In conjunction with

ASEAN Ceramics 2017 Bangkok

ICTA2017

International Conference on Traditional and Advanced Ceramics 2017

August 31 – September 1, 2017

Bangkok International Trade & Exhibition Centre (BITEC), THAILAND

Organized by

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Contents

Abbreviations

Plenary Lectures: PL

Invited Lectures: IL

Oral: O

Poster: P

Ceramic for Industrial Technology: IND

Advanced Ceramics: ADV

Ceramic Art and Design: ART

Glass and Coatings Technology: GLA

Materials Testing and Characterization: MAT

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Message from ICTA2017 Conference Chair

Dear Colleagues,

On behalf of the Organizing and Technical Committees, we are delighted to host the International Conference on Traditional and Advanced Ceramics (ICTA2017) in conjunction with ASEAN Ceramics 2017 at BITEC, Bangkok, Thailand during August 31 to September 1, 2017.

The conference consists of 4 plenary lectures, 13 invited lectures, 31 oral research presentations and 73 poster presentations covering recent advancements in Ceramic and Glass Materials research ranging from Industrial Ceramics, Advanced Ceramics, Ceramic Art and Design, Glass and Coatings Technology and Materials Testing and Characterization. A total of 120 scientists and researchers from universities, institutes and industries from 11 countries are contributing to this International Conference to discuss and share further developments in Ceramic and Glass Materials.

We would like to welcome you to ICTA2017 and ASEAN Ceramics 2017 in Bangkok which is one of the most attractive tourist destinations in South East Asia, a city that is full of traditional and modern cultures. We also hope that all of you can have an excellent opportunity for interaction and friendship with participants from over the world.

And thank you all sponsors such as SCG Chemicals Co., Ltd., Advanced Materials Cluster, Chulalongkorn University, Faculty of Engineering, Kasetsart University, Faculty of Engineering and Industrial Technology, Silpakorn University, Center of Excellence on Petrochemical and Materials Technology (PETROMAT), Asian Exhibition Services (AES) Ltd., and all committees and the participants.

Finally, I would like to thank you to all of you for your kind support and your participation in ICTA2017 and ASEAN Ceramics 2017 at BITEC, Bangkok, Thailand.

Dr. Somnuk Sirisoonthorn
ICTA2017 Conference Chair

Message from ICTA2017 Conference Chair

Dear Colleagues,

On behalf of the organization committee, I would like to welcome you to Bangkok, the capital city of Thailand and to the International Conference on Traditional and Advanced Ceramic 2017 (ICTA2017). For this special occasion, the conference is held in conjunction with ASEAN Ceramics 2017, the most comprehensive ceramic-exhibition in Asia. ASEAN Ceramic 2017 and ICTA2017 eventually bring together ceramic experts, ceramic suppliers, machine manufacturers, ceramic scientists and engineers from all over the world.

ICTA2017 has potentially become one of the most distinguished international meetings for researchers, scientists, engineers, and specialists in the fields of ceramic and glass. The conference offers the most updated researches in science and technology of this field, as well as the opportunity for the ceramic and glass experts to present, share and discuss their works intensively on the topics of Ceramic Industry Research, Advanced Ceramics, Ceramic Art and Design, Glass and Coatings Technology and Materials Testing and Characterization.

The success of ICTA2017 depends on many people who have worked very hard in planning and organizing the technical program/exhibition and supported all the meeting arrangements. Thus, I would like to thank all the organization committee, technical committee, sponsors and the participants for all the successful outcomes of the meeting.

Assistant Professor Dr. Sirithan Jiemsirilers
ICTA2017 Conference Chair

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National Metal and Materials Technology Center

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Valaya Alongkorn Rajabhat University

Technical Program

August 31, 2017

Room	Meeting Room 211-213 (2nd Floor)		
08:30-09:00	Registration		
09:00-09:30	Opening Ceremony (Event Hall 101, 1st Floor)		
09:30-10:30	*Coffee Break & Exhibition*		
Room	Meeting Room 211-213 (2nd Floor)		
Session Chair	Asst. Prof. Dr. Oratai Jongprateep, Kasetsart University, Thailand		
10:30-11:15	PL-01: Chemical Vapor Deposition of Environmental Coating for SiCf/SiC Composite Prof. Dr. Takashi Goto Tohoku University and Vice President of Ceramics Society of Japan, Japan		
11:15-12:00	PL-02: Rheological Principles of Development Ceramic Based Complex Materials with Extreme Dynamic Strength Prof. Dr. Laszlo A. Gomze University of Miskolc, Hungary		
12:00-13:15	*Lunch & Exhibition*		
Room	Meeting Room 211	Meeting Room 212	Meeting Room 213
Session	*Advanced Ceramics 1*	*Ceramic Art and Design*	*Materials Testing and Characterization 1*
Session Chair	Asst. Prof. Dr. Niti Yongvanich Silpakorn University & Dr. Chatr P. Kowalski Chulalongkorn University, Thailand	Asst. Prof. Dr. Nutthita Chuankrerkkul Metallurgy and Materials Science Research Institute, Thailand	Dr. Somnuk Sirisoonthorn National Metal and Materials Technology Center, Thailand
13:15-13:30	IL-01: The Time Journey of Crystalline Glazes Prof. Dr. Bekir Karasu Anadolu University, Turkey	ART-O-083: Optimum Composition and Temperature to Produce Jewelry from Bone Ash Sutham Srilomsak Khon Kaen University, Thailand Cancelled	IL-05: Effect of Firing Temperature on Ceramic Properties of Laotian Clay Dr. Sengphet Keokangdon National University of Laos, Laos
13:30-13:45		ART-O-093: The Optimize Composition of Waste Coffee Grounds for Making Small Vase Set Ash Glazes Thanawat Taonoke Valaya Alongkorn Rajabhat University, Thailand	IL-06: NSTDA Characterization and Testing Service Center for Industries Dr. Natthaphon Wuttiphan National Science and Technology Development Agency, Thailand
Session		*Ceramic Industrial Technology 1*	
Session Chair		Asst. Prof. Dr. Karn Serivalsatit & Asst. Prof. Dr. Thanakorn Wasanapiarnpong Chulalongkorn University, Thailand	
13:45-14:00		IL-04: Cogeneration with Gas Turbines - Cost Reduction in Ceramic Tiles Manufacturing Emilio Rigamonti Solar / Turbomach, Switzerland	IL-07: Empowering the Future of the Industry through Sustainable Solutions Dr. Azlin Binti Hamidi SIRIM Berhad, Malaysia
14:00-14:15	IL-02: Nano Second Technology for Ceramics Engineering Application Prof. Dr. Tadachika Nakayama Nagaoka University of Technology, Japan		IL-08: Characterization of Mesoporous Nanocomposites for Pesticide Sensing Applications Dr. Bralee Chayasombat National Metal and Materials Technology Center, Thailand

14:15-14:30	ADV-O-043: Effect of Peptizing Agent Concentration on Morphology of Unsupported Alumina Membrane Nantana Thongdee Suranaree University of Technology, Thailand	IND-O-056: Influence of In-situ Calcium Hexaluminate on Mechanical Properties in Alumina-Magnesia Monolithic Refractories Kouichiro Washijima Kyoto Institute of Technology, Japan	IL-09: Bio-inspired Synthesis and Characterization of 3D Functional Nanostructures Dr. Eileen Fong Nanyang Technological University, Singapore
14:30-14:45	ADV-O-050: Effect of Nonaxial Stress on Dynamic Hysteresis of Soft PZT Bulk Ceramic Cancelled Sorawitch Suntornmatrik Suranaree University of Technology, Thailand	IND-O-012: Fracture Energy and Fracture Toughness of In-situ Calcium Hexaluminate (CA6)-Alumina Monolithic Refractory Jiraprabha Khajornboon Kyoto Institute of Technology, Japan	IL-010: Assessment of Structural Steel Corrosion in Thailand Climate Dr. Amnuaysak Chianpairot National Metal and Materials Technology Center, Thailand
14:45-15:00	ADV-O-070: Direct Liquid Injection Chemical Vapor Deposition and Characterization of Graphene: Optimization of Copper Foil Substrate Surface Taworn Intaro Chulalongkorn University, Thailand	IND-O-019: Preparation of Porous Fused Silica Ceramics by Starch Consolidation Using Glutinous Rice Flour as a Binder Kedkaew Kanlai Chulalongkorn University, Thailand	IL-011: Synthesis and Characterization of Zinc Oxide / Polyaniline Nanocomposites for Solar Cell Applications Dr. Arnold Alguno University Iligan Institute of Technology, Philippines
15:00-15:15		IND-O-071: Automatic Controls of Rheological Parameters for Pressure and Traditional Casting and Robot Glazing: How Process Control Can Support The Sanitary-ware Industry For The New 4.0 Concept Riccardo Grassi Marcheluzzo Ceramics S.r.l., Italy	IL-012: Characterisation Facilities for Micro- and Nano-materials in VAST/IMS Prof. Dr. Nguyen Quang Liem Institute of Materials Science (IMS), VAST, Vietnam
Room	Event Hall 101 (1st Floor)		
15:15-16:30	*Coffee Break & Poster Session*		
Room	Restaurant, Samutprakan		
18:00-20:00	*Banquet*		

September 1, 2017

Room	Meeting Room 211-213 (2nd Floor)
08:30-09:00	Registration
Room	Meeting Room 211-213 (2nd Floor)
Session Chair	Dr. Somnuk Sirisoonthorn, National Metal and Materials Technology Center & Asst. Prof. Dr. Sirithan Jiemsirilers, Chulalongkorn University, Thailand
09:00-09:45	PL-03: Porous and Dense Geopolymers Prepared from Waste Fly Ash for Eco-friendly Environmental Materials. -Their Preparation and Application- Prof. Dr. Takaomi Kobayashi Nagaoka University of Technology, Japan

09:45-10:30	PL-04: Eco-Friendly Ceramic Membrane Bioreactor (MBR) Based on Recycled Agricultural and Industrial Wastes for Waste Water Reuse (REMEB) Prof. Dr. Alpagut Kara Anadolu University and President of Turkish Ceramic Society, Turkey		
10:30-11:00	*Coffee Break*		
Room	Meeting Room 211	Meeting Room 212	Meeting Room 213
Session	*Advanced Ceramics 2*	*Ceramic Industrial Technology 2*	*Glass and Coatings Technology*
Session Chair	Dr. Pitak Laoratanakul National Metal and Materials Technology Center, Thailand	Asst. Prof. Dr. Duangrudee Chaysuwan Kasetsart University, Thailand	Dr. Anucha Wannagon, National Metal and Materials Technology Center & Dr. Apirat Theerapapvisetpong Chulalongkorn University, Thailand
11:00-11:15	IL-03: Laser Processing of Ceramics Dr. Teiichi Kimura Japan Fine Ceramics Center (JFCC), Japan	IND-O-015: Compressive Strength and Setting Time Modification of Class C Fly Ash-based Geopolymer Partially Replaced with Kaolin and Metakaolin Khanthima Hemra National Metal and Materials Technology Center, Thailand	IL-013: The Relation between Chemical Composition, Nature of Elastic Waves, and Macroscopic Properties of Multicomponent Glasses and Glass Melts Prof. Dr. Reinhard Conradt RWTH Aachen University, Germany
11:15-11:30		IND-O-016: Effect of NaOH Concentration on Microstructure and Mechanical Properties of Geopolymer Prepared from Kaolin Washing Process Waste Sitthisak Prasanphan Chulalongkorn University, Thailand	
11:30-11:45	ADV-O-007: Development of Perovskite Solar Cells Inspired by Ceramic Science and Technology Yoshikazu Suzuki University of Tsukuba, Japan	IND-O-004: Preparation of Carbon Fiber Reinforced Metakaolin Based-geopolymer Foams Darunee Wattanasiriwech Mae Fah Luang University, Thailand	GLA-O-017: The Effect of Decolorizing Agent on The Optical Properties of High Iron Contents Soda-lime Silicate Glass Ekarat Meechoowas Department of Science Service, Thailand
11:45-12:00	ADV-O-042: Photocatalyst Activities of Iron Oxide-doped Titania under Visible Light Sorawit Amornwutiroj Kasetsart University, Thailand	IND-O-008: Factors Affecting Green Supply Chain Performance of Lamphang Ceramics Industry Nattida Wandaruk Chiang Mai University, Thailand Cancelled	GLA-O-024: Comparison of the Properties of Glasses Made from Two Different Bottom Ashes Wanida Nonthathi King Mongkut's University of Technology Thonburi, Thailand
12.00-12.15	ADV-O-047: Luminescence Property of Ceramic Phosphors Synthesized by Melt Quenching Technique Kenji Toda Niigata University, Japan	IND-O-053: Synthesis of Spinel Color Pigments from Aluminum Dross Waste Niti Yongvanich Silpakorn University, Thailand	GLA-O-023: Radiation Shielding Properties of $BaO-ZnO-B_2O_3$ Glass for X-ray Room Nisakorn Sangwaranatee Suan Sunandha Rajabhat University, Thailand

12.15-12.30	ADV-O-075: Effects of an Intermediate c-GaN Buffer Layer on Structural and Optical Properties of AlN Films on MgO (001) Substrates Nutthapong Discharoen Chulalongkorn University, Thailand	IND-O-055: Preparation of Consolidated Body of Zeolite from Rice Husk Ash Masahiro Takahashi Kyoto Institute of Technology, Japan	GLA-O-097: Effect of Eu^{3+} Ions on the Physical, Optical and Luminescence Properties of Lithium Aluminium Phosphate Glasses Narong Sangwaranatee Suan Sunandha Rajabhat University, Thailand
12:30-13:45	*Lunch & Exhibition*		
Session	*Advanced Ceramics 3*		*Materials Testing and Characterization 2*
Session Chair	Asst. Prof. Dr. Pornapa Sujaridworakun Chulalongkorn University, Thailand		Dr. Ekarat Meechoowas Department of Science Service, Thailand
13:45-14:00	ADV-O-014: Flexible Collagen/Biphasic Calcium Phosphate Composite Scaffold for Dental Implants Autcharaporn Srion National Metal and Materials Technology Center, Thailand		MAT-O-022: Non-proportionality and Scintillation Properties of YAG:Ce Scintillator by Compton Coincidence Technique Wuttichai Chaiphaksa Nakhon Pathom Rajabhat University, Thailand
14:00-14:15	ADV-O-051: Effect of Time and Temperature on Bovine Serum Albumin Protein Incorporated 3D Printed Hydroxyapatite by Biomimetic Co-Precipitation Technique Faungchat Thammarakcharoen National Metal and Materials Technology Center, Thailand		MAT-O-034: Preparation, Properties and Moisture Buffer Value of the Porous Ceramic Tile Rung-Arun Sanngam National Metal and Materials Technology Center, Thailand
14:15-14:30	ADV-O-061: Effect of Nucleation Heat Treatment on Mechanical and Chemical Properties of Mica-based Glass-ceramics as Restorative Dental Materials Sukanda Angkulpipat Kasetsart University, Thailand		MAT-O-067: Study of Thermal Property of Glass-ceramics Produced from Soda Lime Glass Waste by Single-step Sintering Process Nattawat Kulrat Mahidol University, Thailand
14:30-14:45	ADV-O-062: Effect of Fluorapatite and Nucleation Time of Mica-based Glass-ceramics for Restorative Dental Materials Sahadsaya Prasertwong Kasetsart University, Thailand		MAT-O-111: Micromorphology of Porosity Related to Electrical Resistance of Dental Luting Cements Viritpon Srimaneepong Chulalongkorn University, Thailand
14:45-15:30	*Closing Ceremony & Awardings*		

List of Poster Presentations

Session: Ceramic for Industrial Technology

IND-P-005 **The Construction of the Small CNC Milling Machine for Ceramic Cup Products**
Cancelled
Anantakul Intarapadung
Phranakhon Rajabhat University, Thailand

IND-P-006 **Analyzing the Performance of Ceramic Kiln by Using Thermal Image Technique for Reducing Energy Costs**
Siwat Lawanwadeekul
Lampang Rajabhat University, Thailand

IND-P-020 **The Adsorption of Cadmium Ions on Fly Ash Based Geopolymer Particles**
Sujitra Onutai
Chulalongkorn University, Thailand

IND-P-025 **Near Infrared Reflective Property of Spinel Pigment**
Krongkarn Sirinukunwattana
Ministry of Science and Technology, Thailand

IND-P-029 **Utilization of Alkali Treated Natural Fibers in the Fabrication of Lightweight Precast Concretes**
Cancelled
Pat Sooksaen
Silpakorn University Sanam Chandra Palace Campus, Thailand

IND-P-037 **Effect of Oxide Addition on Physical and Mechanical Properties of Fly Ash-Based Geopolymers**
Pimpun Henpraserttae
National Metal and Materials Technology Center, Thailand

IND-P-040 **The Effect of Fiber Glass on the Properties of Pozzolan Cement Composites**
Seksan Tasa
Maejo University, Thailand

IND-P-045 **Utilization of Coal Fly Ash as Raw Material for Refractory Production**
Rinyapat Sukkae
Thammasat University, Thailand

IND-P-048 **Preparation and Characterization of Ceramic from Power Plant Bottom Ash**
Cancelled
Tharathip Sreesattabud
Pibulsongkarm Rajabhat University, Thailand

IND-P-052 **The Fabrication of Mullite from Aluminium Buff Mixture**
Nuntaporn Kongkajun
Thammasat University, Thailand

IND-P-057 **Utilizaton of Aluminium Dross Residue as a Raw Material for Ceramic Floor Tile**
Benya Cherdhirunkorn
Thammasat University, Thailand

IND-P-060 **Effects of Grog, Wood Ash and Cement on Physical – Mechanical Properties of Unfired Clay Bricks**
Soravich Mulinta
Lampang Rajabhat University, Thailand

IND-P-063 **The Comparison of Dolomite and Cullet addition on Physical – Mechanical Properties of Clay Bricks**
Ratthaphon Kantajun
Lampang Rajabhat University, Thailand

IND-P-066 **Effects of Pig Bone Ash, Lampang Kaolinite and Fly ash on Physical – Mechanical Properties of Bone China Body**
Apinan Khankhom
Lampang Rajabhat University, Thailand

IND-P-069 **Utilization of Aluminium Dross as a Main Raw Material for Synthesize Geopolymer**
Pimchanok Puksisuwan
Thammasat University, Thailand

IND-P-077 **Synthesis of Cu-doped $ZnFe_2O_4$ Black Pigment with High NIR Reflectance**
Mantana Suwan
National Metal and Materials Technology Center, Thailand

IND-P-078 **Effects of Dolomite and Al_2O_3 Addition on Properties of $CoFe_2O_4$ Black Pigment**
Nuchjarin Sangwong
National Metal and Materials Technology Center, Thailand

IND-P-085 **Development of Geopolymer Mortar from Metakaolin Blended with Agricultural and Industrial Wastes**
Chayanee Tippayasam
King Mongkut's University of Technology North Bangkok, Thailand

IND-P-095 **Effect of Aluminum Hydroxide Addition on Properties of Fired Refractory Clay Brick**
Siripan Nilpairach
Chulalongkorn University, Thailand

IND-P-096 **Fabrication and Characterization of Low Thermal Expansion Cordierite/Spodumene/Mullite Composite Ceramic for Cookware**
Pranee Junlar
Chulalongkorn University, Thailand

IND-P-098 **Influence of Lignite Bottom Ash on Pyroplastic Deformation of Stoneware Ceramic Tiles**
Tarit Prasartseree
Chulalongkorn University, Thailand

IND-P-103 **Upgrading of Waste Gypsum for Building Materials**
Piyalak Ngernchuklin
Thailand Institute of Sciencetific and Technological Research, Thailand

IND-P-104 **Study for Commercialization of Ash Utilization in Geopolymer Concrete Block**
Pichit Janbunjong
Thailand Institute of Sciencetific and Technological Research, Thailand

IND-P-110 **Development of Thai Lignite Fly Ash and Metakaolin for Pervious Geopolymer Concrete**
Duangrudee Chaysuwan
Kasetsart University, Thailand

Session: Advanced Ceramics

ADV-P-003 **Porous Alumina Processing Using the Direct Foaming Technique Based on Slurry Boiling**
Kritkaew Somton
National Metal and Materials Technology Center, Thailand

ADV-P-010 **Effect of Basic Hydrothermal Treatment Time on Morphology of Aroxide P25 TiO_2 Nanostructures**
Panpailin Seeharaj
King Mongkut's Institute of Technology Ladkrabang, Thailand

ADV-P-021 **Enhancement Photocatalytic Activity of BiOBr Using GO and rGO by Facile Preparation**
Tuangphorn Prasitthikun
Chulalongkorn University, Thailand

ADV-P-027 **The Utility of Rice Husk Ash from Biomass Power Plant of Nakhon Ratchasima Province in Order to Synthesis of Nano-silica for Using Cathode Material of Lithium Ion Battery**
Onlamee Kamon-In
Nakhon Ratchasima Rajabhat University, Thailand

ADV-P-028 **Microwave Synthesis of Hydroxyapatite Nanoparticles and the Application in Film Bio-composites**
Pat Sooksaen
Silpakorn University Sanam Chandra Palace Campus, Thailand

ADV-P-036 **Synthesis Zeolite from Water Treatment Sludge and Its Application to the Removal of Brilliant Green**
Khemmakorn Gomonsirisuk
National Metal and Materials Technology Center, Thailand

ADV-P-039 **Structural Refinement and Electrical Properties of $BaZr_{0.7}In_{0.3}O_{3-\delta}$ Ceramics**
Surasak Niemcharoen
King Mongkut's Institute of Technology Ladkrabang, Thailand

ADV-P-044 **Waste Eggshell as Low-cost Starting Material for Synthesizing $CaZrO_3$ Powder**
Rangson Muanghua
King Mongkut's Institute of Technology Ladkrabang, Thailand

ADV-P-046 **Synthesis of Boron Carbide Powder by Carbothermic Reduction Process**
Amarinee Laeknok
Chulalongkorn University, Thailand
Cancelled

ADV-P-049 **Preparation of Porous Cylindrical Tubes Substrates from Zeolite and Clay for TiO_2 Photocatalyst Coating**
Nithiwach Nawaukkaratharnant
Chulalongkorn University, Thailand

ADV-P-064 **Electrical Properties of Rice Husk Ash and Fly Ash Blended Cement-PZT Ceramic Composites**
Nittaya Jaitanong
Maejo University, Thailand

ADV-P-074 **Influence of Polycaprolactone Coating on Properties of Drug Impregnated Hydroxyapatite for Localized Bone Tuberculosis Treatment**
Waraporn Suvannapruk
National Metal and Materials Technology Center, Thailand

ADV-P-076 **Powder Injection Moulding of Magnesium Aluminate Spinel**
Nutthita Chuankrerkkul
Metallurgy and Materials Science Research Institute, Thailand

ADV-P-080 **Effect of Molten Salts on Synthesis and Upconversion Luminescence of Lanthanide-doped Alkaline Yttrium Fluorides**
Karn Serivalsatit
Chulalongkorn University, Thailand

ADV-P-087 **Preparation and Characterization of Lead-Free $(Ba_{0.4}Sr_{0.4}Ca_{0.2})(Zr_{0.05}Ti_{0.95})O_3$ Ceramics Using BST Seed Induced Method**
Jiraporn Dangsak
Mae Fah Luang University, Thailand

ADV-P-088 **Phase Formation and Grain Growth of BSCZT Ceramics Prepared by BST-BZT Seed Induced Method**
Jiraporn Dangsak
Mae Fah Luang University, Thailand

ADV-P-089 **Effects of Eu Doping and Calcination Temperatures on Chemical Compositions, Microstructure and Luminescent Intensity of $BaAl_2O_4$**
Oratai Jongprateep
Kasetsart University, Thailand

ADV-P-090 **Microstructural Evolution and Dielectric Constants of $Ba_{0.05}Sr_xCa_{0.95-x}TiO_3$ (x=0, 0.225, 0.475, 0.725 and 0.95) Synthesized by the Solution Combustion Technique**
Nicha Sato
Kasetsart University, Thailand

ADV-P-091 **Effects of Sn Concentration on Chemical Composition, Microstructure and Photocatalytic Activity of Nanoparticulate Sn-doped TiO_2 Powders Synthesized by Solution Combustion Technique**
Kornkamon Meesombut
Kasetsart University, Thailand

