studied by using NR and chitin nanofiber derived from shrimp shell composites (NR/CNF). NR were filled with CNF at various loading level from 1 - 20 wt%. Dielectric parameters such as dielectric constant and loss factor increases on increase in CNF. The dielectric constant at 10^5 Hz of the NR composites filled with 20 wt% CNF reached 3.83, which was 2 times of that of pure NR, because of the simultaneously improved interfacial and dipole polarizability. This work provides a simple and nontoxic method to prepare a sustainable natural hybrid filler and explore its novel application.

Keywords: Natural Rubber, Chitin Nanofiber, Composites, Dielectric.

Study of Ytterbium Dopant in Bismuth Vanadate Nanophotocatalyst on Antibacterial Property under Visible Light Irradiation

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Abstract

In this work, antibacterial property was investigated by the inhibition of antimicrobial activity against *Escherichia coli (E. coli)* and *Streptococcus aureus (S.aureus)* (Gram-negative and Gram-positive bacterial pathogen) by ytterbium doped bismuth vanadate (Yb doped $BiVO_4$) photocatalyst under visible light irradiation. The amount of Yb dopant in $BiVO_4$ was varied at 0, 1, 3 and 5% synthesized by sonochemical process. The crystalline structure of the samples was investigated by X-ray diffractometer (XRD) and shown in the presence of tetragonal phase by the addition of Yb dopant. Meanwhile, optical property of different Yb loading in $BiVO_4$ was analyzed by diffuse reflectance UV-Vis spectrometer with blue shift to UV region due to phase change structure from monoclinic to tetragonal phase comparing with bare $BiVO_4$ sample. For antimicrobial activity, the optimized concentration of pure $BiVO_4$ photocatalyst was firstly studied as 0, 5, 10 and 20 mg/ml in DI water. The optimized $BiVO_4$ concentration at 20 mg/ml showed the highest photocatalytic reaction for antibacterial activity. Therefore, the influence of Yb-doped $BiVO_4$ photocatalyst on antibacterial activity was conducted at 20 mg/ml for 4, 6 and 8 hours under visible light irradiation. The antibacterial activity can be significantly enhanced by the presence of Yb in $BiVO_4$ photocatalyst under visible light irradiation at 6 hours resulting to high efficiency of the bacterial growth inhibition on *E. coli* and *S.aureus*.

Keywords: Antibacterial, Bismuth Vanadate, Photocatalyst, Ytterbium.

Study of Co-magnetron Sputtering Crystalline HfZrN Films on an Unheated Substrate

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Abstract

In this paper, the crystalline HfZrN films were deposited by co-magnetron sputtering without an external heating substrate. The crystalline, morphology and chemical composition of the HfZrN films deposited on a silicon wafer were investigated by x-ray diffraction (XRD), field-emission scanning electron microscopy (FE-SEM), and X-ray photoelectron spectroscopy (XPS) techniques. The dielectric constant was calculated by spectroscopic ellipsometry (SE). From the results, with increasing the sputtering power of Zr cathode, the film thickness and content of Zr in the HfZrN film and film crystalline increase gradually. Finally, X-ray absorption spectroscopy analyzed and discussed the distribution of the nitrogen atom in the HfZrN films.

Keywords: Co-Magnetron Sputtering, HfZrN, Unheated Substrate.

Chemical Sterilization of The Culture Medium for *in vitro* Culture of *Dendrobium* Hybrid Using Biogenic Silver Nanoparticles

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Abstract

Chemical sterilization of plant culture medium using silver nanoparticles is an alternative method besides autoclaving because it is simple and cost-effective. Biosynthesis of silver nanoparticles has gained much attention because it is a facile and environmental-friendly approach with the various biomedical applications. However, the efficiency of using biosynthesized silver nanoparticles (BAgNPs) for decontamination of plant culture medium and phytotoxicity to *Dendrobium* hybrid remains unknown. Therefore, this study aimed to investigate the effect of BAgNPs at different concentrations (0, 0.1, 1, 10, 100 and 1000 mg/L) on culture medium sterilization and to observe the effect of various concentrations of BAgNPs on the growth and antioxidant activity of *Dendrobium* hybrid. The results show that the minimum concentration of BAgNPs at 10 mg/L completely inhibited the contamination from microorganism. The highest fresh weight, dry weight and amount of chlorophyll of *Dendrobium* hybrid were observed at 10 mg/L. Moreover, BAgNP concentration at 10 mg/L showed the highest amount of the total phenolic content and FRAP value at 179.25±1.93 µg GAE/g FW and 3.77±0.02 µg $FeSO_4$/g FW, respectively. The results suggested that the use of BAgNPs at 10 mg/L was the optimum concentration for medium sterilization without the adverse effect on the growth of *Dendrobium* hybrid.

Keywords: Biosynthesis, Chemical Sterilization, Orchid, Phytotoxicity, Silver Nanoparticle.

Optical and Electronic Materials

Improvement of Luminescence Performance by Addition Potassium Fluoride in Li_2O-AlF_3- NaF-P_2O_5 Glass Doped with Eu_2O_3 Content for Efficient Reddish-Orange Applications

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Abstract

One mol % of europium (Eu^{3+}) with the addition of potassium fluoride in Li_2O-AlF_3-NaF-P_2O_5 glass has been prepared using a melt-quenching technique. The physical properties were measured to know the compactness of the glasses. The structural behavior of groups PO_4 and OH group of the glasses was discussed through the FTIR spectra. Using absorption spectra and Judd-Ofelt (J-O) theory, the J-O intensity parameters (Ω_2, Ω_4 and Ω_6) and radiative properties of excited states of Eu^{3+} ions in glasses were calculated. Photoluminescence properties were generated excitation, emission and lifetime for the glasses. It is observed that the enhancement of the Eu^{3+} emission at 613 nm is due to the addition of potassium fluoride. The lifetime associated with the transition from the $^5D_0$ state was proved to be single exponential. The CIE chromaticity diagram was estimated the CIE color coordinates and color purity of the prepared glasses. Under 365 nm, UV lamp was accomplished reddish-orange emissions, which is suitable for reddish-orange applications.

