Program and Abstract Book

In conjunction with ASEAN Ceramics 2015 Bangkok

International Conference on

ICTA2015

Traditional and Advanced Ceramics 2015

September 9 - 11, 2015

EH106, BITEC, Bangkok, Thailand

Organized by

Sponsored by

ICTA2015

International Conference on

Traditional and Advanced Ceramics 2015

September 9 - 11, 2015

Bangkok International Trade & Exhibition Centre (BITEC)

Bangkok, Thailand

Disclaimer

This book contains the abstracts of papers to be presented at International Conference on Traditional and Advanced Ceramics 2015 (ICTA 2015). They reflect the author's opinions and are published as submitted without change in the interest of timely dissemination. The inclusion in this publication does not necessarily constitute endorsement by the organizers.

Contents

Abbreviations

Plenary Lectures: PL	Advanced Ceramics: A
Invited Lectures: I	Ceramic for Industrial Technology: C
Oral: O	Glaze and Glass Technology: G
Poster: P	

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Message from ICTA2015 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 (ICTA2015) in conjunction with ASEAN Ceramics 2015 at BITEC, Bangkok, Thailand during September 9-11, 2015.

The conference consists of 3 plenary lectures, 13 invited lectures, 31 oral research presentations and 56 poster presentations covering recent advancements in Ceramic and Glass Materials research ranging from Industrial Ceramics, Advanced Ceramics, and Glaze and Glass Technology. A total of 120 scientists and researchers from universities, institutes and industries from 10 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 ICTA2015 and ASEAN Ceramics 2015 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 Chulalongkorn University, Asian Exhibition Services (AES) Ltd., SCG, Office of Naval Research Global (ONRG), Faculty of Engineering, Kasetsart University and Faculty of Engineering and Industrial Technology, Silpakorn University, 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 ICTA2015 and ASEAN Ceramics 2015 at BITEC, Bangkok, Thailand.

Dr. Somnuk Sirisoonthorn
ICTA2015 Conference Chair

Message from ICTA2015 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 2015 (ICTA2015). For this special occasion, the conference is held in conjunction with ASEAN Ceramics 2015, the most comprehensive ceramic-exhibition in Asia. ASEAN Ceramic 2015 and ICTA2015 eventually bring together ceramic experts, ceramic suppliers, machine manufacturers, ceramic scientists and engineers from all over the world.

ICTA2015 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, and Glaze and Glass Technology.

The success of ICTA2015 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
ICTA2015 Conference Chair

Conference Committee

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Program Overview

Wednesday, September 9, 2015

08:00 – 09:30	Event Hall 106	Conference Registration
09:30 – 10:00	Event Hall 106	Opening Ceremony
10:00 – 10:30	Grand Hall, 2nd Floor	Refreshment
10:30 – 12:00	Event Hall 106, Meeting Room	**PL**: Plenary Lecture 1 & 2
12:00 – 13:30	Event Hall 106	Lunch & Exhibition
13:30 – 17:10	Event Hall 106, Meeting Room 1	**AI & AO**: Advanced Ceramics Session 1 & 2
13:30 – 17:20	Event Hall 106, Meeting Room 2	**CI & CO**: Ceramic for Industrial Technology Session 1&2
14:55 – 15:30	Event Hall 106	Refreshment
17:30 – 18:00	Event Hall 106, Meeting Room 1	Poster Sessions **AP**: Advanced Ceramics **CP**: Ceramic for Industrial Technology **GP**: Glaze and Glass Technology
18:00 – 20:00	Grand Ballroom 202, 2nd Floor	Banquet

Thursday, September 10, 2015

09:30 – 10:00	Event Hall 106	Conference Registration & Refreshment
10:00 – 11:20	Event Hall 106, Meeting Room 1	**AI & AO**: Advanced Ceramics Session 3
10:00 – 11:20	Event Hall 106, Meeting Room 2	**CI & CO**: Ceramic for Industrial Technology Session 3
11:20 – 13:00	Event Hall 106	Lunch & Exhibition
13:00 – 14:35	Event Hall 106, Meeting Room 1	**AI & AO**: Advanced Ceramics Session 4
13:00 – 14:35	Event Hall 106, Meeting Room 2	**CI & CO**: Ceramic Industrial Technology Session 4
15:00 – 15:45	Event Hall 106, Meeting Room 2	**GO**: Glaze and Glass Technology Session
14:35 – 15:00	Event Hall 106	Refreshment
15:45 – 16:00	Event Hall 106, Meeting Room 1	Closing Ceremony

ICTA2015
International Conference on
XII Traditional and Advanced Ceramics 2015

Technical Program

September 9, 2015

Time	Event Hall 106		
08:00 - 09:30	Registration in front of Meeting Room		
Time	**Event Hall 106**		
09:30 - 10:00	Opening Ceremony		
10:00 - 10:30	*Refreshment*		
Time	**Meeting Room, Event Hall 106**		
10:30 - 11:15	**PL-01** **Importance of Pyroplastic Deformation Control Towards Obtaining Thin-walled Ceramic Sanitaryware Products** Prof. Dr. Alpagut Kara Ceramic Research Center (SAM) and Anadolu University, Turkey		
11:15 - 12:00	**PL-02** **Geopolymers in Australia with a Focus on Development of Fire Resistant Products** Prof. Dr. Arie van Riessen Curtin University, Australia		
12:00 - 13:30	***Lunch & Exhibition***		
Time	**Meeting Room 1**	**Time**	**Meeting Room 2**
Session: Advanced Ceramics 1		***Session: Ceramic for Industrial Technology 1***	
Session Chair: Dr. Natthaphon Raengthon, Chulalongkorn University & Dr.Sorachon Yoriya, National Metal and Materials Technology Center		*Session Chair: Dr. Lada Punsukumtana, Department of Science Service & Dr. Charusporn Mongkolkachit, National Metal and Materials Technology Center*	
13:30 - 13:55	**AI-01** **Thermoelectric Ceramics with Ordered Mesoporous Structure** Prof. Dr. Hyung-Ho Park, Yonsei University, Korea	13:30 - 13:55	**CI-01** **Spray-powder Flowability Produced with EIRICH Eco-Prep® Technology** Mr. Ralf Loebe, Maschinenfabrik GUSTAV EIRICH GmbH& Co KG, Germany
13:55 - 14:10	AO-01 **Graphene for Electroconductive Yyttira-stabilised Zirconia (YSZ) Ceramics** Kalaimani Markandan University of Nottingham, Malaysia	13:55 - 14:10	CO-01 **Feasibility Study of Porcelain Production by a Direct Sintering Technique** Wirat Lerdprom Imperial College, UK.

14:10 - 14:25	AO-02 **Synthesis of Highly Flexible and Super Hydrophobic Silica Aerogel** HeeYoon Chung Yonsei University, South Korea	14:10 - 14:25	CO-02 **Clay Minerals of Traditional Ceramics in Watershed Areas** Sarunya Promkotra Khon Kaen University, Thailand
14:25-14:40	AO-04 **Multi-Layered Titanium Dioxide Films and their Combination Effect with Solar Water Heating on Disinfection of *Escherichia coli*** Wreerat Laithong King Mongkut's University of Technology Thonburi, Thailand	14:25-14:40	CO-03 **Mechanical Behavior of Fired Clay Brick from Stream Sediments under Uniaxial Compressive Loading** Kritika Trakoolngam Khon Kaen University, Thailand
14:40 - 14:55	AO-05 **Tin Oxide Aerogels Synthesized using Non-alkoxide Precursor by Ambient Pressure Drying** Yoon Kwang Lee Yonsei University, South Korea	14:40 - 14:55	CO-04 **Property and Characterization of Raw Materials in Lampang to Assess the Suitability for Ceramics Industry** Parinya Somrang National Metal and Materials Technology Center, Thailand
14:55 - 15:30	*Refreshment*	14:55 - 15:30	*Refreshment*
Session: Advanced Ceramics 2		***Session: Ceramic for Industrial Technology 2***	
Session Chair: Dr. Pitak Laoratanakul, National Metal and Materials Technology Center		*Session Chair: Asst. Prof. Dr. Wantanee Buggakupta, Chulalongkorn University*	
15:30 - 15:55	**AI-02** **The Fabrication and Dielectric Constant of (1-3) Piezoceramic Polymer Composites** Assoc. Prof. Dr. Jerapong Tontrakoon, Chiang Mai University, Thailand	15:30 - 15:55	**CI-02** **Crystalline Glazes: Crossing Boundaries** Asst. Prof. Dr. Niti Yongvanich, Silpakorn University, Thailand

15:55 - 16:10	AO-06 **Effect of Modified CCTO Dispersion on the Dielectric and Mechanical Properties of PVDF** Anshuman Srivastava Indian Institute of Technology (BHU), India	15:55 - 16:20	**CI-03** **Review and a Research on Green NIR Reflective Pigment** Asst. Prof. Dr. Pattana Rakkwamsuk King Mongkut's University of Technology Thonburi, Thailand
16:10 - 16:25	AO-07 **Synthesis and Investigation of MoO_3 Microfilms and Nanorods by Thermal Chemical Vapor Deposition** Pitchanunt Chaiyo Ubon Ratchathani University, Thailand	16:20 - 16:35	CO-05 **Conversion of Aluminum Dross Residue into Value-added Products** Pat Sooksaen Silpakorn University, Thailand
16:25 - 16:40	AO-08 **Preparation of Mesoporous $La_{0.7}Sr_{0.3}MnO_3$ Films for High Temperature Electrode Applications using Evaporation-induced Self-assembly Process** Chang-Sun Park Yonsei University, South Korea	16:35 - 16:50	CO-06 **Turning EAF Dust Waste into Oil Spot Ceramic Glaze** Wantanee Buggakupta Chulalongkorn University, Thailand
16:40 - 16:55	AO-09 **Charge Concentration Effect of F-doped Zinc Oxide on the Interface Potential Barrier with $PbZr_{0.52}Ti_{0.48}O_3$** Pilgyu Byeon Yonsei University, South Korea	16:50 - 17:05	CO-07 **Effect of Frit Content on the Metal Marking and Scratching Resistance of Celadon Glaze** Jae-Hwan Pee KICET, South Korea
16:55 - 17:10	AO-10 **A Study on the Polarization Effect of $Ba_xSr_{1-x}TiO_3$ ($0 \le x \le 1$) on the Tunnel Electroresistance of Ferroelectric Tunnel Junction** Tae-Won Lee Yonsei University, South Korea	17:05 - 17:20	CO-08 **Development of Decorative Ceramic Glaze from Palm Fiber Ash** Mohd Al Amin Muhamad Nor University Malaysia Terengganu, Malaysia
17:30 - 18:00	**Poster Presentations** (Meeting Room 1)		
18:00 - 20:00	Grand Ballroom 202, 2nd Floor		

September 10, 2015

Time	Event Hall 106		
09:30 - 10:00	Registration & Refreshment		
Time	**Meeting Room 1**	**Time**	**Meeting Room 2**
Session: Advanced Ceramics 3		***Session: Ceramic for Industrial Technology 3***	
Session Chair: *Asst. Prof. Dr. Pornapa Sujaridworakun, Chulalongkorn University*		*Session Chair: Asst. Prof. Dr. Nutthita Chuankrerkkul, Metallurgy and Materials Science Research Institute & Asst. Prof. Dr. Karn Serivalsatit, Chulalongkorn University*	
10:00 - 10:25	**AI-03** **Morphology Control of Metal Oxide Particles for Multifunctional Cosmetic Application** Prof. Dr. Tsugio Sato, Tohoku University, Japan	10:00 - 10:25	**CI-04** **Synthesis and Microstructure Observation of Molten Metal Corrosion Resistant Yttria Based Refractory** Assoc. Prof. Dr. Tadachika Nakayama, Nagaoka University of Technology, Japan
10:25 - 10:50	**AI-04** **Photocatalysis as a New Environmental Application of Fine Ceramics: Performance and Evaluation** Dr. Koji Takeuchi, National Institute of Advanced Industrial Science and Technology (AIST), Japan	10:25 - 10:50	**CI-05** **Fabrication and Characterization of Thermal Barrier Coatings of Yttrium Stabilized Zirconia by Suspension Plasma Spray and EBPVD Method** Dr. Hyung-Tae Kim, Korea Institute of Ceramic Engineering and Technology (KICET), Korea
10:50 - 11:05	AO-11 **Optical and Electrical Characteristics of ZnO Films Prepared by the Solution Reaction Method** Saki Fukui Tohoku University, Japan	10:50 - 11:05	CO-09 **Effect of Spark Plasma Sintering Conditions on the In-situ Synthesis of Polycrystalline CeB_6 Ceramics** Erhan Ayas Anadolu University, Turkey
11:05 - 11:20	AO-12 **Preparation of Porous Hollow Cylindrical Composite Containing Activated Carbon and Zeolite for TiO_2 Coating** Nithiwach Nawaukkaratharnant Chulalongkorn University, Thailand	11:05 - 11:20	CO-10 **Novel Soft Chemical Synthesis Methods of Ceramic Materials** Kenji Toda Niigata University, Japan
11:20 - 13:00	***Lunch & Exhibition***		

Session: Advanced Ceramics 4		*Session: Ceramic for Industrial Technology 4*	
Session Chair: *Asst. Prof. Dr.Thanakorn Wasanapiarnpong,* *Chulalongkorn University*		*Session Chair:* *Asst. Prof. Dr.Sirithan Jiemsirilers,* *Chulalongkorn University*	
13:00 - 13:25	**AI-05** **Synthesis of Nitride Photocatalyst Materials by Ammonothermal Method** Prof. Dr. Tomoaki Watanabe Meiji University, Japan	13:00 - 13:25	**CI-06** **Mechanical Properties of SMFMZS (SrO-Mn_2O_3-Fe_2O_3-MgO-ZrO_2-SiO_2) System Glass Fibre Reinforced Concrete (GFRC) Materials** Prof. Dr. Bekir Karasu, Anadolu University, Turkey
13:25 - 13:50	**AI-06** **Status and Standards in ISO/TC206 'Fine ceramics'** Dr. Shuji Sakaguchi National Institute of Advanced Industrial Science and Technology (AIST), Japan	13:25 - 13:50	**CI-07** **Environmental Friendly Ceramic Building Materials** Dr. Toyohiko Sugiyama, National Institute of Advanced Industrial Science and Technology (AIST), Japan
13.50-14.05	AO-13 **Hydrothermally Grown ZnO Nanorods for Ammonia Gas Sensor Applications: Effect of Surface Defects** Suranan Anantachaisilp Mahidol University, Thailand	13.50-14.05	CO-11 **Effect of Porosity and Pore Size on Microstructures and Mechanical Properties of Metakaolin Blended with $Ca(OH)_2$ and PLA as Porous Geopolymers** Chayanee Tippayasam Kasetsart University, Thailand
14.05-14.20	AO-14 **Transesterification of Soybean Oil using Bovine Bone Waste as New Catalyst** Suwilai Chaveanghong Mahidol University, Thailand	14.05-14.20	CO-12 **Properties of Geopolymer Paste from Fly Ash Blended with Metakaolin as Pervious Geopolymer Concrete** Phachongkit Boonanunwong Kasetsart University, Thailand
14.20 - 14.35	AO-15 **Novel Hydroxyapatite Bioceramic Composite with Enhanced Osteoblast Cell Supporting Ability** Jitlada Sansatsadeekul National Metal and Materials Technology Center, Thailand	14.20 - 14.35	CO-13 **The Mechanical Compressive Strength Property of Biomass Wood Ash-fly Ash Hybrid Geopolymer Mortar** Omar A. Abdulkareem Universiti Sains Malaysia (USM), Malaysia
14:35 - 15:00	*Refreshment*		