ADV-P-092 **Preparation of Zeolite NaA - Activated Carbon Composite Filter Aid from Rice Husk Charcoal for Drinking Water**
Thanakorn Wasanapiarnpong
Chulalongkorn University, Thailand

ADV-P-099 **A Study of Mechanical Properties of Bone Cement Containing Micro and Nano Hydroxyapatite Particles**
Phanrawee Sriprapha
Chiang Mai University, Thailand

ADV-P-100 **Enhancing the Phase Conversion of Hydroxyapatite from Calcium Sulphate Hemihydrate by Hydrothermal Reaction**
Nuntiwat Pewkeaw
Chulalongkorn University, Thailand

ADV-P-101 **High-Resolution X-ray Diffraction and Micro-Raman Investigations of Cubic AlGaN/GaN on GaAs (001) Substrate by MOVPE**
Nattamon Suwannaharn
Chulalongkorn University, Thailand

ADV-P-112 **TSynthesis of SrAl2O4:Eu2+, Dy3+ Phosphorescent Pigments Via Combustion Assisted Sol-Gel Method**
Muhammed Said OZER
Osmangazi University, Turkiye

ADV-P-105 **Preparation of Near-Infrared (NIR) Reflective Pigment by Solid State Reaction between Fe_2O_3 and Al_2O_3**
Chumphol Busabok
Thailand Institute of Sciencetific and Technological Research, Thailand

Session: Ceramic Art and Design

ART-P-031 **Manufacturing Innovation and New Product Development Strategy of Pottery in Order to a Community Ban Dan Kwian to Increase Market Opportunities and Ability to Compete ASEAN and Global Markets**
Chaisiri Luangnaem
Nakhon Ratchasima Rajabhat University, Thailand

ART-P-032 **Development of Dan Kwian Pot Pottery Products**
Chon Yeenang
Nakhon Ratchasima Rajabhat University, Thailand

ART-P-033 **The Development of Dan-Kwian Ceramic Jewelry to Contemporary Aesthetics in Nakhon Ratchasima Province**
Kriangkrai Duangkhachon
Nakhon Ratchasima Rajabhat University, Thailand

ART-P-094 **Improvement and Development of Dan Kwian Stoneware Clay in Order to Increasing Sustainable Productivity**
Onlamee Kamon-In
Nakhon Ratchasima Rajabhat University, Thailand

ART-P-107 **The Production and Quality Development of Handcraft Pottery**
Nattawut Ariyajinno
Chiang Mai University, Thailand

Session: Glass and Coatings Technology

GLA-P-009 **Fabrication of Glass-ceramics from a Mixture of Glass Cullet, Eggshell and Perlite**
Napat Chantaramee
Maejo University, Thailand

GLA-P-013 **Optical and Structural Studies of Er_2O_3 doped Potassium Sodium Niobate Silicate Glass-Ceramics**
Ploypailin Yongsiri
Valaya Alongkorn Rajabhat University, Thailand

GLA-P-018 **Effect of the Addition of $ZrSiO_4$ on Alkali-resistance and Liquidus Temperature of Basaltic Glass**
Napaporn Vaiborisut
Chulalongkorn University, Thailand

GLA-P-038 **Surface Morphologies and Durability on Water Contact Angle of Titanium Dioxide Nanoparticle Thin Films**
Cancelled
Buppachat Toboonsung
Nakhon Ratchasima Rajabhat University, Thailand

GLA-P-073 **A Novel Radiation Shielding Material for Gamma-Ray: The Development of Lutetium Lithium Borate Glasses**
Keerati Kirdsiri
Nakhon Pathom Rajabhat University, Thailand

GLA-P-084 **Effects of TiO_2 Content and Sintering Temperature on the Thermal and Mechanical Properties of Na_2O-CaO-P_2O_5 Bioactive Glass-Ceramics**
Pratthana Intawin
Chiang Mai University, Thailand

GLA-P-086 **Mechanical Properties and Microstructure of Li_2O-SiO_2-Al_2O_3-K_2O-P_2O_5-ZrO_2-CaO Glass-Ceramics**
Manlika Kamnoy
Chiang Mai University, Thailand

GLA-P-108 **Crystal Structure and Optical Properties of ZnO Thin Film Prepared by Asymmetric Bipolar Pulsed-DC Magnetron Sputtering Method**
Cancelled
Nuwat Phimpabut
Loei Rajabhat University, Thailand

Session: Materials Testing and Characterization

MAT-P-011 **Development of Dental Ceramic Brackets Fabricated by Powder Injection Moulding**
Nutthita Chuankrerkkul
Metallurgy and Materials Science Research Institute, Thailand

MAT-P-026 **Comparing Near Infrared Reflective Spectrum between Two Different Spectrophotome**
Krongkarn Sirinukunwattan
Ministry of Science and Technology, Thailand

MAT-P-035 **Preparation, Characterization and Utilization of TiO_2-rGO Nanocomposites for Photocatalytic Decomposition of MB Dye under Sunlight Irradiation**
Chaval Sriwong
King Mongkut's Institute of Technology Ladkrabang, Thailand

MAT-P-041 **Feasibility Study of Using Basalt Fiber as the Reinforcement Phase in Fiber-Cement Products**
Parinya Chakartnarodom
Kasetsart University, Thailand

MAT-P-054 **Precipitation/impregnation Synthesis Ruthenium-loaded Cobalt Oxide Nanoparticles for Application in Gas Sensor**
Viruntachar Kruefu
Maejo University, Thailand

MAT-P-059 **Characterization of Fe_2O_3 Nanowires and Its Solar Cell Applications**
Suphaporn Daothong
Maejo University, Thailand

MAT-P-068 **Evaluation of Thermal Shock Resistance for Ceramic Materials by Young's Modulus**
Jun Arikawa
Kyoto Institute of Technology, Japan

MAT-P-072 **Synthesis and Characterization of Cu-doped SnO_2 Thin Films by Aerosol Pyrolysis Technique for Gas Sensor Applications**
Tipawan Khlayboonme
King Mongkut's Institute of Technology Ladkrabang, Thailand

MAT-P-081 **Stress-Induced Transformation and Ferroelastic Domain Switching in Ce-TZP/alumina Composite on Fracture Surface**
Haruki Nakagawa
Kyoto Institute of Technology, Japan

MAT-P-082 **Effect of Addition of MgO and ZrO_2 on High Temperature Deformation of Fine-grained Al_2O_3**
Reo Teradaira
Kyoto Institute of Technology, Japan

MAT-P-106 **The Optimal Ratio to Talc Mixed with Cordierite – Mullite Refractories Clay Body from Raw Materials and Narathiwat Clay (In Thailand)**
Cancelled
Natrawut Ariyajinno
Chiang Mai University, Thailand

PLENARY LECTURES

PL - 01

Chemical Vapor Deposition of Environmental Coating for SiC_f/SiC Composite

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Keywords: chemical vapor deposition, laser, CMC, SiC/SiC composite

Ceramics are generally brittle and usually not applicable for engineering structural usage, whereas fiber rein-forced ceramics matrix composite (CMC), in particular SiC fiber/SiC matris (SiC_f/SiC) composite can be a promising structural material due to high strength, high corrosion resistance and high ductility. The SiC_f/SiC composite is a candidate material for gas turbine of jet engine and channel box of nuclear furnace. The corrosion resistance and mechanical properties at high-temperature and under heavy radiation strongly depend on purity and microstructure. Since SiC_f/SiC composite should survive in severe conditions such as in boiling water, high-temperature steam and heavy nuclear radiation, it should be fabricated by chemical vapor deposition (CVD) in a pure and dense form with a large scale size more than several meters. We have been fabricating SiC and relating materials by thermal CVD, plasma CVD and laser CVD. By using halide precursors with thermal CVD, bulky SiC can be prepared at more than 2 mm/h, while SiC can be prepared at most 5 mm/h around 1700 K by laser CVD. The laser irradiation in CVD can enhance the deposition rate of SiC more than several 100 times than that of conventional CVD particularly at a low temperature region. The laser and plasma assisted CVD can also lower the deposition temperature a few hundred degree than thermal CVD. The environment coating on SiC_f/SiC composite consists of several components such as $Yb_2Si_2O_7$ interface layer and SiAlON bonding layer. The $Yb_2Si_2O_7$ layer can ensure the high strength of SiC fiber by sliding and drawing of SiC fiber from the SiC matrix. β-$Yb_2Si_2O_7$, X1- and X2-Yb_2SiO_5 have been prepared by CVD. The SiAlON layer can prevent the Al deficiency embrittling the interface strength. a-, b- and AlN-like SiAlON have prepared by CVD depending of deposition condition.

PL – 02

Rheological Principles of Development Ceramic Based Complex Materials with Extreme Dynamic Strength

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Keywords: alumina, ceramics, CMC, collision, composite, corundum, diamond-like, dynamic, materials, nanoparticles, phase-transformation, rheology, silicon-nitride, solid-stage, strength

It is obvious that ceramic materials have different modules of elasticity and melting temperatures depending on their chemical compositions and morphological and crystalline structures. Because of these the composite materials created from components and particles of different melting temperatures and modules of elasticity have better ability to absorb and dissipate kinetic energy during dynamic beats and high speed collisions. Examining the behaviors of different ceramics and CMCs under high speed collisions in several years the authors have confirmed the advantages of hetero-modulus, hetero-viscous and hetero-plastic complex material systems. Applying the rheo-mechanical principles the authors first have developed new corundum-matrix composite materials reinforced with **Si_2ON_2**, **Si_3N_4**, **SiAlON** and **AlN** submicron and nanoparticles. These new nanoparticles reinforced hetero-modulus CMCs have excellent dynamic strength during their collisions with high density metallic bodies with speeds of 1000 m/sec or more. During the high energy collisions the phase transformation of submicron and nanoparticles of alpha and beta silicone-nitride crystals into **diamond-like** cubic **c-Si_3N_4** particles [1-3] were observed.
Based on the rheological principles and the energy engorgement by fractures, heating, melting índ phase transformations in solid stages of components the authors successfully developed several new hetero-modulus, hetero-viscous and hetero-plastic complex materials with extreme dynamic strength. These new composite materials generally are based on traditional ceramic matrixes (**$Al_2O_3x2SiO_2$, Al_2O_3, Si_3N_4, SiC**), and non-ceramic components with different melting temperatures and modules of elasticity. To prepare new CMCs with increased dynamic strength in additions to the ceramic matrix both materials with relatively low (**graphite, Mg, Al, Ti, Si**) and high (**borides, nitrides** and **carbides**) modules of elasticity were used.
Analytical methods applied in this research were scanning electron microscopy, X-ray diffractions and energy dispersive spectrometry. Digital image analysis was applied to microscopy results to enhance the results of transformations.

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PL - 03

Porous and Dense Geopolymers Prepared from Waste Fly Ash for Eco-friendly Environmental Materials. -Their Preparation and Applications-

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Keywords: Geopolymers, fly ash, eco-environmental materials.

Geopolymer is alumino-silicate material and can be applied for many applications as ceramics which are easily prepared. This is due to that geopolymers have several attractive properties of high strength, low permeability, high acid and hazardous resistance materials, adsorbents and immobilization of toxic materials [1, 2]. Therefore, geopolymer is an effective manner to process and reuse silicates, aluminates or alumino silicates in mineral waste. This paper presents synthesis of the dense and the porous structures of geopolymers by using fly ash and industrial waste as the raw materials. Here, aluminum hydroxide waste (Al-waste) and fly ash were used to synthesis the dense geopolymers for cement materials [3]. The Al-waste based geopolymer influenced the geopolymer strength, when sodium hydroxide (NaOH) concentration was changed at different curing temperatures. When preliminary treatment of microwave oven heating was implemented in lower NaOH paste of geopolymer, the successful synthesis of geopolymer cement was obtained [4]. In addition, porous fly ash geopolymers was achieved using a household microwave oven. The geopolymer paste was cured within 1 min by using a microwave oven at different output power. Porous geopolymers were formed immediately at 850 W power of the microwave oven.

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PL - 04

Eco-friendly Ceramic Membrane Bioreactor (MBR) Based on Recycled Agricultural and Industrial Wastes for Waste Water Reuse (REMEB)

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Keywords: REMEB, ceramic membrane, olive oil wastes, ceramic wastes, marble wastes

REMEB (Recycled Membrane Bioreactor) is a Research and Development project funded by the European Commission under grant agreement No. 641998, in the framework of the call H2020-WATER-2014. It is a project for first market application developments. With a total budget of 2,361,622.50 EUR, it has a duration of three years, started in September 2015 and concluding in August 2018. The main objectives of the REMEB project are the implementation and validation of a low cost recycled ceramic membrane bioreactor (MBR) for water reuse in a Wastewater Treatment Plant (WWTP). Wastewater treatment through the use of a membrane bioreactor (MBR) can be an exceptional alternative to increase the reclaimed water as a worldwide habitual application. The main problem of the current MBRs, using inorganic membranes, is the high running and maintenance costs of the technology. REMEB project proposes a new type of MBR which will significantly decrease the cost of the technology. In this sense, the project will develop a ceramic, ecological and competitive MBR for municipal and industrial wastewater treatment plants (WWTP), from ceramic raw materials and by-products and agro-industrial wastes. As a first approach, the low cost ceramic membranes will be developed in Spain with typical raw materials used in the ceramic tile industry like chamotte from fired tile scrap and wastes obtained in agricultural and industrial processes such as olive oil solid wastes and marble working wastes. Then, the membrane will be replicated at a pilot scale in Turkey and Italy, being also ceramic strategic areas, by using recycled materials and wastes products available in these countries. The differences between manufactured membranes will be examined. Seven work packages are established for REMEB project. For the replication studies; SAM is responsible for researching different wastes from Turkey and their characterization. Especially, SAM has been working with fired tile scraps, olive oil wastes and marble dust. This invited paper will report on the results achieved in the project up till now.

INVITED LECTURES

IL - 01

The Time Journey of Crystalline Glazes

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Keywords: Crystalline glaze, History, Art, Technical side, Importance, Review.

Crystalline glazes have very important place among all type of glazes and possess a long history. According to archaeological findings, they have firstly been made in Orient, mainly China. When the time passes, oriental glazes were being imitated and crystalline glazes, with their colour changes, fit into the natural and sensuous lines of Art Nouveau. Industrial ceramics and European potteries were making many stylistic and technological advances at that time, and the race for production and experimentation began. The production and advancements were made by Europe into the first decade of the 20th century but unfortunately, nearly all crystalline work stopped at the beginning of World War One. Especially after World War Two, since this specific type of glazes attracts people's attention with their glamourous appearance many artistic and technical works have being continued. Hereby, general overview will be given covering the history, importance, preparation, artistic and technical development and usage of crystalline glazes.

IL - 02

Nano Second Technology for Ceramics Engineering Application

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Keywords: Motion Control, nanoparticle, PTV, hybrid, ZrO_2, pulsed electric field

Electrochemistry of non-aqueous solution is a chemistry to deal electron transfer between materials in non-aqueous solutions and various phenomena associated with it. By using appropriate non-aqueous solvent or a mixed solvent other than water, it becomes possible to cause a new reactions or purpose reactions by material's dissolved state and the reactivity changes. Furthermore, electro-rheological (ER) fluid is a functional fluid application that the rheological properties change by applying an electric field. This paper is intended to develop a new ceramic structure control method by combining the electrochemical of non-aqueous and the ER fluid. The main purpose of this study is a driving control of micro-structure by electric field. In particular, the drive control of the micro-structure in a non-aqueous solution to control from the outside by the electric field, are considering applications such as metering pump in the non-aqueous solution. In this study, we investigated the behavioral mechanisms of the inorganic material in non-aqueous solution when an electric field is applied. When a DC electric field is applied to the ZrO_2 balls in the polysiloxane solution, repetitive motion between the electrodes on an irregular interval was observed. In this repetitive motion, ZrO_2 balls is moved to the opposite polarity of the electrodes by the time elapsed from the beginning to the contact with the electrode. It has conducted a survey from the point of view of the electrochemical of non-aqueous solutions and electrophoresis for the mechanism of this repetitive motion.

IL – 03

Laser Processing of Ceramics

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Keywords: Laser-enhanced CVD, Laser Sintering, Coating, Additive Manufacturing

In recent years, high power lasers have been developed rapidly and expected to be used as a heat source for high temperature processes used for ceramics production. Our recent challenges in laser processing of ceramics will be presented; (1) atmospheric laser-assisted CVD using electrospray source supply (ES-LCVD), and (2) laser sintering of ceramics.

Electrospray is an electrostatic atomization technique to form tiny liquid droplets. Dense alumina (Al_2O_3) coatings can be obtained by ES-LCVD from aluminum acetylacetonato-acetone source solution, and the deposition rate was 200 μm h^{-1}. Zinc oxide (ZnO) films were also obtained from zinc carboxide – alcohol solution and the morphologies could be controlled from dendritic to dense by organic additives to the solution.

3D printing (Additive Manufacturing) is expected to be a next-generation manufacturing technology. In 3D printing of resin/plastics and metals, products are usually formed by laser melting-solidification process of raw powders. However, because ceramics become amorphous after melting-solidification process, laser sintering is a key technology for 3D printing of ceramics. We have successfully sintered alumina, by formation of densely-packed powder layer and effective laser heating technique. The sintering depth of alumina was 300 μm after 10 s laser irradiation at the laser density of 250 W/cm^2. Reaction sintering of silicon carbide (SiC) was examined by laser irradiation to pellets of SiC-Si-C powder mixture, and dense β-SiC was formed after several 10 s laser irradiation under Ar atmonsphere.

IL – 04

Cogeneration with Gas Turbines
Cost Reduction in Ceramic Tiles Manufacturing

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Keywords: Ceramic Tiles, Cogeneration, Gas Turbines, Efficiency, Energy, Cost reduction

As the demand for manufactured products increases, Asian Ceramic industry need to become creative to satisfy the need of reliable and clean energy in order to stay competitive in the international market.

This paper shows how industrial gas turbines can be integrated in the ceramic manufacturing process providing a significant cost reduction, a reliable source of energy and high environmental advantages.

Gas turbines exhausts are perfectly fitting with Ceramic Atomizers, bringing high quantity of heat into the drying process and increasing significantly the overall process efficiency.

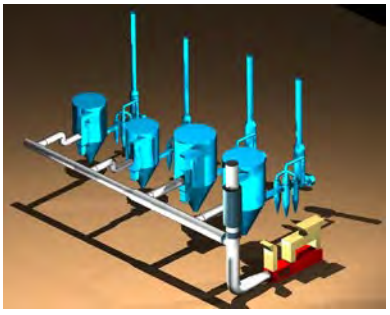
Several factors are driving the installation of Gas Turbines in combination with an Atomizer:

- Ceramic manufacturing need **large quantities of electricity and hot air**
- Gas turbine cogeneration is **reducing the overall energy costs**
- The use of gas turbine's exhausts into the Atomizer is further **enhancing the productivity**
- Optimized fuel usage – reduction in greenhouse gases with **Great environmental benefits**
- **Stable power** – More reliable Electrical and Thermal power

A gas Turbine connected to an Atomizer increases the **Global process efficiency from 27-32% to 75-90%.**

Cogeneration in ceramic application provides simultaneous and independent generation of electrical power and heat adequate to Customer needs with high reliability & availability and a significant emission reduction.

The **integration** of Gas Turbine exhaust air into the Spry Dryer drying process **is technically proven and well known. Solar experience is unrivalled** having more than 100 units connected to Atomizers in several manufacturing sites of the main Ceramic Group Leaders.



IL - 05

Effect of Firing Temperature on Ceramic Properties of Laotian Clay

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Keywords: Laotian clay, Mineralogical, Firing temperature, Physical properties.

The objective of this study was to evaluate the effectiveness of clay minerals. The mineralogical compositions are very important to promote the highly significant of physical and chemical properties to develop of ceramic industry applications. The raw materials consist of a kaolinitic Laotian clay (LC) is one as crucial for evaluating their potential suitability as raw material used for the preparation of ceramic products. The raw clays were characterized with XRD, XRF and TGA/DSC. Ceramic green bodies were pressed hydraulically using a round stainless steel mould 23 mm diameter, under a pressure of 50MPa. After drying, the ceramic green bodies were fired at different temperatures (1100 - 1250ºC) for 3 hr at a heating rate of 5ºC/min. The effect of firing temperature and soaking time on the densification behavior of the clay ceramic were assessed by phase composition, color changes of the fired bodies, shrinkage, density, porosity, water absorption, compressive strength, and scanning electron microscopy (FE-SEM). XRD analyses confirmed that the mineralogical composition of the raw clays consisted of quartz and kaolinite as the major phase minerals in the LC clay. Upon firing, the crystalline phases detected were only quartz and mullite. The physical and mechanical properties of all specimens such as shrinkage, density, porosity, water absorption and compressive strength values were recorded. The test results showed that increased in the mechanical strength while lowering of the porosity and water absorption values.

IL - 06

NSTDA Characterization and Testing Service Center for Industries

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IL – 07

Empowering the Future of the Industry through Sustainable Solutions

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SIRIM is a premier industrial research and technology organisation in Malaysia, wholly-owned by the Ministry of Finance Incorporated. With over forty years of experience and expertise, SIRIM is mandated as the machinery for research and technology development, and the national champion of quality. SIRIM played a major role in the development of the country's private sector. With its unique advantages in research and technology innovation, industry standards and quality, SIRIM offers specialised solutions to serve the needs of all industry sectors, making it the ideal technology partner for SMEs. By tapping into our expertise and knowledge base, SIRIM focus on developing new technologies and improvements in the manufacturing, technology and services sectors to enable businesses and enhance lives. To assist in the development of the Malaysian industry, SIRIM also focuses on alternative materials such as advanced materials. In addition to its highly-specialized expertise. SIRIM has been exploring with Petronas vendors as well as local universities of oil and gas to identify potential of new material development. Collaboration NanoMalaysia Berhad and SIRIM QAS International Sdn Bhd to set up a nano verification scheme for nano products, where Industrial Centre of Innovation in Nanotechnology is tasked with testing and validating the product. Industrial Centre of Innovation in Nanotechnology was equipped with the latest labs and equipment as well as dedicated team of researchers and technical specialists who are not only carries out research work, but also offers comprehensive technical services and consultancy. Industrial Centre of Innovation in Nanotechnology is the advanced materials research entity and has the strategic role of nucleating and championing development of indigenous materials technology. With the involvement of Industrial Centre of Innovation in Nanotechnology in material characterization can help the industry in improving the quality of the product.

IL - 08

Characterization of Mesoporous Nanocomposites for Sensing Application

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The needs for nano-level hybrid composites of metals, ceramics, or polymer are growing rapidly in recent days. These hybrid nanocomposite materials show superior properties than those of conventional materials and applicable in many fields, such as medical, food, agriculture of electronic applications. Sensors and transducers are types of electronic devices that applied the use of these smart materials and developed extensively. The development of these materials relies greatly in advanced material characterization techniques. In this study, we use enzyme biosensors for insecticide detection as a case study for measuring, evaluation and comparison of physical characterization techniques, i.e., x-ray diffraction (XRD), small angle x-ray scattering (SAXS), gas absorption-desorption, scanning electron microscopy (SEM) and transmission electron microscopy (TEM). Understanding the microstructures and its related physical properties would lead to improvement in the performance of the sensors. The objective of this study is to measure and compare each physical characterization techniques via the study on the enzyme biosensors.

One of the factors that affects performances of the enzyme biosensors is a material for enzyme immobilization. In this study, the material chosen for enzyme immobilization is mesocellular silica foam (MCF). It is a type of mesoporous silica with a structure that is composed of uniform spherical cells interconnected by windows. In this way, it has a 3 dimensional pore structure. So it is expected to have better substance diffusion compared to the 2 dimensional pore structure of conventional mesoporous silica. In this study, spherical MCF was synthesized with various synthesis conditions that leads to different pore structures. Additionally, Au particles were impregnated on the MCFs for better immobilization. The MCFs both before and after gold impregnation were characterized using techniques mentioned above. The results of each techniques will be discussed comparatively and relationships between physical properties and electrochemical performances of the fabricated enzyme biosensors will also be discussed.

IL - 09

Bio-inspired Synthesis and Characterization of 3D Functional Nanostructures

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Biologically derived molecules have attracted tremendous attention for their unique macroscopic and microscopic structures. Using bio-inspired strategies, we can begin to tailor the morphologies and chemical compositions of the nanomaterials via engineered self-assemblies between inorganic precursors and these biomolecular templates. In this work, we will demonstrate some novel strategies to prepare a variety of 3D hierarchical carbon hybrid nanoarchitectures. These nanostructured materials displayed excellent electrochemical properties when evaluated as electrode materials, making them promising for use in metal-ion batteries.