Keywords: Potassium Fluoride, J-O, Luminescence, Phonon Sideband, Color Coordinate

Luminescence Behavior of Sm^{3+} ion Doped Pottasium Aluminium Gadolinium Phosphate Glasses as Orange Laser and Photonics Applications

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Abstract

Potassium aluminium gadolinium phosphate (KAGP) doped with difference concentration of Sm^{3+} ions were synthesized by melt-quenching technique. The samples were further used to measure some physical, optical and luminescence properties. Absorption spectra show the hypersensitive transitions $^6H_{5/2}\rightarrow{}^6P_{3/2}$ and $^6H_{5/2}\rightarrow{}^6F_{7/2}$ at the wavelengths 402 and 1233 nm respectively. The photoluminescence spectra were recorded under 401 nm excitation, displayed the emission bands at 562, 597, 644 and 703 nm that corresponding to the transitions $^4G_{5/2}\rightarrow{}^6H_J$ (J=5/2, 7/2, 9/2, 11/2) respectively, and the concentration quenching of Sm^{3+} showed at 1.0 mol%. Using the highest concentration of Sm^{3+} for emission spectra, Judd-Ofelt (J-O) analysis was performed to calculate the various radiative properties such as transition probabilities (A_R), radiative lifetimes (τ_R), branching ratios (β_R) and stimulated emission cross-section ($\sigma(\lambda_p)$) for different excited states. From the results of J-O parameter found to be $\Omega_2 > \Omega_6 > \Omega_4$ and the highest value of radiative properties was $^4G_{5/2}\rightarrow{}^6H_{7/2}$ transition. The decay curve for lower concentration was single exponential and became non-exponential for higher concentrations of the $^4G_{5/2}$ level. According to the chromaticity coordinates (CIE), it indicated that the KAGP glass doped Sm^{3+} ions at 1.0 mol% lie in orange region. The KAGP glass doped concentration of Sm^{3+} at 1.0 mol% has potential application in developing the orange laser and suitable for optical device also.

Keywords: Luminescence, Phosphate, Samarium, Glass.

White Light Emission and Judd-Ofelt Analysis of Dy^{3+} Doped Mixed Alkali Borate Glass for W-LEDs Material

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Abstract

The Dy^{3+} doped lithium sodium potassium borate glasses with white light-emitting were prepared by the melt quenching technique. In this work, optical, photoluminescence properties and Judd-Ofelt analysis of borate glasses have been investigated. For optical properties, Dy^{3+} doped glasses showed the absorption in visible and near-infrared region which originate from $^6H_{15/2}$ ground state to higher state. While the luminescence properties of Dy^{3+} doped glasses, the emission spectra were presented more intense at 483 nm (blue light) and 574 nm (yellow light) which are essential for white light emitting materials, whilst decay time decrease with an increase of Dy_2O_3 contents. The emission intensity of Dy^{3+} doped glasses were enhanced by adding Dy_2O_3 concentrations until 0.5 mol%, after that the emission intensities were decreased due to the concentration quenching effect. Judd-Ofelt is analyzed by using the absorption and photoluminescence results, The stimulated emission cross-section has been investigated in this work. The CIE 1931 chromaticity investigation shows that Dy^{3+} doped glass emitted light with white color. Hence, these glasses may be suitable candidates for use in W-LEDs material.

Keywords: Alkali Borate Glass, Dysprosium, Judd-Ofelt, White Light Emission.

A Study on Physical and Luminescence Properties of Sm^{3+} ions Doped Li_2O: Al_2O_3: La_2O_3: B_2O_3 Glasses

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Abstract

The $10Li_2O$: $20Al_2O_3$: $10La_2O_3$: $60\text{-}xB_2O_3$: xSm_2O_3 glasses doped with various Sm^{3+} concentration were prepared following melt quenching procedure to study physical and luminescence properties. The results showed that by adding more Sm^{3+} into glass matrices, causes the density and molar volume of glasses increase due to the increasing of NBOs in glass matrices. Refractive index, optical absorption, photoluminescence spectra and lifetime were carried out at room temperature. Absorption spectra indicate photon absorbed light in visible and near infrared regions. From emission spectra with under 402 nm excitation, the strongest emission peak revealed at 598 nm which corresponding to $^4G_{5/2} \rightarrow {}^6H_{7/2}$ characteristic transition level of Sm^{3+}. The optimum doping concentration of Sm^{3+} in lithium aluminium lanthanum borate glass is 0.5 mol%. The investigation result of CIE1931 showed that Sm^{3+} doped glasses emitted light with orange color.

Keywords: Borate Glass, Sm^{3+}, Physical, Luminescence.

Influence of Calcium Fluoride on the Radiative Properties of Sm^{3+} Doped Zinc Borophosphate Glasses

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Abstract

Borophosphate glass containing Calcium Fluoride (CaF_2) doped with Samarium ion 1 mol% concentration. The glass compositions based on $(64\text{-}x)P_2O_5\text{-}5B_2O_3\text{-}15ZnO\text{-}15Li_2O\text{-}xX\text{-}1Sm_2O_3$ (x = 0 & 15 ; X = Ca) are prepared by melting and quenched technique. The optical and photoluminescence were obtained from the UV-Vis-NIR spectrophotometer and spectrofluorophotometer. The ground state $^6H_{5/2}$ as the start transition in the absorption spectrum and the Judd-Ofelt intensity parameters (Ω_2, Ω_4, and Ω_6) were determined. The emission spectra of borophosphate glass with CaF_2 were recorded at an excitation of 401 nm which gave four peaks namely $^6H_{5/2}$, $^6H_{7/2}$, $^6H_{9/2}$, and $^6H_{11/2}$. The results of radiative properties for the $^4G_{5/2} \rightarrow {}^6H_{7/2}$ transition were found to be higher in the zinc borophosphate glass containing CaF_2. Based on these results, zinc borophosphate glass containing CaF_2 can be used as a candidate for the orange laser application.

Keywords: Zinc Borophosphate, Absorption, Photouminescence, Radiative.

Investigation of Manganese Oxide (Mn_2O) Doped in Calcium Sodium Borosilicate Glasses for Photonics Materials Application

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Abstract

In this work, MnO_2 doped in calcium sodium borosilicate (CNBS) glasses were investigate. The glass samples doped MnO_2 concentration (where x = 0.00, 0.05, 0.10, 0.50, 1.00 and 2.00 mol%) were synthesized by melt quenching method. The structural and optical characteristics of glass samples via FTIR, XRD, optical absorption, and photoluminescence were studied and discussed. The X-ray diffraction spectra of CNBS glasses are shown no sharp peaks are observed in the spectra which indicate the amorphous nature of the glasses. The optical absorption in the UV-Vis region shown broad absorption band around 470 nm. The intensity band of absorption spectra increase with increasing MnO_2 concentration. The luminescence properties were measured carried out using Cary Eclipse Fluorescence spectrophotometer.

Keywords: Glasses, Manganese Oxide, Luminescence, Borosilicate.