		Session: Glaze and Glass Technology	
		Session Chair : *Asst. Prof. Dr. Duangrudee Chaysuwan,* *Kasetsart University &* *Dr. Apirat Theerapapvisetpong,* *Chulalongkorn University*	
		15:00 - 15:15	GO-01 **Study of Melting Ability of Granulated Glass Batch** Kanit Tapasa Department of Science Service, Thailand
		15:15 - 15:30	GO-02 **Modification of the Composition of Low-Temperature-Sintering Alumina Crucibles for Glass Melting** Parida Jampeeruang Department of Science Service, Thailand
		15:30 - 15:45	GO-03 **The Effect of SiO_2 and B_2O_3 on the Glass-Ceramics Glaze Properties** Lada Punsukumtana Department of Science Service, Thailand
15:45 - 16:00	**Closing Ceremony**		

Poster Presentations

Session: Advanced Ceramics	
AP-01	**Hydroxyapatite-Bioglass Composites: Microstructural Study and Bioactivity Test** Pat Sooksaen Silpakorn University, Thailand
AP-02	**Effect of Substitution of Zn^{2+} and Zr^{4+} on Structural and Magnetic Properties of $BaFe_{12}O_{19}$** Rewadee Wongmaneerung Maejo University, Thailand
AP-03	**Morphological Controlled Synthesis of Zinc Oxide for the Application to Sunscreen Cosmetics** Mizuki Yoshida Tohoku University, Japan
AP-04	**Solvothermal Synthesis of Nb Doped TiO_2 and NIR Shielding Ability** Makoto Hamanaka Tohoku University, Japan
AP-05	**Effect of Sintering Temperature on Microstructure and Properties of Porous Anode-supported for Solid Oxide Fuel Cells Fabricated by Ceramic Injection Moulding** Nutthita Chuankrerkkul Chulalongkorn University, Thailand
AP-06	**The Effect of Glass/PVA Composite Composition on the Adhesion and Strength of a 96% Alumina Joint** Kritkaew Somton National Metal and Materials Technology Center, Thailand
AP-07	**Effect of Alumina (Al_2O_3) on the Characteristics of Sintered Mullite Ceramics Synthesized with Kaolin from Narathiwat of Thailand** Santi Pongphot Chiang Mai University, Thailand
AP-08	**Phase-Selective Hydrothermal Preparation and Upconversion Luminescence of $NaYF_4:Yb^{3+},Tm^{3+}$** Thanataon Pornphatdetaudom Chulalongkorn University, Thailand
AP-09	**High Performance Ag/AgBr/TiO_2 Photocatalyst-Coated Silica Beads** Jate Panichpakdee Thailand Institute of Scientific and Technological Research (TISTR), Thailand
AP-10	**Synthesis and Sintering of Magnesium Aluminate Spinel Nanopowders Prepared by Precipitation Method using Ammonium Hydrogen Carbonate as a Precipitant** Adison Saelee Chulalongkorn University, Thailand

AP-11	**Effect of Particle Sizes of $BaTiO_3$ (BT) Seed on Microstructure and Electrical Properties of $(Ba_{0.85}Ca_{0.15})(Zr_{0.1}Ti_{0.9})O_3$** Manlika Kamnoy Chiang Mai University, Thailand
AP-12	**The Electrical Properties of BCZT Lead-Free Ceramics Induced by $BaZrO_3$ Seeds** Manlika Kamnoy Chiang Mai University, Thailand
AP-13	**Effects of $NaNbO_3$ Crystals on Characterization of $(K_{0.5}Na_{0.5})NbO_3$ Ceramics** Chavalit Suksri Chiang Mai University, Thailand
AP-14	**Phase Structure, Microstructure and Electrical Properties of BCZT Ceramics Prepared by Seed-Induced Method** Wasuporn Hirunsit Chiang Mai University, Thailand
AP-15	**Tuning the Band Gap of ZnO Thin Films by Mg Doping** Chavalit Suksri Chiang Mai University, Thailand
AP-16	**Antibiotics Impregnated Hydroxyapatite for Localized Bone Tuberculosis Treatment: Influences of Solvent and Loading Techniques on Total Drug Content** Waraporn Suvannapruk National Metal and Materials Technology Center, Thailand
AP-17	**Effect of $SrTiO_3$ Nano-crystals on the Electrical Properties of $Na_{0.47}K_{0.47}Li_{0.06}NbO_3$ Ceramics by Seed Induced Method** Uraiwan Intatha Mae Fah Luang University, Thailand
AP-18	**Synthesis and Structural Studies of Nanowires Composite Materials from Rice Husk Ash by Metallothermic Processes** Ladarat Kanlayavisut Ubon Ratchathani University, Thailand
AP-19	**Effect of Hydroxyapatite Bioceramic Bodies on Subcutaneous Soft Tissue Reaction of Laboratory Rats** Rungsarit Koonawoot Chiang Mai University, Thailand
AP-20	**Phenol Removal from Wastewater Contaminated Using Activated Carbon/Zeolite Composite Coated with Titanium Dioxide** Khemmakorn Gomonsirisuk Chulalongkorn University, Thailand
AP-21	**The Effect of β-SiC Nanowires on the Properties of Mullite Composites** Wasana Khongwong Thailand Institute of Scientific and Technological Research (TISTR), Thailand
AP-22	**Influence of Silane Coupling Agent and Nano-Filler on the Properties of Dental Resin Composite Cements** Wasana Khongwong Thailand Institute of Scientific and Technological Research (TISTR), Thailand

AP-23	**Effect of $TaSi_2$ Addition on the Densification and Mechanical Properties of ZrC-20 vol % SiC Composites Prepared by Spark Plasma Sintering** Erhan Ayas Anadolu University, Turkey
AP-24	**Effects of Preparation Process and Sintering Temperature on Mechanical Properties of Al_2O_3/ZrO_2 Micro-composite** Saowaluk Chiangka Suranaree University of Technology, Thailand
AP-25	**Effect of Milling Time on the Properties of BYF Doped PZT Energy Harvesting Ceramics by High Energy Ball Milling** Arjin Boonruang Thailand Institute of Scientific and Technological Research (TISTR), Thailand
AP-26	**The Synthesis of Ru/NiO Nanoparticles with Gas-sensing Properties** Viruntachar Kruefu Maejo University, Thailand
AP-27	**Comparison of Milling Techniques of 0.98PZT-0.02BYF Piezoelectric Ceramic for Energy Harvester** Piyalak Ngernchuklin Thailand Institute of Scientific and Technological Research (TISTR), Thailand
AP-28	**A Facile Method for Preparation of $La_{0.5}Sr_{0.5}MnO_3$ Material by Atmospheric-Pressure Plasma Jet** Sagung Dewi Kencana National Taiwan University of Science and Technology, Taiwan
AP-29	**Influence of Time, Temperature and Solution Refreshing on Rapid Biomimetic Coating of Calcium Phosphate Coating on Titanium** Faungchat Thammarakcharoen National Metal and Materials Technology Center, Thailand
AP-30	**Size Reduction of Titanium Dioxide to Obtain Nano Particles by the Solution Combustion Technique** Rachata Puranasamriddhi Kasetsart University, Thailand
AP-31	**Effect of $SnCl_4$ Concentration on Transparent and Conducting Undoped Tin Oxide Thin Films** S.Tipawan Khlayboonme King Mongkut's Institue of Technology Ladkrabang, Thailand
AP-32	**Effect of Solvents on Photocatalytic Activity of $BiVO_4$ under Visible-Light Prepared by Precipitation-calcination Process** Pornapa Sujaridworakun Chulalongkorn University, Thailand

Session: Ceramic for Industrial Technology	
CP-01	**The Experimental of Low Temperatures Color Slip for Decorative on Earthenware Bodies** Soravich Mulinta Lampang Rajabhat University, Thailand
CP-02	**Powder Injection Molding of Mullite: The Study of Binder Dissolution Behavior during Debinding Step using Statistical Methods** Parinya Chakartnarodom Kasetsart University, Thailand
CP-03	**Powder Injection Molding of Mullite: The Study of Mechanical and Physical Properties of the Sintered Products using Statistical Methods** Parinya Chakartnarodom Kasetsart University, Thailand
CP-04	**Preparation, Characterization and Catalytic Performance of Zn-SBA-15 Catalysts** Supranee Lao-Ubol Thailand Institute of Scientific and Technological Research (TISTR), Thailand
CP-05	**Analytical Study of Ancient Pottery from the Archaeological Site of Ban Bo Suak form Nan Province, Thailand** Usanee Malee Chiang Mai University, Thailand
CP-06	**Effect of Borax on Lightweight Material from Cullet and Fly Ash** Sutthima Sriprasertsuk Department of Science Service, Thailand
CP-07	**Rate of Reaction and Mechanical Poperties on Calcined Kaolin-based Geopolymer** Narumon Lertcumfu Chiang Mai University, Thailand
CP-08	**Utilization of Coal Bottom Ash as a Raw Material for Stoneware Ceramics** Benya Cherdhirunkorn Thammasat University, Thailand
CP-09	**Utilization of Expanded Perlite as a Source of Silica for Synthesizing Wollastonite by Solid State Reaction** Napat Chantaramee Maejo University, Thailand
CP-10	**Synthesis of Lightweight Aggregate from By-product of Paper Industrial for Concrete Application** Suteerapun Punlert National Metal and Materials Technology Center, Thailand
CP-11	**Effect of Talc on phase Formation and Mullite Morphology of Different Thailand Clays** Nattawut Ariyajinno Chiang Mai University, Thailand

CP-12	**Development of the Common Brick Product to the Properties Fulfilled the Requirements of Thai Community Product Standard** Tamonwat Hirunchartanan Lampang Rajabhat University, Thailand
CP-13	**The Fabrication of Refractory Cordierite from Aluminium Buff Mixture** Nuntaporn Kongkajun Thammasat University, Thailand
CP-14	**Effect of Sodium Silicate and Used Gypsum Mold Additions on Properties of Lightweight Fired Clay Brick** Thanakorn Wasanapiarnpong Chulalongkorn University, Thailand
CP-15	**Preparation of Porous Silicon Carbide Ceramic by In-Situ Carbothermal Reduction Method from Rice Husk Charcoal** Chalermkwan Makornpan Chulalongkorn University, Thailand
CP-16	**Effect of Coarse Aggregate Replacement with Working Mold from Ceramic Industry in Lightweight Aggregate Concrete** Pronpimon Sakultong King Mongkut's University of Technology Thonburi, Thailand
CP-17	**Evaluation of Electrostatic Charge of Inorganic Pigments Coated by Silanes for Laser Beam Printer** Jae-Hwan Pee KICET, South Korea
CP-18	**A Recovery Process of High CaO Fly Ash after Wet Condition and their Characterization** Sorachon Yoriya National Metal and Materials Technology Center, Thailand
CP-19	**Carbon Structure Synthesized from Coconut Coir and their Properties** Angkana Chumphu National Metal and Materials Technology Center, Thailand
CP-20	**Effect of Quartz Addition on the Properties of Clay Body for Trakuan Pottery** Chiawchan Saengthong Sisaket Rajabhat University, Thailand
CP-21	**An Efficient Photocatalyst Materials TiO_2 for Degradation of Organic Pollutants in Wastewater** Kamonwan Pinato Chulalongkorn University, Thailand
CP-22	**Red Loess Development as Raw Materials for Clay-Based Ceramics** Kritika Trakoolngam Khon Kaen University, Thailand
CP-23	**Porous Geopolymer using Aluminium Dross and Aluminium Powder as Foaming Agents** Anut Saikrasoon Chulalongkorn University, Thailand

Session: Glaze and Glass Technology	
GP-01	**Preparation and Characterization of Bioactive Glass/Polycaprolactone Composites for Bone Tissue Engineering** Wilaiwan Leenakul Rajamangala University of Technology Phra Nakorn, Thailand

PLENARY LECTURES

Plenary Speakers

PL-01
Prof. Dr. Alpagut Kara
Anadolu University, Turkey
"Importance of Pyroplastic Deformation Control Towards Obtaining Thin-walled Ceramic Sanitaryware Products"

PL-02
Prof. Dr. Arie Van Riessen
Curtin Universiy, Western Australia
"Geopolymers in Australia with a Focus on Development of Fire Resistant Products"

PL-01

Importance of Pyroplastic Deformation Control Towards Obtaining Thin-walled Ceramic Sanitaryware Products

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Ceramic sanitaryware production requires high amount of raw materials and energy due to large sized and complicated shaped products and complex production processes. In addition, production of such products limits the use of automatic systems and leads to high cost of labor. According to the relevant standards, water absorption of sanitaryware products should be less than 0.5 % due to their use in water interactive areas. Fired sanitaryware bodies include high level of glassy phase in which crystalline phases of mullite and residual quartz are dispersed as a result of viscous flow sintering. High firing temperatures up to 1240°C and long firing times for 10 to 12 hours are necessary in order to achieve required technological properties such as low water absorption from such complex pieces. Under such firing conditions, products are also expected to be resistant to pyroplastic deformation to satisfy the required dimensional tolerances and thus cast thickness is kept at above certain value. This study aims to understand the factors affecting pyroplastic deformation of sanitaryware bodies in detail, while attaining a thin-walled product. In order to achieve this aim, several formulations were prepared by employing different fluxing agents. Type and amount of crystalline and glassy phases were also varied within a certain range. The firing conditions were almost kept the same to the industrial conditions. The results showed that it was possible to reduce wall thickness from 11-12 mm down to 5-6 mm while doubling the fired strength

Keywords: sanitaryware, thin-walled, pyroplasticity, strength

PL-02

Geopolymers in Australia with a Focus on Development of Fire Resistant Products

Arie van Riessen and Les Vickers
Curtin University, Perth, Western Australia

Abstract

This paper will be presented in two parts. The first part will be a brief overview of existing and potential commercial geopolymer activities in Australia. Details of Bayer derived geopolymer as a potentially new commercial product will be included in this section.

The second part of the presentation will focus on development of fire resistant geopolymers. Using local Western Australian fly ash the strategy for improving fire resistance of geopolymers will be outlined. This will include information about the judicious addition of fillers and fibres to ensure structural integrity through minimal expansion/shrinkage during thermal exposure.