IL - 10

Assessment of Structural Steel Corrosion in Thailand Climate

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Due to climate change and industrial development, the atmosphere in Thailand becomes more corrosive to steel infrastructure. Thus, the field exposure program based on ISO standard was carried out to create the atmospheric corrosion data base used for materials selection and maintenance planning. The widely used structural steels were exposed at 7 test stations in Thailand, that represent urban, suburban, marine, industrial-marine and rural atmospheres. Along with exposed samples, galvanic-type corrosion monitoring sensors were installed on the exposure test racks to monitor corrosion behavior. The environmental factors affecting corrosion including relative humidity, temperature, time of wetness, sulfur dioxide, airborne salinity, wind speed and direction were also collected simultaneously. The correlation between corrosion rates and environmental factors were later analyzed in order to formulate corrosion rate estimation equations.

From the results of our exposure program, the corrosion rates of structural steels in Thailand are strongly affected by the corrosive effect of airborne sea salt. The effects of local monsoon and geography also cause variation in atmospheric corrosivity among different coastlines. The corrosion map of Thailand based on collected corrosion data and estimation equations was constructed. The systematic collection of more data at more test locations will improve the accuracy of the corrosion map.

IL - 11

Synthesis and Characterization of Zinc Oxide / Polyaniline Nanocomposites for Solar Cell Applications

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We report on the growth of zinc oxide/polyaniline (ZnO/PANI) nanocomposites deposited on glass substrate. Zinc oxide/polyaniline (ZnO/PANI) nanocomposites were grown on glass and platinum-coated glass substrates through chemical bath deposition and dip-casting technique. These nanocomposites exhibited good potential for solar cell device. Morphological, structural, optical and electrical characteristics were elucidated to observe the change on the power conversion efficiency of the device. Scanning electron micrographs revealed the presence of nanorods and plate–like structures. We found out that increasing the concentration of NH_4OH triggered increase in nanostructure diameter. The surface morphology of nanocomposites significantly changed as the molar concentration of NH_4OH precursor varies. X-ray diffraction (XRD) results exhibited strain (~0.98-1.0%) and changes on the crystallite sizes of the nanostructures which ranges from 200 nm–800 nm. Fourier transform infrared (FTIR) spectra suggested possible interactions of oxygen from the ZnO and the amine (–NH) bonds of PANI polymer chains due to shifting of significant peaks.

Shifting of peaks in the FTIR spectra suggest that interaction of ZnO and PANI chains occured. The measured optical band gap is in good agreement with reported values. This result indicates that the grown ZnO/PANI nanocomposites is a good material for solar cell device.

IL - 12

Characterisation Facilities for Micro- and Nano-materials in VAST/IMS

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This report highlights the characterisation facilities available in VAST/IMS for studying micro- and nano-materials. Upon the necessity of certain studies, micro- and nano-materials are characterised using suitable techniques. For the morphology of materials, scanning electron microscopy (SEM) and atomic force microscope (AFM) are used that allow to check the size and shape at the several nanometer scale. Optical microscopes can be also used to see the microstructure with different domains. For determining the crystalline structure, X-ray powder diffraction (XRD) and high-resolution transmission electron microscope (HR-TEM) are used that help to identify the crystalline phases, even the atomic layers in a nanocrystal. For characterising the optical properties, various spectroscopic techniques are being used including absorption, photoluminescence, time-resolved photoluminescence. For studying the magnetic properties, the B-H curves are measured as a function of the technological parameters for preparation of magnetic particles or magnetic thin films. All the characterisation

IL - 13

The Relation between Chemical Composition, Nature of Elastic Waves, and Macroscopic Properties of Multicomponent Glasses and Glass Melts

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Understanding the relation between the structure of a glass and its macroscopic properties has been a challenge for many decades. The static disorder of glass structure in space, i.e., the absence of a translational symmetry of its atomic structure, poses a major difficulty to such understanding. Things become much easier when such macroscopic properties are taken into consideration which are based on the vibrational properties of a glass. These are, in specific, the heat capacities and elastic moduli of glasses. These quantities reflect randomly distributed and distinctly directed phononic states, respectively, and thus are excellent probes to reveal local structural features of materials. At temperatures well above Debye's temperature, heat capacities probe the short-range order, i.e., the nature of cation-anion polyhedra, whereas the elastic properties probe the nature of linkage among such polyhedral. As concluded from the macroscopic properties and ab initio calculations alike, these features are identical for glasses and their isochemical low-density crystalline polymorphs. This, in turn, allows one to quantitatively predict glass properties, even of multicomponent glasses, from the nature and constitutional relations of their crystalline counterparts. In a final part, the principle is extended to the prediction of viscosity.

ORAL PRESENTATIONS

IND-O-004

Preparation of Carbon Fiber Reinforced Metakaolin Based-geopolymer Foams

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Keywords: metakaolin based-geopolymer foam, carbon fiber reinforcement, oxidation treatment, mechanical and thermal properties.

In this report, metakaolin based-geopolymer foams reinforced with 0.3 wt % carbon fibers have been prepared. Potassium silicate and potassium hydroxide solutions were used as activating agents while hydrogen peroxide was used as a blowing agent. In order to create chemical interfacial adhesion between fibers and the matrix, oxidation treatment using 3 M of nitric acid solution was performed for 10, 30, 50 and 70 min. Effects of oxidation treatment time on mechanical and thermal conductivity were not significantly observed. However, both flexural strength and fracture toughness were significantly improved when the geopolymer foams were reinforced with carbon fibers while thermal conductivity was only slightly changed.

IND-O-008

Factors Affecting Green Supply Chain Performance of Lampang Ceramics Industry

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Keywords: Lampang Ceramics Industry, Green Supply Chain, Analysis Hierarchy Process.

Presently, environmental concern has been interested by several industry sectors including ceramics industry which must be adapted toward this trend. Especially, in Ceramics Industry which has been grown rapidly in Lampang. The concept of Green Supply Chain, which refers to the effective management in reducing the environmental effects from the production to the product life cycle or to adopt the principle of Environmental Management with Supply Chain Management, become more important. This research aims to study the factor that affect the performance of Green Supply Chain of Lampang Ceramics Industry. The data investigation of this research is the questionnaires which were gathered from 20 stakeholders in Lampang Ceramics Industry. The research factors are divided into 5 major groups which are Green Design, Green Purchasing, Green Manufacturing, Green Logistics and Reverse Logistics. The questionnaire is consisted of 4 parts which are: Part 1 the details of each factor which are the definitions of those 5 major group of factors, Part 2 the questions about the relevant factors, Part 3 the suggestions and Part 4 the general information of company. Then, the data were analyzed using descriptive statistic and priority of each factor by using the Analysis Hierarchy Process (AHP). The understanding of factors affecting the Green Supply Chain Performance of Lampang Ceramics Industry was indicated in the summary result along with each factor weight. The result of this research could be contributed to the development of indicators or the performance evaluation of Green Supply Chain of Lampang Ceramics Industry in the future.

IND-O-012

Fracture Energy and Fracture Toughness of In-situ Calcium Hexaluminate (CA6)-Alumina Monolithic Refractory

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Keywords: Fracture energy, Fracture toughness, Calcium hexaluminate, Monolthic refractory.

Metal and steel industries are the main consumer of refractories in the world. Especially, these industries use monolithic refractory at ladle furnace. One of main raw materials for monolithic refractory is calcium aluminate cement which is not only responsible for binding agent among other raw materials but it also provides CA6 plate-like microstructure which causes self-toughening characteristics and thermal expansion to refractory materials.

In the present study, the tendency of CA6 formation under variation of firing condition and silica addition was investigated together with the measurement of mechanical properties such as fracture energy and fracture toughness.

Subsequently, in-situ CA6 was formed by using sintered alumina mixing with alumina cement and 2 mass% of silica in stoichiometric composition to achieve 100 mass% and 50 mass% of CA6 in high alumina monolithic refractory. The raw materials were mixed with appropriate amount of water to cast in 10×10×100 mm mould and left at room temperature for 24 h before demoulding and dried at 110°C for 24 h. Samples were fired at a temperature from 1400-1500°C for 1-5 h of holding time. After that, fired samples were characterized for phase composition (XRD), apparent porosity (Archimedes), microstructure (SEM) and mechanical properties (3-point bending test) such as fracture energy and fracture toughness. The results showed that both samples could not get CA6 content as expected and the apparent porosity did not exhibit in the same tendency, except the microstructures of both samples were achieved in the same shape as hexagonal plate-like morphology. However, the mechanical properties of both specimens did not relate with the CA6 formation amount and microstructures. Particularly, when the stable fracture energy and the increase fracture toughness was achieved from sample prepared at 50 mass% CA6 instead of sample prepared at 100 mass% CA6.

IND-O-015

Compressive Strength and Setting Time Modification of Class C Fly Ash-based Geopolymer Partially Replaced with Kaolin and Metakaolin

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Keywords: Class C fly ash-based geopolymer, Kaolin, Metakaolin, Compressive strength, Setting time.

Class C fly ash is widely used as a geopolymer raw material. It contains high calcium oxide and iron oxide resulting in a fast setting property. The influence of using kaolin and metakaolin replaced class C fly ash in geopolymer processing were investigated in term of compressive strength and setting time. Kaolin and metakaolin which calcined at different temperature of 600°C and 700°C replaced Class C fly ash between 0 to 50 wt. %. The geopolymers were prepared at constant KOH concentration as 6.0 M, K_2SiO_3/KOH ratio as 1.0, and solid/liquid ratio as 1.5 and 7 days of curing. The compressive strength is obviously increased when fly ash was replaced with both kinds of metakaolin, although, it is inclined to decrease when replaced by kaolin. The compressive strength is increased up to 13% and 47% with the replacement by 50 wt. % of metakaolin calcined at 600°C and 700°C, respectively. On the other hand, the replacement by 50 wt. % of kaolin give the initial setting time prolonging from about 6 min. to 80 min. However, the initial setting time of metakaolin calcined at 600°C and 700°C replacement are also improved to about 37 min. and 20 min., respectively. These results from their difference of amorphous phase and reactivity of the replacement materials. XRD analysis reveals the combination phases of amorphous geopolymeric gel that is the broad hump centered at 28 – 30° 2θ, and products from the reaction such as calcium oxide, potassium sulfate, calcium silicate hydrate and potassium mica which the latter are from unreacted metakaolin. They are confirmed by FT-IT result and microstructure evaluation by SEM. Therefore, the partially replacement of fly ash with kaolin and metakaolin in fly ash-based geopolymer production are affected to the compressive strength and resulted to modify the setting time.

IND-O-016

Effect of NaOH Concentration on Microstructure and Mechanical Properties of Geopolymer Prepared from Kaolin Washing Process Waste

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Keywords: Waste-based geopolymer, Muscovite, Mica, Metakaolin

The utilization of waste from kaolin washing process as raw materials for the geopolymer production was studied. Waste has approximately 100 thousand tons/year from the kaolin washing industry at Ranong province in the south of Thailand. The main composition of waste is muscovite, mica and kaolin (kaolinite and halloysite). In this study, the waste was calcined in the temperature range of 600 to 800 ˚C in order to transform kaolin into metakaolin. Moreover, the degree of muscovite and mica crystallinity was decreased, due to state of disorder. Therefore, the calcined waste can be used to produce as the geopolymer. The alkali activator used was the mixture of NaOH solution in the range of 4 M to 10 M and Na_2SiO_3 solution in the weight ratio of 2:1. Geopolymer samples were prepared by hydraulic press process at 3000 psi and cured at 7 days at room temperature. NaOH concentration was found to significantly effect on both microstructure and compressive strength of the waste-based geopolymer. The results showed that geopolymer samples had the highest compressive strength about 27 MPa of calcined waste at 700 ˚C and NaOH concentration of 10 M. The dissolution of muscovite and mica phases in geopolymer samples was identified by XRD technique, the decreasing intensity. FT-IR results showed the broad band and the shift toward lower wavenumber in the range of 1015-1012 cm^{-1} when increasing NaOH concentration, assigned to the Si-O-Si and Si-O-Al asymmetric stretching vibration. SEM micrograph of geopolymer samples displayed more geopolymeric gel and more denser with 10 M NaOH concentration.

IND-O-019

Preparation of Porous Fused Silica Ceramics by Starch Consolidation Using Glutinous Rice Flour as a Binder

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Keywords: Porous fused silica ceramics, Starch consolidation

Porous fused silica ceramics have found broad applications due to their unique properties such as low density, high specific surface area, high refractoriness, low thermal expansion, and excellent thermal shock resistance. In this study, porous fused silica ceramics were prepared from industrial fused silica crucible waste by starch consolidation using glutinous rice flour as a binder. The slurries with solid loading of 29 vol% were prepared. The amount of glutinous rice flour was varied from 1 to 9 wt%. After mixing the slurries were poured into a plastic mold and kept in an oven at 75 ˚C for an hour to promote starch gelatinization. The green samples were dried and sintered at a temperature range of 900-1300 ºC for an hour. Bulk density and compressive strength of the fused silica ceramics with 7 wt% glutinous rice flour sintered at 1150˚C were 1.26 g/cm^3 and 13.33 MPa, respectively. The phase of the sintered specimens remained amorphous with very low thermal expansion coefficient of 0.58 x 10^{-6} C^{-1}.

IND-O-053

Synthesis of Spinel Color Pigments from Aluminum Dross Waste

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Keywords: Color pigment, Ceramics, Spinel, Aluminum dross, Glaze

Spinel-based ceramic color pigments were successfully synthesized from utilization of aluminum dross waste and relevant oxide precursors by solid-state processing. Cobalt ions were selected as a chromophore to produce blue pigments. The conventional oxide route was also carried out for comparison purposes. The spinel phase readily formed when fired at 1100 °C; longer duration yielded a higher degree of purity. No preferential orientation of XRD reflection was observed, indicating random crystallographic arrangement. Phase formation was also confirmed by Fourier Transformed Infrared Spectroscopy (FTIR) which displayed both Co-O tetrahedral and Al-O octahedral which are the main framework for a spinel crystal. Slightly sharper FTIR peaks for the dross route compared to those from the oxide route suggest a difference in crystallinity between the two with different precursors. The particle size distribution was relatively wide (5 – 30 micron), possibly due to a crude nature of the dross precursor. The UV-vis spectra showed absorption in the range of 450-550 nm which is associated with the blue color caused by a shift of the 3d7 electrons of Co2+. The obtained dross-route pigments possessed both a and b color parameters (a = -2.3 to -2.6; b = -3.4 to -4.0) in the negative territory, implying greenness and blueness respectively. The L values were in the 20-30 range. When incorporating into practical glazes, the b parameters unexpectedly became more negative, indicating an even deeper blue tone. This result suggested a high potential for utilization of this dross waste as an alternative precursor source for sustainable production of spinel ceramic pigments.

IND-O-055

Preparation of Consolidated Body of Zeolite from Rice Husk Ash

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Keywords: Rice husk ash, Zeolite, Geopolymer

Rice husks (RHs) are agricultural wastes which consisted of approximately 80 mass% organics and about 20 mass% silica. Despite the massive amount of production worldwide, so far it has been recycled only for low-value applications. However, in Thailand, RHs applied as fuel for thermal power generation systems and then it produced ash (Rice husk ash: RHA) in large quantity, three million ton per year, with silica and carbon. In addition, our research group reported that using the reaction of geopolymer can synthesize zeoliteA with consolidated body. ZeoliteA is a kind of zeolite and widely used as humidity conditioning materials and builder for detergent due to its low silica-alumina ratio. And MFI zeolite are also a kind of zeolite but the silica-alumina ratio is very high. So, MFI zeolite has catalytic activity and well-defined micropore structure. However, MFI zeolite is not widely utilized because of difficulty to make consolidated MFI.

So, in the present study, the possibility of the usage of RHA as raw materials for functional materials, especially consolidated body of zeoliteA and MFI zeolite were investigated to suggest high-value application of RHs. Using geopolymer reaction, to synthesize consolidated zeoliteA and MFI zeolite with 100% was also challenged.

For zeoliteA, RHA and sodium aluminate were weighted as Si:Al:Na=1:1:1.23 in molar ratio and mixed with de-ionized water 40 mass% of solids weight to prepare slurry. And then, the slurry was poured into mold and heat-treated at 50, 60℃ for 24 h under steam atmosphere. After heat-treatment, consolidated bodies were characterized for phase composition (XRD) and microstructure (SEM).

For MFI zeolite, using RHA, metakaolin and water glass as raw materials with TPA (Tetra propyl ammonium bromide) technique or S.C. (Seed crystal) technique with specific heat-treatment conditions were conducted. The same characterizations as zeoliteA also were done.

IND-O-056

Influence of In-situ Calcium Hexaluminate on Mechanical Properties in Alumina-Magnesia Monolithic Refractories

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Keywords: Effective fracture energy, $MgAl_2O_4$ spinel, Calcium hexaluminate, Monolithic refractory.

Alumina-magnesia monolithic, castable refractories are used to line the inner wall of steel ladles. While firing, in-situ $MgAl_2O_4$ spinel is occurred from the reaction of Al_2O_3 and MgO to lead volumetric expansion of refractories. Moreover in-situ Hibonite ($CaO \cdot 6Al_2O_3$: CA6) is formed from the reaction between $CaO \cdot Al_2O_3$, which is a main component of calcium aluminate cement, and Al_2O_3 at high temperatures in refractories. CA6 causes 3% of volume expansion owing to anisotropic grain growth from the formation of hexagonal plates. However, studies about the relationship between CA6 formation and mechanical properties in alumina-magnesia monolithic refractories have not yet been done. Crack propagation due to thermal shock is critical damage for refractories. So, the effective fracture energy, γ_{eff}, which is related with crack propagation, are important mechanical property for our materials.

In the present study, γ_{eff} of two monolithic compositions, containing spinel and CA6 were evaluated under the comparison between using preformed spinel and magnesia (i.e., in-situ spinel), as sources of spinel. Both monolithic refractory compositions were prepared by using spinel and CA6 with a mass ratio of 1:1 under stoichiometric compositions calculation. And samples were fired around the CA6 forming temperature, 1300 -1500 ºC. After that, samples were tested for identification and quantitative analysis of crystalline phases by XRD, apparent porosity by Archimedes, pore distribution by mercury porosimetry, γ_{eff} by work of fracture (WOF) method, and microstructure by SEM. The results showed that γ_{eff} of sample contained preformed spinel was higher than one of sample using magnesia because of preformed spinel sintering progressed. But for both samples, the formation CA6 hexagonal plates increased the porosity, resulted in decreasing γ_{eff} with increasing heat treatment temperature. So, it was cleared that the increasing porosity due to CA6 hexagonal plates spoiled the reinforcement of chemical bonds by spinel sintering.

IND-O-071

Automatic Controls of Rheological Parameters for Pressure and Traditional Casting and Robot Glazing: How Process Control Can Support the Sanitary-ware Industry for the New 4.0 Concept

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Keywords: Viscosimeter – Rheology – Slip – Glaze

Viscometers are ideal for measuring and controlling viscosity of ceramic slurries and glazes.
Most precision cast product demand that the casting stage, where the ceramic slurry is applied, is precisely controlled while robot glazing asks for constant glaze parameters to allow the best plant performances.
Typically, sanitary-ware industry can waste a lot of material and obtain low yields of fired products due to improper rheological parameters control.
Manufacturers link the ceramic slurry and glaze control with off-line viscosity measurements. However, the manual viscosity measurement method and the ever-changing process conditions within the plant hamper proper control of this critical stage. The condition of the off-line viscosity measurement is often a non-agitated sample that may not give a true representation of the resistance to flow, i.e. viscosity of the monitored fluid.
Aim of Marcheluzzo Ceramics report is to present the results obtained with an automatic system developed by the Company to have a more accurate and automatic method to measure and eventually control the viscosity, thixotropy, density and temperature of the ceramic slurry and, with exclusion of the thixotropy, of the glaze, with remote access to the data and alarms for all the monitored parameters.

ADV-O-007

Development of Perovskite Solar Cells Inspired by Ceramic Science and Technology

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Keywords: perovskite solar cells, low-cost hole transportation layer, lead-free active layer, 3-step method

Perovskite solar cells (PSCs) were first reported by Kojima et al. with a power conversion efficiency (PCE) of 3.81% in 2009. Recently, the PCE of PSCs has been much improved to 22.1%, and thus PSCs are focused all over the world. There exists some problems of PSCs, such as (1) expensive organic hole transportation material, (2) insufficient reactions between starting materials, and (3) using lead (Pb) in the active layer. Here we present our recent development of PSCs as follows:

(1) A new low-cost hole transportation layer (CuI)
An organic material, (spiro-OMeTAD), is generally used as a hole conductor of perovskite solar cells (PSCs), but spiro-OMeTAD is much more expensive than other materials used in PSCs. Here, we have prepared PSCs with a cost-effective CuI hole transport layer by spin coating. The CuI-based PSC recorded PCE of 2.22% (max) on the day of production and PCE of 6.52% (max) after the 20 days of production.

(2) A new process for the active layer (i.e., 3-step method).
A new 3-step method for the active layer has been developed, based on the 2-step method with an additional spin-coating of $CH_3NH_3(I,Br)$ solution on the $CH_3NH_3PbI_3$ film to scavenge remnant PbI_2. The 3-step method improved light absorption of the film by converting the residual PbI_2 into $CH_3NH_3PbI_{3-x}Br_x$. The maximum power conversion efficiency was improved from 12.9 % (2-step) to 14.4 % (3-step).

(3) A potential lead-free active layer
Methylammonium bismuth iodide, $(CH_3NH_3)_3Bi_2I_9$, is a promising lead-free perovskite active layer for solar cells. By using gas-assisted deposition method, we have successfully prepared dense and smooth $(CH_3NH_3)_3Bi_2I_9$ active layer, resulting in 25% improvement in V_{OC} and 17% improvement in efficiency compared with the conventional 1-step method.

ADV-O-014

Flexible Collagen/Biphasic Calcium Phosphate Composite Scaffold for Dental Implants

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Keywords: Collagen, Biphasic calcium phosphate, Composite, Scaffold, Flexible

Bone, a rigid organ, is a composite material composed of three major components which are a mineral phase of calcium phosphate, an organic phase of polymer such as collagen type I and water. Of its dry mass, around 60-70% is bone mineral. Most of the rest is collagen. To turn the hard bone to the soft bone, the ratio of collagen must be higher than the mineral phase of calcium phosphate. Therefore, the objective of this work is to prepare the flexible collagen/biphasic calcium phosphate (BCP) scaffold through freeze drying technique. Due to the flexibility of Col/HA composite, it is potential to be used as a dental implant material particularly for root canal healing. The effects of cooling rate before freeze drying and ratio between collagen and BCP on the morphology, texture profile and mechanical properties of the composite were investigated and discussed. The morphology of the composite was analyzed by scanning electron microscopy (SEM), meanwhile, a double compression test was used to determine the textural properties and mechanical properties of soft materials. Results show that the different cooling rates of the sample before freeze drying affected on the morphology of the composite. The faster the cooling rate the morphology of the composite appeared as the layer of plate like structure from icy plate which enhanced the strength and flexibility of the composite compared to the pure collagen as a control. The composite produced by using the slower cooling rate appeared in the form of polymer network like structure obtained a higher strength but lower flexibility. With increasing BCP in the composite, the Young's modulus was increased, in contrast the flexibility was reduced. However, all these samples showed a good handling characteristic with a flexible properties which is suitable enough to be used as a dental implant material particularly for root canal healing.

ADV-O-042

Photocatalyst Activities of Iron Oxide-doped Titania under Visible Light

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Keywords: TiO_2, Fe-doped TiO_2, P25, Visible light, Textile dyes

Metallic doping is one of the methods used to modify surface characteristics of titania (TiO_2) for shifting the active range from UV to visible. In this study, photocatalytic performance of TiO_2 doped by iron oxide (Fe-TiO_2) under visible light illumination was investigated. A set of various Fe (III) (0, 0.1, 0.5, 1.0, 2.5, 5.0, 10.0 wt%) was doped onto a commercial TiO_2 (Degussa P25, Germany) using a one-step impregnation method. The synthesized powders were calcined at 300, 400, 500 and 600ºC for 4 h, respectively. Microstructure and phase present of the calcined powders were characterized using field emission scanning electron microscopies (FE-SEM), transmission electron microscopies (TEM) and an X-ray diffractometer (XRD), respectively. Photocatalytic performance of the catalyst powders calcined was studied by degradation of textile dyes under visible illumination within a fix maximum interval set in this study. Kinetic studies of the dye degradation were determined and discussed.