X-ray Source Using Pyroelectric Crystals under UV Laser Irradiation

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Abstract

Pyroelectric crystals such as lithium niobate ($LiNbO_3$) and lithium tantalite ($LiTaO_3$) have spontaneous polarization which varies with temperature. The surface polarization charge of the crystal is usually screened by the free charges that accumulate on the surface at equilibrium. The change in polarization of the crystal due to the temperature change generates a high electric field, resulting in emitting energetic electrons without external voltage when the crystals are heated or cooled. X-ray sources have been reported as applications of the electron emission from pyroelectric crystals. One of the X-ray sources using a pyroelectric crystal excited by a Peltier device is commercialized. The use of a Peltier device, however, has problems. It requires an electric wire, the response is slow due to its heat capacity, thus downsizing is difficult. To remove a Peltier device, Nakahama et al. irradiated an contentious infrared laser (CW Nd:YLF) on the graphite layer coated on the crystal. However, in X-ray sources using an IR laser, the response is also slow, because it takes a time that the temperature of the crystal rises up. In this paper, we excited a $LiNbO_3$ crystal with pulse UV laser light (the wavelength of 266 nm) in the vacuum. Electrons emitted from the $LiNbO_3$ crystal collided with a Cu target and generated X-ray. The X-ray source is a compact and does not require any external voltage. Temperature of the LiNbO3 crystal does not rise in during UV laser irradiation. This phenomenon is novel one in X-ray generation using pyroelectric crystals.

Keywords: X-ray Generation, Pyroelectric Crystal, UV Laser Light, $LiNbO_3$

Giant Dielectric Properties of (Sn/Ta) Co-doped TiO_2 Ceramics

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Abstract

The (Sn/Ta) co-doped TiO_2 have been synthesized by a solid-state reaction method. Crystal structure, microstructure, electrical, and giant dielectric properties were systematically investigated. The mean grain size was slightly reduced. The dielectric constant (ε′) reduced as the doping content increased, whereas the dielectric loss (tanδ) was decreased. The semiconducting grain resistance slightly changed, whereas the insulating grain boundary resistance significantly enhanced, resulting in an improved dielectric response. The low tanδ and high ε′ were well described by the internal barrier layer capacitor (IBLC) model.

Keywords: TiO_2; Giant/Colossal Permittivity; Co–Dopant; Grain Boundary; IBLC.

Investigation on Optically Ultraviolet Response of Low-Dimensional ZnO Structures Prepared by Chemical Processes

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Abstract

Zinc oxide is a semiconductive material that has exceptional optical and electrical properties with wide bandgap energy of 3.37 eV and high binding energy of 60 meV that make ZnO a potential candidate for application in optoelectronics. Ultraviolet light has spectrum range that is near the bandgap energy of ZnO is considered to be suitable for exciting ZnO. A low dimensional nanostructure is an important key to tuning property of semiconductor because of quantum size effect to change density of state in the same semiconductor. In this work we have investigated low-dimensional ZnO structures including ZnO thin film representing two-dimensional structure, ZnO nanorod representing one-dimensional structure and ZnO nanoparticle representing zero-dimensional structure. All of the above ZnO structures were prepared by chemical processes. ZnO thin film was prepared by sol-gel spin coating method while ZnO nanorod was fabricated by hydrothermal process and ZnO nanoparticle was synthesized via co-precipitation route. Comparison study on photo response properties of all structures was conducted under ultraviolet light with wavelength 365 nm. The crucial factors including active surface area per volume, interaction in low-dimensional structures and specific properties in each structure are considered to play key role on optical ultraviolet response.

Keywords: Zinc Oxide, Low-Dimensional Structure, ZnO Thin Film, ZnO Nanorod, ZnO Nanoparticle.

Preparation and Characterization of Ag Nanoparticle/SiO_2 Composite for Optical Application

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Abstract

A facile method to fabricate volumetric light-guide plate (LGP) by micro-nanostructure of Ag/SiO_2 composite was presented in this study. The Ag nanoparticle/SiO_2 composite were first prepared from a mixture of yellowish-brown Ag nanoparticle colloids and SiO_2 powder by electrostatic self-assembly method and examined its physical and chemical properties by scanning electron microscopy (SEM) and Energy dispersive X-ray spectroscopy (EDX). The small particles (Ag/SiO_2 composite) in the LGP could produce multiple scattering effect with different size of micro-nanoparticles, which improved the light-scattering performance of the LGP. The effective light scattering of the material into LGP was obtained from the increased amount of the particles. Meanwhile, surface plasmon resonance effect of Ag also improved the optical properties of the LGP, which could be further applied to process with micro-nano components to design device in optical application. In additional, optical properties and light scattering mechanism of the Ag nanoparticle/SiO_2 composite in the LGP was discussed and presented.

Keywords: Light Scattering Particles, SiO_2 Powder, Silver Nanoparticle, Surface Plasmon Resonance, Light-Guide Plate.

Preparation of Sm^{3+}-doped Na_2O-B_2O_3-CaO-SiO_2 Glass from Eggshell Wastes

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Abstract

In this research, calcium carbonate from waste eggshells was used to produce the soda-lime borosilicate glasses (Na_2O-B_2O_3-CaO-SiO_2) doped with samarium ions (Sm^{3+}) in different concentrations of Sm_2O_3 (0, 0.1, 0.2, 0.3, 0.4 and 0.5 mol%). A conventional melt-quenching method at 1,100 °C for 3 hours was applied in this work to produce the glass samples. The samples were then characterized by using XRD, DTA, FE-SEM, FT-IR, Raman spectroscopy, UV-Vis spectrophotometer and PL techniques. The results showed that the obtained glasses had amorphous structure, and the glass density tends to increase with the addition of Sm_2O_3 concentration. The FTIR spectra on the main glass structure illustrated the composition of the trigonal BO_3 and tetrahedral BO_4 borate groups mixing with SiO_4 tetrahedra with non-bridging oxygen. The addition of samarium ions was found to improve the light absorption at 403 nm (6H5/2→ 6P3/2), and, as a result, to enhance the emission intensity at 562 nm (4G5/2→ 6H5/2), 600 nm (4G5/2→ 6H7/2), 646 nm (4G5/2→ 6H9/2) and 708 nm (4G5/2→ 6H11/2), denoted for orange emission. The result confirmed that 0.3 mol% Sm_2O_3-doped glass exhibited the highest emission intensity, which suggested a high potential for using as an efficient luminescent and environmentally-friendly glass for the use of optical electronics materials.

Keywords: Soda-Lime Borosilicate Glass, Eggshell Waste, Luminescent Glass, Samarium, Photoluminescence.