INVITED LECTURES

Invited Speakers

Session: Advanced Ceramics

AI-01
Prof. Dr. Hyung-Ho Park
Yonsei University, Korea
"Thermoelectric Ceramics with Ordered Mesoporous Structure"

AI-02
Assoc. Prof. Dr. Jerapong Tontrakoon
Chiang Mai University, Thailand
"The Fabrication and Dielectric Constant of (1-3) Piezoceramic Polymer Composites"

AI-03
Prof. Dr. Tsugio Sato
Tohoku University, Japan
"Morphology Control of Metal Oxide Particles for Multifunctional Cosmetic Application"

AI-04
Dr. Koji Takeuchi
National Institute of Advanced Industrial Science and Technology (AIST), Japan
"Photocatalysis as a New Environmental Application of Fine Ceramics: Performance and Evaluation"

AI-05
Prof. Dr. Tomoaki Watanabe
Meiji University, Japan
"Synthesis of Nitride Photocatalyst Materials by Ammonothermal Method"

AI-06
Dr. Shuji Sakaguchi
National Institute of Advanced Industrial Science and Technology (AIST), Japan
"Status and Standards in ISO/TC206 'Fine Ceramics' "

Session: Ceramic for Industrial Technology

CI-01
Mr. Ralf Loebe
Maschinenfabrik GUSTAV EIRICH GmbH&Co KG, Germany
"Spray-powder Flowability Produced with EIRICH Eco-Prep® Technology"

CI-02
Asst. Prof. Dr. Niti Yongvanich
Silpakorn University, Thailand
"Crystalline Glazes: Crossing Boundaries"

CI-03
Asst. Prof. Dr. Pattana Rakkwamsuk
King Mongkut's University of Technology Thonburi, Thailand
"Review and a Research on Green NIR Reflective Pigment"

CI-04
Assoc. Prof. Dr. Tadachika Nakayama
Nagaoka University of Technology, Japan
"Synthesis and Microstructure Observation of Molten Metal Corrosion Resistant Yttria Based Refractory"

CI-05
Dr. Hyung Tae Kim
Korea Institute of Ceramic Engineering and Technology (KICET), Korea
"Fabrication and Characterization of Thermal Barrier Coatings of Yttrium Stabilized Zirconia by Suspension Plasma Spray and EBPVD Method"

CI-06
Prof. Dr. Bekir Karasu
Anadolu University, Turkey
"Mechanical Properties of SMFMZS (SrO-Mn_2O_3-Fe_2O_3-MgO-ZrO_2-SiO_2) System Glass Fibre Reinforced Concrete (GFRC) Materials"

CI-07
Dr. Toyohiko Sugiyama
National Institute of Advanced Industrial Science and Technology (AIST), Japan
"Environmental Friendly Ceramic Building Materials"

AI-01

Thermoelectric Ceramics with Ordered Mesoporous Structure

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Mesoporous materials have a structure containing nano-sized pores of 2~50 nm. Their pore size, pore distribution (regular/irregular, open/close), and pore shape can be controlled easily according to the synthesis process. The existence of pores in the material grants distinctive properties such as decreased dielectric constant from increased porosity and decreased thermal conductivity from increasing phonon scattering. Therefore the mesoporous materials can be used in many applications such as thermal insulators, low dielectrics, thermoelectrics, gas sensors, and so on. Mesoporous materials can be prepared by sol-gel procedure using evaporation induced self assembly (EISA) process and the pore structure including porosity, pore size, and pore distribution could be controlled. The structural, mechanical, and electrical properties of mesoporous materials showed a strong dependency on porous structure. In this presentation, mesoporous ceramic thin films were prepared by using EISA process for applying to thermoelectrics. Thermoelectric properties are defined through the figure of merit, $Z = \sigma S^2/\kappa$, where σ, S, and κ are electrical conductivity, Seebeck coefficient and thermal conductivity, respectively. Therefore high electrical conductivity and low thermal conductivity are desired to enhance thermoelectric property. In this presentation, various experimental approaches including a control of pore structure and introduction of dopants and nano-materials to enhance the thermoelectric property will be discussed. Through the approaches, the authors could control thermal conductivity and electrical conductivity of mesoporous ceramic thin films individually to optimize the thermoelectric property.

ICTA2015
International Conference on
Traditional and Advanced Ceramics 2015

AI-02

The Fabrication and Dielectric Constant of (1-3) Piezoceramic Polymer Composites

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Keywords: PZT-polymer, (1-3) composites, dielectric property.

Piezoceramic-polymer composites having (1-3) type connectivity and of a scale size suitable for high frequency >1 MHz transducers was carried out in this study. The piezoceramics ($PbZr_{0.52}Ti_{0.48}O_3$, PZT) were prepared by the conventional mixed oxide route. The starting powders of PbO, ZrO_2 and TiO_2 were mixed and calcined at 800°C. The calcined powder was mixed with excess PbO and a lithium/bismuth-based glass forming in order to lower the sintering temperature to approximately 1000°C. A method for extruding rods of approximately 400 μm diameter was developed. The rods were assembled and impregnated with epoxy resin to form 1-3 composites containing approximately 20 and 50 vol% piezoceramics. Both PZT rods and the composites were studied by a scanning electron microscope (SEM). The dielectric properties of the composites were measured. The equivalent capacitance model was employed to determine the dielectric for comparison.

AI-03

Morphology Control of Metal Oxide Particles for Multifunctional Cosmetic Application

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Keywords: *Solvothermal reaction, Oxide particles, Morphology control, Multifunctional cosmetics.*

Metal oxides have been used as various functional materials, such as electronics, pigments, UV-shielding materials, etc. The morphology controlled particles of CeO_2, ZnO, $K_{0.80}(Li_{0.27}Ti_{1.73})O_4$ and Al_2O_3 were fabricated by solvothermal reactions in order to realize multifunction, such as UV-shielding, comfort, glossing, soft-focusing, etc. for cosmetic application.
The nanoparticles of Ca^{2+} doped CeO_2 were prepared by the coprecipitation reaction of Ce^{3+} and Ca^{2+} at room temperature followed by the oxidation with H_2O_2. Plate-like microparticles of CeO_2 were prepared by the reaction of $Ce(NO_3)_3$ and $NaHCO_3$ at room temperature followed by calcination in air. The plate-like microparticles of $K_{0.80}(Li_{0.27}Ti_{1.73})O_4$ were fabricated by flux method using a KCl flux. The plate-like microparticles of Al_2O_3 were prepared by the reaction of $Al(NO_3)_3$ and $NaHCO_3$ aqueous solutions around 240°C. The morphology controlled ZnO, such as plate-like, rod-like, star-like and spherical ones were formed by solvothermal reactions using $Zn(NO_3)_2$ and various alkalis and surface modifiers, such as hexamethylenetetramine, monoethanolamine, triethanolamine, ethylene glycol, Fe^{3+}, etc. around 80°C.
The nanoparticles of Ca^{2+} doped CeO_2 showed excellent UV-shielding ability with the low oxidation catalytic activity. The plate-like microparticles of $K_{0.80}(Li_{0.27}Ti_{1.73})O_4$ showed excellent comfort and gloss as well as UV-shielding ability. Coating CeO_2 nanoparticles on plate-like microparticles of $K_{0.80}(Li_{0.27}Ti_{1.73})O_4$ was useful to improve the comfort without loss of the UV-shielding ability. The plate-like microparticles of CeO_2 and Al_2O_3 also showed nice comfort as well as UV-shielding ability and gloss, respectively. The rod-like and star-like ZnO particles showed excellent soft focus property as well as excellent UV-shielding ability.
These morphology controlled oxide particles may have high potentials for the application to multifunctional cosmetics, such as UV-shielding, comfort, glossing, soft-focusing, etc.

AI-04

Photocatalysis as a New Environmental Application of Fine Ceramics: Performance and Evaluation

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Keywords: photocatalysis, test method, standardization, ISO

Some metal oxides like titanium dioxide (TiO_2) are activated by the sun or indoor light to form active oxygen species that cause decomposition of environmental and biological pollutants. This semiconductor photocatalysis has been expected to be a new fine ceramic industry through composites, coatings and other surface treatment. Practical materials contain photocatalyst either in the substrate or on the substrate as a thin film. The substrate can be ceramic, glass, metal, plastic or paper.

The major functions of environmental photocatalysis are air and water purification, antimicrobial, and self-cleaning effects, under mild conditions without requiring additional energy. These functions have never been obtained by any other material. However, the performance is not always visible, and there have been low quality products in the market. We have started the standardization of test methods a decade ago, in order to promote the development of more efficient materials, to remove fake materials from the market, and eventually to protect consumers. The domestic standardization committee in Japan consists of leading members from academy, industry, government and users. International standardization has been discussed in ISO/TC 206 (Fine Ceramics). Then our activity shifted towards the test methods for the photocatalysts that work under indoor lighting environment (ILE), in order to respond to the indoor environmental issues,

Since most of the test methods have been standardized internationally, now we need accredited testing laboratories, performance criteria of products, certification and labelling systems, in order to disseminate reliable products. The Photocatalysis Industry Association of Japan (PIAJ) copes with preparing these systems. About 100 photocatalytic products are now certified and the sales of products are gradually increasing in Japan. We hope such systems to be expanded into Asia and world level with the cooperation of all the sectors in photocatalysis community.

AI-05

Synthesis of Nitride Photocatalyst Materials by Ammonothermal Method

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Keywords: photocatalyst, nitride, ammonothermal

Metal nitrides and oxynitrides have received much attention owing to various applications in electronic devices because of their unusual dielectric and optical properties and ionic conductivity as well as their catalytic activity, and show particular potential as photocatalysts for the splitting of water. They have a number of other intriguing properties as well. Particularly intriguing are the recent findings that some Ta-based oxynitrides can serve as visible-light-driven photocatalysts because of their narrow band gaps. For example, Domen et al. reported recently that Ta-based oxynitrides such as TaON, Y2Ta2O5N2, and LaTaON2 show high activity for water reduction and oxidation in aqueous solutions containing sacrificial reagents under visible-light irradiation. Despite these promising findings, transition metal oxynitrides have been much less investigated in terms of syntheses, properties, and applications, than have the corresponding oxides. For example, transition metal oxynitrides are still generally synthesized by the conventional but rather difficult routes of calcining oxide or reactive oxide precursors with flowing ammonia at high temperatures. However, the products so obtained rarely exhibit the expected properties, but rather tend to exhibit low crystallinity, slow reaction rates, and significant structural defects because of the long duration and high temperature of calcination.Among the new methods for synthesizing oxynitrides, the use of supercritical ammonia shows promise. Important advantages of this method compared with the conventional methods are that it gives well-crystallized nitrides such as GaN[1] , CaAlSiN3[2] ,LaTaON2[3] ,SrAlSiN3[4] , Ta3N5[5]at relatively low temperatures and it suppresses defect formation because the reaction scheme is not so much a solid-state reaction as it is a liquid-state reaction. However, there are a few reports about the synthesis of transition metal nitrides in supercritical ammonia. Thus, in the present talk, we will demonstrate the synthesis of well-crystallized nitrides and oxynitrides at low temperature by reacting metal precursors in ammonia under supercritical conditions.

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AI-06

Status and Standards in ISO/TC206 'Fine Ceramics'

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(Secretary, ISO/TC206)

ISO/TC206 'Fine ceramics' is one of a technical committee (TC) in the International Organization for Standardization, established in 1992. The first plenary meeting for this TC was held in 1994, and the latest meeting is held in August 2015, in Jeju, Republic of Korea. The scope of this TC covers very wide field concerning the ceramic materials for industrial applications, in forms of powders, monoliths, coatings and composites, and in functions of mechanical, thermal, chemical, electrical, magnetic, optical and their combinations. This TC consists of 18 participating member (P-member) countries and 13 observing member (O-member) countries. We already have 80 published standards from this TC. About 30 new work items are under discussion, about 15 items are waiting for starting the discussion, and about 10 items are in the process for revision of the published standards. In this TC, we have 12 working groups; terminology, powders, chemical analysis, composites, porous ceramics, mechanical properties, physical and thermal properties, joining, photocatalysis, coatings, electrical and optical application and engineering application. More than twenty years have passed since starting this TC, generally speaking, the categories of the discussed items tends to shift, from some testing methods for fundamental properties (strength, density, thermal properties etc.), to some properties for specified applications, such as ceramic bearing materials, photocatalytic materials and electrical applications. In this presentation, I will explain the background, current situation, published standards from this TC, work items under discussion, and some future proposals to this TC, including the explanation of the discussion in the plenary meeting of this year.

CI-01

Spray-powder Flowability Produced with EIRICH Eco-Prep® Technology

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Keywords: Dry preparation, Tiles, Flowability, Savings

In the last 50 years, ceramic body and press granules preparation for ceramic industries especially ceramic tile industry were globally dominated by wet preparation process. Ceramic bodies generally consist of clays and hard materials. All raw materials will be ground with water addition in ball mill as a slip which has approximately 35% humidity and less than 63 microns. It means that milling time and consequently energy consumption are depending on the lowest grinding property of raw materials. Afterwards a slip is screened and spray dried to spray granules with required pressing moisture at approximately 6% to 7%. The flowability and particle size distribution (PSD) of 0 to 800 microns give a wide range of pressed tile dimensions possibility. Since energy prices such as gas and electricity have been raising dramatically and new production process had been developed, many tile manufacturers are in a re-thinking position on the traditional wet preparation process. Dry preparation process has been an alternative process to wet preparation process in the market for 20 years. The available outdated dry preparation process in the market has the following process: dry grinding of soft and hard materials together, in most of the cases (sometimes also separate); screening; and so called pre-wetting. This process have negatively proven results as the unachievable flowability, the incompatible of particle size distribution (PSD) with 30% to 45% less than 100 microns, and the necessity of recipe changing. A number of manufacturers, who has this process, is globally operating with low success and is mostly producing only smaller tile sizes. MASCHINENFABRIK GUSTAV EIRICH GmbH & Co KG, a well-known mixer and granulator manufacturer from Germany, has extended its range of process technologies. It has incorporated several technological innovations in saving production costs and offering complete preparation technologies such as in ceramic industry, the **EIRICH Eco-Prep® Technology**. The technology is not only based on dry grinding of raw materials independently together or separate but also based on more than 100 years experience in mixing and granulating technology. Press granules from the **EIRICH Eco-Prep® Technology** have similar properties in flowability and particle size distribution (PSD) with no recipe changing necessary. Furthermore there is neither further dosing equipment nor aerator in front of the presses necessary. The **EIRICH Eco-Prep® Technology** can also be implemented to existing dry preparation plant, which has not reached the expectation. Achievable cost saving is approximately 30% to 40% per tonne of dry press granules. Meanwhile in South-East-Asia, MASCHINENFABRIK GUSTAV EIRICH GmbH & Co KG had delivered and commissioned the **EIRICH Eco-Prep® Technology**, which successfully is running at 800 tonnes of press granules per day. The proven **EIRICH Eco-Prep® Technology** for the dry preparation of press-powder with similar product behaviors as traditional spray-powder for tile industry is the solution to save production cost and is the process of the future.