ADV-O-043

Effect of Peptizing Agent Concentration on Morphology of Unsupported Alumina Membrane

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Keywords: Ceramic membrane, Peptizing agent, Sol-gel, Mesoporous

Ceramic membranes have received significant attention from both academia and industry, as they show the great potential in several important applications. For example, ceramic membranes are promising for H_2 separation, the recovery of CO_2 from natural gas and the reduction of green-house gas emission from flue gas. The aim of the present study was to evaluate the effect of peptizing agent concentration on morphology of unsupported alumina membranes that are suitable for gas separation. The unsupported alumina membranes were prepared by the sol-gel method using aluminum-tri-sec-butoxide as a precursor and acetic acid as a peptizing agent. The particle size distributions of produced boehmite sols, as measured by dynamic light scattering technique, range from 10 to 600 nm. The increase in the concentration of acetic acid results in formation of particles of smaller median diameter. The pore volume and size distribution of unsupported alumina membranes were characterized by the Brunauer–Emmett–Teller (BET) method of adsorption of nitrogen gas. The pore size distributions of membranes were rather narrow in the range of 3 to 6 nm. The average diameter and volume of pores increase while the concentration of acetic acid increases.

ADV-O-047

Luminescence Property of Ceramic Phosphors Synthesized by Melt Quenching Technique

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Keywords: Phosphor, Melt, Rare earths

RoHS directive restricts the use of hazardous substances such as lead, mercury, cadmium and hexavalent chromium in the manufacture of electrical and electronic equipment after July 2006. Although a mercury-discharge based fluorescent lamps were not the restriction object at present, the mercury based lighting will be prohibited in the near future. Therefore, the importance of mercury-free illumination using new phosphor materials and emitting devices is increasing. For rapid screening and synthesis of new ceramic phosphors, we have applied novel synthesis technique “Melt Quenching Synthesis”. In the melt synthesis, the mixture of oxides or their precursors is melted in a short period of time (5-60 seconds) by a strong light radiation in Xe arc imaging furnace. A spherical molten sample where multiple cations were mixed homogeneously was directly solidified on a Cu hearth. The Melt Quenching reactor system has some advantages; i) the whole part of solid reactants can be kept at a steady temperature, and ii) heat can be transferred very fast to substances because each reactant is perfectly melted. The phosphors synthesized by the “Melt Quenching Synthesis” show superior luminescence property because of high homogeneity, high crystallinity and relatively few defects. This novel technique is powerful tool for rapid screening and improvements of phosphor materials.

ADV-O-050

Effect of Nonaxial Stress on Dynamic Hysteresis of Soft PZT Bulk Ceramic

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Keywords: hysteresis, energy dissipation, nonaxial load, soft PZT.

The effects of electric field and nonaxial mechanical stress on hysteresis area were investigated in soft PZT bulk ceramic. Poled samples were attached on and pressed though a set of custom-made sample holders. The poling direction of a sample attached on a sample holder makes an angle θ with the compressive load direction and the set of sample holders can make angles 0°, 15°, 30°, 45° and 60°. Hysteresis curves were measured by a modified sawyer tower circuit under compressive stress 2 to 25 MPa and piezoelectric constant d_{33} were measured before and after being pressed. The scaling relations between hysteresis area and electric field and compressive stress were obtained in the form of $\langle A - A_{\sigma} \rangle \propto f^{-0.4} E_0^{n}$ at each angle of inclination with a different n, which reveals the difference in energy dissipation under nonaxial stress and stress free conditions. At a fixed nonaxial stress, the exponent n linearly increased as θ increased, while piezoelectric constant d_{33} after being pressed was nearly constant as θ increased. These results would suggest that the nonaxial stress could be decomposed into compressive stress and shear stress and both stresses could result in 90° domain switching. Their contributions on domain switching could be on a par, but only the compressive stress could be capable to constrict the domain movement during electric field applied.

ADV-O-051

Effect of Time and Temperature on Bovine Serum Albumin Protein Incorporated 3D Printed Hydroxyapatite by Biomimetic Co-Precipitation Technique

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Keywords: Bone substitutes, Calcium phosphates, Hydroxyapatite, Biomimetic, Bovine serum albumin.

Biomimetic process could be employed to co-deposit calcium phosphate and incorporate active ingredients to alter the storage content and releasing profile compared to typical direct absorption technique. By using bovine serum albumin (BSA) as a model protein, the effect of soaking times and solution temperatures in biomimetic co-precipitation process on weight change, phase composition and microstructure of protein deposited three dimensional printed hydroxyapatite (3D printed HA) were studied. At 23 °C, weight change of all samples monotonically increased with increasing soaking time whereas the weight change initially increased, but leveled off later with increasing soaking time when using solution temperature of 37 °C. At 50 °C, no difference in weight change with soaking time was observed, but even decreased at at 24 hours soaking period. This could be related to the rivalry between the dissolution of 3D printed HA, the precipitation of new calcium phosphate crystals and the incorporation of BSA during biomimetic process at different times and temperatures. From X-ray diffraction and scanning electron microscopy, no influence in time and temperature on the phase composition and microstructure was observed. New plate-like calcium phosphate crystals were formed and octacalcium phosphate and HA were found to be the main phases of all biomimetically BSA deposited 3D printed HA.

ADV-O-061

Effect of Nucleation Heat Treatment on Mechanical and Chemical Properties of Mica-based Glass-ceramics as Restorative Dental Materials

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Keywords: Mica-based glass-ceramic, Heat treatment, Nucleation, Chemical solubility

Machinable mica-based glass-ceramic with 4% fluorapatite derived from SiO_2-Al_2O_3-MgO-MgF_2-$SrCO_3$-$CaCO_3$-CaF_2-P_2O_5 system was developed as restorative dental materials to replace the damaged or worn out teeth for esthetic and applicable purposes. It has several remarkable properties such as hardness, insulation, corrosion resistance, wear resistance, chemical resistance and biocompatibility. This study aimed to focus on effect of heat treatment time relating to properties by varying the optimum nucleation time for 3, 12 and 48 h at 643°C, and crystallization for 3 h at 872°C, respectively. The three glass-ceramics were analyzed using universal testing machine (UTM) for biaxial flexural strength and fracture toughness. Micro Vickers hardness tester was for hardness. The crystalline microstructures were characterized by scanning electron microscopy (SEM) resulted that the glass-ceramics produced with different heat treatment times showed different crystal sizes and distribution. The glass-ceramic with 48 h nucleation time presented smallest crystals with homogeneity, lowest chemical solubility especially for acetic acid (326.07 $\mu g \cdot cm^{-2}$) and fracture toughness (1.063 $MPa \cdot m^{1/2}$) but highest biaxial flexural strength (223.86 $N \cdot mm^{-2}$) and hardness (407.99 HV). It was concluded that the difference of nucleation times influenced the physical, mechanical and chemical properties of glass-ceramics. However, all values of research were acceptable according to ISO 6872:2015, Dentistry-Ceramic materials, type II class b, which could be used as single-unit anterior or posterior prostheses.

ADV-O-062

Effect of Fluorapatite and Nucleation Time of Mica-based Glass-ceramics for Restorative Dental Materials

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Keywords: Mica-based glass-ceramics, Heat treatment, Restorative dental materials, Nucleation time

The aim of this study was to prepare mica-based glass-ceramics with varied fluorapatite content by mole percent contents (mol %) 2, 3.5 and 6 (GCF2, GCF3.5 and GCF6) and nucleation time 3 h and 48 h which were investigated by DTA, XRD, SEM, and biaxial flexural strength. The results showed that optimum nucleation and crystallization temperature were GCF2: 650 °C and 940 °C, GCF3.5: 643° C and 897 °C and GCF6: 701 °C and 877 °C, respectively. Patterns of XRD were found that when the fluorapatite content increased, as a result, higher anorthite and lower calcium mica intensity were shown. From SEM analysis, it revealed interlocked plate-like mica, needle-like microstructures of fluorapatite, respectively, in all specimens. During the heat treatment with longer nucleation time, it caused small and fine grains of crystallization. It was noticed that larger grain size, less opacity and more hardness were derived from adding the content of fluorapatite. The GCF3.5 was the most suitable type of glass-ceramics that possessed the highest strength. Furthermore, the tendency of smaller grain size and high biaxial flexural strength of glass-ceramics was better with longer time in heat treatment process. In this research, the properties of glass-ceramics were acceptable according to ISO 6872:2015 type 2 class 2b which can be used for restorative dental materials as inlays, onlays and crowns.

ADV-O-070

Direct Liquid Injection Chemical Vapor Deposition and Characterization of Graphene: Optimization of Copper Foil Substrate Surface

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Keywords: Direct liquid injection, Chemical vapor deposition, Copper foil, Graphene

This study purposes to optimize Cu foil substrate surface for the CVD growth of graphene. We employ chemical pretreatments and thermal annealing at high temperature to modify surface morphology and crystal orientation of the Cu foil. Initially, we remove oxide on Cu foil by chemical cleaning in HCl. Subsequently, an electro-polishing in H_3PO_4 was utilized to reduce a surface roughness. Then, Cu foil was subjected to thermal annealing at temperature between 890 to 980^{o}C for 5 to 30 min in order to enlarge the grain size of the (111) domains. During thermal annealing, total pressure and N_2 gas flow rate were kept at 2 mbar and 300 sccm, respectively. Surface morphology and crystal orientation of the Cu foil were investigated by scanning electron microscopy, atomic force microscopy and X-ray diffraction. We find that chemical cleaning using HCl at 37% concentration for 40 s removes most of the oxide and residues on the Cu foil surface. In addition, we achieve the minimum RMS roughness of 2.2 nm when Cu foil surface was electro-polished in 60% H_3PO_4 at the voltage of 2.5 V for 40 s. We then anneal the Cu foil and observe that, at 920 ^{o}C for 10 min, the Cu foil yields the strongest X-ray diffraction intensity ratio from a desirable (111) plane. In order to test the quality of the Cu foil after treatment, we conducted direct liquid injection CVD at 950 ^{o}C for 10 min on Cu foils prepared at various annealing conditions. Cyclohexane with flow rate of 5.94 mmol/min and N_2 were used as a carbon precursor and carrier gas, respectively. We found that only Cu foil annealed at 920 ^{o}C for 10 min, which produces the minimum roughness, yields monolayer graphene, according to Raman spectroscopy, while, at other annealing conditions, multilayer graphene is observed.

ADV-O-075

Effects of an Intermediate c-GaN Buffer Layer on Structural and Optical Properties of AlN Films on MgO (001) Substrates

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Keyword: Buffer layer, Structural property, Optical property and Cubic AlN

Effects of an intermediate cubic GaN (c-GaN) buffer layer on structural and optical properties of AlN grown films on MgO (001) substrates by RF-MBE have been investigated. There are 2 types of c-GaN intermediated layers: a one-step buffer layer with a 7-nm-thick c-GaN layer and a two-step buffer layers with a sequence of a 7 nm- and a 200 nm-thick c-GaN layers. Raman spectra of the AlN films with a two-step c-GaN buffer layers showed the cubic-phase AlN (c-AlN) related phonon modes at 662 cm^{-1} and 902 cm^{-1}, which are corresponded to TO and LO phonons, respectively. On the other hand, the AlN film with one-step buffer layer and the AlN film directly grown on MgO (001) substrate showed the hexagonal-phase AlN related phonon modes at 610 cm^{-1}, 653 cm^{-1}, 884 cm^{-1} and 912 cm^{-1}, which are corresponded to A_1 (TO), E_2 (high), A_1 (LO) and E_1 (LO) phonons, respectively. This demonstrates that structural phase of AlN can be modified from hexagonal to cubic phase with an insertion of a two-step c-GaN buffer layer. This result was confirmed by $2\theta/\omega$ scan mode in X-ray diffraction measurements. Additionally, UV-VIS spectroscopy measurements were performed to investigate fundamental optical parameters like bandgap and absorption coefficient of AlN films. It is found that the AlN film with two-step c-GaN buffer layer exhibited the optical parameters of c-AlN. While other AlN films showed the optical parameters of mixed-phase AlN. Optical bandgaps for the AlN films with two-step, one-step and without c-GaN buffer layer are 5.11, 5.11 and 5.36 eV, respectively. These values agree with a theoretical value of cubic AlN. Our results demonstrate that a use of an intermediate c-GaN buffer is a one of the key factors that increase cubic phase purity in the MBE grown c-AlN film.

ART-O-083

Optimum Composition and Temperature to Produce Jewelry from Bone Ash

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Nowadays, many Thai and Asian people cremate the bodies of deceased relatives and keep the remains (bone ash) at temples or in their homes to remind them of their loved ones. Furthermore, some people use the services of private companies to make jewelry from the ashes of relatives who have passed away. This can bring some comfort to the living. However, these companies charge very high prices for this service due to the technical complexity of the process. The current study examines a way to produce bone ash jewelry in a more economical fashion. It proposes an optimum composition and temperature to produce this jewelry using a simple technique.

ICTA2017

ART-O-093

The Optimize Composition of Waste Coffee Grounds for Making Small Vase Set Ash Glazes

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Keywords: Ash glazes, Coffee bean, Purposive Sampling

In this work, the optimize composition ratio of glazed ashes from waste coffee grounds was carried out, in order to make small vase set which inspired by coffee bean. The waste coffee grounds were prepared by firing at 1,250˚C in electric furnace with oxidation and reduction atmosphere. Then, the obtained coffee ashes were mixed with feldspar and Kaolin from Lampang by using purposive sampling technique. The purposive sampling technique is the composition calculated technique that normally used for estimated the optimize ingredient of glazed ashes. The purposive sampling technique is using only 10 formulas and each formula was calculated to 100% of weight ratio. The study found that the glazed ashes from waste coffee grounds gave the attractive individual glazes and might be develop for further ceramics commercial glazes in the future.

GLA-O-017

The Effect of Decolorizing Agent on The Optical Properties of High Iron Contents Soda-lime Silicate Glass

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Keywords: High iron content sand, Soda-lime silicate glass, Decolorizing agent.

The aim of this study is to decolorize the high iron content (more than 0.1 %wt Fe_2O_3) glass. The soda-lime silicate glass contained 0.13 wt% iron oxide (Fe_2O_3) was prepared from high iron content sand with 0.17 wt% of Fe_2O_3. Iron oxide in soda-lime glass presents in two forms Fe^{2+} (green) $\leftrightarrow$ Fe^{3+} (yellow). Normally this sand is not suitable to produce tableware. The glass manufactures are required high purity of sand because they want to control the amount of iron oxide as low as possible. Usually tableware glass is contained small amount of iron oxide (0.01 - 0.04 wt% Fe_2O_3) for avoiding iron effect (green color). The soda-lime silicate glasses were decolorized by three different agents, Neodymium oxide (Nd_2O_3) Manganese oxide (MnO) and Tin oxide (SnO_2) 0.125 0.25 0.50 1.00 and 2.00 %wt respectively. The glasses were melted twice in the platinum crucible and investigated the optical properties using UV-Vis spectroscopy. The results of the color in CIE L*a*b* system were found that glass containing MnO and SnO_2 slightly changed to white shade but still presented in green. However glasses containing 1.00 and 2.00 %wt SnO_2 were nearly clear. The glasses containing Nd_2O_3 the results were satisfied. The glass containing 0.50 %wt Nd_2O_3 showed very clear. Anywise the color of glasses containing 1.00 and 2.00 %wt Nd_2O_3 turned to blue. The reaction of glasses containing MnO and SnO_2 occur according to the mechanism of chemical decolorization. The reactions describe by the following equation $Fe^{2+} + Mn^{3+} \leftrightarrows Fe^{3+} + Mn^{2+}$ and $Fe^{2+} + Sn^{5+} \leftrightarrows Fe^{3+} + Sn^{4+}$. But the reactions are limited and strongly depending on the redox equilibrium. For Nd_2O_3 the reaction present according to physical decolorization. Because the color of Nd_2O_3 is stable in glass melted that can dismiss the color of Fe_2O_3 directly. Therefore, this method can be applied for the tableware glass production with high iron content sand.

GLA-O-023

Radiation Shielding Properties of BaO-ZnO-B_2O_3 Glass For X-ray Room

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Keywords: X-ray shielding materials, Barium oxide, Half value layer (HVL)

This study is to investigate a radiation shielding glass and parameters that necessary for x-ray room. Nowadays, the common used of radiation shielding glass is lead (Pb) by the International Electrotechnical Commission (IEC) standard is determined about the characteristics of radiation interaction. In this study, we performed a comparison of lead glass product commercial window, and proposed lead-free glass in the composition of xBaO:20ZnO:(70-x)B_2O_3 which are applied used for lead glass replacement. The result found that, the linear attenuation coefficients were increased with the increase of BaO concentrations and the decrease of x-ray tube. The developed glass samples were investigated in terms of half value layer (HVL) and mean free path (MFP) that found decreased with the increase of BaO concentrations which the good characteristics for application in a x-ray shielding glass manufacturing.

GLA-O-024

Comparison of the properties of glasses made from two different bottom ashes

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Keywords: bottom ash, black glasses, recycled glass

Bottom ash is a waste byproduct generated from the combustion or incineration of materials such as coal and household waste. It is a mixed oxide powder of variable composition, though typically high in silica. As a low-cost, readily available material, it has found applications primarily in construction for use as backfill. As a silica-rich, mixed oxide powder though, it may also have glass forming ability. This research studied the possibility to use domestically produced bottom ash powder in glass making. Two bottom ash powders were used, one from a waste incinerator (Phuket) and the other from a coal-fired electric plant (Mae Moh Power Plant, Lampang). The bottom ash was milled into a fine powder and melted within the temperature range of 1300-1500 ºC, for 2 hours. The melts were cast in a steel mold and then annealed at 500 ºC for 2 hours. It was found that both bottom ashes could successfully produce glasses. The density, hardness and optical characteristics of the glasses will be discussed.

GLA-O-097

Effect of Eu^{3+} Ions on the Physical, Optical and Luminescence Properties of Lithium Aluminium Phosphate Glasses

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Keywords: phosphate glasses, europium oxide, luminescence properties.

The physical, optical and luminescence properties of lithium aluminium phosphate glasses different doping europium oxide have been investigated to evaluate their properties for solid-state lighting applications. The density and molar volume measurements were carried out at room temperature. The absorption spectra were investigated in the UV-Vis-NIR region from 200 to 2500 nm. The emission spectra, excited with 394 nm excitation wavelength showed four emission transitions corresponding to $^5D_0 \rightarrow {}^7F_1$ (591 nm), $^5D_0 \rightarrow {}^7F_2$ (612 nm), $^5D_0 \rightarrow {}^7F_3$ (648 nm) and $^5D_0 \rightarrow {}^7F_4$ (698 nm). The optimal concentration of Eu_2O_3 in lithium aluminium phosphate glasses was 1.00 mol%.

MAT-O-022

Non-proportionality and Scintillation Properties of YAG:Ce Scintillator by Compton Coincidence Technique

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Keywords: Scintillator; non-proportionality; Compton coincidence technique

The aim of this research, have been characterized non-proportionality and the scintillation properties of YAG:Ce scintillator by the Compton coincidence technique (CCT). The ^{137}Cs was used as a radioactive source with an energy 662 keV and were recorded at seven scattering angles of 30°-120°. The electron energy resolution, the light yield and non-proportionality were measured. It was found that, the linear relations are observed for YAG:Ce scintillator indicated that the energy resolutions are inverse proportional to the square root of energy. In addition, the result show that the light yield slightly increased with increasing the electron energy and were observed YAG:Ce scintillator demonstrated good proportional property in the electron energy range.

MAT-O-034

Preparation, Properties and Moisture Buffer Value of the Porous Ceramic Tile

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Keywords: MBV, Porous ceramic, dolomite, diatomite

The humidity control porous material in interior construction can be used for comfort and wellbeing of the residents. The porous material can absorb excess moisture in the building when the humidity is high and release moisture out to the air when the humidity is low. The porous ceramic tiles with ability to absorb and release moisture were produced by using some mixtures of dolomite and/or diatomite. After firing at 900-1100ºC, the physical properties and Moisture Buffer Value, MBV were investigated. The porous ceramic tiles with 10% dolomite (HCTD10) or 10% diatomite (HCTDA10) after firing 1100ºC showed high MBV of 5.78 and 6.84 g/m^2 %RH in comparison to 0.39 and 0.42 g/m^2 %RH for the general brick and concrete, respectively. Bending strength 30.22 MPa and porosity 40.30% of HCTD10 were higher than those of HCTDA10 which was 28.01 MPa and 22.31%. On the other hand, average pore size of HCTD10 was 0.30 μm, larger than HCTDA10 which was 0.20 μm. In addition, phase and structure changes before and after humidity absorption were also studied by XRD and SEM, in order to anticipate the consistency in long term using of the porous ceramic tiles.

MAT-O-067

Study of Thermal Property of Glass-ceramics Produced from Soda Lime Glass Waste by Single-step Sintering Process

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Keywords: Thermal properties, Soda lime glass, Glass-Ceramics, Sintering.

Soda lime glass (SLG) is known as one type of glass mainly used for the manufacture of beverages and food packaging. The feasibility to produce glass-ceramics (GC) from SLG consists of large proportion of silicate and has considerably low of melting temperature. Due to large consumption of beverages and foods, SLG makes up a large bulk of the waste. Producing glass-ceramics (GC) from SLG is thus interesting. Processing of SLG to GC is strongly dependent on their thermal property. Before processing, thermal profile of SLG was analyzed differential scanning calorimetry; crystallization temperature at 711 ºC was identified when heating at 5 ºC/min rate. It was also possible to extract information about crystallization kinetic by applying the Kissinger and Ozawa relation. It was found that crystallization activation energies were 365.06 and 381.60 kJ/mol, respectively. For the GC processing, SLG powder was mixed with precursors to the ratio of 60SLG-35SiO_2-2TiO_2-2ZnO-1CuO before sintering with single step method at 711, 800, 850, 900, 950, 1,000 ºC. An analysis by XRD has shown that there were two phases; alpha- and beta-phase, in the sintered samples. Different sintering temperatures have yielded different proportion of alpha- to beta-phases. SEM/EDX has also revealed uneven distribution of different oxides in the glass-ceramics.

MAT-O-111

Micromorphology of Porosity Related to Electrical Resistance of Dental Luting Cements

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Keywords: micromorphology, electrical resistance, porosity, dental luting cements

Dental luting cement is not only served as adhesive materials for prosthesis but also serve as a protective barrier for the pulpal tissue. The aim was to investigate the relation between micromorphology of porosity and electrical resistance of dental luting cements. Five dental luting cements were evaluated: zinc phosphate, glass ionomer, and three types of resin luting cements. Porosity of the specimen was analyzed by micro computed tomography. Electrical resistance of cement specimen was measured at voltage of 125 V in 0.1 M KCl solution from the first day up to 30 days and solubility of each specimen was calculated from the weight change. The resin luting cements provided the highest electrical resistance regardless of amount of porosity. Zinc phosphate and glass ionomer had high porosity and the lowest resistance (14 and 3 kΩ, respectively). Although zinc phosphate and glass ionomer were soluble, their solubility values were not significantly different. The electrical resistance of luting cement was not directly affected by the amount of porosity however the cross-section of 3D images showed that it seem to be related to pore connection. There is no correlation between electrical resistance and percentage of porosity but the morphology of porosity may have an influence on the electrical property of luting cement. Models of pore connection were proposed to explain the electrical resistance of luting cement.

POSTER PRESENTATIONS

IND-P-005

The Construction of the Small CNC Milling Machine for Ceramic Cup Products

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Keywords: small CNC milling machine, step motor, ceramic cup

The purpose of this study is to construct the small CNC milling machine for ceramic cup products. This machine has an aluminum structure (width: 59.5 cm, length: 65.2 cm, and height: 66 cm). The thickness of the aluminum is 3.81 cm in order to support and install other three internal components: (1) sliding and driving support system that is 41.0 cm on the x-axis, 37.5 cm on the y-axis, and 24.0 cm on the z-axis, respectively, as well as it has a step motor controlling the movements on the x-axis, y-axis, and z-axis, respectively; (2) the piecework plate consists of an acrylic plate supporting the holder of the square shaped stone; and (3) the control system that has a 24 volt and 6.5 amp power supply , a step motor control board, spindle control board, 24 volt fan, switch, and E-Stop button.