Development of Eu^{3+}-doped Oxyfluoride Glass for Active Laser Medium

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Abstract

In this research, Eu^{3+}-doped barium sodium borate oxide and oxyfluoride glasses were prepared by melt-quenching technique and investigated their physical, optical and photoluminescence properties, such as density, molar volume, refractive index, absorption spectra, excitation spectra, emission spectra and luminescence decay time. The emission spectra under 394 nm, showed the emission bands centered at 590, 613, 652 and 700 nm, corresponding to the $^5D_0 \rightarrow {}^7F_1$, $^7F_2$, $^7F_3$ and $^7F_4$ transitions, respectively. The luminescence decay times were found to be 1.843 ms for oxide glass sample and 1.893 ms for oxyfluoride glass sample. The color coordinates of the emitted light for both glass samples were found to be (0.65, 0.35) in the CIE 1931 chromaticity diagram, located in reddish orange region. The result show that the emission intensity of the oxyfluoride glass sample is higher than the oxide glass sample because the oxyfluoride glass owns less non-radiative transitions than the oxide glass. Judd-Ofelt theory was evaluated in this work for analyze the radiative properties and found that the glass samples have the ability for using as the active laser medium.

Keywords: Borate Glass, Europium, Photoluminescence, Judd-Ofelt.

Effect of Microwave-Assisted Heat Treatment on the Structural, Electrical and Thermoelectric Properties of Flexible Sb_2Te_3 Films Prepared by DC Magnetron Sputtering

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Abstract

Flexible Antimony telluride (Sb_2Te_3) thin films were coated on polyimide substrate by DC magnetron sputtering using an alloy 99.9% Sb_2Te_3 target. The effects of microwave-assisted heat treatment at various temperatures 473, 523, 573, and 623 K for 1 min under N_2 atmosphere on the [Sb]:[Te] ratio, structural, surface morphology, electrical, and thermoelectric properties were studied. The [Sb]:[Te] ratio of flexible Sb_2Te_3 film was determined by energy dispersive spectrometry (EDS). EDS analysis revealed that the Te ratio was slightly decreased when heat treatment increased. The crystal structure and surface morphology of flexible films were characterized by x-ray diffraction (XRD) and a field emission scanning electron microscope (FE-SEM), respectively. All samples are confirmed the polycrystalline Sb_2Te_3 with a hexagonal structure. The crystallinity is heightened by the heat treatment process. Electrical transport properties were measured by Hall effect measurements. The Seebeck coefficient and electrical conductivity were simultaneously measured at room temperature by a DC four-terminal method (ZEM-3). The results indicated that the microwave heat treatment can enhance the electrical conductivity and Seebeck coefficient of the flexible films leading to reaching a maximum power factor of 1.71 mW/K^2m, which is annealed at 523 K.

Keywords: Flexible Sb_2Te_3, Microwave-Assisted, Heat Treatment, DC Magnetron Sputtering

Development of Au Nanostructure by Colloidal Lithography for Plasmonic Sensing Applications

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Abstract

Herein, we describe the cost-effective method to prepare well-defined gold (Au) nanostructure arrays. We show a nanopattern template as a mask by combining colloidal lithography and reactive ion etching. The nanopattern template was controlled in size and geometry by varying reactive ion etching conditions. Utilizing dc magnetron sputtering, Au nanostructure arrays were successfully prepared on the glass slide, and silicon dioxide (SiO_2) coated silicon (Si) wafer substrate. The results indicated that the tunability of the localized surface plasmon resonance peak position was dependent on the geometry of Au nanostructure arrays. The demonstrated nanofabrication method was a promising application in quantum plasmonic sensing chips.

Keywords: Plasmonic, Au Nanostructure, Colloidal Lithography, Reactive ion Etching.

Optical Properties of Au NP Arrays Deposited with TaO Ultra-Thin Films

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Abstract

In this study, plasmonic Au nanoparticle (NP) arrays deposited on a silicon wafer and glass slide substrates were prepared by dc-magnetron sputtering and thermal dewetting. Subsequently, the sputtered tantalum oxide (TaO) ultra-thin films were deposited on the Au NP arrays. The optical properties of the prepared samples were characterized by UV-VIS-NIR spectrophotometer and spectroscopic ellipsometer (SE). The physical structures were analyzed by grazing-incident X-ray diffraction (GIXRD) and filed-emission scanning electron microscope (FE-SEM). The surface plasmon extinction peak can be observed in the visible region depending on the TaO film thickness. The result indicated that the localized surface plasmon peak shift decreased and broadened with increased TaO thickness. This proposed fabrication offers potential as a plasmonic chip for molecular gas-sensing applications.

Keywords: Plasmonic, Au NPs, TaO Ultra-Thin Films, Sputtering.

Sensors, Sensing Materials and Related Devices

The Sensitivity Improvement of Electrochemical Non-enzymatic Glucose Sensor by Means of Solar-Radiation on Gold Nanoparticles-decorated Iron Oxide Nanorods

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Abstract

Electrochemical sensors have gained tremendous interests in advanced clinical diagnoses owing to short processing time with good sensitivity and selectivity toward the target molecules/ions. The characteristics of such sensors, e.g., sensitivity, specificity, and limit of detection, are interpreted from electrochemical signal that majorly depends on not only the sensing material functionalized on the electrode but also the ability of charge transport at "electrolyte-to-sensing material" and "sensing material-to-conducting electrode" interfaces. The vanishment of charge carriers at the interfaces is known as a major reason leading to the deterioration of sensor's sensitivity and detection limit. Therefore, proposing of an effective approach to facilitate charge transport become a key solution to achieve high performance biochemical sensors based on electrochemical activity. Here, the photo-induced electrochemistry is synchronized with iron oxide nanorods (α-Fe_2O_3-NRs) decorated by gold nanoparticles (Au-NPs) to obtain high performance non-enzymatic glucose sensors. The growth of α-Fe_2O_3-NRs and the decoration of Au-NPs are accomplished by facile hydrothermal and chemical reduction syntheses, respectively. It was found that the Au-NPs/α-Fe_2O_3 electrode demonstrates the glucose response in the broad concentration range of 100 μM - 4 mM. Interestingly, under solar radiation (A.M 1.5G, 100 mW/cm^2), the sensitivity of the sensor is drastically improved from 0.42 μA/mM to 16.43 μA/mM (~ 40 times higher than unexposed condition). The enhancement of glucose sensing performances of Au-Ps/α-Fe_2O_3 electrode is attributed to the synergetic effects from (i) the plasmonic-induced electron injection at the interface of α-Fe_2O_3-NRs and Au-NPs resulted from localized surface plasmon resonance (LSPR) of Au-NPs and (ii) the oxidation of glucose molecules with photogenerated holes at the valence band of α-Fe_2O_3-NRs that facilitate the electron transfer. Our results strongly highlight that photo-induced electrochemistry is a powerful approach to enhance the electrochemical activities of metal-decorated metal oxide electrode that consequently provides a high performance enzyme-free glucose sensors.

Keywords: Enzyme-Free Glucose Detection, Iron Oxide Nanorods, Gold Nanoparticles, Charge Transfer, Localized Surface Plasmon Resonance.