CI-02

Crystalline Glazes: Crossing Boundaries

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Keywords: Crystalline glaze, Ceramics, Crystallization, Materials Engineering

Crystalline glazes are unique in a way that they demonstrate distinct crystal growth in the matrix of the molten glaze. Various requirements for successful glazes with macro-crystals include high fluidity, coating thickness, special chemical composition and firing condition. Willemite (Zn_2SiO_4)-based crystals was well known to produce spectacular effects with various sizes and shapes appearing to float on a glaze background. However, for most potters, such fascination is frequently, if not always, coupled with frustration due to their complexity in nature. In order to tackle these difficulties, scientific fundamentals behind the crystal growth phenomena in the glazes should be established in addition to the already pressing constraints of art and design of the products. This study was focused on the paradigm of materials science (structure-processing-property) in order to exemplify the incorporation of aesthetics into the basic scientific principles of materials chemistry and characterization. Through interdisciplinary research with the artist from the Faculty of Decorative Arts at Silpakorn University, this study has fostered and manifested the concept of integration in crystalline glazes, eliminating the explicit boundary between art and science. By bridging expertise in both materials engineering and ceramic art design, the aesthetic work based on the art-science integration concept has been successfully demonstrated and exhibited at the National Research Expo in 2014. This perception of academic boundary crossing has proved to be pivotal, if not inevitable, for perfecting and progression towards both improvement and innovation of pottery products.

CI-03

Review and a Research on Green NIR Reflective Pigment

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Abstract

In hot climate regions, large amount of electricity in buildings is consumed by air-conditioning systems. Coating on a building envelope with solar reflective coating can enhance thermal performance of a building. Pigment in the coating plays a major role on its solar reflective property. This talk and presentation will give a review on a development of various NIR/IR reflective pigments. It will also report a development of green-NIR reflective pigments in which Cr_2O_3, a green pigment oxide, was used as the host component and the mixtures of Al_2O_3, V_2O_5 and TiO_2 were used as the guest components. Al_2O_3, V_2O_5 and TiO_2 were mixed at different 36 compositions. The mixed samples were calcined at 1150 °C for 4 hours and were ground with an agate ball mill for 7 minutes at a speed of 250 rev/min. Finally, the pigments were sieved to obtain the particle sizes of 0.5 - 2.0 µm. The reflectance for all samples were measured and computed in accordance with the ASTM E891 standard. It was found that a maximum reflectance, in the wavelength ranging between 780 and 2100 nm, of 82.8% was obtained from the sample with a composition of 80%Cr_2O_3, 14%Al_2O_3, 4%TiO_2 and 2% V_2O_5. The pigment was further investigated when it was used for a production of a ceramic tile. A ceramic glaze was prepared using the pigment at 6%wt. The water at 55.5%wt was added into the pigmented glaze to obtain the slurry with specific gravity of about 1.4. The slurry was then sprayed onto a clay biscuit that was further fired at 1100 °C. Experiments showed that the NIR reflectance of the pigmented glaze slightly dropped to 76.3%. The techniques found from this development can be further employed for other NIR/IR reflective pigments.

CI-04

Synthesis and Microstructure Observation of Molten Metal Corrosion Resistant Yttria Based Refractory

Tadachika NAKAYAMA[a,*], Son Thanh Nguyen [a], Hisayuki Suematsu [a], Tsuneo Suzuki [a], Makoto Nanko [a], Hong Baek Cho [a], Minh Triet Tan Huynh [a] and Koichi Niihara[a]

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Keywords: $Y_2Ti_2O_7$, Corrosion, Mechanical properties, Refractories

When the demand for finding new refractory materials which can sustain molten metal at very high temperature becomes imperative, $Y_2Ti_2O_7$, the main phase precipitated in oxide dispersion strengthened (ODS) steel, has been considered a promising candidate. In this study, ceramic discs of $Y_2Ti_2O_7$ were firstly sintered from Y_2O_3 and TiO_2 by solid-state reaction and hot-pressing method, and then densified by Hot-isostatic-pressing (HIP) before being employed to fabricate sandwiched structures with aluminum (Al) foils. The phase identification by X-ray diffraction confirmed no reaction between the molten Al and the ceramics, while the micro-structural observation and energy dispersive X-ray spectroscopy results revealed that the densification has improved the resistance of $Y_2Ti_2O_7$ ceramics against molten-metal penetration. The result of this study should be good reference data for designing for crucible, casting molds.

CI-05

Fabrication and Characterization of Thermal Barrier Coating of Yttrium Stabilized Zirconia by Suspension Plasma Spray and EBPVD Method

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Keywords: Thermal Barrier Coating, YSZ, Lanthanide, EBPVD, Suspension Plasma Spray

To meet the demand for the higher operating temperatures of gas turbines, extensive research efforts have been carried out attempting to enhance the performance of thermal barrier coatings (TBCs) in the field of coating process as well as topmost layer materials. Fabrication of TBCs with segmented microstructures has been widely studied with various coating processes such as suspension plasma spray (SPS), plasma spray physical vapor deposition (PS-PVD), and electron beam physical vapor deposition (EBPVD). One the other hand, rare-earth zirconate system is one of the most promising candidates for replacing yttira-stabilized zirconia (YSZ) in TBC applications.

In this study, thermal barrier coatings of YSZ or rare-earth added zirconate system are fabricated via suspension plasma spray and EBPVD method. At first, the SPS process is applied to produce TBCs with a segmented structure by using YSZ suspension. Four different experiment sets are carried out by controlling the ratio between surface roughness of substrate and feed stock size in order to examine the effect of size ratio on the microstructure of SPS-prepared coatings. Secondly, Lanthanum/gadolinium zirconate coatings are fabricated by suspension plasma spray. Phase formation, microstructures, and thermal conductivities are examined with the deposited coatings of lanthanum/gadolinium zirconate compositions. The third set of experiment is controlling columnar structure of YSZ coatings prepared by EBPVD as a function of rotation speed. The possibilities of these coatings for TBC application are also discussed.

CI-06

Mechanical Properties of SMFMZS (SrO-Mn_2O_3-Fe_2O_3-MgO-ZrO_2-SiO_2) System Glass Fibre Reinforced Concrete (GFRC) Materials

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ABSTRACT

Glass fibre reinforced concrete (GFRC) contains high-strength glass fibres that embedded in cement-based matrix. In such a composite structure, while the fibres are load carrying element, the matrix is base protecting fibres from the environmental effects and facilitates fibbers' motion. For this reason, Zrn1 coded glass fibres belonging to SMFMZS (SrO-Mn_2O_3-Fe_2O_3-MgO-ZrO_2-SiO_2) system was used as a reinforcing material to produce GFRC structures. With the standard sample, concretes which containing glass fibre at the rate of %1, %3 and %5 wt. were prepared and TS EN 196-1 standard procedure was used for the experimental studies. Analysis for the test samples were carried out in order to determine mechanical properties. According to results, Zrn1 coded glass fibre added concrete samples as 1 wt. % show better compressive strength than others.

Furthermore, the detailed micro-structural observations on the glass fibre reinforced concrete (GFRC) structures were made by SEM and energy dispersive X-ray spectroscopy (EDXS) combination. Consequently it has been determined that Zrn1 fibres can be used to get high durability and mechanical strength having concrete structures.

Keywords: SMFMZS system fibre, GFRC, Mechanical strength, Chemical durability, Characterisation.

CI-07

Environmental Friendly Ceramic Building Materials

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The global warming is one of the most serious problems. The decrease of CO_2 emissions in our daily life is an important subject today. Recently, an application of water retentive materials as a paving material has attracted a great deal of attention in Japan. This material is effective for reducing heat island phenomenon, which is also a recent problem in many cities in Japan. Water retained in the material during rainfall evaporates when heated by sunshine. The latent heat absorbed by evaporating water works to cool the surroundings. The water retentive ceramic products are expected to be useful for building materials as well as pavements. Several performances is however required on the water retentive ceramics when it is used as building materials. Its cost and quality are the important factors. Porous ceramic materials formed by pressing without firing is one of ideal low cost and eco-friendly candidates. The porous ceramics is also expected to be produced from recycled ceramic materials. By optimizing its composition and forming method, a water retentive material with high performance was developed. The trial product had the properties as follows; fracture toughness: 1300N, bending strength: 175N/cm, water absorption: larger than 30%, and precision in size (length): +-0.5mm for 150mm. The product showed also enough frost resistance. In this paper, the fundamental properties of the porous ceramics prepared without firing are discussed with referring to the results of the field experiments.

Another subject recently studied by several tile makers in Japan is the glazed tile with high solar reflectance. The exterior walls covered with such a high solar reflectance tile keeps the surface temperature of the wall lower under the strong sunshine of summer. It is effective against heat-island phenomenon. In this paper, the outline of the research results on visible and infrared reflectance of many kinds of glazes is also discussed.

ORAL PRESENTATIONS

AO-01

Graphene for Electroconductive Yyttira-stabilised Zirconia (YSZ) Ceramics

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Abstract

A simple and upscalable method has been reported to produce graphene-Yytria stabilised zirconia (YSZ) ceramic composite with significant improvement in electrical properties. The material was consolidated by annealing in presence of Argon gas that allowed densification of the ceramics. Relative density of YSZ reinforced with 2wt% graphene was approximately 95.1%. A detailed x-ray diffraction analysis was found to be useful to study the phases and crystallinity of graphene- YSZ ceramic composite. A very low graphene loading (0.2 wt.%) led to increase in electrical conductivity up to 3 orders of magnitude in comparison to monolithic ceramic.

AO-02

Synthesis of Highly Flexible and Super Hydrophobic Silica Aerogel

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Keywords: aerogel, nanoscale pore structure, flexibility, mechanical property.

The aerogels are made with sol–gel produced materials consisting of interconnected nano-particle building blocks. The structure contains the nano-sized open pores and highly porous, around 99% volume in material with three-dimensional network. Generally aerogels have very high surface area, low density, and very low thermal conductivity. These properties lead various applications such as thermal insulator, acoustic insulator, low dielectrics, gas sensor, and so on. Especially super hydrophobic aerogels can be used for oil-spill cleanup and waterproof products. Although having these attractive properties, the aerogels have serious weak point that they are fragile and brittle. Due to these fragility and brittleness, aerogels are easily broken into pieces and eventually into powder. Therefore in the study, highly flexible and super hydrophobic aerogels were prepared by using a two-step (acid–base) sol–gel process followed by supercritical drying. The effects of various sol–gel parameters on the flexibility of the aerogels were investigated. To investigate the microstructures of the aerogels, scanning electron microscopy was used. The Young's modulus of the aerogels was determined by using an uniaxial compression test. To measure the pore volume and surface area, N_2 adsorption-desorption analysis was employed. To investigate the bond in the aerogel, Fourier transform infrared spectroscopy was used. The aerogels consist of cross-linked network in three dimension because the presence of non-polar alkyl groups (i.e. methyl) attached to the silica particles, the inter-chain cohesion is minimized resulting in an increase in elasticity and flexibility of three-dimensional network of aerogel. Moreover, the alkyl group in network mainly contribute to the main properties of flexibility and hydrophobicity. The properties of flexibility and hydrophobicity will be compared with those of Rao's group, for example, young's modulus of 10^4 N/m^2 and contact angle of 160˚. The flexible aerogel was found to be bent to any shape with high flexibility and super hydrophobicity.

Acknowledgement: This study (Grants No. C0296981) was supported by Business for Cooperative R&D between Industry, Academy, and Research Institute funded Korea Small and Medium Business Administration in 2015.

AO-03

Photoelectrodeposition Effect of Gadolinia-modified Ceria Particles on The Removal of Lead (II) Ions from Water

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Keywords: Cerium oxide, Gadolinium oxide, Photocatalyst, Lead.

A photocatalytic efficiency of CeO_2 semiconductor depends on a recombination rate between photoinduced electrons and holes. One method to delay the recombination is to create heterojunctions of p- and n-type materials, made of a metal oxide and a modified CeO_2. In this work, we report results of utilizing an incorporation of Gd_2O_3 in CeO_2 for the removal of Pb(II) ions in water by using photocatalytic capabilities of solely CeO_2, and Gd_2O_3-CeO_2 prepared by a solid-state reaction method at two different calcination temperatures. The UV-photocatalytic activity for Pb(II) ion removal of the Gd_2O_3-modified CeO_2 particles is significantly higher than that of pure CeO_2. A solid solution $Gd_{0.1}Ce_{0.9}O_{1.95}$ phase coexisting with the CeO_2 matrix phase obtained at a calcination of 1400°C, shows a high ability of photoelectrodeposition for the Pb(II) ions removal, compared to the two-phases mixture of Gd_2O_3-CeO_2 calcined at 1000°C. The high photocatalytic activity is also supported by a strong photoluminescence signal from the $Gd_{0.1}Ce_{0.9}O_{1.95}$-CeO_2 suggesting a high efficiency of photogenerated charge separation. The high activity can be due to a formation of heterojunctions between p-type $Gd_{0.1}Ce_{0.9}O_{1.95}$ and n-type CeO_2, promoting transfer of photogenerated electron-hole pairs and efficiency restraining recombination of the charges.

AO-04

Multi-Layered Titanium Dioxide Films and their Combination Effect with Solar Water Heating on Disinfection of *Escherichia coli*

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Keywords: Solar radiation, Titanium dioxide, Disinfection, *E. coli*

The research work reports a designed fabrication of muli-layered titanium dioxide films and studies their effectiveness on disinfection of *E. coli* in water, particularly examining the photocatalytic effect in comparison to solar disinfection, as solar hot water produced by the asymmetrically parabolic concentrator. For film preparation, the 150-µm thick titania layers have been coated on the 3-mm suction blasted glass substrate *via* thermal spray coating prior to screen printing on its top. Surface area of the titania film has been fixed at 9.5×11.5 cm^2 as well as the constant water volume of 660 cm^3 for each unit of reactor. The starting concentration of *E. coli* in this study is 2.15×10^{11} CFU/ml. The experiment has been conducted under sunlight during daytime for 8 hours; from 8:30-16:30 hrs. Under the average solar radiation density of 364 W/m^2, the multi-layer coated titania film has shown its great ability in *E. coli* reduction to 51.16% for total number of living *E. coli*, compared to 71.16% for the condition without the titania coated films. The work has confirmed the efficiency of solar heating in a combination with the photocatalytic activity of the film on treating *E. coli* by a factor of two during 08:30-10:30 hrs, suggesting in a benefit merit that the use of titania film is essential to enhance the disinfection efficiency during the morning period. After the entire period of solar exposing, the remaining living *E. coli* has been counted and found as 20.70% and 31.40% for respectively the conditions with and without the titania films.

AO-05

Tin Oxide Aerogels Synthesized using Non-alkoxide Precursor by Ambient Pressure Drying

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Keywords: tin oxide, crystallite size, specific surface area, gas sensing properties

Recently, detection of environmental pollutant, toxic, combustible and process gases are highly important for society to control, monitor and protect from polluted materials. Various methods can be applied for gas sensing like mass spectrometry, gas chromatography, semiconductor gas sensors, etc. Among them, solid-state semiconductor gas sensors offer considerable advantages comparing to other sensing methods. They can be manufactured with low price, miniaturized easily and designed to operate with high reliability and at high temperature. Tin oxide (SnO_2) is wide band gap semiconductor and room temperature band gap is 3.6 eV. This material has been widely investigated as gas sensors by many researchers. Tin oxide can be reacted sensitively with small amount of gases at relatively low operating temperature due to its easy adsorption of gases at the surface. In case of oxides the gas sensing sensitivity could be sharply increased with very small grain size (< 6 nm) and high surface area. And pure SnO_2 sensing performance can also be improved with dopants. Thus, the nano-sized porous materials could be very powerful tool to enhance the sensitivity. Synthesizing tin oxide using tin alkoxide precursors is significantly expensive. Therefore in this study, synthesizing porous tin oxide aerogel using non-alkoxide precursor was tried by sol-gel process and ambient pressure drying. The gelation was attained using epoxide initiated process. Water and ethanol solvent ratio significantly altered the textural properties of the tin oxide aerogels. High specific surface area and small crystallite size(< 6.5 nm) were appeared with our tin oxide aerogel after annealing at 450 ºC. The results were beneficial for gas sensing properties. The sensitivity of SnO_2 aerogel sensor to CO was measured and the performance were analyzed as a function of specific surface area. The CO gas sensing property of tin oxide aerogel was clearly enhanced with increased specific surface area about maximum 24 times.