By testing the efficiency of the machine with 11.5 conical ceramic cup samples, it was found that the results had surfaces as smooth as the models. The main problem was that the piecework must be milled for two times: 1.5 hours of the semi-rough process and 2 hours of the finishing processes. The highest average spindle speed for each process is 600-800 rounds/minute.

IND-P-006

Analyzing the Performance of Ceramic Kiln by Using Thermal Image Technique for Reducing Energy Costs

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Keywords: Ceramic Kiln, Thermal Efficiency, Thermal Image and Energy.

The aim of this research is to find a way to reduce energy costs by using thermal image technique for investigating the thermal efficiency of ceramic furnaces. The case study is "Ban Nam Jo Ceramic". The researchers collected information by doing in-depth interviews within the research area, collecting preliminary data and using the thermal images in the technical analysis. The researchers also measured the temperature and volume of gas in the furnace. After that, the calculation to find the energy balance and the thermal efficiency of ceramic kilns were performed. The data showed that the first measured furnace had the calculated thermal efficiency of 9.99%. After the maintenance, the thermal efficiency increased to 16.64%. Furthermore, the volume of liquid petroleum gas decreased by 40%, and the damage in products after firing decreased by 3 %.

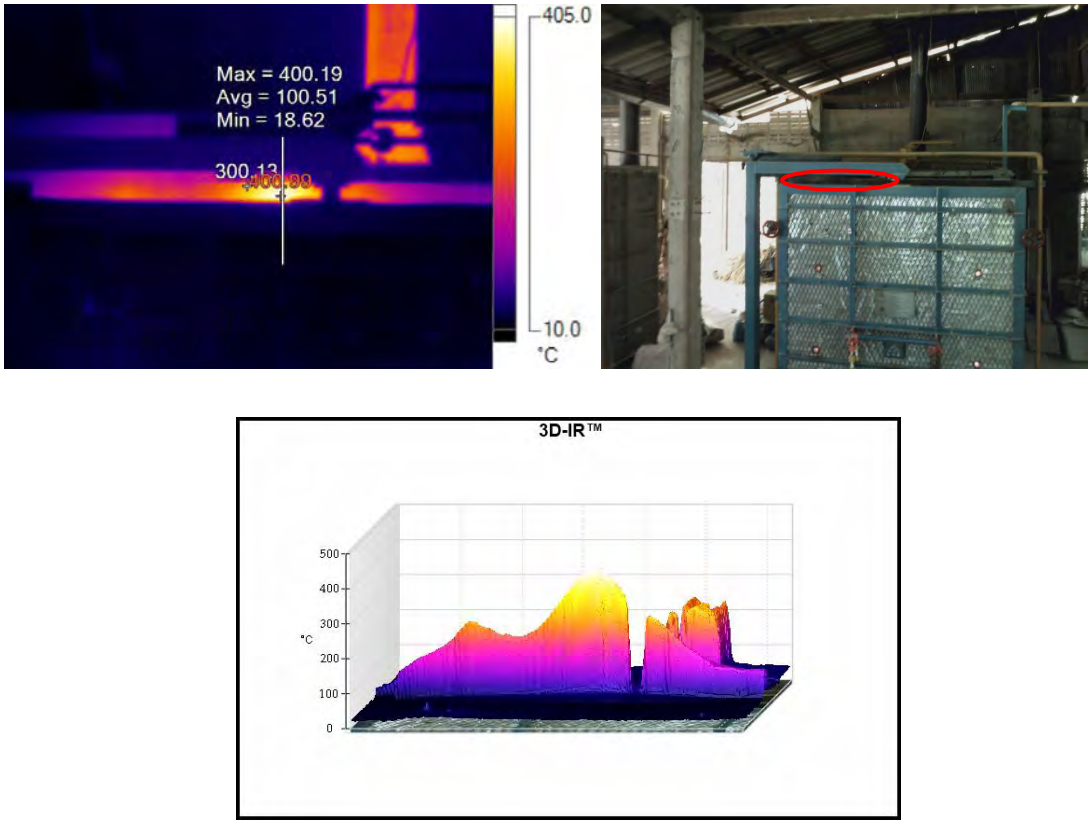

Fig. 1 Inspection the ceramic furnaces by using thermal image technique

IND-P-020

The Adsorption of Cadmium Ions on Fly Ash Based Geopolymer Particles

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Keywords: fly ash, geopolymer, adsorption, waste water treatment

Geopolymer particles from waste coal fly ash were prepared in order to investigate adsorption process of Cadmium ions. The aim of the study is to focus on factors which affect adsorption process of heavy metals on geopolymer materials. The raw fly ash was mixed with sodium hydroxide solution and sodium silicate solution. After that geopolymer was cured at 80 ºC for 24 hr. The sample was ground and washed until pH=7. The obtained geopolymer particles were dried at 60 ºC. The raw materials and geopolymer were characterized. The XRD results showed a highly amorphous structure in obtained geopolymer. The major components of waste coal fly ash and synthesized geopolymer were SiO_2, Al_2O_3, Fe_2O_3 and CaO. The BET surface area of fly ash and geopolymer particles were 0.83 m^2/g and 85.01 m^2/g, respectively. The adsorption conditions (initial concentration from 10-120 mg/L, a temperature at 25-45 ºC, pH of the cadmium ions solution from 1-5, 0.02-0.14 g. of geopolymer and contact time for 5-180 min) were studied. From removal efficiency results, synthesized geopolymer had high removal capacity for the cadmium ions (Cd^{2+}). At pH 5 of the solution, the highest Cd^{2+} removal capacity was obtained. In addition, the removal efficiency increases with an increasing geopolymer dosage, contact time and a decreasing of Cd^{2+} initial concentration. Moreover, both Langmuir and Freundlich models were investigated for studying adsorption isotherm. The result showed Langmuir model is more suitable for geopolymer adsorption of cadmium ion in aqueous solution than Freundlich model.

IND-P-025

Near Infrared Reflective Property of Spinel Pigment

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Keywords: Spinel, NIR reflectance and Inorganic Pigment

Inorganic pigment is one of the most durability and resistance to solar radiation. This is because of the highly heat reflection in the near infrared (NIR) wavelength (92% is heat built up accumulated in the NIR region). A general formula of inorganic pigment is spinel pigment, AB_2O_4, which is composed of A^{2+} and B^{3+} cation occupied in the tetrahedral and octahedral, respectively. Thus, this study is going to reveal the near infrared reflectance (NIR) properties of four different spinel pigment colours (Pink, Blue, Brown and Black). All of the pigments were synthesized via conventional solid-state reaction. As received powder pigments were characterized through X-ray diffraction (XRD) and UV/Vis/NIR spectrometer. Pink shade of pigment contains $CoAl_2O_4$ as main crystal structure reaching 88.5% of NIR reflectance (700-2500 nm). Thus, this pink powder exhibits the high performance of NIR reflective pigment. Blue ($CoAl_2O_3$) and Brown ($FeCr_2O_4$) pigments give 35.4% and 40.5% of NIR reflectance, respectively. 5.8% of NIR reflectance found on the Black pigment (Ni_6MnO_8). Therefore, the crystal structure as spinel-type oxide does not directly relate to NIR reflective property.

IND-P-029

Utilization of Alkali Treated Natural Fibers in the Fabrication of Lightweight Precast Concretes

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Keywords: Lightweight, concrete, rice straw, coconut coir, adhesion

This research fabricated lightweight concretes using ordinary Portland cement and natural fibers. The fibers were rice straw and coconut coir, which are found in large quantity throughout Thailand as agricultural wastes. The use of natural fibers not only reduces the overall weight but also reduces manufacturing cost due to cement powder saving. Concretes were fabricated with low bulk densities while maintaining high compressive strength values. The amounts of fibers in concrete compositions in this study were: 30, 40 and 50%vol rice straw and 20%vol rice straw mixed with 10%vol coconut coir. The water to cement ratio was kept within the range 0.4-0.5 and the hydration period was carried for 28 days. Coarse rice straw fibers (1-5 mm) and fine rice straw fibers (<1 mm) were treated with 15% sodium hydroxide and found effective for removing hemicellulose, lignin and fatty acids. The treatment improved surface roughness of the cellulose fibers. The adhesion between the fiber surface and cement phase was greatly improved.

The study showed that the lowest density value was obtained from 50%vol coarse rice straw samples (average value of 0.98 g/cm^3). Lightweight concrete containing 20%vol fine rice straw fiber and 10%vol fine coconut coir in the composition showed highest compressive strength value of 138.7 kg/cm^2 with bulk density reduced by 30% compared to cement mortar. The lowest thermal conductivity value was found in specimen with 20%vol fine rice straw mixed with 10%vol coconut coir (0.559 W/m.K). Low thermal conductivity value of the lightweight concretes may be applied as pre-cast walls which possess energy saving function.

IND-P-037

Effect of Oxide Addition on Physical and Mechanical Properties of Fly Ash–Based Geopolymers

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Keywords: Fly ash–Based Geopolymers; Zinc oxide; Titanium oxide; Compressive strength

Geopolymers are inorganic polymeric materials with amorphous nature, formed by aluminosilicate and alkali-metal-silicate solution under alkaline conditions. They are the most promising eco-friendly alternative to ordinary Portland cement (OPC) and cementitious materials. The aim of this study is to examine the effect of 0–3 wt% TiO_2 and ZnO addition on the microstructure and compressive strength of fly ash–based geopolymer composites application in construction and refractory materials. The composites were prepared by activating high calcium (ASTM Class C) fly ash in a combination of 5 M concentration of sodium hydroxide and sodium silicate solution (2.5:1 weight ratio) reinforced with basalt fibers. The samples were cured at 50 °C for 5 h and aged at R.T. for 28 days before performing the characterizations. The microstructure observation found that with both additives, the specimens were dense and homogeneous, though some un-reacted phases were investigated. The compressive strength of the composites with 3 wt% TiO_2 addition was 65 MPa, which increased by 16% compared to TiO_2 free samples. However, the compressive strength of the samples with ZnO addition was slightly decreased. The thermal and optical characteristics of the composites will be later discussed.

IND-P-040

The Effect of Fiber Glass on the Properties of Pozzolan Cement Composites

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Keywords: cement, pozzolan, fiber glass, composites.

In this research, the effect of fiber glass on the properties of pozzolan cement composites was investigated. In experimental, the mixture of cement powder and rice husk ash 20 wt% of cement and the fiber glass is added of 10, 20, 30, and 40 wt% of cementious were blended. Then, the samples were demolded after 24 h casting and cured in saturated lime water for 7 and 28 days. The samples were dried in air for 24 h. Finally, those samples were characterized. X-ray diffraction technique (XRD) and energy X-ray dispersive spectroscopy (EDS) were studied phase and chemical compositions, respectively. Scanning electron microscopy (SEM) was studied microstructure. Moreover, the mechanical properties were studied via the compressive strength.

IND-P-045

Utilization of Coal Fly Ash as Raw Material for Refractory Production

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Keywords: Fireclay brick, coal fly ash, Fire clay.

In this research, fireclay bricks were produced using fire clay and coal fly ash as raw materials. Coal fly ash was added to the mixture from 10-50 wt%. The shaped samples were sintered at the temperatures of 1100-1400 ºC. The mechanical property, thermal property, phase structure and microstructure of the fireclay bricks were studied.

It was found that coal fly ash can be used in the fabrication of fireclay bricks. The lower linear shrinkage and lower thermal conductivity were obtained as the higher amount of coal fly ash was added. However, Bulk density and cold crushing strength were lower in the samples contained coal fly ash. The effects of coal fly ash on the phase structure and microstructure of the fireclay bricks were investigated using XRD and SEM technique, respectively. Mullite phase decreased with the higher coal fly ash added, whereas anorthite phase increased.

IND-P-048

Preparation and Characterization of Ceramic from Power Plant Bottom Ash

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Keywords: Ceramic, Bottom ash, Phase, Physical properties

The bottom ash from Mae Moh Power plant was use to mix with cement in construction technology. However, it is not popular in construction as fly ash. To increase the value of bottom ash, it was mix with clay and feldspar then press and sinter at 1200°C to identify the phase and physical properties of ceramics including microstructure, density, shrinkage, weight loss and hardness. The composition of bottom ash sample are depends on the initial mineral composition. The X-ray diffraction results of bottom ash showed that it was consists of SiO_2, Al_2O_3, CaO, Fe_2O_3, K_2O and TiO_2. Low density of pure bottom ash ceramic can be increased when clay and a little among of feldspar are added. However, when the feldspar was increased the density was decreased. The hardness of all ceramics was not significant difference. Nevertheless, the mix ceramics seem to be reduced the hardness compared to pure bottom ash ceramic.

IND-P-052

The Fabrication of Mullite from Aluminium Buff mixture

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Keywords: mullite, refractory, aluminium buff

The aim of this work is to obtain mullite ceramics from industrial waste mixture. Aluminium buff from aluminium part manufacturer was used as rich source of alumina for mullite batch compositions. The powder mixtures were compacted by uniaxial pressing. The green compacts were sintered at temperature in the range of 1200-1400°C for 2 hours in air. The physical properties were characterized by Archimedes method and Brazilian test. Phase and microstructural analysis were done by X-ray diffraction (XRD) and scanning electron microscopy (SEM). The results showed that sintered samples derived from formulations containing clays were composed of mullite along with corundum as a secondary phase. Ceramics bodies prepared with additional clays showed better physical properties than the ones of pure aluminium buff.

IND-P-057

Utilizaton of Aluminium Dross Residue as a Raw Material for Ceramic Floor Tile

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Keywords: Aluminum dross, Floor tile, Aluminium recycle

In aluminium dross recycle process, the residues obtained after mechanically separation are the small particles contained small amount of aluminium metal. This residue contains mainly silicon dioxide (SiO2) and aluminum oxide (Al2O3), which could be used as raw materials for ceramics. In this work, aluminum dross residue was mixed with commercial floor tile clay in order to produce ceramic body. The mixtures of commercial clay and aluminum dross residue with ratios of 100:0 90:10 80:20 70:30 60:40 50:50 and 40:60 were ball-milled and oven dried at 80˚C. The dried powder was pressed into pellets under uniaxial pressure of 170 MPa. To obtain the suitable sintering temperature, samples were sintered at 1100˚C, 1150˚C, and 1200˚C. The microstructure and phase structure of sintered samples were investigated using scanning electron microscopy (SEM) and X-ray diffraction (XRD) techniques, respectively. Shrinkage, water absorption and density were measured. Modulus of rupture (MOR) of these samples was also determined. Ceramic samples at all ratios could be sintered at 1100˚C. The 10 wt% aluminium dross residue showed the optimum properties with low water absorption, good strength and high bulk density.

IND-P-060

Effects of Grog, Wood Ash and Cement on Physical – Mechanical Properties of Unfired Clay Bricks.

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Keywords: Grog, Mechanical strength, Shrinkage, Unfired Clay Brick.

The aim of this research was to study the physical–mechanical properties of unfired clay bricks. The component ratio of clay brick as an addition grog material 50–100%, Wood Ash 10–50%, and Cement powder 10–50%. The characterization of raw materials were analyzed by particle analyzer, X-ray fluorescence(XRF) and X-ray diffraction (XRD). The shrinkage volume, bulk density, bending strength and compressive strength of unfired clay brick were tested. The results showed that physical and mechanical properties of unfired clay bricks after aging at 25°C, 24h. In unfired clay brick consisting of 60% grog material, 10% wood ash and 30% Cement powder had a shrinkage volume of 6.5% and bulk density of 1.9 g/cm^2. The unfired clay brick resistant of bending 92 kg/cm^{2}and compressive strength at 180 kg/cm^2. These physical – mechanical properties of unfired clay bricks achieved the requirements of Thai industrial standard (TIS 77-2545).

IND-P-063

The Comparison of Dolomite and Cullet addition on Physical – Mechanical Properties of Clay Bricks.

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Keywords: Dolomite, Cullet, Brick, Shrinkage, Compressive strength.

The purpose of this study was to study and characterize the properties of physical – mechanical for clay bricks. The raw materials used in the study are from local sources. They are Sri Khum red clay, dolomite and cullet. The component ratio of clay brick as an addition Sri Khum red clay 50–90 %, foaming agent (dolomite and cullet) 10–50%. The characterization of raw material was analyzed by particle analyzer, X-ray fluorescence(XRF) and X-ray diffraction (XRD). The shrinkage, water absorption and compressive strength of clay brick were tested. The results showed that the properties of clay bricks after firing at temperature at 900°C were studied. The Sri Khum red clay 80% and cullet 20% had a shrinkage of 6.95%, water absorption of 20.4% and compressive strength of 182 kg/cm^2. The physical – mechanical of clay brick achieved the requirements of Thai industrial standard (TIS 77-2545).

IND-P-066

Effects of Pig Bone Ash, Lampang Kaolinite and Fly ash on Physical – Mechanical Properties of Bone China Body.

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Keywords: Lampang kaolinite; Pig bone ash; Fly ash; Bone china body

The object of this work was to study the effects of pig bone ash, lampang kaolinite and fly ash for bone china bodies. The mixing ratio of bone china clay as an addition pig bone ash 50-70% lampang kaolinite clay 10-35% and fly ash 5-20% on physical-mechanical properties of bone china body. The raw material were analyzed by X-ray diffraction(XRD), X-ray fluorescence(XRF) and particle analyzer. The shrinkages, bulk density, water absorption, mechanical and microstructure of bone china bodies were investigated. The result showed that the addition of pig bone ash increased physical-mechanical properties. In bone chinaware consisting of 50% pig bone ash, 40% lampang kaolinite clay and 10% fly ash had a shrinkage by 5.3%, a bulk density of 0.19 g/cm^2. The water adsorption of 0.22% and a fractural strength of 180 kg/cm^2.

IND-P-069

Utilization of aluminium dross as a main raw material for synthesize geopolymer

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Keywords: Aluminium dross, Bagasse ash, Geopolymer.

The use of aluminium dross as a raw material for geopolymer synthesis was studied. The geopolymer was prepared using aluminium dross from secondary aluminium industry, bagasse ash from a biomass power plant and liquid alkaline activators, which is a mixture of sodium silicate solution (Na_2SiO_3) and sodium hydroxide solution (NaOH). Aluminium dross consists mostly of alumina (Al_2O_3), silicon oxide (SiO_2) and aluminium nitride (AlN). The mixtures were uniaxially pressed into a cylinder die. The cylinder samples were cured for 3, 7, 14 and 28 days at the room temperature. The mechanical property and thermal property of geopolymers were investigated. In addition, scanning electron microscopy (SEM) was carried out in order to study the microstructure of the geopolymers, respectively. The results showed that aluminium dross could enhance the mechanical property of geopolymers and meet the TIS requirements.

IND-P-077

Synthesis of Cu-doped $ZnFe_2O_4$ Black Pigment with High NIR Reflectance

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Keywords: Near-infrared reflective pigment, $ZnFe_2O_4$, Black pigment, Cool pigment.

A progressive increase of temperature in the city intensifies the usage of large amount of energy for cooling systems. To reduce building energy consumption, near-infrared (NIR)-reflective pigment has been applied to coat construction and building envelopes such as wall and roof. The NIR-reflective pigment can absorb less NIR and reflect its to surrounding that can reduce the heat absorbed and transferred into the building. This work aims to synthesize high NIR-reflective $ZnFe_2O_4$ black pigment. The $ZnFe_2O_4$ pigments were synthesized by calcination of ZnO and Fe_2O_3 at 900, 1000 and 1100 ˚C for 3 h. Effects of Cu doping were investigated by adding 3 to 30 wt.% CuO to the starting raw materials. X-ray diffraction (XRD) analysis of the undoped sample shows strong reflections of pure $ZnFe_2O_4$. Its color hue determined by the CIE 1976 *L*a*b** colorimetric method changed from dark brown to light brown, and the NIR reflectance calculated in the wavelength range of 700 to 2500 nm following the ASTM E903 standard decreased from 65.2 to 61.2% for the sample synthesized at 1100 ˚C. With the increase of doping level, the color hue changed from brown to grey black for the samples doped with Cu. XRD analysis of the doped samples revealed a slight shift of XRD peaks toward higher diffraction angles compared to those of the undoped samples. The addition of Cu into $ZnFe_2O_4$ resulted in a reduction of NIR reflectance due to the color changes from light brown to dark brown and to grey black with increased the Cu content. The NIR reflectance was significantly reduced from 61.2% for the undoped sample (light brown) to 33.9% for the darkest sample doped with 23.4 wt.% CuO (grey black) after calcination at 1000 ˚C.

IND-P-078

Effects of Dolomite and Al_2O_3 Addition on Properties of $CoFe_2O_4$ Black Pigment

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Keywords: Cobalt ferrite, Spinel, Doping, Near-infrared reflectance, Cool pigment.

A spinel cobalt ferrite ($CoFe_2O_4$, a general formula of ($CoO{\cdot}Fe_2O_3$)) black pigment has been synthesized by solid-state reaction of Co_3O_4 and Fe_2O_3 at 1100 ^oC for 3 h. Its blackness value (L^*) determined by the CIE 1976 $L^*a^*b^*$ colorimetric method was 19.59, and the NIR reflectance calculated in the wavelength range of 700 to 2500 nm following the ASTM E903 standard was 17.5%. A pre-determined amount of dolomite ($CaMg(CO_3)_2$) and alumina (Al_2O_3) have been incorporated into a starting raw material to replace Co_3O_4 and Fe_2O_3, respectively, to form the doped cobalt ferrite pigment with chemical formula of $(CoO)_{1-2x}(MgO{:}CaO)_x{\cdot}(Al_2O_3)_y{\cdot}(Fe_2O_3)_{1-y}$ (where x = 0, 0.25, 0.35 and 0.5; y = 0, 0.25 and 0.5) to alter color hue and NIR reflectance of the cobalt ferrite. The incorporation of dolomite and Al_2O_3 resulted in a decrease of blackness (increase of L^*) and an increase of NIR reflectance. At an optimum condition of x = 0.25 and y = 0.5, the $(CoO)_{0.5}(MgO{:}CaO)_{0.25}{\cdot}(Al_2O_3)_{0.5}{\cdot}(Fe_2O_3)_{0.5}$ pigment has reasonable high blackness with L^* = 22.73 and high NIR reflectance of 64.5%. A slight decrease of blackness compared to the undoped $CoFe_2O_4$ (*i.e.* L^* increases from 19.59 to 22.73.) is a good tradeoff for a dramatic increase of NIR reflectance (*i.e.* NIR reflectance increases from 17.5 to 64.5%.). This high NIR-reflective black pigment can be utilized as cool black pigment for building envelope coating.

IND-P-085

Development of Geopolymer Mortar from Metakaolin Blended with Agricultural and Industrial Wastes

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Keywords: Geopolymer mortar, Metakaolin, Wastes, Compressive Strength

Geopolymer is a greener alternative cement produced from the reaction of pozzolans and strong alkali solutions. Generally, the cement industry is one of largest producers of CO_2 that caused global warming. For geopolymer mortar usage, Portland cement is not utilized at all. In this research, geopolymer mortars were prepared by mixing metakaolin, various wastes (fly ash, bagasse ash and rice husk ash) varied as 80:20, 50:50 and 20:80, 15M NaOH, Na_2SiO_3 and sand. The influence of various parameters such as metakaolin to Ashes ratios and pozzolans to alkali ratios on engineering properties of metakaolin blended wastes geopolymer mortar were studied. Compressive strength tests were carried out on 25 x 25 x 25mm cube geopolymer mortar specimens at 7, 14, 21, 28 and 91 air curing days. Physical and chemical properties were also investigated at the same times. The test results revealed that the highest compressive strength is 20% metakaolin - 80% fly ash geopolymer mortar and as the curing times increases, the compressive strength of geopolymer mortar also increases. The mixing of metakaolin and bagasse ash/rice husk ash presented lower compressive strength while higher water absorption and porosity. For FTIR results, Si-O, Al-O and Si-O-Na^+ were found. Moreover, the geopolymer mortar could easily plastered on the wall.

IND-P-095

Effect of Aluminum Hydroxide Addition on Properties of Fired Refractory Clay Brick

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Keywords: Fired refractory clay brick, Dragon kiln, Aluminum hydroxide, Ratchaburi.