The Effect of Temperature on Carbaryl Pesticide Detection by Using Ion-Sensitive Field Effect Transistor

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Abstract

This research studies the effect of temperature on carbaryl pesticide detection by ion-sensitive field-effect transistor (ISFET) based on acetylcholinesterase (AChE) enzyme inhibition assay. The sensitivity of ISFET sensor is tested in different pH buffers. To detect carbaryl pesticide, AChE is immobilized on the gate surface of ISFET and the carbaryl is measured at concentrations between $1x10^{-7}$ M to $1x10^{-3}$ M. The signal response of carbaryl that inhibit the AChE function are compared in different temperature of 22, 25, 30, 35 and 37 °C. The results found that at temperature 30 and 35 shows better signals for detection of carbaryl pesticides with the sensitivity of 14.284 and 15.367 %Inhibition / log M, respectively. The concentration range is $1x10^{-6}$ to $1x10^{-5}$ M with the limit of detection (LOD) of $1x10^{-6}$ M**.** Additionally, the carbaryl pesticide are tested in cabbage extracted solution in concentration range $1x10^{-6}$ to $1x10^{-5}$ M which provide the sensitivity of 12.316 %inhibition / log M that close to the carbaryl in buffer solution. This can be noted that cabbage extracted solution has less effect to the measurement of carbaryl by enzyme-ISFET sensor. This work has potential to apply ISFET for field tests of carbaryl detection.

Keywords: ISFET, Carbaryl, Acetylcholinesterase, Pesticide

Photoelectrochemical Hydrogen Peroxide Detections Based on Bismuth Vanadate Thin Film Prepared by Pulsed Laser Deposition System

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Abstract

The detection of single biochemical molecules from electrochemical measurements has been of great interest in quality and contaminant monitoring in the food and beverage industry and environmental science. In view of single-molecule detection, The specificity and sensitivity interpreted from the electrical signal should be concerned. Although the receptor (small molecule or polymer) is functionalized on the working electrode to achieve high specificity, the detected current is still low. Therefore, the obtained sensitivity toward each biochemical molecule is still difficult. In this research, the photoelectrochemical approach is demonstrated to increase the detected current using hydrogen peroxide (H_2O_2) as a model molecule. Monoclinic bismuth vanadate (m-$BiVO_4$) film on fluorine-doped tin oxide (FTO) as a working electrode for biochemical-molecular detection is prepared from pulsed laser deposition. The fabricated electrodes exhibit current change under solar radiation, indicating photocarrier generation. The detected current obtained from the exposed condition increases as a function of H_2O_2 concentrations (3.18-17.58 μA/cm^2, 0.01-5 mM) which is higher than the unexposed condition. The increment of the detected current pointed to the excellence of H_2O_2 detection is described via the interaction between H_2O_2 and the photogenerated hole at the valence band of m-$BiVO_4$ under solar radiation. Employing our approach allows us to decrease the detection limits of biochemical-molecular detection based on electrochemical measurement.

Keywords: Photoelectrochemical, Hydrogen Peroxide, Bismuth Vanadate.

Vehicle-theft Detection Device with Image Recognition on Google Cloud Vision

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Abstract

According to the annual report from Royal Thai Police, there are more than 500 cars stolen every year. However, less than 10% could be traced back. Such crime not only consequently leads to economic and social problems but also break the certitude in national security. The development of current technology on object detection and data communication provides a possibility to build a vehicle-theft detection device with image recognition on google cloud vision. This device can precisely detect the car's information, e.g., car brand and vehicle registration number, and then compares the collected information with database containing the list of stolen vehicles. Finally, in case the matching information is found, the device will send to the staff, the details of car brand, vehicle registration number, car photo as well as the car location through LINE application. The experimental results indicate that the Vehicle-Theft detection device can potentially detect the stolen vehicles with the accuracy as high as 75%.

Keywords: Vehicle Detection, Image Recognition, Google Cloud Vision.

Gas Sensors Based on Tellurium-filled Carbon Nanotubes

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Abstract

Improvement in sensitivity of gas sensors based on carbon nanotubes (CNTs) so far has been achieved mostly by grafting external structures or functional groups onto the outside of CNTs to facilitate gas adsorption and charge transfer or incorporating CNTs into a matrix that swells up after absorbing gas and pushes CNTs apart, increasing electrical resistance of CNTs. However, the effect of filling materials inside the hollow of CNTs on the sensitivity of CNTs based gas sensors has not been widely investigated. Tellurium-filled single-walled carbon nanotubes (Te-SWNTs) have already been successfully synthesized but the investigation about their various properties is still quite limited. In this study, gas sensors using Te-SWNTs as sensing material were fabricated and their response to volatile organic compound (VOC) gases were investigated and compared to that of gas sensors based on pristine single-walled carbon nanotubes (SWNTs).

In order to fabricate gas sensors, chemical vapor deposition grown Te-SWNTs and pristine SWNTs were dispersed by sonication in ethanol and then dropped onto a Si/SiO_2 (100 nm) substrate with interdigitated Ti/Au electrodes with a gap of 250 μm. Then the samples were heated to 100˚C for 15 minutes to drive off ethanol. Electrical resistance of gas sensors was first measured in nitrogen atmosphere and after introducing VOC gas by bubbling liquid VOC such as ethanol, acetone and toluene by nitrogen gas. Gas response was taken from the change in electrical resistance of gas sensors when VOC gas was introduced compared to in nitrogen atmosphere. It was found that gas sensors based on Te-SWNTs show larger change in resistance than pristine SWNTs when exposed to several VOC gases, corresponding to higher sensor response. The mechanism related to improvement in gas response to VOC gases by filling the hollow of SWNTs will be discussed in the presentation.

Keywords: Carbon Nanotubes, Gas Sensors, Tellurium Nanowires

Study of Novel Neutron Detector Using Vertical Type BGaN Semiconductor

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Abstract

Recently, a neutron solid state detector is expected as novel neutron imaging technique because of high responsibility and high resolution. Then, we have proposed BGaN semiconductor detector as novel neutron detector. BGaN is a semiconductor material in which B atoms having a large neutron capture cross-section are mixed with GaN having low gamma-ray sensitivity. Because of these properties, only neutrons generating alpha particles by a B(n, alpha)Li reaction are detected in BGaN detectors, and it is possible to achieve the high n/gamma discrimination. In the examination of BGaN Schottky diodes, the possibility of neutron detection using BGaN was indicated. However, in the evaluation of detection sensitivity and alpha particle path length, it was obtained to need a thicker sensitive layer. Therefore, we have developed BGaN epitaxial growth technique and fabricated the vertical type BGaN diodes with a thick sensitive layer.