Acknowledgement: This work (Grants No. C0277323) was supported by Business for Cooperative R&D between Industry, Academy, and Research Institute funded Korea Small and Medium Business Administration in 2015.

AO-06

Effect of Modified CCTO Dispersion on the Dielectric and Mechanical Properties of PVDF

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Keywords: Polymer ceramic composites, Doped Calcium Copper Titanate (CCTO), Mechanical properties, Electrical properties.

Abstract
The effect of varying amount of modified Calcium Copper Titanate (CCTO) in PVDF has been investigated on the mechanical and dielectric properties of the composites. Phase analysis has been done using powder X-ray diffraction (XRD). Microstructural, dielectric and mechanical properties have been studied. Composites exhibit higher values of Young's modulus than that of PVDF. Dielectric measurements were made in the frequency range 10^{-2} to 10^{6} Hz using Novocontrol (Alpha-A High Performance Analyzer ZG4) in the temperature range 40^{o} to 120°C. Dielectric permittivity increases with the increase in ceramic content. Dielectric loss increases slightly with increasing temperature and decreases with increasing frequency. Dielectric relaxations have been studied using modulus spectroscopy. Two dielectric relaxations have been observed, one in the low frequency range and the other in the intermediate frequency range. The low frequency relaxation is attributed to the Maxwell-Wagner-Sillar type while the high frequency relaxation is due to α_c relaxation associated with the molecular motion of the polymer chains in the crystalline regions of PVDF.

AO-07

Synthesis and Investigation of MoO_3 Microfilms and Nanorods by Thermal Chemical Vapor Deposition

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Keywords: MoO_3 microfilms, MoO_3 nanorods**,** thermal chemical vapor deposition

MoO_3 microfilms and nanorods can be synthesized by using the powder of MoS_2 as starting materials by thermal chemical vapor deposition. The prepared products on substrates were investigated by field emission scanning electron microscope (FESEM), X-ray photoemission spectroscopy (XPS) and Raman spectroscopy. FESEM images showed the uniformly microfilms and nanorods-like with diameter around 50-100 nm and length of about through 6 μm, respectively. XPS patterns and Raman shifts revealed the prepared products consisting of MoO_3 structure phases.

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AO-08

Preparation of Mesoporous $La_{0.7}Sr_{0.3}MnO_3$ Films for High Temperature Electrode Applications using Evaporation-induced Self-Assembly Process

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Keywords: mesoporous film, electrical properties, surface area

Micro-solid oxide fuel cells (μ-SOFCs) has become of interest as a potential economical, clean and efficient means of producing electricity in a variety of industrial applications. μ-SOFCs should has unique characteristics with high operating temperature (300 to 500°C) to achieve fast ionization for high power generation efficiency. So, the electrode of μ-SOFCs should also has thermally and chemically stable at high operating temperature. To achieve high temperature stability, electrode uses ceramic instead of unstable metal electrodes at high temperature. Several ceramic materials have been studied and among them, $La_{0.7}Sr_{0.3}MnO_3$ (LSMO) has been focused greatly because this material has good conductivity and thermal stability. Recently, mesoporous metal oxide materials have attracted increasing interest for ceramic electrode of fuel cells owing to their increased specific surface area, pore volume, and the density of surface active sites. In the case of mesoporous structures, pores of 2 to 50 nm are achieved with regular distributions. The mesoporous structure can be synthesized using the evaporation-induced self-assembly (EISA) process which is simple, easy, and low cost. EISA means a self-assembly process of surfactants which form micelles by a gradual increase in concentration. In this study, LSMO thin films were prepared by using EISA process with various annealing temperature. Metal propionate precursor and Brij-S10 copolymer surfactant were used to synthesize mesoporous LSMO films. The microstructures and surface morphology of the prepared thin films were observed by using scanning electron microscopy. X-ray diffraction and grazing incidence small-angle X-ray scattering were used to investigate the pore ordering and crystal structure of mesoporous LSMO films, respectively. The surface area of the LSMO was measured using N_2 adsorption desorption analysis. Hall measurement equipment was used to measure the electrical properties of mesoporous LSMO thin films. Thermal treatments lead to a collapse of porous structure and surface cracks were formed by a collapse of inner pores. The surface area of mesoporous LSMO film was increased up to 165% with an annealing temperature increase from 350°C to 650°C. The electrical conductivity value of mesoporous LSMO was determined to be 46 S/cm at a measurement temperature of 500°C.

Acknowledgment: This study was supported by a grant from DAPA and ADD, Republic of Korea.

AO-09

Charge Concentration Effect of F-doped Zinc Oxide on the Interface Potential Barrier with $PbZr_{0.52}Ti_{0.48}O_3$

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Keywords: ferroelectric tunnel junctions, screening length, FZO, PZT

Recently, electric devices need to be equipped with non-volatile memory and such memory size is gradually smaller. To miniaturize such memories, many kinds of memory are suggested. Among the suggested memory, resistive random access memory (ReRAM) had been attracted much attention and many studies are suggested. There are also many resistive switching (RS) mechanisms; filament model, Mott Hubbard metal-insulator transition, Metal-O-Metal conduction chain, etc. Among the many mechanism, ferroelectric tunnel junctions (FTJs), composed of two metal electrodes and ultrathin ferroelectric barrier positioned between two metal electrodes, have been to the fore as promising candidates for nonvolatile resistive memories. FTJs are resulted from potential barrier difference caused by polarization direction and each electrode charge compensation ability that is screening length. Screening length is affected by charge concentration and mobility. The electron tunnel transmission not only may be controlled by the ferroelectric polarization but also can be controlled by the screening length producing giant tunnel electroresistance (TER). The ferroelectric tunnel function structure can be synthesized using the atomic layer deposition (ALD) and sputtering process for F-doped zinc oxide (FZO) and $PbZr_{0.52}Ti_{0.48}O_3$ (PZT), respectively. Here we will demonstrate FZO electrode charge concentration effect on TER in the Pt/FZO/PZT/Hg structure. To investigate FZO/PZT interface band bending, X-ray photoelectron spectroscopy and near edge X-ray absorption fine structure were performed. The carrier concentration of FZO was measured by using hall measurement. From the results, FZO electrode with high charge concentration was found to induce less TER effect than that with low charge concentration.

Acknowledgment: This work was supported by the Industrial Strategic technology development program (10041926, Development of high density plasma technologies for thin film deposition of nanoscale semiconductor and flexible display processing) funded by the Ministry of Knowledge Economy (MKE, Korea).

AO-10

A Study on the Polarization Effect of $Ba_xSr_{1-x}TiO_3$ ($0 \leq x \leq 1$) on the Tunnel Electroresistance of Ferroelectric Tunnel Junction

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Keywords: Ferroelectric tunnel junction, Barium strontium titanium oxide, tunnel electroresistance, polarization effect

Non-volatile memory has been emerging due to many advantages which are faster write and read speeds, lower power consumptions, higher storage density, etc. Ferroelectric tunnel junction (FTJ) is one of the highlighted candidates of this technology using tunneling current through ferroelectric layer. It is a device which contains a few nanometer thick ferroelectric layer between two electrodes. It can induce tunnel electroresistance effect which is resistance difference between ON and OFF states. It originates in polarization orientation in ferroelectric thin films which related to additional barrier interface at the interface with electrode. Polarization charges effect induces asymmetric potential profiles which results in resistance difference. In our research, $Ba_xSr_{1-x}TiO_3$ (BSTO: ($0 \leq x \leq 1$)) is used as a ferroelectric layer with F-doped ZnO (FZO) electrode. It is known that ferroelectric properties of this material such as polarization and curie temperatures depend on the strontium (Sr) contents. With less Sr, curie temperature at which loss of ferroelectricity happens increases and polarization effect enhances in BSTO. So it is expected that with lower Sr contents FTJ shows better resistive switching properties.
In this study, FTJ is fabricated by using sputter and atomic layer deposition each for BSTO and FZO layers on Pt substrates. The composition was varied as x = 0, 0.2, 0.5, and 1, and the temperature was changed from 25°C to 120°C. Also carrier concentration in FZO electrode was changed by control of F doping (0, 0.2, 0.5, 0.7, and 1.2 wt%) which affects the barrier height of electrode. Carrier concentration in FZO was measured by Hall effect measurement. Interface barrier and band structures were investigated by X-ray photoelectron spectroscopy and near edge x-ray absorption spectroscopy. Resistive switching characteristics of Pt/FZO/BSTO/Hg were measured by using a two-probe measurement system with an Agilent B1500A semiconductor device analyzer. Through these analysis, polarization effect of BSTO on the tunnel electroresistance of FTJ was investigated.
Acknowledgment: This work was supported by the Industrial Strategic technology development program (10041926, Development of high density plasma technologies for thin film deposition of nanoscale semiconductor and flexible display processing) funded by the Ministry of Knowledge Economy (MKE, Korea).

AO-11

Optical and Electrical Characteristics of ZnO Films Prepared by the Solution Reaction Method

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Keywords: ZnO, Thin films, Conductivity, Transmittance

Transparent conductive films are widely used for various applications. ITO (indium tin oxide) film is currently most commonly used, however, there is a concern about the supply shortage because indium is an expensive minor metal. ZnO is an n-type semiconductor possessing the wide band gap energy of 3.37 eV and considered as one of the most attractive candidates to replace ITO. ZnO films have been prepared by a variety of methods. Recently, the thin film formation via the solution process has attracted attention because it is easy and environmentally friendly. In this work, ZnO films were fabricated by the homogeneous precipitation reaction assisted by a seeding technique.

After dissolving 20 mM $Zn(CH_3COO)_2$ and 22 mM LiOH in ethanol, the solution was heated at 70^{o}C for 2 h to form ZnO seed nanoparticles. And 4.7 mM N-Trimethoxysilylpropyl-N,N,N-trimethyl ammonium chloride (TSA) and 111 mM H_2O were added to the solution to obtain transparent seed solution. Then, desired amounts of seed solution were spin-coated on a glass substrate, followed by heating at 100^{o}C for 30 min to remove the solvent. After that, the substrates were put into a mixed aqueous solution of 0.08 M $Zn(CH_3COO)_2$ and 0.08 M hexamethylenetetramine, and the solution was kept at 95^{o}C for 3-9 h. Finally, the substrate was washed, dried and heated at 300^{o}C for 1 h to form a ZnO film. The morphologies of the ZnO films and ZnO seed nanoparticles were observed by a field-emission scanning electron microscope (FE-SEM) and a transmission electron microscope (TEM), respectively. The crystalline phase of the film was determined by X-ray diffraction (XRD) analysis. The transmittance and electric resistivity of the films were measured by an UV-vis spectrophotometer and four probe method, respectively.

By the ZnO seed technique, homogeneous ZnO films were successfully prepared, where the microstructure of ZnO film greatly changed depending on the concentration and dispersion state of seed solution. It was found that the addition of the silane coupling agent called TSA in the seed solution was useful to obtain the well dispersed seed solution, consequently, to get homogeneous dense ZnO films with the high transparency and electric conductivity.

AO-12

Preparation of Porous Hollow Cylindrical Composite Containing Activated Carbon and Zeolite for TiO_2 Coating

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Keywords: Porous, Hollow Cylinder, Activated Carbon, Zeolite.

There are many materials that are used for removing the organic compounds in wastewater, particularly activated carbon, zeolite and titanium dioxide. Although, a performance of these materials is high, especially in powder form but the powder is still difficult to be removed from the wastewater after treatment. The aim of this research is to prepare a hollow cylindrical composite material containing activated carbon and zeolite which are used as a porous substrate for coating TiO_2 powder. Activated carbon and zeolite NaA were weighted in various percentages and mixed with ball clay in a high speed ball mill. The mixtures were blended with special binder to be dough and formed to be the hollow cylindrical tubes by extrusion method. The hollow cylindrical tubes with about 1 cm in diameter were cut into 2.5 cm long and the tubes were fired at 550, 600 and 650°C for 2 hours under inert atmosphere. The fired tubes were determined their properties; physical properties, chemical property and mechanical property. To investigate the photocatalytic performance of coated tubes by lignin degradation under UV light, fired tubes were dip-coated with TiO_2-P25 suspension and the dipped tubes were fired at 600°C for 1 hour under inert atmosphere. The results showed that crush strength of fired tubes increasing with the amount of zeolite increased especially after fired at 650°C. The XRD patterns of fired tubes showed peaks of zeolite and quartz. The physical properties, microstructure and photocatalytic performance of the tubes are discussed.

AO-13

Hydrothermally Grown ZnO Nanorods for Ammonia Gas Sensor Applications: Effect of Surface Defects

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Keywords: ZnO nanorod, Hydrothermal, Surface defect, ammonia gas sensor

ZnO nanorods were grown via low temperature (90ºC) hydrothermal method and subsequently thermal annealed at 650ºC for 30 min. in pure O_2 gas and Zn vapor gaseous environments in order to modify the surface defects. The effect of native surface defects on ammonia gas sensing properties of ZnO nanorods was examined using cathodoluminescence (CL) spectroscopy as well as electrical and gas sensing measurements. The as-grown, O_2, and Zn annealed nanorods revealed CL peaks centered at 1.90 eV (YL), 1.70 eV (RL), and 2.44 eV (GL) which are attributed to Li_{Zn} deep acceptors or O interstitials, acceptor-like V_{Zn} complexes, and donor-like VO related centers, respectively. The ammonia gas response sensitivity was found to be 22.6 for O_2 anneal (RL), 1.4 for Zn vapor anneal (GL) and 4.1 for the as-grown (YL) samples. Hydrogen plasma treatment quenched the RL and inverted the ammonia electrical response due to the incorporation of shallow hydrogen donors. Changes to the gas sensing response were attributed to a shift in the ZnO Fermi level position relative to the ammonia gas chemical potential due to the formation near surface donor or acceptor centers.