Properties of refractory clay brick used in firebox of dragon kiln must be relatively high refractoriness, low thermal shrinkage and durable. Aluminum hydroxide is an interesting material due to its high in active alumina (gamma-alumina) content after decomposition of hydroxide, high melting point and reasonable cost. The aim of this study is to evaluate the effect of an additive, $Al(OH)_3$, on the fried properties of refractory clay brick. The ratio of $Al(OH)_3$ to clay ration focused on in this study were 0:100, 25:75, 50:50, 75:25 respectively. The specimens as 5x5x5 cm were formed by hand molding and were then fired at 1200, 1300, 1400 °C. Their properties including thermal resistant, volume shrinkage, strength, bulk density, water absorption, and slaking time were investigated. The result reveal that the best condition consists of the ratio of $Al(OH)_3$ to clay at 50:50 and fired at 1300 ºC. It is high in refractoriness of 1400 °C, low volume shrinkage of 5% and relatively low density of 1.69 g/cm^3, with moderate water adsorption of 15 % and useable compressive strength of 12.4 MPa. These properties suitable for using in firebox of dragon kiln of Ratchaburi province.

IND-P-096

Fabrication and Characterization of Low Thermal Expansion Cordierite/Spodumene/Mullite Composite Ceramic for Cookware

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Keywords: Ceramic Cookware, Cordierite-Spodumene-Mullite, Composite, Low Thermal Expansion

Ceramic cookware can be taken a direct flame or stove top for the duration without damage. The selected materials must have low thermal expansion coefficient, high strength, low water absorption and high thermal shock resistance, reasonable in cost and easy to be produced. Cordierite and spodumene composite has been interested for ceramic cookware due to their fitted properties. In previous work, study in the cordierite-spodumene composite with low thermal expansion coefficient of 2.60×10^{-6} /°C when sintered at 1250 °C with a ratio of spodumene 60 wt% and cordierite 40 wt% can withstand the pot shape samples. However, the sample showed relatively high water absorption and low strength which was not appropriate for using in this application. In this research, mullite is introduced to be added to improve the strength and densification of ceramic composite. Spodumene, ball clay, calcined talc and calcined alumina are used in the starting raw materials and formed by slip casting. All samples are sintered in a temperature range from 1250-1300 °C in an electric furnace. Water absorption and bulk density were tested by Archimedes method, modulus of rupture was tested by the three point bending method, microstructure were investigated by SEM and the coefficient of thermal expansion was measured by dilatometer. It was found that the mullite phase was investigated when adding mullite more than 30 wt% in cordierite-spodumene composite.

IND-P-098

Influence of Lignite Bottom Ash on Pyroplastic Deformation of Stoneware Ceramic Tiles

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Keywords: Pyroplastic Deformation, Warpage, Anorthite, Lignite Bottom Ash.

Electricity generation at Mae Moh Power Plant in Lampang, Thailand, uses lignite as fuel. The output is 3.0 to 3.5 million tons of fly ash per year and 1.5 to 2.0 million tons of bottom ash per year. Fly ash is widely used in concrete application but for bottom ash, it is not very useful. When considering the phase of bottom ash containing quartz, anorthite and hematite, it was found that there are suitable chemical compositions for replacement of raw materials in ceramic tile. Generally, the stoneware tiles are composed of quartz, mullite, feldspar, and glass phase. Water absorption of stoneware ceramic tiles is below 3%, high strength, fire resistance, and low warpage. Firing or sintering at rather high temperature as 1000-1250 ºC is the manufacturing process for this type of tile. The changes in crystal structure and glassy phase formation in tile texture during sintering will be often result the tile to warpage or bent. The more or less lean depends on the viscosity of the glassy phase that occurs at high temperatures in the tile if less viscosity will cause higher warping rate that effect on the shape, and quality of the workpiece. The research has reported that anorthite phase improves the viscosity of a liquid phase or glassy phase when the tile is sintering at high temperatures and lead to high density and low water absorption. This research is interested in studying the effect of using lignite bottom ash as an ingredient in ceramic tile texture to produce low water absorption type by analyzing the effect of percentage of lignite bottom ash to warpage and important properties of ceramic tiles.

IND-P-103

Upgrading of Waste Gypsum for Building Materials

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Keywords: by-product gypsum; hemihydrate gypsum; building materials

In this research, waste gypsum ($CaSO_4 \cdot 2H_2O$), a by-product material from industrial factory, was upgraded and then used as raw material for building materials. The by-product gypsum possessed a high acidic value of 3-point pH scale and moisture content of 28 %. The two properties had an impact on setting reaction and hardening of gypsum. Therefore, the studies of gypsum phase transformation to calcium sulfate hemihydrate ($CaSO_4 \cdot 0.5H_2O$) were focused on washing process and amount of calcium carbonate ($CaCO_3$) added at 0, 1, 3, 5 and 10 % wt. After washing, waste gypsum and washed water were reduced from high acidic value to neutralization (pH = 7) as a result of $CaCO_3$. Next, the neutralized gypsum was heated to the optimal temperature at 160 ºC for 2 hours and transformed to hemihydrate gypsum phase observed by XRD. Finally, the relationship of water/hemihydrate gypsum ratio-mechanical property such as bending strength will be investigated and the results will be discussed.

IND-P-104

Study for Commercialization of Ash Utilization in Geopolymer Concrete Block

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Keywords: geopolymer, pozzolan, heat curing, biomass ash

The cost minimization is a major concern for commercialization of geopolymer concrete block production. In this study, ash from biomass was introduced to geopolymer concrete block during fabrication process in order to reduce the amount of sodium silicate solution which generates high cost. And Sodium oxide is used to stimulate polymerization reaction which saves the electricity cost machine cost in oven curing process.

The first experiment, ash and sodium oxide were mixed in the composition resulting of heat releasing of alkaline reaction and then stimulate polymerized reaction. The strength of geopolymer samples was investigated. Two mixtures and two conditions of curing were applied for geopolymer cube (5*5*5 cm^3). The first mixture was general geopolymer mixture with sodium hydroxide as control, another was sodium oxide mixture for comparing heat stimulate polymerized reaction. The first mixture was cured in both conditions; 3-day hot cure in an oven at 60-80°C and room temperature water cure. The result showed that the water cured geopolymer strength at 28-day was 77% of hot cure. While the sodium oxide mixture cured with water cure showed the result that the average compressive strength of geopolymer at 14-day curing is 88% of hot cure.

The second experiment, silicate in biomass ash as a substitution of sodium silicate solution was also studied. High silicate oxide from jatropha ash was used. The ratios of Sodium silicate solution and jatropha biomass ash were designed as follow; 100: 0, 90: 10, 75: 25, 50: 50 0: 100. The result showed that compressive strength was declined when increasing of the jatropha ash. In conclusion that jatropha biomass ash cannot be used as substitution material for sodium silicate solution in geopolymer concrete block. The results will be discussed in details.

IND-P-110

Development of Thai Lignite Fly Ash and Metakaolin for Pervious Geopolymer Concrete

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Keywords: Pervious geopolymer concrete, Thai lignite fly ash, Metakaolin, Water permeability

The study was to use Thai lignite fly ash and metakaolin to produce geopolymer paste as binder material in pervious concrete. The proper ratio of fly ash to metakaolin were varied as 100:0, 90:10, 80:20, 70:30, 60:40, 50:50 and 40:60. Seven alkali solution to pozzolan (L/P) ratios viz., 0.2, 0.3, 0.4, 0.5, 0.6, 0.7 and 0.8 by were prepared and physical, mechanical and chemical properties of pervious geopolymer concrete were carried out. The results presented that the particle of fly ash was sphere with smooth surface, while metakaolin was partly agglomerated and irregular shaped. The increase of fly ash in the ratio of fly ash to metakaolin affected the lower requirement of volume of alkali solution. The compressive strength and splitting tensile strength of pervious geopolymer concrete at 28 days were 3.74-5.41 MPa and 2.16-2.75 MPa, respectively. The void ratio and water permeability were 28.54-30.74% and 1.90-2.09 cm/sec, respectively. In addition, the functional group of Si-O-Na+, the product of geopolymerization reaction, was found. Therefore, geopolymer paste from fly ash and metakaolin could be used for pervious concrete with satisfied properties. However, the price of pervious cement concrete is 1,898-2,168 THB/m^3, while the price of pervious geopolymer concrete is 2,123-4,173 THB/m^3 due to the energy cost to transform kaolin into metakaolin by an electric furnace. The cost can be reduced by increasing the ratio of fly ash to metakaolin.

ADV-P-003

Porous Alumina Processing Using the Direct Foaming Technique Based on Slurry Boiling

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Keywords: Porous alumina, Direct foaming, Slurry boiling, Bubble diameter

The effect of slurry solids content was studied for a novel direct foaming method based on slurry boiling to produce porous alumina ceramics. Slurries with solids contents of 30 to 45 wt. % were produced by conventional processing methods. The physical properties of slurry density and surface tension were measured, as well as thermal properties such as specific heat and latent heat, which were obtained using differential scanning calorimetry (DSC). Samples were fabricated by boiling the slurries on a hot plate until the liquid was completely evaporated. The resultant porous samples were presintered at 1000 °C and were examined to determine the pore size and structure. The measured pore diameter of samples obtained from this experiment were compared with theoretical calculations of departing bubble diameter from a heated surface proposed by Fritz, and Cole & Rohsenow. It was found that the pore size had a relationship with slurry solids content depending on the thermal gradient. The pore size, at a position away from the heated surface, increased as the solids content increased. However, the pore size at the heated surface did not vary significantly with solids content. The results showed that a direct foaming method based on slurry boiling is capable of producing porous alumina and that solids content of the slurry may be utilized to somewhat control pore size and structure.

ADV-P-010

Effect of Basic Hydrothermal Treatment Time on Morphology of Aroxide P25 TiO_2 Nanostructures

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Keywords: TiO_2, hydrothermal treatment, microstructure, nanotube

The effect of hydrothermal treatment time on morphology, optical property and photocatalytic activity of TiO_2 (commercial grade Aroxide®P25 consisting of ~80 wt% anatase and ~20 wt% rutile phases) nanostructures under basic condition was investigated in this study. P25 TiO_2 nanoparticles were hydrothermally treated in highly basic aqueous solution of 10 M NaOH at 130 °C for different times at 8, 16, and 24 h. Transmission electron microscopy (TEM) study showed that after the hydrothermal treatment for 8 h, the microstructure of P25 TiO_2 was transformed from distorted spherical nanoparticles with average particle size of 25±7 to nanotubes (average width and length of 4±1 and 157±39 nm, respectively) which led to increasing of the BET specific surface area from 82 to 179 m^2/g. By increasing the hydrothermal treatment time to 16 h, the nanotube structure was gradually condensed to have average width of 5±1 nm and length of 93±23 nm and became agglomerated nanoparticle structure when the hydrothermal treatment time reached 24 h resulting in reduction of the specific surface area. X-ray diffractometry (XRD) analysis showed that after the basic hydrothermal treatment, TiO_2 nanotubes exhibited low degree of crystallinity and consisted of anatase and rutile phases with the phase ratio varied from the pristine P25 TiO_2 nanoparticles. The optical property examined by ultraviolet-visible spectroscopy (UV-Vis) suggested that the optical band gap energy (E_g) of the hydrothermally treated TO_2 tended to increase due to the formation of the nanotubes. The photocatalytic activity evaluated by methylene blue dye (MB) degradation under UV light irradiation showed that the conversion of P25 TiO_2 nanoparticles into nanotube structure via the basic hydrothermal treatment for 8 h could enhance the MB degradation efficiency by increasing the surface adsorption area.

ADV-P-021

Enhancement Photocatalytic Activity of BiOBr Using GO and rGO By Facile Preparation

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Keywords: BiOBr, graphene oxide, reduced graphene oxide, visible-light responsive photocatalyst.

The photocatalyst semiconductor BiOBr nanoparticles with graphene oxide (GO) and reduced graphene oxide (rGO) sheets were synthesized via a simple and low-cost precipitation method at room temperature. Various amounts (0.1-2 wt %) of GO and rGO were added into the mixed solution precursors containing Bi $(NO_3)_3.5H_2O$: KBr in a molar ratio of 1:1 and stirred at room temperature to get precipitated powder without further heat treatment. The as-synthesized composites were characterized by X-ray diffraction (XRD), transmission electron microscopy (TEM), filed-emission scanning electron microscopy (FE-SEM), UV–Vis diffuse reflectance spectra (DRS) and Brunauer–Emmett–Teller (BET). The photocatalytic activities and reusability of the obtained samples were evaluated by degradation of Rhodamine B (Rh-B) in aqueous solution under visible-light irradiation. The results showed that the photocatalytic activities and stability of BiOBr/GO and BiOBr/rGO nanocomposites were enhanced compared to the pure BiOBr. The amount of GO and rGO in composites is an important factor for photocatalytic activity improvement. Furthermore, it was shown that BiOBr/rGO exhibited higher photocatalytic efficiency than BiOBr/GO nanocomposites.

ADV-P-027

The Utility of Rice husk ash from Biomass power plant of Nakhon Ratchasima province in order to synthesis of Nano-silica for using cathode material of lithium ion battery

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Keywords: Rice husk ash, Nano-silica, Li_2FeSiO_4, Lithium Ion Battery.

The Li_2FeSiO_4 materials could preparation from different synthesis route for generate cathode of battery. It's improving electrochemical properties by modified of Nano-structure in Li_2FeSiO_4 because it will lead to higher conductivity and higher electrochemical performance. In this paper, Li_2FeSiO_4 prepared via a modified planetary ball mill process using Nano-silica from rice husk ash for silica source in the synthetic process. Then, the Li_2FeSiO_4 precursor calcination at 650°C for 10 hours in Argon atmosphere. To investigated morphology of Li_2FeSiO_4 using by XRD and SEM. The XRD pattern of Li_2FeSiO_4 revealed an orthorhombic unit cell in space group $P2_1$. Moreover, the electrochemical properties of Li_2FeSiO_4 are increasing owing to good morphology and nano crystalline.

ADV-P-028

Microwave Synthesis of Hydroxyapatite Nanoparticles and the Application in Film Bio-composites

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Keywords: Hydroxyapatite, microwave, morphology, nanoparticles, composite

Hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_2$: HA) is a member of calcium phosphate which has been extensively used as a repair material for bone substituted owing to its similar to mineral components of human hard tissue. It has a good biocompatibility, bioactivity, osteoconductivity with human body and has the ability to promote cells that make bone. This research synthesized nanocrystalline hydroxyapatite via microwave assisted heating method. Calcium nitrate tetrahydrate and di-ammonium hydrogen orthophosphate solutions were prepared to obtain Ca/P ratio = 1.67. The effects of heating time and heating power of microwave oven (2.45 GHz) as well as pH of the mixed solution were studied which affected the morphology of nanoparticles and the crystallinity. Characterization techniques include XRD, FE-SEM and FTIR. HA nanoparticles were obtained when synthesized with pH = 11, microwave power 320-800 watts and heating time 10 - 30 min. Impurity phase were found at lower pH value. Particle size increased and particle shape changed from spherical to rod and plate-like when microwave power was increased. The synthesized HA can be made into bio-composites with poly lactic acid (PLA) using solvent casting method. In-vitro study for bioactivity was carried out in the SBF solution which formed hydroxyl-carbonate apatite (HCA) layer on the HA–PLA composite surface. The layer thickness increased with increasing soaking time. The porous microstructure gives channels for bone ingrowth and would could the microscopic bioresorption.

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ADV-P-036

Synthesis Zeolite from Water Treatment Sludge and Its Application to the Removal of Brilliant Green

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Keywords: Waste, Sludge, Zeolite, Faujasite.

In this work, water treatment sludge from the water treatment plant was used to synthesize zeolite material. In the synthesis, the washed sludge was mixed with sodium hydroxide and then heated at 600 ºC for 6 h. After agitation, the aged material was heated in a water bath at 80 ºC for different period of aging times. Based on XRD and SEM analyses, Faujasite zeolite was obtained. Then, the feasibility of employing the obtained zeolite as adsorbent for Brilliant Green (BG) removal was investigated. The effect of adsorbent dosage and contact time were examined. Adsorption kinetics and isotherm were also evaluated. The results showed that the obtained zeolite has potential for applying as low-cost adsorbent for the removal of BG from wastewater with higher than 97% adsorption efficiency.

ADV-P-039

Structural Refinement and Electrical Properties of $BaZr_{0.7}In_{0.3}O_{3-\delta}$ Ceramics

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Keywords: Proton-conducting perovskite, trivalent-doped barium zirconate, Rietveld refinement

One of the most investigated compounds for proton-conducting fabrication is perovskite solid-oxide materials. Among those, trivalent-doped barium zirconate is widely studied because of its mechanical and chemical stability. In addition, the high symmetry of barium zirconate is the advantageous for high mobility of protonic defects. In this work, the solid solution of 30% indium doped barium zirconate with system $BaZr_{0.7}In_{0.3}O_{3-\delta}$ was prepared by conventional solid-state procedure. Analysis of X-ray diffraction (XRD) reveals cubic perovskite structure (space group: *Pm-3m*) with unit cell parameter a = 4.1904 Å. Structural study of ceramics refined by Rietveld technique confirms the cubic symmetry with χ^2 = 1.45. The microstructure of sintered pellets was characterized. The conductivity of samples was measured using impedance technique and activation energy was calculated.

ADV-P-044

Waste Eggshell as Low-cost Starting Material for Synthesizing $CaZrO_3$ Powder

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Keywords: Chicken eggshell, $CaZrO_3$

The utilization of biowaste has been emphasized in our society for the environmental concerns. Chicken eggshell waste in the poultry industry has been focused recently because of its reclamation potential. The possibility of using $CaCO_3$ from chicken eggshell waste as a starting material for synthesizing the electroceramic $CaZrO_3$ powder via conventional solid state reaction was investigated in this work. The effect as a function of calcination temperature and soaking time on phase formation of $CaZrO_3$ powder was investigated by X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FT-IR) and Raman spectroscopy. The morphology and microstructure were characterized via Scanning electron microscope (SEM). X-ray fluorescence examined the components of $CaCO_3$ from chicken eggshell waste. The XRF results showed that chicken eggshell waste contained more than 96.0% of $CaCO_3$ by weight. The XRD pattern peaks matched the peaks of calcite $CaCO_3$ ICDD No. 85-1180 very well. The calcination temperature and soaking time have been found to have pronounced effect on phase formation of the calcined $CaZrO_3$ powder; the results showed that pure phase of $CaZrO_3$ powder was obtained successfully when calcination condition at 900°C for 4 h. SEM results showed that the particle morphology of $CaZrO_3$ has an average size around 127.35 ± 16.93 nm. This study indicated that $CaCO_3$ from chicken eggshell waste is an alternative starting material for synthesizing $CaZrO_3$ powder.

ADV-P-046

Synthesis of Boron Carbide Powder by Carbothermic Reduction Process

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Keywords: Boron carbide, Carbothermic reduction, Powder synthesis

Boron carbide is one of the hardest materials, ranking third behind diamond and cubic boron nitride. Combined with its light weight, high melting point, good resistance to chemicals and high neutron absorption cross-section, boron carbide is the promising material for many applications. In this study, synthesis of boron carbide powder was attempted using an economic method; Carbothermic reduction process. Boric acid and activated carbon were used as a source of boron and reducing agent. The starting materials were mixed in various ratios. The powder synthesis was carried out under a flow of argon atmosphere in a furnace to 1400-1700°C for 1-3 h. The X-ray diffraction phase analysis results showed that boron carbide powder was successfully synthesized but free carbon was also detected in the stoichiometric starting composition, implying the requirement for excess boron in the reaction. In addition, morphology evolution of the synthesized powders was observed using scanning electron microscopy. The effects of process parameters, e.g., composition ratio, temperature, holding time on the reaction kinetics, phase present and morphology of the synthesized powders were discussed. The guideline for future study on the carbothermic reduction process in order to produce pure boron carbide powder with the uniform microstructure was also pointed out.

ADV-P-049

Preparation of Porous Cylindrical Tubes Substrates from Zeolite and Clay for TiO_2 Photocatalyst Coating

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Keywords: Porous substrate, TiO_2 coating, Lignin degradation, Photocatalyst.

Titanium dioxide (TiO_2) is the one of photocatalyst materials that widely used for decolorization of organic compounds in wastewater by photocatalytic mechanism which can be activated by UV light. Unfortunately, in the case of fine TiO_2 power, filtration of the powder after water treatment process is difficult. In this research, coating or immobilizing the TiO_2 powder on substrates using for removing the color of lignin concentration is interesting. The objectives of this research are to prepare the floating porous cylindrical tube substrates composed of zeolite NaA and ball clay, and then to determine the efficiency of lignin degradation. Zeolite NaA powder, Surat Thani ball clay and organic binder solution were mixed before extruding and cutting to be 1.5 cm diameter cylindrical tube with 2.5 cm in length and 0.3 cm in thickness. After that, the dried tubes were fired at 650 - 800 °C for 2 hours and were then coated with TiO_2-P25 suspension before re-firing at 600 °C for 1 hour in an electrical furnace. The fired uncoated tubes were characterized in terms of phase composition, porosity and radial crush strength. From the XRD pattern of the tubes fired at 800 °C showed that the zeolite NaA phase was disappeared. On the other hand, the zeolite NaA phase was found in the samples fired at another lower temperature. For the coated tubes, polyurethane foam was filled into the hole to make the tubes can be floated on the water surface. After that, the photocatalyst degradation property by determining the decreasing of concentration of lignin solution under tungsten lamp irradiation of the floated tubes were tested.

ADV-P-064

Electrical Properties of Rice Husk Ash and Fly Ash Blended Cement-PZT Ceramic Composites

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Keywords: Rice Husk Ash; Fly Ash; Cement; PZT ceramic

Electrical properties and microstructure of rice husk ash and fly ash blended cement-PZT ceramic composites were investigated. Ordinary Portland cement was partially replaced with rice husk ash and fly ash in rang of 0-30% by weight of binder. PZT based piezoelectric ceramic of mid particle sizes (450μm) were used at 50% by volume to produce the composites. The blended cements and PZT ceramic composites were mixed and pressed together. After that the composites were cured with 97%RH in water bath chamber for 3 days before measurements. The electrical properties such as dielectric properties were measured under room temperature. The interface and morphology of the composite were also investigated.

ADV-P-074

Influence of Polycaprolactone Coating on the Release of Drug Impregnated Hydroxyapatite for Localized Bone Tuberculosis Treatment

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Keywords: Bone Tuberculosis, Coating, Polycaprolactone, Drug Impregnation, Hydroxyapatite.

The use of carrier to deliver drugs to the treatment area is a new technique to provide local, sustained, and high concentrations of drugs without systemically exposing patients to toxic side effects and might decrease the drug administration period. In this study, two tuberculosis drugs (rifampicin and isoniazid) were experimentally loaded into three dimensionally printed porous hydroxyapatite (3D printed HA). Uncoated and polycaprolactone coated samples were prepared and compared for mechanical properties, microstructure, drug content and releasing behaviors. For both drugs, coated samples showed greater compressive resistance than uncoated samples. Uncoated samples displayed rough surface containing numerous pores while smooth and dense surface was observed for coated samples. Drug contents in coated samples were slightly lower than those of uncoated samples. By releasing in simulated body fluid, all the samples displayed biphasic releasing profile including fast release of high amount of drugs initially and followed by a continuous and small release afterward. Polycaprolactone coating was observed to effectively decrease the initial release and prolong the releasing period of rifampicin loaded sample, but did not help for isoniazid loaded sample. This dissimilarity in efficacy could be related to the difference in solubility in media of both drugs.

ADV-P-076

Powder Injection Moulding of Magnesium Aluminate Spinel

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Keywords: $MgAl_2O_4$, spinel, ceramic injection moulding, binder

Magnesium aluminate spinel ($MgAl_2O_4$) is a ceramic materials that has good mechanical strength as well as good thermal and optical properties. Therefore, it can be used in various applications such as in metallurgical, chemical and electrical industries. Powder injection moulding (PIM) is a useful method in fabrication of small and complex-shaped components. PIM was carried out in this work to fabricate the spinel bodies. The powder loadings were in range of 48 – 52 vol%. The binder composed mainly of a water soluble polyethylene glycol (PEG) with a minor constituent of polyvinyl butyral (PVB) was applied for feedstock prepararion. Powder injection moulding was carried out with a small injection machine available in the laboratory. Several feedstock compositions and process parameters were systematically carried out to optimise the injection moulding technique. Binder removal using water was performed for the study of debinding behaviour for the moulded specimens at various temperatures and times. The as-leached specimens were then subjected to sintering at 1650 °C for 1 hour. The physical and mechanical properties of the sintered samples were characterised and tested. The sintered density of higher than 95% of the theoretical value can be achieved from the spinel specimens fabricated by powder injection moulding.