We fabricated vertical type BGaN diodes by metal-organic chemical vapor deposition (MOCVD). The thickness of the radiation-sensitive BGaN layer in the diode is about 5 μm. In the irradiation experiment, alpha particles and thermal neutrons were irradiated. The energy spectrum measurement was carried out using the multi-channel analyzer.

We evaluated the detection property of fabricated BGaN diodes by irradiating alpha particles. Firstly, the dependence of the energy spectrum on alpha-particle irradiation energy was evaluated. The energy peak when irradiated with 2.3 MeV alpha particles was located on the highest channel side. The Bragg curve of 2.3 MeV alpha particles was calculated using a radiation simulator (PHITS Ver. 3.07) and we confirmed that the alpha particles had a path length of about 5 μm. These results indicate that the fabricated 5 μm-BGaN layer is depleted and functions as a sensitive layer. Furthermore, a neutron detection signal was detected by thermal neutron irradiation.

Keywords: Group-III Nitride, Neutron Detector, BGaN, Epitaxy

Comparison of X-ray Penetration Image Contrast between CdTe and TlBr Detectors

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Abstract

Penetration imaging using X-rays has become an indispensable technology in various fields such as medicine, industry, and security. In the field of semiconductor detector materials, CdTe has been attracting attention because of its large atomic number and density, as well as its large band gap, which allows it to operate at room temperature. In recent years, as the demand for imaging of high-energy X-rays has increased, TlBr has also been attracting attention as a next-generation detector because of its high detection efficiency for high-energy γ-rays due to its large atomic number and density band gap. The design of a readout circuit for thallium bromide has confirmed that it can work as an image sensor by our team, but its effect on the image quality of X-ray penetration images has not been confirmed. In this study, we compared the image quality, especially contrast, of X-ray image sensors of CdTe and TlBr detectors. A lead plate with a slit (X-ray chart) was used as the subject, and the contrasts of penetration image were compared between the areas where X-rays irradiated from the X-ray tube passed through the slit and the areas where attenuated X-rays were detected without passing through the slit. As a result, both calculated and measured values showed that the contrast when imaging with the CdTe was larger than that with the TlBr detector. It was concluded that this was due to the different response functions.

Keywords: CdTe, TlBr, X-ray Penetration Imaging

IoT-based Real Time pH Monitoring of University of Mindanao's Chemical Laboratory Wastewater

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Abstract

If wastewater, a by-product of industrial and commercial facilities, is not treated, it could cause environmental and health problems. The proposed IoT-Based Real-Time pH Monitoring of wastewater can regulate the disposed waste through web browsers. The device has undergone several trials with wastewater from the chemical laboratory at different pH levels. It gave the signal to the solenoid motor to position either close when the pH level is greater than pH 7.5 and less than pH 6.5 or open when the pH level is pH 6.5 to pH 7.5. The output's accuracy was measured using buffer solutions at different temperatures. It showed that the value of the pH level varied in temperature with significantly small changes. The system monitoring in the web browser captured the data every minute and saved it in a database for data comparison purposes. The device conformed to the Department of Environmental Natural Resources - Environmental Management Bureau (DENR-EMB) in the Philippines' standard permissible pH level (pH 6.0 to pH 9.0). Using an Arduino NANO microcontroller that served as a central processing unit and a Node MCU to connect the system to the internet, the equivalent output of an industrial pH meter was obtained, allowing the user to monitor the system at any time using a web browser.

Keywords: pH, IoT, Buffer Solution, Solenoid Motor, Arduino NANO, Node MCU.

Preparation of Copper Oxide Films by Electrochemical Deposition Technique for Extended Gate Field Effect Transistor pH Sensor

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Abstract

In this work, copper oxide (CuO) film was prepared by electrochemical deposition technique on commercial indium-tin oxide/glass substrate with two electrode configuration. The precursor solution was the 0.1 molar aqueous of copper sulfate. The films were prepared at different times of 30 to 120 second. Then, the deposited films were annealed at 400 °C to achieve CuO film. The influence of electro-deposition voltage and deposition times on structural property, morphological features had been studied. The CuO films were used to fabricate the pH sensor based on extended-gate field effect transistor (EGFET). The sensitivity and linearity of prepared device was performed in the standard buffer solutions with pH range of 2-12. It was found that the device demonstrated the sensitivity and linearity of 28.5 mV/pH and 90.1 %. It can be seen that the prepared CuO films can be used as pH sensing application with EGFET device.

Keywords: Copper Oxide, Electrodeposition, pH Sensor.

Low Cost and Compact Size Potentiostat for Electrochemical Measurement

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Abstract

In this work, the low cost electrochemical potentiostat based on compact size were designed and demonstrated. The 32 bit processor of ESP32 microcontroller with wireless communication was used as main microcontroller. The 18 bits analog to digital convertor (MCP3423), and a 16 bits digital to analog convertor (AD5060) were used as signal capture and signal generator. The analog frontend circuits such operation amplifier, signal amplifier, current to voltage convertor etc. for electrochemical measurement were designed and fabricated on print circuit board with compact size about name-card size. Then, the fabricated potentiostat were tested with the 1% precision resistance that exhibited high linearity. For electrochemical measurement, the fabricated potentiostat were performed with commercial carbon screen-printed electrode in aqueous ferrocyanide solutions which were demonstrated the oxidation and reduction peaks of cyclic voltammogram results. The fabricated device can be used as electrochemical instrument for internet of things (IoT) systems.

Keywords: Potentiostat, Electrochemical Sensor, Instrument.

Humidity Sensor Based-on Quartz Crystal Microbalance of Sprayed Silver Nanoparticles Films

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Abstract

In this work, the silver nanoparticles (Ag NPs) film was prepared by compressed air spray deposition technique. The properties of prepared Ag NPs film were characterized by X-ray diffraction, UV-visible spectroscopy, and scanning electron microscope. Then, the Ag NPs film was prepared on 2 MHz crystal microbalance to fabricate the humidity sensor. The measurement systems had been composed of fabricated sensor, oscillator circuit, and frequency counter. The sensor performances were obtained in the term of frequency shift of device at various humidity levels. The conditions of saturated salt solutions following NIST standard was used as humidity values for measurement. It was found that the fabricated device exhibited approximately frequency shift of 25 Hz in humidity range of 11-93 %RH. Moreover, the device demonstrated low hysteresis characteristic 1 %RH at 48 %RH.

Keywords: Silver Nanoparticles, Humidity Sensor, Quartz Crystal Microbalance.