AO-14

Transesterification of Soybean Oil using Bovine Bone Waste as New Catalyst

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Keywords: Bovine bone waste, Solid catalyst, Transesterification, Methyl ester yield

In the present study, a cost-effective solid base catalyst derived from bovine bone waste was utilized to catalyze transesterification of soybean oil. The catalyst was prepared by a simple approach in one calcination step (various calcination temperatures 350°C-1100°C). Effect of calcination temperatures on physico-chemical properties and catalytic activity was studied. After calcinations, the catalysts were characterized by Powder X-ray diffraction (PXRD), Scanning electron microscopy (SEM), N_2 adsorption-desorption isotherms and Fourier transform infrared spectroscopy (FT-IR). Additionally, the catalytic activity of all material samples towards biodiesel formation was assessed based on the methyl ester content of the reaction mixture, as quantified by Proton nuclear magnetic resonance spectroscopy (^{1}H-NMR). The catalytic activity tests were performed in a closed-system, with various parameters having an influence on methyl ester yield. Among the catalytic activity tests after optimization of the reaction conditions (65°C, 3 h) the highest methyl ester yield (97%) was achieved by using bovine bone calcined at 750°C resulting from the presence of CaO. Moreover, the catalyst (calcined at 750°C) can be reused for 4 cycles without any need for regeneration. The easy-to-prepared, low-cost, commercially available (retail price < US 1$ per kilogram) and reusable material could promote bovine bone waste as a promising catalyst for biodiesel production.

AO-15

Novel Hydroxyapatite Bioceramic Composite with Enhanced Osteoblast Cell Supporting Ability

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Keywords: Hydroxyapatite, Recombinant Fusion Protein, Fibronectin, Statherin

A novel bioceramic, consisting of highly osteoconductive hydroxyapatite (HA) and a biologically active recombinant fusion protein, was synthesized and characterized. Nano-sized HA powders were prepared using a solid-state reaction and then uniaxially pressed and sintered. XRD and SEM were used to identify phases and morphology. Moreover, we designed a fusion protein comprising a cell adhesion peptide corresponding to residues 32 to 51 of the fibronectin protein ($FNIII_{7-10}$) linked to *N*-terminal 15 amino acid residues (N15) of statherin. The SN15 provides both electrostatic and hydrogen bonding interactions for stable binding to the HA scaffold. The designed fusion protein gene was subcloned into pET28a(+) vector and *E. coli* BL21 (DE3) were used as a host for protein expression. The obtained recombinant fusion protein, determined to have molecular weight of 54K daltons by SDS-PAGE, was then adsorbed to HA using simple dip-coating method for osteoblast cell studies. Unmodified and unfused $FNIII_{7-10}$ protein-modified HA samples were used as controls. As expected, both fusion and unfused proteins could enhance cell proliferation and differentiation on the HA surface. The HA modified with the fusion protein exhibited similar level of cell proliferation and differentiation to the unfused $FNIII_{7-10}$-modified HA. Additionally, the fusion of the SN15 domain to the $FNIII_{7-10}$ protein provided an unpredicted synergistic effect enhancing cell spreading on the HA surface. Cells grown on all tested surfaces were then dyed with crystal violet prior to applying shear force using a parallel flow cell for stability test of cell adhesion. We found that our recombinant fusion protein could effectively serve as a mediator to stably support osteoblast cells on HA scaffolds.

CO-01

Feasibility study of porcelain production by a direct sintering technique

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Keywords: Porcelain, Direct Sintering, Fast Firing, Vitrification

Fast firing process has been developed for several decades in order to lower manufacturing costs by reducing energy consumption while maintaining product quality. Previous work by Wirat and Carty has demonstrated that phase evolution of porcelains can be predicted by using temperature and log-dwell time scale; a method that is valid from fast firing through conventional firing schedules. Since the effect of heating rate can be considered insignificant, in this study we used direct sintering in which samples are immediately subjected to maturing temperature. X-ray diffraction and microstructural characterization confirmed that phase evolution was heating rate independent, (even using 1000K/min) and direct sintering provided comparable physical properties compared to conventionally fired samples such as density and water absorption. However, a decrease in diametral compressive strength was observed. Various aspects were found to influence the strength and we are currently investigating those effects.

CO-02

Clay Minerals of Traditional Ceramics in Watershed Areas

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Keywords: clay mineral composition, traditional ceramics, watershed area, northeast Thailand

Clay mineral compositions of raw materials from traditional potteries in the northeast Thailand were examined by x-ray diffractometry. The survey was covered in two watershed areas, where were Phong and Chi watersheds, located in Khon Kaen, Maha Sarakham, Udon Thani, Sakon Nakhon and Nakhon Ratchasima provinces. The comparison of oriented samples and original soils by the powder x-ray diffraction techniques, clay mineral compositions were determined and classified depending on each production process. The samples were sampling from the green bodies, sticky clays, mixed clays and kiln clays. Quartz was a common mineral found with caly minerals. For the green bodies, the major minerals were quartz and clay mineral groups of kaolinite, smectite and chlorite. The major mineral of clay types of mixed and kiln raw materials were found similar to those of green bodies. Conversely, clay minerals of kiln materials were different from green bodies and mixed materials which were composed of substantially quartz. The original clay samples from Sakon Nakhon province consisted of dominant quartz and kaolinite group which were more complexity than the samples from other pottery areas.

CO-03

Mechanical Behavior of Fired Clay Brick from Stream Sediments under Uniaxial Compressive Loading

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Keywords: mechanical behavior, fired clay brick, stream sediments, uniaxial compressive strength

Mainly raw material for fired clay brick is applicable from fine stream sediments in lower Phong and upper Chi River sub-watershed. Sampling sites of this raw material are normally found along the river nearby brickyards. Their mineral compositions by x-ray diffractometry (XRD) are found principally quartz, clay mineral groups (mica, kaolinite, and chlorite group), hematite, evaporite, corundum, and also pyrolusite. Semi-quantitative analysis indicates quartz, clay mineral groups, and others in the range of 85-95, 5-7, less than 1%, respectively. On the other hand, forsterite, zircon and mullite group are additional observed less than 0.2% in fired clay bricks. These minerals affect highly strength of fired clay brick. Mechanical behavior of fired clay brick is evaluated by uniaxial compressive strength of a brick unit and a prism unit. The compressive strength of the brick unit is found in the range of 0.43-1.03 MPa with 0.35-1.17% strain. However, the compressive strength of the prism unit obtains half diminished scale of the fired brick unit. If its density increases, the compressive strength of the brick unit will be more significant. Apparent densities of bricks associate to water filled in void or pore in each period of time (13-17%), and bring about linear relationship of elastic moduli at the ultimate stress and strain variable. Air-dried fired brick unit with water absorption is accomplished against the compressive force than the normal condition for 10% as a minimum.

CO-04

Property and Characterization of Raw Materials in Lampang to Assess the Suitability for Ceramics Industry

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Keywords: Lampang, Raw Material, Kaolin, Pottery Stone

Lampang, a province in northern Thailand, is the important source of ceramics raw materials, such as kaolin, pottery stone, and ball clay. About 50 samples from 15 sources were collected to analyze the chemical composition, mineral composition, and physical properties. Kaolin samples principally consisted of quartz and kaolinite. Its greyish color after firing at 1200 °C made it suitable for stoneware product that does not require white body. The principal ball clay mineral is kaolinite, associated with illite and quartz. All ball clay samples are fine grain, high unfired strength and highly plastic, which are suitable for tableware production. Pottery stone which can be found at Kaolin deposit, showed a mixed mineralogy of quartz, albite, and muscovite, while some samples showed the presence of kaolinite. It showed significantly low on shrinkage. Pottery stone are widely used as flux in both ceramics body and glaze. These analyzed characteristics were put into the ceramics raw materials database which can be searched on-line. This data is useful for the researching of ceramics body compositions with mainly contained raw materials from Lampang.

CO-05

Conversion of Aluminum Dross Residue into Value-added Products

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Keywords: Dross, aluminum, refractory, ceramic, sintering

Aluminum dross residue is obtained from secondary aluminum recycling process. It contains aluminum oxide, sodium chloride, potassium chloride and depending on the scrap type may contain, carbides, nitrides, sulphides, phosphides and metallic aluminum. It must be sent to landfills; although it is sealed to prevent from leaching, the potential for leaching exists and could harm the environment. The disposal of salt slag is a worldwide problem. The utilization of it in the right way is challenging and would have an impact on reducing environmental problems.
In this study, porous ceramics and ceramic refractories were fabricated from aluminum dross residue as it contained high alumina content in the composition. The residue was first characterized for its composition using XRF. It was then ball milled to obtain a controlled particle size range for further processing. Water leaching on the residue had been carried out to dissolve the salts and remove ammonia gas generated by the reaction between aluminum nitride (AlN) and water. Porous ceramics were prepared by template method using ceramic slip containing aluminum dross residue of 34-52 wt% and a combination of alumino-silicate based clays. The products could be well sintered in the temperature range 1170-1200°C without large internal cracking, distortion and partial melting of the bulk structures. For ceramic refractories, 60-90 wt% of aluminum dross residue was utilized in the compositions. Refractories were sintered between 1200 and 1400°C. All the ceramics were studied for phase composition, physical properties and thermal shock behavior. Alumina, Al_2O_3 was the main crystalline phase found in all sintered samples according to XRD analysis. Mullite phase was also found in all the sintered bodies which further gave the strength and refractoriness. All synthesized porous ceramics and refractories had excellent heat-resistant characteristics and could be advantageous for various applications such as metal filtering, catalytic support.

CO-06

Turning EAF Dust Waste into Oil Spot Ceramic Glaze

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Keywords: Electric Arc Furnace dust, steel recycling waste, oil spot glaze

Electric Arc Furnace (EAF) is commonly used in steel recycling industries. Apart from steel metal product, a waste in the form of dust is also produced and so called EAF dust. The fine particulates mainly contain zinc-iron oxides along with a small amount of heavy metals like chromium and lead, and have been categorized as a toxic waste. Proper treatments can be crucially required in order to recover crude zinc oxide and iron oxide from the dust; however, no practical recycling plants have been now readily operated in Thailand. To reduce its toxicity, EAF dust could be mixed with sand and vitrified into glass. Therefore, EAF dust can possibly be employed as a ceramic glaze raw material. This work pointed out how to make decorative “oil spot” ceramic glaze by substitution of EAF dust for a conventional iron oxide. The prepared glaze mixtures were applied over the ceramic bodies and fired at 1250 ^{o}C in oxidation atmosphere. The as-fired glaze appearances with tiny and silvery crystals floating over dark brown based-glaze were exhibited. Phase content and characteristics of the obtained glaze were analyzed. The roles of zinc oxide to iron oxide ratios on oil spot and crystal generation was concerned. A comparison of oil spot effects due to different iron oxide sources was presented and discussed. Oil spot glaze made from a combination of EAF dust and a commercial frit was also proposed.

CO-07

Effect of Frit Content on the Metal Marking and Scratching Resistance of Celadon Glaze

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Keywords: Celadon glaze, Frit, Metal marking, Scratching, Reducing firing.

The using of a stainless steel knife and fork against a dinner plate results in a metal marks and scratches which are not easily removed. High-quality celadon glazes are often just as susceptible to knife marking and scratching as other glazes. Metal marking and scratching are related to surface roughness, hardness and toughness of glaze. To improve the glaze properties, frits were added in the traditional celadon glaze and reducing firing atmosphere was controlled. Surface roughness of celadon glaze was decreased with increasing the reducing agent content (LPG flowing rate) and increasing the frits content. Though hardness of glaze without frit was increased with increasing the reducing agent content, hardness of glaze with frit was not changed extremely with increasing the reducing agent content. To evaluate the metal marking and scratching resistance, wear resistance test was used with stainless steel ball. After wear test, many metal marks and wide scratching trace were observed in the traditional celadon glaze. However, a few metal mark and scratch were observed in the celadon glaze with frit. The friction coefficient of glaze in the wear test was strongly depended on the frit contents.

CO-08

Development of Decorative Ceramic Glaze from Palm Fiber Ash

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Keywords: Glaze, Palm fiber ash, Feldspar, Calcium carbonate

Abstract. Palm fiber ashes are the industrial waste which is abundantly available in Malaysia. In this study, palm fiber ash were used to produce decorative ceramic glaze. The content of minerals in the palm fiber ash were analyzed by using X-Ray Diffraction (XRD) and X-Ray Fluorescence (XRF), respectively. The formulations of glaze with different composition of raw materials were studied by adding different amount of calcium carbonate and feldspar. The glaze slurries then coated on ball clay body bisque which obtained from Kg. Dengir and sintered at 1200 ° C for two hours.The glaze was characterized in terms of its physical appearance (type of glaze and colour), chemical resistance and thermal shock resistance. Both glossy and matte glaze produced by using different composition of glaze formulation. The presence of silica minerals (79 %) contributed to glossy surface to the glaze. Is it clearly seen that the glossiness of glaze improved by increasing amount of feldspar. Feldspar acts as fluxing agent which form a glassy phase at lower temperature. In addition, the presence of small amount of iron oxide (2.2 wt.%) contributed to brown colour of glaze. An addition of calcium carbonate give effect to the colour of glaze, which change from brown to yellow colour as amount of CaCO3 increased. The result shows that the glaze produced has chemical resistance towards acids and based, and high thermal shock resistance. As a conclusion, the palm fibre ash were highly suitable to supply abundant and cheap raw materials for producing decorative ceramic glaze.

CO-09

Effect of Spark Plasma Sintering Conditions on the In-situ Synthesis of Polycrystalline CeB_6 Ceramics

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Keywords: CeB_6, Cathode Material, Spark Plasma Sintering, In-situ Synthesis, Polycrytalline

Abstract

Rare-earth hexaborides, REB_6, have attracted much attention because of their unique characteristics including high melting point, chemical stability, efficiency, superconductivity, magnetic properties, and thermionic emission. The advantages of using REB_6 derive from their crystal structure, which is composed of RE metal atoms are surrounded by a boron octahedron network. In REB_6 group, cerium hexaborides (CeB6) are the most promising cathode materials due to having Kondo compound behaviour and lower work function (2.5 eV), lower operation temperature, higher resistance to C contamination and lower volatility than lanthanum hexaborides (LaB_6) which means a longer service life.

Compared to the nanowires, thin films and singlecrystallines, the polycrystalline bulk materials can provide large size, low cost, simple preparation and can be fabricated easily to various devices. Therefore, there are great research prospects for bulk polycrystalline CeB_6 cathode materials especially for its excellent field emission or thermionic emission properties. Spark Plasma Sintering (SPS) is the most favorable method for effective bulk CeB_6 fabrication which is fundamentally different from CVD, E-Beam Floating Zone Melting and Hot-Pressing Sintering methods. It obviously contributes to full densification, reduces the sintering temperature, shortens the sintering time and improves the mechanics and emission properties by Joule heat and spark plasma generated by high pulsed electric current.

In current study, synthesis and densification of CeB_6 from starting powders of cerium oxide (CeO_2) and amorphous boron (B) by SPS (FAST) was investigated. Dense CeB_6 samples were obtained by applying a two-step heating schedule under specific SPS conditions. Phase and microstructural features of the samples were investigated extensively. It was the first time to obtain high dense bulk polycrystalline CeB_6 effectively from CeO_2 and amorphous B with two-step SPS regime.

CO-10

Novel Soft Chemical Synthesis Methods of Ceramic Materials

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Keywords: Solid State Reaction, Soft Chemistry, Ionic Diffusion, Water.