ADV-P-080

Effect of Molten Salts on Synthesis and Upconversion Luminescence of Lanthanide-doped Alkaline Yttrium Fluorides

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Keywords: Molten Salt, Upconversion Luminescence, $NaYF_4$, $LiYF_4$

Upconversion luminescence materials have recently received attentions because of theirs light conversion ability from infrared into visible and ultraviolet light. In this work, alkaline yttrium fluoride doped by ytterbium and thulium (AYF_4: 20%Yb^{3+}, 0.5%Tm^{3+}) were synthesized by molten salt method at 400 °C for 2 hours with different eutectic molten salts, i.e. $NaNO_3$-KNO_3, $NaNO_3$-$LiNO_3$, KNO_3-$LiNO_3$, and $NaNO_3$-KNO_3-$LiNO_3$. Pure hexagonal $NaYF_4$ microrods were successfully synthesized using eutectic $NaNO_3$-KNO_3 molten salt. Under 980 nm laser diode excitation, upconversion luminescence in both visible and ultraviolet region was clearly observed. On the other hand, for the use of other eutectic molten salts containing $LiNO_3$, the mixed phases of tetragonal $LiYF_4$ and orthorhombic $Y_6O_5F_8$ were obtained. These powders emitted only visible light with 10 times lower intensity than the hexagonal $NaYF_4$ microrods synthesized using $NaNO_3$-KNO_3.

ADV-P-087

Preparation and Characterization of Lead-Free $(Ba_{0.4}Sr_{0.4}Ca_{0.2})(Zr_{0.05}Ti_{0.95})O_3$ Ceramics Using BST Seed Induced Method

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Keywords: lead free ceramic, perovskite, seed induced method, molten salt.

The solid solution of lead-free $(Ba_{0.4}Sr_{0.4}Ca_{0.2})$ $(Zr_{0.05}Ti_{0.95})$ O_3 (BSCZT) ceramics were prepared from the seed induced method. The $Ba_{0.6}Sr_{0.4}TiO_3$ (BST) were used as the seed crystals, they were prepared using the molten salt technique. The phase formation was examined using the X-ray diffraction technique (XRD). It was found that the single phase perovskite structure of BST was obtained at a temperature of 800°C. The ceramics were prepared using the conventional solid state reaction with adding of BST seed crystals at 2.5, 5, 7.5 and 10 mol%. The structure showed that a single phase perovskite was obtained after sintered at 1400 °C. This work confirmed that BST seed crystal successfully diffused into BSCZT ceramic and the BSCZT ceramic with a seed crystal showed higher dielectric than the BSCZT ceramic without seed crystals.

ADV-P-088

Phase Formation and Grain Growth of BSCZT Ceramics Prepared by BST- BZT Seed Induced Method

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Keywords: perovskite structure, X-ray diffraction, seed Induced.

In this work, lead-free $(Ba_{0.4}Sr_{0.4}Ca_{0.2})(Zr_{0.05}Ti_{0.95})$ O_3 (BSCZT) ceramics were prepared by the seed induced method using $(0.5Ba_{0.6}Sr_{0.4}TiO_3–0.5BaZr_{0.05}Ti_{0.95}O_3)$ (BST-BZT) seed crystals. Seed crystals with concentrations of 0, 2.5, 5, 7.5, 10 mol% were mixed with BSCZT powder for 24 hours and sintered at 1400 °C for 4 hours. The phase formation and microstructure of BSCZT ceramic were characterized by X-ray diffraction technique (XRD) and the scanning electron microscopy (SEM). All samples showed a single phase perovskite structure without impurities and exhibited the existence of the tetragonal phase. The density values of the ceramics decreased from 4.90 to 4.75 g/cm^3 with increasing seed crystal concentrations. The grain size of the sample without seed was 3.71 µm, whereas the grain size of 8.99 µm was observed for the sample with 10 mol% seed crystal. The maximum dielectric constant at room temperature was 1592 for the sample with 7.5 mol% seed crystal while dielectric constant of the sample without seed was 1484. From the results in this work, BST-BZT seed can increase grain size and improve the dielectric constant.

ADV-P-089

Effects of Eu Doping and Calcination Temperatures on Chemical Compositions, Microstructure and Luminescent Intensity of $BaAl_2O_4$

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Keywords: Barium Aluminate, Photoluminescent, Doping, Calcination.

Photoluminescent (PL) materials are commonly utilized in applications such as leakage test, crack monitoring, banknote forgery detection, and fingerprint detection. Doping, chemical compositions and microstructure, are generally accepted as factors that influence luminescent intensity of spinel-structure phosphors such as $SrAl_2O_4$, $CaAl_2O_4$, and $BaAl_2O_4$. This study aimed at synthesizing $BaAl_2O_4$ photoluminescent powders by a solution combustion technique. Effects of Eu doping and calcination temperatures on chemical compositions, microstructure and luminescent intensity of the materials were also examined. Experimental results indicated that Eu concentrations did not exhibit any significant effects on chemical compositions and particle morphology. Higher calcination temperatures, on the contrary, resulted in reduction of secondary phase formation, and alteration of morphology of particles and porosity. The greatest luminescent intensity was achieved in the $BaAl_2O_4$ sample with 3 mol% Eu subjected to calcination at 900˚C. Enhancement of the luminescent intensity in this sample might be attributed to minimal secondary phase and pore content.

ADV-P-090

Microstructural Evolution and Dielectric Constants of $Ba_{0.05}Sr_xCa_{0.95-x}TiO_3$ (x=0, 0.225, 0.475, 0.725 and 0.95) Synthesized by the Solution Combustion Technique

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Keywords: Barium Strontium Calcium Titanate, Solution Combustion, Microstructure, Dielectric Constant.

Barium strontium calcium titanate is a dielectric material exploited in fabrication of electronic devices such as capacitors, signal filters and satellite components. Dielectric properties can be enhanced through compositional and microstructural control. This study, therefore, aimed at synthesizing barium strontium calcium titanate ($Ba_{0.05}Sr_xCa_{0.95-x}TiO_3$, where x=0, 0.225, 0.475, 0.725 and 0.95) powders by a solution combustion technique. The powders were pressed, sintered at 1450°C and tested for their properties. Experimental results revealed that strontium content did not significantly influence chemical composition, particle sizes and density. All powders exhibited a single phase corresponding to $Ba_{0.05}Sr_xCa_{0.95-x}TiO_3$ with fine particles with the average size smaller than 0.4 micrometer. All sintered samples had density higher than 96% of theoretical density. On the contrary, the results indicated that strontium content affected grain size, grain morphology and dielectric constant of the sintered samples. The highest dielectric constant of 530 (at 1 MHz) was achieved in the $Ba_{0.05}Sr_{0.225}Ca_{0.725-x}TiO_3$. Dielectric constant was discussed with respect to microstructure.

ADV-P-091

Effects of Sn Concentration on Chemical Composition, Microstructure and Photocatalytic Activity of Nanoparticulate Sn-doped TiO_2 Powders Synthesized by Solution Combustion Technique

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Keywords: Sn doped TiO_2, Nanoparticles, Solution Combustion synthesis, Photocatalytic

Utilization of photocatalytic properties of materials can be perceived through a wide range of applications, such as anti-bacterial, water treatment, and self-cleaning materials. It has been established that doping can result in alteration of photocatalytic activities. This study aimed at studying effects of tin concentration on chemical composition, microstructure, band gap energy, and photocatalytic activities of tin-doped titanium dioxide powder synthesized by solution combustion technique. Experimental results revealed that concentration of tin significantly influenced chemical composition of the powders. A semi-quantitative analysis indicated that tin oxide secondary phase increased from 11 to 23 wt%, as the Sn increased from 2.5 to 10 mol%, respectively. Tin concentration, nevertheless, did not significantly influence microstructure of the powders. All powders had average particle size ranging from 13.1 to 13.4 nm, which agglomerated into clusters with average sizes ranging from 103 to 140 nm. A slight increase of band gap energy was observed at higher tin concentration. The most prominent photocatalytic activities, determined from decomposition of methylene blue, was found in the titanium dioxide powder with 2.5 mol% Sn.

ADV-P-092

Preparation of Zeolite NaA - Activated Carbon Composite Filter Aid from Rice Husk Charcoal for Drinking Water

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Keywords: Zeolite NaA, Composites, Rice husk charcoal, Drinking water filter aid

The desirable ion exchange properties of zeolite NaA and the high adsorption capacity of odor and free chlorine of activated carbon are interesting topics to this research. The aim of this research is focused on the synthesis of zeolite NaA and activated carbon composite powder from rice husk charcoal which mainly consisted of amorphous silica and carbon containing organic compounds. Rice husk was fired in an incineration furnace around 700 ºC to produce rice husk charcoal (RHC) as raw material for the composite synthesis. The mixture of Si/Al ratio at 1 in alkaline medium was used in zeolite NaA synthesis was aged for 12 hours. After aging, various synthesis temperatures of 85-100 ºC and time for 1-5 hours were investigated. It was found that zeolite NaA and activated carbon composite powder could be synthesized started from rice husk charcoal. Room temperature aging before the synthesis could promote nucleation of zeolite NaA resulted in the smaller particle size than that of non-aging conditions. The slip, after that, was prepared from the mixture of 38 wt% of synthesized zeolite NaA and carbon composite powder, 10 wt% of phenolic resin, 1 wt% of carboxymethylcellulose and 51 wt% of water. Composite ceramics were prepared by slip casting method. The slip was mixed in a rapid ball mill (450 rpm) for 15, 30, 45 and 60 minutes and was then poured into plaster molds for 3 hours in order to maintain hollow casting. The green body was dried and fired at several firing temperature of 600, 650, 700 and 750 ºC for 1 hour in reduction atmosphere. Samples fired at 700 ºC with different milling time (15, 30, 45 and 60 minutes) show good mechanical strength which are 2.59 2.99 3.48 and 3.47 MPa, phase analysis and morphology were characterized using X-ray diffraction and scanning electron microscopy.

ADV-P-099

A Study of Mechanical Properties of Bone Cement Containing Micro and Nano Hydroxyapatite Particles

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Keywords: Hydroxyapatite, PMMA, Bone Cement.

In this research, mechanical properties of bone cement containing micro and nano hydroxyapatite (HA) particles were studied. The bone cement was prepared from mixing between poly-methy methacrylate (PMMA) and methy methacrylate (MMA) with the ratio 1:0.55 by wt%. Hydroxyapatite powder was prepared from bovine bone. The bone was heated in hot water at 200 °c for elimination of tissue, after which the bone was dried and calcined at 800 °c for 3 hrs. The calcined bone then was crushed into powder and ball-milled for 24 hrs. The micro HA particles were then obtained. The micro particles were then further milled employing the vibro-milling machine for 2 hrs. The micro and nano HA sizes are about 0.5 mm and 140 nm, respectively. The both size powders were treated with γ- methacryloxy-propyl-trimethoxy silane in 0.2 wt% acetic acid. In order to controlled the pH at 2.9, before they were mixed into the bone cement with equally weight. The mixtures were pressed into 304 stainless steel mould in order to rectangular shape. A scanning electron microscope (SEM) and x-ray diffractometer (XRD) were employed to characterize the samples. From compressive strength test, it was found that the mixtures of bone cement and HA nano particle has shown higher compressive strength than pure bone cement.

ADV-P-100

Enhancing the Phase Conversion of Hydroxyapatite from Calcium Sulphate Hemihydrate by Hydrothermal Reaction

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Keywords: Hydrothermal process, Hydroxyapatite, Three dimensional printing

Hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_2$) is a well-known biocompatible material which is widely used as bone graft in orthopedic and dental applications due to its chemical structure similar to that of human bone. Several processes have been employed to synthesize and fabricate hydroxyapatite into desired shape. In this study, we studied the feasibility of fabricating hydroxyapatite by hydrothermal conversion of calcium sulphate hemihydrate ($CaSO_4 \cdot 0.5H_2O$) based mixture. The spherical samples (7 mm in diameter) were three dimensionally printed and hydrothermally treated in 1M disodium hydrogenphosphate (Na_2HPO_4) at 100°C -180°C for 2-8 hrs. Phase analysis by X-ray diffraction indicated that monetite ($CaHPO_4$) coexisted with hydroxyapatite when hydrothermally treating the samples at pH 9. However, when pH of disodium hydrogenphosphate was adjusted to pH 11, the samples were completely converted to hydroxyapatite without any structural destruction. Therefore, hydrothermal reaction could possibly be employed to enhance the phase conversion of hydroxyapatite in term of conversion rate compared to typical atmospheric conversion.

ADV-P-101

High-Resolution X-ray Diffraction and Micro-Raman Investigations of Cubic AlGaN/GaN on GaAs (001) Substrate by MOVPE

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Keywords: AlGaN, III-Nitride, high-resolution XRD, micro-Raman spectroscopy

In this study, AlGaN/GaN heterostructures were grown on GaAs (001) substrates by metal organic vapor phase epitaxy with different Al contents. Trimethyl aluminum (TMAl), trimethyl gallium (TMGa) and 1,1-dimethylhydrazine (DMHy) were used as a precursor of Al, Ga, and N, respectively. The Al content, which was varied by [TMAl]/([TMAl]+[TMGa]) ratio, and crystal structure of AlGaN/GaN films was assessed by high-resolution X-ray diffraction in 2θ/ω-scan and reciprocal space mapping (RSM) modes. From the 2θ/ω-scan profiles, even though they were not clearly resolved between GaN and AlGaN peaks due to a low Al content, the compositions of Al can be estimated to be 5.8 ± 0.8% and 12.7 ± 0.3%, when the [TMAl]/([TMAl]+[TMGa]) ratio was increased from 0.15 to 0.30. RSM results showed strong diffraction peaks of cubic (002) of GaN and AlGaN along with that hexagonal (10-11) planes. This indicates that the AlGaN/GaN heterostructure contained an amount of cubic structure including hexagonal structure. The hexagonal (10-11) planes were tilted approximately ±7-degrees in ω-axis, which confirm that the hexagonal phase was generated on the (111) plane of cubic phase. The integrated intensities of those peaks were determined to compare an amount of overall cubic and hexagonal structures. It is seen that the films contained Al content tended to present lower hexagonal phase incorporation. Besides, Micro-Raman spectra show that the cubic-phase related peak became dominant when the Al was incorporated in the films, while the GaN layer showed a significant hexagonal-phase related peak. Since the thickness of AlGaN films was decreased with increasing Al content, consequently, an amount of hexagonal phase inclusion in the films was found to affect by the layer thickness. Thus, the effects of layer thickness on a determination of structural phase were analyzed.

ADV-P-112

Synthesis of $SrAl_2O_4:Eu^{2+}$, Dy^{3+} Phosphorescent Pigments Via Combustion Assisted Sol-Gel Method

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Keywords: Phosphorescence, Sol-gel, Strontium aluminate, combustion, afterglow.

Long afterglow $SrAl_2O_4:Eu^{2+}$, Dy^{3+} yellow-green phosphorescent pigments were synthesized through citrate sol-gel method being assisted with nitrate combustion reaction. Two different precursor groups were used in the preparation of relevant solutions for comparison. First group consists of nitrate salts of four basic components (Sr, Al, Eu and Dy) and second one includes $SrCO_3$, $Al(OH)_3$, Eu_2O_3 and Dy_2O_3.

Nitrate precursors were dissolved in distilled water and gelated with citric acid addition at 50 °C as conventional sol-gel process. After gelation completed, temperature increased to 200 °C which yielded combustion reactions to occur. On the other hand, second group precursors were directly dissolved in concentrated citric acid solution at 200 °C with vigorous mixing. After the solution became a homogenous liquid, nitric acid was titrated to ignite the combustion reaction. For both groups the combustion reactions resulted in a black volumous powder being then sintered under reducing atmosphere. Second group combustion powders required sintering temperatures as higher as 1300 °C however; nitrate precursor based ones gained phosphorescent property even being sintered at 1100 °C.

As opposed to time consuming gelating-drying procedure of conventional sol-gel process, combustion assisted method fastened the production route for commercial applications. In addition, it has been shown that carbonate and oxide precursors could be directly employed instead of nitrate precursors in the sol-gel production of phosphorescent pigments.

ADV-P-105

Preparation of Near-Infrared (NIR) Reflective Pigment by Solid State Reaction between Fe_2O_3 and Al_2O_3

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Keywords: Pigment, Calcination, Heat Reflection

Reflective pigment was prepared by using Fe_2O_3 and Al_2O_3 as starting materials. Fe_2O_3 and Al_2O_3 powders were mixed at 0.8:1, 1:1 and 1.2:1 mole ratio using ball milling. The mixed powders were dried and calcined at temperature of 1500°C, 1600°C and 1700°C for various soaking time at 2, 8 and 20 h. Phase data were analyzed by x-ray diffractometry. It was found that $(Fe_{1-x}, Al_x)_2O_3$ presented as a new phase in calcined powders at temperature of 1500°C to 1700°C for 2 h. The other new phase such as $FeAl_2O_4$ was detected in calcined powders at temperature of 1700°C for 8 and 20 h. From the experimental results indicated that complete reaction was occurred when higher calcination temperature and longer soaking time were used, resulting in spinel structure ($FeAl_2O_4$) generated. Then, the synthesized powders were mixed with exterior paint by mass ratio of 0:100, 10:90, 20:80, 30:70 and 40:60, respectively. The mixed paints were sprayed on metal sheets. Then the coated metal sheets were exposed under 200 watts lamb and measured the temperature difference between the exposed side and opposite side. The result showed that at the ratio of 30:70 exhibited the highest temperature difference of 14°C approximately. From the result, we concluded that spinel structure ($FeAl_2O_4$) is a candidate for near-infrared (NIR) reflective pigment of exterior paint.

ART-P-031

Manufacturing Innovation and New Product Development Strategy of Pottery in order to a Community Ban Dan Kwian to Increase Market Opportunities and Ability to Compete ASEAN and Global Markets

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Keywords: Dan Kwian pottery, innovation, Development, Design.

This research aims to study and analyze Dan Kwian pottery model from wisdom, grandmother and market demand, for the design and development of new products. And improve and develop the clay body and glaze of Dan Kwian stoneware for increased productivity and added value to the commercial. Bring to innovate, design and develop Dan Kwian Pottery products in the competitive market in ASEAN and world markets. Include design and development of packaging for Dan Kwian pottery and increase market opportunities. This research was divided into 3 phases. It was found that the first phase of the product was the identity of Dan Kwian's identity as the market demand, as follows: fish pattern, jar shape, tortoise shape and so on. An alternative to develop and create products is the style of Thai boxing and mask style, this is the conservation of Thai arts and culture. Two phase, the development of Dan Kwian Stone ware body. By experiment on the mixing ratio between Dan Kwain clay and sand clay 11 formula, it was found that the stoneware body had the formula 1 to 4, which consisted of 70-100 Dan Kwian clay and 0-30 percent of sand clay. The water absorption percentage is not more than 3 percent. Also, developed a glaze of wood ash. To improve and develop into a Dan Kwian stoneware with a firing at 1,250℃ in oxidation and reduction atmosphere. It was found that the suitable glazing formulation applied to the clay was 27. The consist of 20% Dan Kwian caly, 20% sand clay, 60% wood ash and 20% soda feldspar. Three phase, Dan Kwian stoneware pottery product are creation through an innovation, design and development product.

ART-P-032

Development of Dan Kwian Pot Pottery Products

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Keywords: Product development, Pottery pots, Dan Kwian, identity.

The development of Dan Kwian pot pottery products is a research that uses participatory action research methodology and qualitative research method. By selecting a specific sampling in area 7, Dan Chai Community, Dan Kwian District, Muang, Nakhon Ratchasima Province. The objective of this research three reasons: 1) the study form and evolution of Dan Kwian pot pottery products. 2) the development of Dan Kwian pot pottery products to form individually. 3) To study the satisfaction of entrepreneurs and consumers towards Dan Kwian pot pottery products. The research found that model of Dan Kwian pot pottery products in the past to convey the wisdom of the grandparents emphasize the usefulness rather than beauty. At present, the style of Dan Kwien pot pottery products has been designed in a popular fashion and computer aided design. Pottery pots have a variety of uses and beauty than in the past. The product development pattern Dan kwian pot pottery products form a new identity. There are 5 forms of models selected: two cat models, one peacock model, one owl model and one cart model from 50 models. The researcher introduced five new pottery pots products to assess the satisfaction of 4 manufacturers and 30 consumers. It was found that the potted pattern is unique. The average of entrepreneurs was 4.75, while the consumer has an average of 4.13. The unique color of the potted skin. The average of entrepreneurs was 4.75, while the consumer has an average of 4.00. Beauty. The average of entrepreneurs was 5.00, while the consumer has an average of 4.27. Usability. The average of entrepreneurs was 5.00, while the consumer has an average of 4.70.

ART-P-033

The Development of Dan-Kwian Ceramic Jewelry to Contemporary Aesthetics in Nakhon Ratchasima Province

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Keywords: Dan Kwian, Ceramic Jewelry, Development, Design.

This research aims to development of Dan-Kwain ceramic jewelry from past to present. In terms of design, the raw materials and decorative techniques used in designed and developed Dan-Kwain ceramic jewelry for unique contemporary beauty. As a result, developed from the original by adopting simple shapes of geometry to be used for modern purposes, the emphasis is on creating different sizes in jewelry, which are large, medium and small. And highlight the color of clay body to light, medium and dark. The raw materials used to create Dan-Kwain ceramic jewelry prototype is Dan-Kwain clay mixed with kaolin and compound clay. At difference mixing ratio to determine the shade, then design and create masterpieces. Test fired with electric furnace at 800 and 1200°C, emphasize the natural brown and orange color of clay body. Decorated with smoked technique with rice husk in clay pot using charcoal stove owing to create a black color in the finished workpiece. Then, put it to sort the appropriate of each set. After that, design a piece of 5 different styles, in which the set consists of necklaces, bracelets and earrings. The most popular set of Dan-Kwain ceramic jewelry from the producer group is the first set inspired by the sphere, which can be prepared easily. Outstanding, the attraction is that the sphere in the center can be rotated. And the dark color in the center contrasted with the light outer circle. Overall, the five set are well received by the producer group. Make a way to see how to produce for sale, by selling it with existing products.

ART-P-094

Improvement and development of Dan Kwian Stoneware clay in order to increasing sustainable productivity

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Keywords: Dan Kwian, Stoneware, Development, Improvement.

This research aims to improvement and development of stoneware body to Dan Kwian pottery in order to compete in ASEAN market. Physical and chemical properties of stoneware Dan Kwian body are investigated. Improvement and development of stoneware body using a mixture of Dan Kwan clay, Sand Dan Kwian And Lampang kaolin. The experiment to find the ratio of stoneware body uses triaxial blend to 18 formulas for hollow casting technique. Then, the firing temperatures at 1,150℃, 1,200℃ and 1,250℃ in Oxidation and Reduction firing conditions. Physical properties such as observation color test, percentage drying and firing shrinkage, water absorption, modulus of Rupture and mullite and glassy phase are studied. The results showed that the mixture ratio of 14 with 40% kaolin had lowest water absorption of 1.63% when firing at 1,250 ℃ in reducing atmosphere. This ratio was used to create the product because of its stoneware properties. In addition, the product was designed as a coffee mug made of Dan Kwian stoneware using hollow casting technique.

ART-P-107

The Production and Quality Development of Handcraft Pottery

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Keywords: Handcraft Pottery, Production Development, Production Technology Transfer, Quality Control, Wisdom

The objectives of this research are 1) to study the handcraft pottery production, 2) to modify the handcraft pottery production method, 3) to develop the handcraft pottery quality, 4) to promote the handcraft pottery occupation, 5) to synthesize the handcraft pottery wisdom and 6) to transfer the ceramics production technology in level of enterprise and industry. Two classes of research technique were use, thus 1) quantity research technique for pottery production factors development and 2) quality research technique for handcraft pottery personnel development. Ceramic technology production transfer, community enterprise management and pottery product-design practice were operated, and finally, their personnel potentials were found. Therefore, two sample groups were required. The sample group of quantity research was three production factors, and other for quality research were twenty personnel from Na-Gra-Seng handcraft pottery group members. Statistical analysis techniques namely; percentage, mean and standard deviation were use.