Improvement of Sensing Characteristics of PDMS-based Capacitive Pressure Sensor via Introduction of Porous Structure Generated by Thermal Decomposition of Ammonium Bicarbonate

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Abstract

PDMS-based capacitive pressure sensors become a workhorse driving broad spectrum from medical monitoring to robotic sensing applications. The improvement of sensing characteristics of such sensor has been focused in two effective approaches; (i) modification of mechanical properties of PDMS layer through either adjusting elastomer: curing agent ratio or introducing porous structure into active layer and (ii) modify relative dielectric constant of PDMS layer by adding high dielectric constant material into PDMS layer. In this work, the enhancement of sensing characteristics of PDMS-based capacitive pressure sensor by introducing porous structure into PDMS active layer is proposed. The thermal decomposition of ammonium bicarbonate (NH_4HCO_3), that produces the following end products; ammonia (gas), carbon dioxide (gas), and water (liquid), is employed as a pore generator during PDMS curing process. The sensor's sensitivity is investigated as function of porosity of PDMS active layer. The increment of sensitivity from 2.11%kPa^{-1}, obtained from sensor prepared by dense PDMS layer, to 4.32 (approx. +104.7%) is observed in the sensor prepared by the PDMS layer containing porosity of 40%. The origin of enhancement in sensitivity can be described by the combination of (i) the increase in deformability of PDMS layer caused by the existence of porous structure in PDMS and (ii) the change in relative dielectric constant during applying load to the sensor induced by the change of volume fraction between PDMS and void in the active layer.

Keywords: Capacitive Pressure Sensors, Polydimethylsiloxane (PDMS), Thermal Decomposition, Ammonium Bicarbonate (NH_4HCO_3),

Special Session: Biomedical Applications

Biomechanical Pattern of Canine Distalization in The Miniscew Position: a Finite Element Analysis

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Abstract

Objectives: The aim of this study was to clarify the biomechanical characteristics of canine retraction in Von Mises stress of the canine periodontal ligament (PDL) and the bone around the orthodontic mini-implant (OMI) using finite element analysis when changing the force angulation focusing on the desired force on the canine and undesirable forces on maxillary bone.

Methods: Finite element models of half of maxilla included in teeth, except the first premolars were produced. A retraction force of 100gram couple force was applied from OMI to the power arm which was attached on the maxillary arch wire. Four different types of loads were applied, and the third principal stresses (X,Y, and Z) of canine area and maxillary bone in standardized areas of most compression were calculated.

Results: In the sagittal plane (Y plane), all the OMI positions showed the distance to move distal displacement were not different. Differences in two different OMI's positions were 0.028-0.03 mm. The 5 mm. of OMI position's force showed the lesser change of angulation than 3 mm. The Von Mises stress of canine PDL, at the 5 mm. of OMI position's force, the canine was rotated depending on the direction of the force with respect to the line of center of resistance (CR), which showed the lowest degree of labiolingual angulations of the canine. The 5 mm. of OMI position, canine's PDL was compressed at palatal area and a bit at distal and edge of labial area. This characteristic induced tipping of the canine. Vertically (Z plane), the both OMI positions represented the amount of intrusive-extrusive displacement of the canine were not different. Differences in four different OMI's positions were -0.005 to -0.002 mm.

Conclusion: In this study, the 5 mm. of OMI position showed a suitable position of OMI placement. Therefore, clinicians should carefully consider the placement of OMI and force angulation and biomechanics is essential to obtain proper canine translation according to the positions of OMI. The further research should evaluate in the higher position of OMI.

Keywords: Canine Retraction; Orthodontic Mini-Implant; Finite Element Analysis; Screw Position; Periodontal Ligament

A Simulation Based Performance Analysis of Field-effect Transistors for Biomedical Sensing

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Abstract

For biomedical applications such as sensing, modern FET (Field-Effect Transistors) needs to be scaled down up to 10nm, has to offer biomedical materials compatibility with very high SNR (Signal to noise ratio). In current scenario, scalability is not a big issue for group IV and compound semiconductor materials; however, finding a biocompatible material which can offer properties such as a high SNR is interesting. The very first ISFET (Ion-Sensitive Field-Effect Transistors) was demonstrated by Bergveld. Bio-FETs are commonly used for sensing and transducer action (converting energy from one to another form). Till now, TFET (Tunnel Field-Effect Transistors), OFET (Organic Field-Effect Transistors), nonmaterial FETs and EGFET (Extended Gate Field-Effect Transistors) have been demonstrated for biomedical applications. In this work, a simulation based analysis of Field-Effect Transistors for biomedical applications with the comparison of performance for different channel materials is presented.

Keywords: Biosensors, Field-Effect Transistors, Biomedical Applications, Compound Semiconductors, & 2D Semiconductors.

Deep Learning and Artificial Intelligence (AI) for Electrophysiology Mapping and Signal Analysis

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Abstract

This paper presents a technique for discriminating abnormal ECG by applying deep learning to differentiate abnormal signals from those measured by intra cardiac monitors. The data signal from the patient is transduced in each in vivo probe electrode to extract the feature by converting it into scalogram images (Time-frequency pattern) for input. classification binary classification. To distinguish whether the ECG signal was abnormal or not, a deep learning transfer learning rate was used with a convolution neural network. The efficacy was shown in f-1 score. It was 90% effective to identify the signal as normal, and the efficacy was shown in f-1 score. Approximately 94% of the signs were identified as abnormal, using actual patient data from the hospital (306-04-22 FDSK-H Fub).

Keywords: ECG, AF, Sinus rhythm, Deep learning, Scalogram, MATLAB.

The Interrelationships Between Low alpha and Musical Frequencies

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Abstract

This study explored the pitches of healing frequency has been found to help relax and heal the pain and sickness of humans and animals. It can also help treat brain disorders. For example, a frequency of 174 Hz can help reduce pain and stress. A frequency of 396 Hz can remove guilt, fear, and the negative feeling. Also, the frequency of 417 Hz can help facilitate change. This study was conducted by evaluating different documents and interviewing experts. The music production was applied to form the process, concept, and analysis in this research. Data was collected from a review of relevant literature verified by fieldwork data, and advice and verification were sought from various experts. The methodology involved four steps: (1) collecting data (2) organizing the data (3) analysis of the data and (4) submission of the product of the research. Electroencephalography (EEG) for measuring Low alpha for used. The aim of this study is to induce the brain waves into the Low alpha by the healing scales, which are comparative symbols without equivalent to Western music frequency and scales. This research revealed that the healing scales could help relax and heal for a low alpha, especially for wellness and cognitive.

Keywords: Low frequency, EEG, Low alpha, Brain wave, Relaxation, Wellness and cognitive.