Rapid progress of the solid state reaction required to fulfill two conditions of “Thermodynamics” and “Kinetics”. Based on defect thermodynamics, many researchers claimed that the ionic-diffusion in ionic crystal is very slow at room temperature. Therefore, the ceramic oxide materials are usually synthesized by a high temperature solid state reaction method. The synthesis at a high temperature leads to increase in the processing cost and irregular particle morphology of the obtained powders.

In this study, we have proposed the novel soft chemical synthesis methods, water assisted room temperature solid state reaction (WASSR) method and solid hydratethermal reaction (SHR) method as new soft chemistry. These methods are very simple and can be synthesized the ceramic materials just by mixing of raw materials added a small amount of water in the case of WASSR method and by storing the mixture of raw materials added a small amount of water in a reactor at low temperature below 373 K in the case of SHR method.

We successfully synthesized the $SrMoO_4$, YVO_4 and $BaTiO_3$ by our proposed solid state method. The reaction mechanism of WASSR and SHR method is different from mechano-chemical reaction, solution reaction and hydrothermal reaction. We discuss the properties of the resultant materials prepared by our proposed solid state reaction method and the reaction mechanism of this method.

CO-11

Effect of Porosity and Pore Size on Microstructures and Mechanical Properties of Metakaolin Blended with $Ca(OH)_2$ and PLA as Porous Geopolymers.

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Keywords: Metakaolin-blended geopolymer, Calcium hydroxide, Polymers, Porosity

Geopolymer is generally made of pozzolan and alkali activators such as sodium alkali or potassium alkali. Geopolymer can be solidified at ambient temperature to be developed as construction materials. Several types of polymer were chosen to create pores in order for porous geopolymers. In this research, the porous geopolymer was developed either to reduce the weight of materials or to utilize as insulation materials. It was performed by metakaolin (MK), calcium hydroxide ($Ca(OH)_2$), 10 molar potassium hydroxide (10M KOH) and potassium silicate (K_2SiO_3) for geopolymer pastes. These geopolymer pastes were mixed with 40%, 50% and 60% of Poly(lactic) acid (PLA) and fired at 550˚C for 6 h., therefore, pores inside geopolymer structure were found and pH level was reduced from 11 to 7-9. Consequently, those geopolymers were characterized the microstructures by Scanning Electron Microscope (SEM), mechanical properties e.g. compressive and flexural strength by Universal Testing Machine (UTM), chemical compositions by X-ray diffraction (XRD) and functional groups by Fourier Infrared Spectroscope (FTIR). Furthermore, the bulk density and apparent porosity of geopolymers were analyzed. The results showed that the quantity of PLA affected the compressive strength and porosity of geopolymers.

CO-12

Properties of Geopolymer Paste from Fly Ash Blended with Metakaolin as Pervious Geopolymer Concrete

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Keywords: Fly ash blended with metakaolin, Geopolymer paste, Pervious geopolymer concrete, Pozzolan

The objectives of this research were to study the properties and the influence of geopolymer paste for pervious geopolymer concrete (PGC). In the research, geopolymer paste was prepared from lignite fly ash (F), metakaolin (M), sodium silicate (NS) and sodium hydroxide (NH) solution 8 mol/L. The ratio of NS/NH was constant at 1.0 and the ratio of alkali liquid/pozzolan (L/P) was 0.7. The research was studied the compressive strength of pervious concrete from metakaolin geopolymer (100M0.7) and 50% fly ash (F) blended with 50% metakaolin geopolymer (50FM0.7). The results showed that the highest compressive strength was received from 50FM0.7. After that, the research was developed to use ratios of fly ash/metakaolin were 0.4, 0.5 and 0.6. In addition, alkali liquid/pozzolan (L/P) ratios as 0.6, 0.7 and 0.8 were mixed to form the geopolymer paste. PGC specimens were prepared as cube 50x50x50 mm^3 from geopolymer paste mixed with coarse aggregates. The compressive strength of PGC specimens was evaluated at 28 days by Universal Testing Machine (UTM), maximum load 50 kN. The results presented that geopolymer paste could replace cement paste in terms of satisfactory physical, chemical and mechanical properties, for example, the highest compressive strength was 5.41 MPa, void ratio of specimens was 28.43-30.34% and flow ability was 147-170%. All results was passed ACI522R-10 standard.

CO-13

The Mechanical Compressive Strength Property of Biomass Wood Ash-fly Ash Hybrid Geopolymer Mortar

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Keywords: Hybrid Geopolymer, Wood ash, Biomass ash, Compressive strength, C-S-H.

Abstract

This paper presents an investigation on the adaptability of biomass wood ash (BWA) as a replacement material to fly ash (FA) based geopolymer mortar from the aspect of compressive strength. The hybrid geopolymer mortars were synthesized by replaced the FA with BWA at dosages of 0%, 5%, 15% and 25% by weight of binders, and activated with an alkaline activator consisting of sodium hydroxide (NaOH) solution and liquid sodium silicate (Na_2SiO_3). The results showed that the replacement of the FA with BWA at levels of 5 % and 15% improved the early strength of the hybrid geopolymer mortar at ages of 3 and 7 days higher than the neat FA-geopolymer mortar, unlike the 25 % ratio which resulted in the lowest strength geopolymer. The results suggested that the BWA could be a potential additive material for making new generation of BWA-FA hybrid geopolymers by replacing the FA with BWA at levels up to 15%. This is due to the high calcium content of the BWA that could provide additional C-S-H and C-A-S-H gel and thus improved the setting and strength properties of the hybrid BWA-FA geopolymer mortar.

GO-01

Study of Melting Ability of Granulated Glass Batch

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Keywords: Granulated Glass Batch, Melting Ability, Glass Melting

In the conventional soda-lime glass production, loose raw materials are normally mixed into a glass batch for melting. Dusting and segregation of the loose glass batch are always occurred during the melting process inside the glass furnace. Also, the loose glass batch has low thermal conductivity which limits the glass melting ability and pulling rate of the glass furnace. Granulation and preheating of glass raw materials have been proposed to solve the problems. In this study, the granulated soda-lime glass batch (SiO_2 50% Na_2CO_3 22.5% $CaCO_3$ 12% $NaAlSi_3O_8$ 9.5% $BaCO_3$ 2.5% ZnO 1.75% Sb_2O_3 1% and K_2CO_3 0.75% by weight) was prepared to study the melting ability in an electric furnace. The granulated batch was also preheated at 500-600°C before melting. The preheating temperature was matched to the temperature of flue gas at the bottom of the stack in the glass furnace. The purpose behind this was aiming to recover the waste heat from the furnace. The experiment exhibited the increased melting ability for the granulated-preheated glass batch.

GO-02

Modification of the composition of low-temperature-sintering alumina crucibles for glass melting

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Keywords: Low sintering, Alumina crucible, Melting glass, Sintering aids.

Four different formulas for producing low-temperature-sintering alumina crucibles were prepared. The original formula was modified by sintering aids, namely, $CaCO_3$, $MgCO_3$, ball clay and ZrO_2. The raw materials were mixed and ground into slurry by using ball mill for 24 hours. The slurry alumina was casted in a plaster mold to form a test sample and a crucible. After drying, the alumina sample and crucible were sintered at 1450 1500 and 1550ºC for 2 hours. The chemical/phase compositions and properties of the sample were investigated. Also, the crucible was tested by melting glass at 1500ºC. It was found that the compositions of the alumina comprised of 85-94% Al_2O_3 2-3% SiO_2 1.7-6.5% ZrO_2 1.4-3.5% CaO and 0.3-1% MgO in the phase of aluminum oxide (Al_2O_3), spinel ($MgAl_2O_4$) and baddeleyite (ZrO_2). The alumina sintered at 1550ºC had 9-12% firing shrinkage, density of 3.35-3.64 g/cm^3 and COE of 7.72-8.17 $^oC^{-1}$ depending on the composition. The resultant properties were similar to the commercial 94% alumina (sintered at 1700ºC). The crucible melting test exhibited that the modified formula alumina crucible could stand high thermal shock and could be taken out from a furnace without any cracks. In conclusion, the selected formula could be used to produce the lower-sintering-temperature alumina crucible, which the sintering temperature was decreased from 1700ºC to 1550ºC. This would save the energy for 15-20%.

GO-03

The Effects of SiO_2 and B_2O_3 on the Glass-Ceramics Glaze Properties

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Keywords: glass ceramic, glaze, diopside

The feasibility of developing glass-ceramic glaze in the system KNaO-CaO-MgO-ZnO with a variation in the composition of SiO_2, TiO_2, and B_2O_3 was studied. The SiO_2, TiO_2, and B_2O_3 were varied in the amount of 2.25-1.50, 0.001-0.10, and 0-0.1 molar equivalents respectively. The samples were one fired at 1180°C or double fired by reheat at the crystallization temperature for 10 minutes. The phase, gloss, hardness, and sintering behavior were examined by X-ray diffraction, glossmeter, Vickers hardness, and side-view hot stage microscope respectively. The results showed the importance effect of SiO_2, TiO_2, and B_2O_3 on the glaze crystallization ability. At the fix value of Al_2O_3 at 0.24 molar equivalents, it was found that lower the SiO_2 content to 1.50 molar equivalents or increase the TiO_2 content to 0.10 molar equivalents increased the glaze crystallization potential. An increase in the B_2O_3 to 0.1 molar equivalents suppressed the potential of glaze crystallization. The phases of samples were amorphous or composed of silicon dioxide and diopside as the main phases depending on the glaze composition and the firing history. In this study, the glaze appearances varied from gloss to matte with the specular gloss values between 22-100 GU. All samples appeared to have high Vickers hardness value in the range of 553-644. The crystallization decreased the gloss but increased the hardness value. Finally, a composition with high hardness and high gloss was identified and its sintering behavior was also presented. These results suggested the limitation and the potential for applying this glass-ceramic glaze system to industry applications.

POSTER PRESENTATIONS

AP-01

Hydroxyapatite-Bioglass Composites: Microstructural Study and Bioactivity Test

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Keywords: Hydroxyapatite, Bioglass, Bioactivity, Microstructure

This study investigated the in-vitro test of surface bioactivity of hydroxyapatite-bioglass composites prepared by sintering the mixture of high purity AR grade hydroxyapatite powder and bioglass powder ($45SiO_2$-$24CaO$-$6P_2O_5$-$24.5Na_2O$), prepared by in-house melt and quenched methods, to obtain strong porous ceramic bodies. The porous microstructure provides channels for bone in-growth and improves the microscopic bioresorption. The study focused on the effect of composition and sintering temperature of ceramics on the microstructure and the in-vitro test properties. Composite samples were characterized for phase formation and microstructures by X-ray diffraction (XRD) and scanning electron microscope (SEM). Bioactivity test was carried out in a simulated body fluid (SBF) at 37°C for various periods of time. SEM images on revealed the formation of hydroxyl carbonate apatite (HCA) layer on surfaces after the SBF immersion. Ion exchange between the composites and the SBF was further investigated by Inductively Couple Plasma-Optical Emission Spectroscopy (ICP-OES). Composites containing higher amount of bioglass showed a better bioactivity after 7 days of immersion in the SBF. The HCA layer thickness increased with increasing soaking period from 3 to 28 days. Early stage of soaking occurred with the release of Ca, Si ions from the composites and the decrease of P ions with slow exchange rate. This study led to a promising platform for hard tissue engineering.

AP-02

Effect of Substitution of Zn^{2+} and Zr^{4+} on Structural and Magnetic Properties of $BaFe_{12}O_{19}$

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Keywords: Barium hexaferrite; Magnetic properties; Hard magnetics

The Zn^{2+} and Zr^{4+}-doped barium hexaferrite according to the stoichiometric formation $BaFe_{(12-(2x/3))}Zn_xO_{19}$ and $BaFe_{(12-(4x/3))}Zn_xO_{19}$ with x = 0, 0.1, 0.3 and 0.5 were prepared by conventional method using ball milling technique. These powders were calcined at various temperatures from 1000 ºC to 1200 ºC for 2 h. The structural, morphology and magnetic properties were carried out by X-ray diffraction (XRD), scanning electron microscopy (SEM) and vibrating sample magnetometer (VSM), respectively. The XRD confirmed the formation of main phase magneplumbite and the crystalline structure of samples is still hexagonal. Pure barium hexaferrite shows only single phase while samples doped with Zn^{2+} and Zr^{4+} ions show α-Fe_2O_3 peaks with $BaFe_{12}O_{19}$. The lattice parameter a and c increased with the Zn^{2+} and Zr^{4+} ion content increasing. The SEM results showed that the particles of pure $BaFe_{12}O_{19}$ were regular hexagonal while doped-samples showed spherical shape. After Fe^{3+} is partly substituted with Zn^{2+}, the magnetic parameters like coercivity and saturation magnetization are decreased. On the other hand, with increasing Zr^{4+} ions, the coercive force and saturation magnetization are slightly increased. The behavior of magnetic properties of materials is explained by the combined effect of the coherent rotation of the magnetic domains and the replacements of Fe^{3+} by Zn^{2+} and Zr^{4+} ions in the tetrahedral and octahedral sites.

AP-03

Morphological Controlled Synthesis of Zinc Oxide for the application to sunscreen cosmetics.

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Keywords: ZnO, morphorogy, cosmetics.

Zinc oxide (ZnO) has excellent ultraviolet radiation absorption properties and is widely used as inorganic sunscreen in personal care product. It also has the high visible light transparency according to the low refractive index, appearing natural on the skin. At the moment, large quantities of ZnO nanoparticles are used in cosmetics. However, the comfort of nanoparticles is modest because of the agglomeration, and it is required to avoid the use of nanomaterials less than 100 nm for cosmetics because of safety concerns.

In the present study, we examined the morphological controlled synthesis of spherical ZnO nanoparticles of approximately 100 nm in diameter by the homogeneous precipitation using a seeding technique. After dissolving 10 mM $Zn(CH_3COO)_2$ and 14 mM LiOH in ethanol, the solution was heated at 70^oC for 2 h to form a ZnO seed solution. After that, the desired amount of the seed solution was added into 0.01 M $Zn(NO_3)_2$, 0.08 M triethanol amine, 0.8 M ethelenglycol and 0.008 M NaOH mixed aqueous solution, followed by heating at 80^oC for 1.5 h to precipitate ZnO particles.

The morphology of the product was examined using a transmission electron microscope (TEM) and scanning type microscope (SEM). The crystalline phase identification was performed by the X-ray diffraction (XRD) method. The UV-shielding properties and visible light transparency of the particles were evaluated by measuring the transmittance of the sample powder dispersed silicon solution using a UV-vis spectrophotometer. The photocatalytic activity was determined by the degradation of dye aqueous solution under UV light irradiation.

By the seeding assisted homogeneous precipitation, the spherical ZnO particles of desired particle sizes could be obtained. The products showed the excellent UV-shielding ability and comfort when applied on the skin. The photocatalytic activity of the spherical ZnO particles was lower than that of commercial ones.