GLA-P-009

Fabrication of Glass-ceramics from a Mixture of Glass Cullet Eggshell and Perlite

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Keywords: cullet, eggshell, perlite, glass-ceramics

Feasibility of producing glass-ceramics from cullet, eggshell and perlite was investigated. In this study, a nucleating agent was synthesized from calcined eggshell and expanded perlite prior to blend with soda-lime waste glass, and then sintered at temperatures ranging from 850 to 1050 °C at a heating rate of 10 ºC/min for 30 - 180 minutes. The crystallization behavior of glass-ceramics was investigated by means of X-ray diffraction analysis and surface morphology, and the chemical compositions were evaluated by scanning electron microscopy and energy dispersive X-ray spectroscopy. The results showed that crystalline phase embedded in the glassy phase were needle-like crystal of wollastonite, cristobalite, and quartz. According to the chemical resistance test, the obtained glass-ceramics showed acceptable corrosion resistance particularly in acidic environment. The weight loss for glass-ceramics immersed in 1 wt% of sodium hydroxide solution was 0.28 - 0.50 wt%, while the weight loss due to 1 vol% of sulfuric acid solution was 0.04 - 0.16 wt%.

GLA-P-013

Optical and Structural Studies of Er_2O_3 doped Potassium Sodium Niobate Silicate Glass-Ceramics

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Keywords: Glass-ceramics, Photoluminescence, Er_2O_3, KNN

In this work, the optical and structural properties of ferroelectric glasses and glass-ceramics from $K_{0.5}Na_{0.5}NbO_3$-SiO_2 doped with 0.5mol% Er_2O_3 system have been investigated. The influent of Er_2O_3 dopant was also compared with the original glass. The $K_{0.5}Na_{0.5}NbO_3$ (KNN) powder was mixed with SiO_2 in composition of 75KNN-25SiO_2 and doped with 0.5 mol% of Er_2O_3. Well-mixed powder was subsequently melted at 1300°C for 15 min in a platinum crucible using an electric furnace. The quenched glasses were then subjected to heat treatment at various temperatures for 4 h. From the study, KNN single phase in transparent glass was successfully prepared via incorporation method. The 0.5 mol% Er_2O_3 dopant allowed the green luminescence after applied UV light. The structural study from several techniques such as XRD, Raman, XANES and EXAFS confirmed the exist of KNN nanocrystals and well incorporated of Er^{3+} in KNN–SiO_2 host lattice.

GLA-P-018

Effect of the addition of $ZrSiO_4$ on Alkali-resistance and Liquidus temperature of Basaltic Glass

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Keywords: Liquidus temperature, Basaltic glasses, Zirconium silicate

Basalt fiber has been used as a reinforced material in cement-based materials because it has higher mechanical strength and cheaper than common silicate based glass-fibers. However, silicate-based glass fibers have low alkali resistance especially in cement matrix composite. In this work, we studied the improvement of alkali resistance by addition of $ZrSiO_4$ in original basalt glass composition. The batch of basalt glass with additional contents ($ZrSiO_4$) of 0, 2.5, 5, 7.5 and 10 wt. % were melted at 1500 ºC. The liquidus temperature (T_L) is important in the fiber glass manufacturing. It need to formulate glass composition which requires a lower melting temperature and is crystallization resistant. T_L as a function of composition is usually determined experimentally. In this study, glassy phase was determined by X-ray Diffraction (XRD). The glass transition temperature (T_g), the crystallization temperature (T_c) and T_L were analyzed by Differential Thermal Analysis (DTA). The results found that the addition of $ZrSiO_4$ in a basalt glass batch decreased only the T_g while the T_c of each sample was closed to original basalt fiber. Moreover, the alkali resistance of these glasses increased with increasing $ZrSiO_4$ content. However, excessive $ZrSiO_4$ contents (7.5 and 10 wt %) resulted in crystallization of ZrO_2 which separated from glassy phase.

GLA-P-038

Surface Morphologies and Durability on Water Contact Angle of Titanium Dioxide Nanoparticle Thin Films

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Keywords: Titanium dioxide nanoparticles, Thin films, Contact angle, Durability

Titanium dioxide nanoparticle thin films on the glass slide of 5x20 cm^2 as substrate were prepared by controlling temperature on sparking system. The sparking system was using the titanium wires as electrodes, the sparking time of 1-5 h and under temperature at 26, 100 and 150 ^{O}C. The as-deposited thin films were analyzed by a scanning electron microscope. The water contact angle was measured for 180 days to calculate of the standard deviation which explained the durability of the as-deposited thin films. The result indicated that at 4 h of sparking time, under temperature of 150 ^{O}C, the as-deposited thin films were the homogeneity surface, the hydrophilic water properties and optimum durability.

GLA-P-073

A Novel Radiation Shielding Material for Gamma-Ray: The Development of Lutetium Lithium Borate Glasses

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Keywords: Shield, Glasses, Gamma-ray, Lutetium.

This work, gamma rays shielding properties of the lutetium lithium borate glasses in the system Lu_2O_3 - Li_2O - B_2O_3 have been evaluated as a shielding material at different energies. While the experimental mass attenuation coefficients (μ_m) has been determined by using the narrow beam transmission method, the theoretical data were calculated using WinXCom program. The good agreements between experimental and theoretical values have been obtained. Both experimental and computational mass attenuation coefficients data were used to obtain the effective atomic number (Z_{eff}), and the effective electron density (N_{el}). Based on the obtained data, the Lu-based glasses have good shielding properties, the improved glasses could be used as gamma rays shielding material. In addition, the physical and optical of the developed glasses have been discussed.

GLA-P-084

Effects of TiO_2 Content and Sintering Temperature on the Thermal and Mechanical Properties of Na_2O-CaO-P_2O_5 Bioactive Glass-Ceramics

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Keywords: Bioactive glass-ceramics; Differential thermal analysis (DTA); Mechanical property

This study deals with the effects of TiO_2 content and sintering temperature on the thermal and mechanical properties of Na_2O-CaO-P_2O_5 glass-ceramics. The effects of TiO_2 on glass transition and crystallization temperature were analyzed via differential thermal analyzer (DTA). In addition, phase formation microstructure and micromechanical properties of TiO_2 added Na_2O-CaO-P_2O_5 glass-ceramics were also investigated by X-ray diffraction (XRD), scanning electron microscopy (SEM) and microhardness measurements. The crystallization peak temperature (T_p) was found to increase with the increase in TiO_2 content. The major crystalline phases were sodium titanium phosphate and calcium phosphate along with rutile as the minor crystalline phases presented in the glass samples. Mechanical properties were obtained from the microhardness measurements for all samples. It was found that the addition of TiO_2 content causes positive effect while the increasing the sintering temperature has negative effect of the samples on Vickers hardness, Knoop hardness and Young's modulus.

GLA-P-086

Mechanical Properties and Microstructure of Li_2O-SiO_2-Al_2O_3-K_2O-P_2O_5-ZrO_2-CaO Glass-Ceramics

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Keywords: Lithium disilicate, Glass-ceramics

In this study, the mechanical properties and microstructure of lithium disilicate glass–ceramics in the Li_2O-SiO_2-Al_2O_3-K_2O-P_2O_5-ZrO_2-CaO glass system were investigated. The glass-ceramics were prepared from the glass melt by casting into mold on hotplate. After that the glass was heat treated at 650-800 °C for 2 h. The heat treatment temperatures were determined from the differential thermal analysis (DTA). The phase formation and microstructure of the glass–ceramics were characterized by X-ray diffraction (XRD) technique and the scanning electron microscopy (SEM). Moreover, the mechanical properties was investigated by Vickers hardness testing. The results indicated that the samples confirmed the occurrence of $Li_2Si_2O_5$, $LiSiO_3$ and SiO_2 phase in prepared glass ceramics. The optimum heat treatment temperature result in the physical properties with a high density value of 2.25 g/cm^3 and the high Vickers hardness values in the range of 5.2-5.5 GPa.

GLA-P-108

Crystal Structure and Optical Properties of ZnO Thin Film Prepared by Asymmetric Bipolar Pulsed-DC Magnetron Sputtering Method

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Keywords: Sputtering, ZnO thin film, Optical constants, Optical energy gap

This research aimed to study crystal structure and optical properties of ZnO thin film prepared by Asymmetric bipolar pulsed-DC magnetron sputtering method. The crystal structure was revealed from X-ray diffraction data. Thin film thickness was measured by Tolansky's method. Optical transmission data was measured by UV-VIS-NIR spectrophotometer equipment. Optical constants such as optical refractive index (n) and optical absorption coefficient (α) were analyzed from transmission data using Swanepoel's method. Optical energy gap of thin film was investigated using Tuac's model.

From the results of XRD analysis, the ZnO thin film showed the polycrystalline structure of Wurtzite Hexagonal. The thin film thickness was 773.9 nm. The transmission spectra of the thin film illustrated interference fringes in the wavelength range of 700-2000 nm and showed absorption edges at around 450 nm. The interference fringes intensity drops in the wavelength range of 400-500 nm. These indicate that the thin films exhibit the absorption edge in the range of around 2.48-3.30 eV. In the optical analysis, the calculated absorption coefficient of the films was found of 10^4 cm^{-1} in the wavelength range of visible light, indicating that the visible light can be through the films with high intensity. These absorption coefficients were used to determine the optical energy gap using Tauc's model. From the calculations, the optical energy gap of the film was 3.31 eV. These results show that the optical properties of the ZnO thin film prepared by Asymmetric bipolar pulsed-DC magnetron sputtering method is suitable for use as an optical window in solar cells manufacturing.

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MAT-P-011

Development of Dental Ceramic Brackets Fabricated by Powder Injection Moulding

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Keywords: Al_2O_3, ZTA, dental brackets, processing

This work employs powder injection moulding (PIM) technique for a fabrication of alumina and zirconia toughened alumina (ZTA) for dental ceramic brackets application. A water soluble binder system, composed of polyethylene glycol (PEG) and polyvinyl butyrol (PVB), has been used in a preparation of feedstock for PIM. Injection moulding was carried out with a laboratory scale equipment. It was found that PEG can be removed rapidly by water leaching and the remaining PVB is removed by subsequent pyrolysis. The components were then subjected to sintering. The development of feedstock formulations and of the processing parameters for the powder injection moulding of ceramic brackets has been carried out. The preliminary study showed that the water soluble binder can be used for the fabrication of ceramic parts by PIM technique. Components retain their shape when leaching of the PEG in water. The rate of the PEG removal depends on water temperature. Density, strength, hardness and microstructure of specimens depended on feedstock compositions and sintering conditions. The relationship between processing parameters, properties and microstructure of the injection moulded specimens were carefully investigated.

MAT-P-026

Comparing Near Infrared Reflective Spectrum between Two Different Spectrophotome

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Keywords: UV/Vis/NIR spectrum, Spectophotometer and NIR reflectance

Nowadays, the demand of using cool material or IR reflectance materials increases because of the energy saving. Cool material be able to reflect NIR spectrum because the solar spectrum consists of 5% UV (wavelength 200-400 nm), 43% Visible (400-700 nm) and 52% NIR (700-2500 nm). This study is going to compare the solar spectrum received from LAMBDA 950 UV/Vis/NIR spectrometer, Perkin Elmer and Spectrophotometer Shimadzu UV-3100. Their spectra were recorded between 300-2500 nm and calculated according to ASTM E903. Samples were blue and white color painted on the glass substrate. The result found that all of the solar spectra received from Shimadzu UV-3100 were 3% and 4% higher than LAMBDA 950 Perkin Elmer especially at the wavelength between 1700-2200 nm. The tested parameters between the two Spectrophotometers were compared and analysed.

MAT-P-035

Preparation, Characterization and Utilization of TiO_2-rGO Nanocomposites for Photocatalytic Decomposition of MB Dye under Sunlight Irradiation

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Keywords: TiO_2-rGO nanocomposite, Reduced graphene oxide (rGO), Photocatalytic decomposition, Methylene blue (MB).

The purpose of this research work was to investigate the preparation, characterization and photocatalytic activities of titanium dioxide-reduced graphene oxide (TiO_2-rGO) nanocomposite catalysts. These catalysts were easily prepared through a direct mixing of TiO_2 (P25) powder suspended in acidic solution with the different amounts of reduced graphene oxide (rGO) suspensions (0.50, 1.00, 1.50 and 2.00 %wt.). Then, the obtained rGO and TiO_2-rGO nanocomposite samples were characterized by UV-visible spectrophotometer (UV-vis), Fourier-transformed infrared spectroscopy (FT-IR), X-ray powder diffraction (XRD), Raman spectroscopy, scanning electron microscopy (SEM), transmission electron microscopy (TEM), photoluminescence spectrophotometer (PL) and diffuse reflectance spectroscopy (DRS) techniques. The results demonstrated that the crystalline phases and functional groups of all samples are corresponding to pristine TiO_2, whereas the characteristic peaks of rGO in the TiO_2-rGO samples could be observed and confirmed by Raman spectroscopy. The TEM result showed that the TiO_2 nanoparticles were impregnated and well-combined with rGO nanosheets. From the DRS result, the absorption band edges of the obtained TiO_2-rGO nanocomposites shifted to visible-light region with increasing amount of rGO loading. Moreover, the photocatalytic activities of all TiO_2-rGO samples were evaluated by photodegrading of methylene blue (MB) dye solution under natural sunlight irradiation. The results revealed that all TiO_2-rGO catalysts exhibited much higher activity than those of the bare TiO_2. The photocatalytic activity of the TiO_2-rGO prepared with 1.50 %wt. rGO has the highest efficiency for the photodegradation of MB than the other catalysts. The improved photocatalytic activity can be attributed to the presence of rGO, leading to the reduction of electron (e^-) - hole (h^+) recombination of TiO_2, increasing charge transfer rate of electrons and surface-adsorbed amount of MB molecules which enhances the photocatalytic activity. Therefore, this research indicates that the photoactivity of TiO_2 incorporated with rGO nanocomposites is superior to the pristine TiO_2.

MAT-P-041

Feasibility Study of Using Basalt Fiber as the Reinforcement Phase in Fiber-Cement Products

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Keywords: basalt, fiber-cement composites, Hatschek process

The aim of this work is to study the feasibility of using basalt fiber as the reinforcement phase in fiber-cement products, the fiber-reinforced construction materials used for roofing, cladding, and ceiling system. The volcanic basalt rock can be melted and drawn into the fiber. In this work, the basalt fiber was produced and used as the reinforcement phase in fiber-cement board produced by Hatschek process. The results from the mechanical test showed that the modulus of rupture (MOR), the modulus of elasticity (MOE), and the toughness of basalt-fiber reinforced cement board were comparable to these properties of the common fiber-cement board in the market.

MAT-P-054

Precipitation/impregnation Synthesis Ruthenium-loaded Cobalt Oxide Nanoparticles for Application in Gas Sensor

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Keyword: Cobalt oxide, Ruthenium, Nanoparticles, Precipitation/impregnation

This study illustrates the facile synthesis of cobalt oxide nanoparticles using cobalt sulfate ($CoSO_4 \cdot 7H_2O$) and sodium hydroxide (NaOH) in aqueous solution by precipitation technique. The precipitated compound was calcined at temperature 800°C for 2h. Ruthenium loaded cobalt oxide nanoparticles (Ru/Co_3O_4 NPs) with 0.25–1.0 wt% were prepared by impregnation methods. Unloaded and 0.25–1.00 wt% Ru/Co_3O_4 sensing films were formed by a spin-coating technique upon alumina substrate with interdigitated gold electrodes following annealed in air at temperature 450°C for 3h. The crystalline, structural, compositional, and morphological features of nanoparticles and sensing films were studied by X-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), and energy dispersive X-ray spectroscopy (EDS). XRD data further revealed peaks are indicated as (220), (311), (511) and (440) crystal planes of cubic structure. Comparison with the literature data revealed that the observed diffraction peaks well match with JCPDS file No. 010761802. The cobalt oxide nanoparticles were observed as particles having the clear spherical morphologies. SEM image analysis showed an average size of cobalt oxide spherical was about 56.36 nm. Precipitation technique and impregnation method are believed to be capable of the preparation of Ru/Co_3O_4 NPs with low-cost and high-volume production.

MAT-P-059

Characterization of Fe_2O_3 Nanowires and Its Solar Cell Applications

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Keywords: Iron oxide, Nanowires, Thermal oxidation

Iron oxide nanowires were synthesized on stainless steel mesh substrate using the thermal oxidation process at the varying temperature of 650, 700 and 750°C for 60 min. The samples were characterized by X-ray diffraction (XRD) and scanning electron microscopy (SEM). The XRD pattern showed that the iron oxide nanowires exhibited the structure of alpha-Fe_2O_3 (hematite). SEM images indicated that the diameter and the length of the nanowires were 180-250 nm and 3-5 μm, respectively. The dye-sensitized solar cell (DSC) properties based on the nanowires substrate was also studied. It was found that the power conversion efficiency (η) of the device was 0.11%.

MAT-P-068

Evaluation of Thermal Shock Resistance for Ceramic Materials by Young's Modulus

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Keywords: thermal shock resistance, Fracture stress, Young's modulus

When a sudden temperature difference is applied to a brittle material such as ceramics, some cracks will occur in the material due to thermal shock and it may fracture in some case. The generated cracks as a fracture source may cause the strength reduction, so the evaluation of thermal shock resistance is very important for ceramic materials. In the conventional evaluation of the thermal shock resistance (thermal shock fracture temperature), the fracture stress is measured after thermal shock test as a function of temperature difference. For this method, however, many specimens are required to estimate fracture stress by bending test and variation of the stress is large. In the present study, we tried to specify the temperature of crack initiation by measuring Young's modulus and fracture stress before and after thermal shock with different temperature difference. Polycrystalline alumina with high purity was used for evaluation of thermal shock resistance. Specimen was machine to 3×4×40 mm. The surface to which the tensile stress was applied by bending test, was polished and heat-treated at 1400 °C for 1 h in order to remove defects such as crack and flaw on the surface. The Young's modulus of all specimens was measured by resonance method. After heating the specimen at the prescribed temperature between 200 °C to 600 °C, it was quickly put into water to apply thermal shock. The Young's modulus of specimens after the test was measured and the change in Young's modulus before and after thermal shock was evaluated. Further, the specimen after the evaluation was subjected to a three-point bending test, and the fracture strength was measured. As a result, it was found that Young's modulus is possible to estimate thermal shock resistance. Further it is also possible to evaluate thermal shock behaviors using only one specimen.

MAT-P-072

Synthesis and Characterization of Cu-doped SnO_2 thin films by Aerosol Pyrolysis Technique for Gas Sensor Application

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Keywords: Cu-doped Tin Oxide, Ultrasonic Aerosol Pyrolysis, Optical Bandgap.

Thin films of un-doped and Cu-doped tin oxide were synthesized on quartz substrates by the purpose-built aerosol pyrolysis apparatus from 0.2 M $SnCl_4.5H_2O$ – ethanol solution. $CuCl_2.2H_2O$ was used as a source of Cu dopant. The copper contents of 1 wt.%, 3 wt.% and 5 wt.% were used for doping SnO_2 film. The influence of copper doping on morphological, structural, optical and electrical properties was examined by FE-SEM, XRD, UV-Vis transmission spectroscopy and Hall effect measurement technique. Thickness of the films was around 300 nm. All films doped by Cu had rutile-phase SnO_2, which indicated that the doping with Cu was occurred. However, the doping decreased intensity of XRD peak and the energy of optical band gap from 4.11 eV for undoped SnO_2 to 4.07-4.09 eV for doped SnO_2. The resistivity was increased for doping of Cu 1% but it was decreased with further increasing in Cu-doping contents. The doping mechanisms of SnO_2 thin films with Cu and properties will be considered using information from characterization techniques.

MAT-P-081

Stress-Induced Transformation and Ferroelastic Domain Switching in Ce-TZP/alumina Composite on Fracture Surface

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Keywords: Tetragonal zirconia, Stress-induced transformation, Ferroelastic domain switching, Toughening mechanism

Tetragonal stabilized zirconia has toughening mechanisms of stress-induced transformation and ferroelastic domain switching. As a result of these discoveries, the toughening mechanism of zirconia ceramics has attracted attention. However, the relationship between these two mechanisms has not been clarified. Therefore, in the present study, we analyzed the Ce-TZP/alumina by using small-area XRD, and investigated the occurrence of two toughening mechanisms and their relationship at room temperature.

The sample used for the experiment was a composite material of Ce-TZP ($0.9ZrO_2$-$0.1CeO_2$) and alumina, the volume fraction of Ce-TZP was 50%. The green compact was sintered at 1450°C and machined to 4×3×40 mm. After that, a four-point bending fracture test was conducted to measure the strength. The fractured surface was analyzed by using a small-area XRD equipment with 2-dimensional detector. The spot size of X-ray was 200 μm. The same analysis was also carried out on as-annealed and polished surfaces.

Stress-induced transformation is a phase transition from tetragonal to monoclinic. So it was evaluated by volume fraction (V_m) of monoclinic crystal obtained from Toraya's equation. The ferroelastic domain switching can be evaluated by examining the orientation of the crystal. It was evaluated by the intensity ratio of $F_{004} = I_{004}/(I_{004}+I_{220})$ of $(004)_t$ and $(220)_t$ around 73°.

The stress-induced transformation on the fracture surface was about 40%, which was higher than about 6% of smooth surface. Ferroelastic domain switching of sample on the fractured surface showed an interesting behavior. Strong orientation occurred on the fractured surface mean the tensile surface side and the compression surface side, but the orientation not observed around the center of the fractured surface. It was suggested that the two mechanisms were partially related in the vicinity of the tensile surface of the fracture surface.

MAT-P-082

Effect of Addition of MgO and ZrO_2 on High Temperature Deformation of Fine-grained Al_2O_3

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Keywords: Plastic deformation, Strain hardening, Grain growth, Addition of oxide.

Polycrystalline Al_2O_3 consisting of fine grains is known to cause strain hardening with dynamic grain growth during high temperature plastic deformation. Previous investigations indicated that kind of elements, amount of additives and measurement condition had great effects on the high temperature plastic deformation mechanism of Al_2O_3.

For polycrystalline Al_2O_3 doped with MgO or ZrO_2 (2500 ~ 25000 ppm), in the present study, compression (certain strain rate) and 4-point bending tests (certain stress) were carried out to investigate the effect of the deformation mechanism and compare each sample as mentioned factors. All samples had very fine grains under 0.7 μm and high density. In the early stages of deformation of Al_2O_3 doped with MgO at higher stresses, diffusional creep controlled by the grain boundary diffusion was dominant deformation mechanism, resulting in the stress exponent $n \simeq 1$. At lower stresses, on the other hand, deformation with $n \simeq 2$ was recognized, suggesting that the interface-reaction seemed to control the creep deformation. Strain hardening resulting from grain growth of Al_2O_3, was observed during creep tests. Furthermore, Al_2O_3 doped with larger amounts of MgO deformed at lower stresses because the strain hardening effect decreased with increasing amount of the second phase ($MgAl_2O_4$ or ZrO_2), which suppressed the dynamic grain growth. Although Al_2O_3 doped with ZrO_2 had the same deformation mechanism as MgO dopant, the strain rates of Al_2O_3 doped with ZrO_2 were nearly one-tenth slower than Al_2O_3 doped with MgO due to the changing of ionic bonding strength at the grain boundaries with a small amount of dopant segregation.

MAT-P-106

The Optimal Ratio to Talc Mixed with Cordierite – Mullite Refractories Clay Body from Raw Materials and Narathiwat Clay (In Thailand)

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Keywords: Talc; Mullite; Cordierite; Refractory; Narathiwat Clay

This research aims to find the appropriate ratio of talc mixed with with Cordierite – Mullite Refractories clay body from Raw Materials and Narathiwat Clay (In Thailand) andstudy the effects of talc on mechanical properties of Cordierite – Mullite Refractories clay body. Calculate the ratio of Cordierite – Mullite Refractories and talc with Line blend diagram were 10 mixing. Analysis from the mechanical properties of Cordierite – Mullite Refractories before and after firing at 1300 °C in oxidation firing. The results showed that the appropriateratio of grog applied to the Cordierite – Mullite Refractories clay body is talc can be mixed with Cordierite – Mullite Refractories clay not more than 20 %.

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