Technical Aspect of 3D Printing in Gynecological Brachytherapy

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Abstract

Brachytherapy is a way of treating cancer that involves placing radioactive sources directly on the tumor. This treatment allows a high radiation dose to be delivered to the tumor target while preserving the surrounding normal tissue. When treating cervical cancer, a high dose rate of brachytherapy with standardized applicators is one of the most common forms of treatment. In some situations, a typical applicator cannot provide adequate dosage coverage for the intended volume. The approaches for 3D printing can improve the amount of dosage coverage to the tumor target. The purpose of this research is to propose a personalized method to improve tumor target coverage that makes use of 3D modeling and printing technology and uses cost-effective materials. In our institute, the 3D printing template was used to treat eight patients with cervical cancer enrolled during the years 2020 and 2022. In conclusion, using a 3D-printed applicator makes it possible to perform high-quality intracavitary or interstitial brachytherapy, which results in positive outcomes while maintaining an acceptable level of toxicity.

Keywords: 3D Printing, Radiotherapy, Cervical Cancer, Implantation Brachytherapy.

The Performance Improvement of Deep Learning in Automatic Femur Segmentation Using External Feature Addition

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Abstract

This paper proposes the idea of external feature addition in preprocessing for a deep learning-based automatic femur segmentation performance improvement, with respect to support a contouring procedure in radiotherapy planning. An external feature is a possible factor affecting to analysis and development of deep learning model, i.e., gender, age or disease. The femur was the target object, predication output, in this experiment which is common organs-at-risk for lower abdominal cancers. Experiments were carried out using cropped-datasets (CT scans) with external feature addition, lying posture as external feature for femur datasets. Datasets were fed to the U-Net model and results were compared to original-resolution datasets and cropped-datasets without an external feature addition. The results reveal that the external feature addition could accurately predict the target object segmentation, with the total accuracy (dice similarity coefficient (DSC) and intersection over union (IoU)) of 60.04% and 43.15%, respectively. Specifically, the novelty of this research lies in the use of deep learning with external feature addition on cropped-datasets to effectively segment femur which is organs-at-risk.

Keywords: Deep Learning, Automatic Segmentation, U-Net, External Feature Addition, Cropping, 3D Reconstruction.

Antibody Conjugated Gold Nanoparticles for Lateral Flow Immunoassay

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Abstract

This work studies the conjugation of antibodies on gold nanoparticles for use in lateral flow immunoassay. Based on point of care testing for identifying the ABO blood group, gold nanoparticles conjugated with antibodies are used to display on the test strip. Gold nanoparticles are synthesized by the Turkevich method. The reaction between antibody conjugated gold nanoparticles (Ab-GNPs) is measured by UV-VIS spectrophotometer. Ab-GNPs are used in lateral flow immunoassay (LFIA) test strip to detect their specific antigen. The size of the gold nanoparticles and the optimum concentration of antibodies used to conjugate onto gold nanoparticles are optimized. The optimized Ab-GNPs are used in LFIA test strip to detect the substance in the saliva sample. The results revealed that the appropriate condition for conjugation of antibodies on gold nanoparticles are gold nanoparticles with average diameter of 45.9 nm and 10 mg/ml of antibodies. The signal bands appeared on the test line to perform the specific interaction between antibody and substance in saliva. The appearance band also occur on the control line to confirm the ability of the antibody conjugated gold nanoparticles.

Keywords: Antibody, Gold Nanoparticles, Lateral Flow Immunoassay

GCMS and Bioassay-guided Isolation of Xanthones from *Mammea siamensis*

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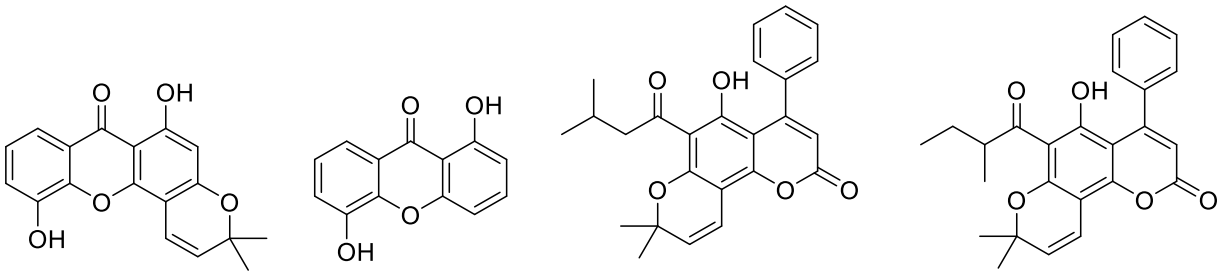
Abstract

*Mammea siamensis (*Miq.) T. Anders. (Guttiferae) is an important medicinal plant in Thailand. Its flowers have long been used as active ingredient in various Thai herbal recipes for treatment in several diseases. In addition, many phytochemical researches revealed that phenylcoumarins and triterpenes are major components in this plant. To explore bioactive compounds from *M. siamensis*, its various parts including leaves, young leaves, twigs, stems, and flowers were investigated. Guided by GCMS and bioassay, two xanthones, 6-deoxyisojacareubin (1) and 1,5-dihydroxyxanthone (2), together with a mixture of phenylcoumarins, mammea A/AA cyclo D (3) and mammea A/AB cyclo D (4) were isolated from the methanol extract of young leaves. The structures were confirmed by means of spectroscopic technique and by comparison with those literature data. This is the first report of xanthones 1–2 from the genus *Mammea*. Compound 2 showed antioxidant activity on DPPH and ABTS radical scavenging method with IC_{50} 70.16±0.97 and 38.86±1.66 µg/mL.



Keywords: *Mammea siamensis*, Xanthones, Phenylcoumarins, Anti-Oxidant Activity

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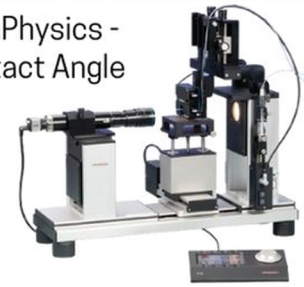

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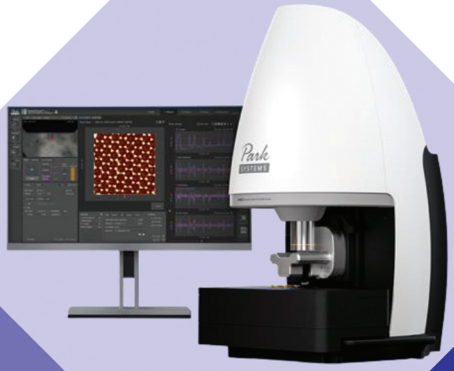

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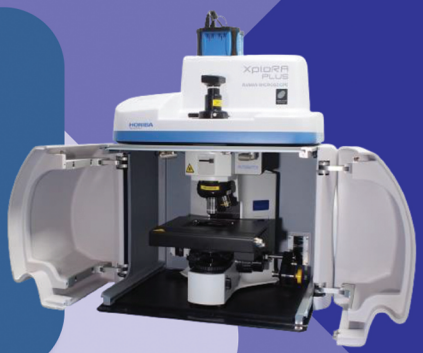

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