AP-04

Solvothermal Synthesis of Nb Doped TiO_2 and NIR Shielding Ability

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Keywords: Titanium oxide, Solvothermal, Morphology, NIR shielding ability

For the purpose of saving energy and thereby reducing carbon dioxide emission, it is gathering attention to design new materials possessing good shielding ability of near-infrared radiation (NIR, with a wavelength of 780 ~ 2500 nm) as well as high visible light (with a wavelength of 380 ~ 780 nm) transparency for smart-window of automobiles and buildings. Nb doped anatase TiO_2 is an n-type wide band gap semiconductor, which permits the high transmittance in the visible light with its fundamental absorption edge lying above 3.2 eV. When the pentavalent Nb is doped into TiO_2, the carrier electron densities can be raised, and consequently, it is expected that the NIR shielding ability can be improved because of the plasma oscillation of free electrons. Generally, the optical property is largely affected by the particle size and morphology. Since solvothermal reaction can easily control the size and morphology, it is a beat approach for Nb doped TiO_2 synthesis.
In this research, we synthesized Nb doped TiO_2 particles by the solvothermal reactions of titanium tetraisopropoxide-niobium ethoxide in ethanol-acetic acid mixed solutions around 240^{o}C for 24 h, and assessed its NIR shielding ability. The products were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), and UV-vis-NIR spectrophotometry.
The products doped with 5-25 mol.% Nb were assigned as the single phase of anatase TiO_2. The Nb doping was confirmed by an increase in the lattice constant of Nb doped TiO_2 and SEM-EDX. In addition, the products showed the good NIR shielding ability.

AP-05

Effect of Sintering Temperature on Microstructure and Properties of Porous Anode-supported for Solid Oxide Fuel Cells Fabricated by Ceramic Injection Moulding

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Keywords: powder injection moulding, nickel oxide, yttria stabilized zirconia, porous ceramic

Ceramic injection moulding (CIM) is a cost effective, near-net-shape fabrication process for small and complex shaped components. It involves preparation of feedstocks by mixing ceramic powder with organic binder, injection moulding of the feedstocks into the mould of the desired shape, removal of the binder (debinding) and, finally, sintering. CIM can be used in a production of porous nickel-yttria stabilized zirconia (Ni-YSZ) anode-supported for solid oxide fuel cells. In solid oxide fuel cells (SOFCs), the ceramic anode layer must be very porous in order to let the fuel flow towards electrolyte. This work also opted for a water-soluble binder system, consisting mainly of polyethylene glycol (PEG), to avoid the use of organic solvents during debinding. A variety of processing parameters, for successful ceramic injection moulding of porous anode for SOFCs, has been studied. Physical and mechanical properties of the porous specimens were examined. The components were also characterised for the microstructure using scanning electron microscope. It has been found that sintering temperatures and holding times strongly affected the microstructure and properties of the specimens. The porosity was optimized for further SOFC development.

AP-06

The Effect of Glass/PVA Composite Composition on the Adhesion and Strength of a 96% Alumina Joint

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Keywords: PVA, Glass, Alumina, Adhesion

This research studied the effect of composition of a glass-based high temperature adhesive on the bond strength of 96% alumina bars. The adhesives studied were composed of 40-70% glass powder, 5-30% polyvinyl alcohol (PVA), and 15-55% water. Half-lengths of green alumina bend bars were bonded together with the adhesive to form a full length bar and then sintered. The flexural strengths of the sintered bars were measured and the resultant fracture surfaces were examined by SEM. The results showed that an initial increase in the PVA and glass content increased the flexural strength to the highest value of 120 MPa, but that further increases resulted in decreased strength. The strength values fluctuated when the PVA content was above 20% and the glass content was 40% or 60%, which indicated poor adhesive homogeneity. SEM analysis of the fracture surfaces showed a separation layer between the alumina and glass adhesive when the glass or PVA content were either too high or too low, which again indicated poor adhesive homogeneity. It was concluded that the optimal composition of the adhesive was 45-55% glass and 7-15% PVA, which gave a minimum flexural strength of 80 MPa.

AP-07

The Effect of Alumina (Al_2O_3) on the Characteristics of Sintered Mullite Ceramics Synthesized with Kaolin from Narathiwat of Thailand

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Keywords: Refractory**,** Kaolin**,** Mullite, Sintering, Narathiwat kaolin

Abstract: Mullite ceramics was prepared by the four composition of talc, sand, kaolin (kaolin from Narathiwat in Thailand) (NT) and alumina. The different amounts of alumina (5, 10, 15 and 20 wt%) were added to produce various mullite-alumina mixtures which are denoted as NA, NB, NC and ND, respectively. The mixtures were pressed into rectangular shapes by hydraulic press with the pressure of 150 Kg/cm^2 then sintered at temperature of 1300 °C and 1350 °C for 2 hours. The morphology of the synthesized alumina-mullite samples were characterized by x-ray diffraction spectroscopy (XRD), and physical-mechanical properties were investigated. Mullite was successfully synthesized. The XRD result was represented phases of mullite. The NA samples sintered at temperature of 1300 °C indicated the best physical-mecanical properties including bulk density (2.23 g/cm^3), bending strength (452.29 kg/cm^2) and thermal expansion coefficients ($5.00x10^{-3}K^{-1}$). The other NA samples sintered at temperature of 1350 °C exhibited the bulk density, bending strength and thermal expansion coefficients are 2.21 g/cm^3, 487.13 kg/cm^2 and 4.99 $x10^{-3}K^{-1}$, respectively. The thermal expansion coefficient of the NT sintered samples have been plotted the length change comparing with measuring temperature range of 30-1200 °C. The suitable condition of the synthesized mullite ceramics is finally obtained the NA samples with 5 percent weight of alumina composition sintered at the temperature of 1350 °C.

AP-08

Phase-Selective Hydrothermal Preparation and Upconversion Luminescence of $NaYF_4:Yb^{3+},Tm^{3+}$

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Keywords: $NaYF_4:Yb^{3+},Tm^{3+}$; Upconversion luminescence; Hydrothermal, Phase Transition

Upconversion luminescence materials have been proved to have a good efficiency on converting low energy light to high energy light. These materials have received considerable attentions for many applications such as bio-labels, sensors, using for developing solar cells and photocatalytic applications under sunlight. Among many inorganic host materials, $NaYF_4$ has been proved to be the best for doping rare-earth ion and have a good upconversion emission due to its low phonon energy, chemical stability, and transparency in the near infrared to ultraviolet range. In this study, $NaYF_4:Yb^{3+},Tm^{3+}$ upconversion luminescence materials were synthesized by hydrothermal method at temperature of 90°C to 200°C for period between 1 hour to 24 hours. The synthesized $NaYF_4:Yb^{3+},Tm^{3+}$ were characterized by X-ray diffraction, scanning electron microscopy, and fluorescence spectroscopy. The hydrothermal temperature and reaction time have strongly influence on phases and upconversion emission of the synthesized $NaYF_4:Yb^{3+},Tm^{3+}$. At 90°C for 1 hour of reaction time, the pure cubic phase of $NaYF_4:Yb^{3+},Tm^{3+}$ was found. After increasing temperature and reaction time, the $NaYF_4:Yb^{3+},Tm^{3+}$ converted from cubic phase to hexagonal phase. Under excitation of 980 nm diode laser, the hexagonal $NaYF_4:Yb^{3+},Tm^{3+}$ exhibited the emission wavelength at about 643 nm ($^1G_4 \rightarrow {}^3F_4$), 539 nm ($^1D_2 \rightarrow {}^3H_5$), 473 nm ($^1G_4 \rightarrow {}^3H_6$), and 329 nm ($^1D_2 \rightarrow {}^3H_6$). The upconversion emission intensity of the hexagonal $NaYF_4:Yb^{3+},Tm^{3+}$ was much stronger, compared with that of the cubic $NaYF_4:Yb^{3+},Tm^{3+}$.

AP-09

High Performance Ag/AgBr/TiO_2 Photocatalyst-Coated Silica Beads

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Keywords: Photocatalyst, Ag/AgBr/TiO_2, Photocatalyst-coated silica beads

Two types of photocatalyst (Ag/AgBr/TiO_2 and TiO_2) were synthesized and coated on silica beads. Various Ag to Ti molar ratios of 0, 0.07, 0.10, and 0.20 in ethanol were prepared and coated on silica beads by sol-gel method. The crystalline structures of these photocatalysts were characterized by XRD. The performance of the photocatalyst on silica beads was evaluated in aspects of efficiency and stability. As for the photocatalytic efficiency, formic acid was used as a model chemical in this study. Results showed that the deposition of Ag/AgBr/TiO_2 at Ag/Ti molar ratio of 0.07 on silica beads showed the best in terms of formic acid degradation as compared to the other Ag/AgBr/TiO_2 and TiO_2-coated silica beads. In addition, for the stability study, the release of silver ions and bromide ions from a series of Ag/AgBr/TiO_2-coated photocatalyst was also evaluated.

AP-10

Synthesis and Sintering of Magnesium Aluminate Spinel Nanopowders Prepared by Precipitation Method using Ammonium Hydrogen Carbonate as a Precipitant

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Keywords: $MgAl_2O_4$, Precipitation, Nanopowder, Sintering

Magnesium aluminate spinel ($MgAl_2O_4$) is widely used in many engineering applications due to its high melting point (2135°C), high mechanical strength, chemical inertness, and good optical properties. Precipitation method is recognized as a convenient and cost-effective method for the synthesis of nanopowders. In this present work, $MgAl_2O_4$ nanopowders were prepared by precipitation method using ammonium hydrogen carbonate as a precipitant. The precipitated precursors were a mixture of ammonium dawsonite ($NH_4Al(OH)_2CO_3 \cdot H_2O$) and hydrotalcite ($Mg_6Al_2(CO_3)(OH)_{16} \cdot 4H_2O$). After calcining at 1100°C for 2 hours, The $MgAl_2O_4$ nanopowders with particle size of 20-40 nm were obtained. The sinterability of the $MgAl_2O_4$ nanopowders was evaluated by sintering compacts of the $MgAl_2O_4$ nanopowders at temperature of 1300-1650°C for 2 hours. The relative density of the sintered $MgAl_2O_4$ ceramics reached about >99% of theoretical density after sintering at 1600°C for 2 hours. The Vicker's hardness and fracture toughness of the sintered ceramics, determined by indentation technique, were also reported.

AP-11

Effect of Particle Sizes of $BaTiO_3$ (BT) Seed on Microstructure and Electrical Properties of $(Ba_{0.85}Ca_{0.15})(Zr_{0.1}Ti_{0.9})O_3$

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Keywords: BCZT, Molten salt, Electrical properties, Lead-free ceramics

The study was conducted to find out the effect of particle sizes of $BaTiO_3$ (BT) seed on the microstructure and electrical properties of $(Ba_{0.85}Ca_{0.15})(Zr_{0.1}Ti_{0.9})O_3$ (BCZT) ceramics. The BT seeds were prepared by the molten salt method. $BaCO_3$ and TiO_2 were mixed and ball-milled. Then, the starting materials powder were mixed with KCl : NaCl salt and then heated at temperatures in the range of 700 to 900 °C with a dwelling time of 2 h. After that, the powder was washed with hot DI water. Results indicated that the samples showed a single pure perovskite phase when using a low temperature of ~750°C. The grain shapes of BT seeds had a mixture of polygon and equiaxed. The particle sizes of BT seeds increased from ~381 to ~600 nm with increasing heating temperatures from 750 to 900°C. After that, the different BT seeds were mixed with $BaCO_3$, $CaCo_3$, ZrO_2 and TiO_3 via the solid state reaction method. The mixed powder was calcined at 1200 °C for 2 h. Then, the calcined powder was pressed into a disc-shaped sample. After that, the samples were sintered at 1450 °C for 4 h. In order to investigate the microstructure and phase structure, SEM and XRD techniques were used. All ceramic samples showed a pure perovskite phase. The dielectric, ferroelectric and piezoelectric properties were measured by using an LCR meter, Sawyer Tower circuit and S5865 d_{33} meter, respectively.

AP-12

The Electrical Properties of BCZT Lead-Free Ceramics Induced by $BaZrO_3$ Seeds

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Keywords: Molten salt method, Seed-induced method, Microstructure, Perovskite phase, Electrical properties.

$Ba_{0.85}Ca_{0.15}Zr_{0.1}Ti_{0.9}O_3$ (BCZT) ceramics were produced by using the seed-induced method. $BaZrO_3$ seeds were prepared via the molten salt method using $BaCO_3$ and ZrO_2 oxides as starting materials. Then, the seed powder was mixed with KCl:NaCl salt and heated at temperatures in the range of 850-950 °C for 2-6 h. After that, the seed powder was washed with hot DI water.The obtained $BaZrO_3$ (BZ) seeds showed a pure perovskite phase. The nano-particle BZ seeds were mixed with $BaCO_3$, $CaCO_3$, ZrO_2 and TiO_2 powder to be prepared by the mixed oxide method. The mixed powder was then calcined at 1200 °C for 2 h. The calcined powder was pressed into a disc-shaped sample. Then, the samples were sintered at 1450 °C for 4 h. The phase formation of samples was analyzed by using x-ray diffraction. The results showed that all ceramics had a single perovskite phase. The electrical properties such as dielectric, ferroelectric and piezoelectric properties were measured as a function of BZ seed content by using automated electrical measurement systems (LCR meter, Sawyer Tower circuit and S5865 d_{33} meter, respectively). Results indicated that BZ seeds improved the electrical properties of the BCZT ceramics.

AP-13

Effects of $NaNbO_3$ Crystals on Characterization of $(K_{0.5}Na_{0.5})NbO_3$ Ceramics

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Keywords: KNN, $NaNbO_3$, molten salt

Lead-free $(K_{0.5}Na_{0.5})NbO_3$(KNN) piezoelectric ceramics were studied. The KNN were synthesized by seed induced method and $NaNbO_3$ crystals used as seeds which were prepared by molten salt synthesis (MSS). The metal oxides of $NaNbO_3$ system were mixed with NaCl salt in the ratio of 1:6. The heating temperatures of 800 to 1000 ˚C and dwelling time for 4h were used. The average particles size of $NaNbO_3$ about 1 to 3 um was obtained. Then, the $NaNbO_3$ seeds were mixed with KNN powder, and ball milled for 24 h. The mixed powder was calcined at 700-900 °C and sintered at 1100-1200 °C. The phase structure and morphology of ceramics were analyzed by X-ray diffraction and scanning electron microscope. Moreover, the electrical properties were studied. The results indicated that the XRD patterns of ceramics showed a perovskite phase. The relative density values of ceramics were 95-98% The $NaNbO_3$ crystal improved the electrical properties of KNN ceramics.

AP-14

Phase Structure, Microstructure and Electrical Properties of BCZT Ceramics Prepared by Seed-Induced Method

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Keywords: BCZT, Seed-induced method, Molten salt, Electrical properties

Abstract

The effect of particle sizes of $CaZrO_3$ (CZ) nanocrystal on the phase structure, microstructure and electrical properties of $Ba_{0.85}Ca_{0.15}Zr_{0.1}Ti_{0.9}O_3$ (BCZT) was studied. The $CaCO_3$ and ZrO_2 were used as starting materials for $CaZrO_3$ (CZ) seeds synthesized by the molten-salt method with the temperature of 1050 °C for 4h and 5h. On heating, KCl:NaCl molten eutectic salt served as a liquid medium for reaction of $CaCO_3$ and ZrO_2 to form $CaZrO_3$. After that, it was washed with hot DI water. The results were found that the CZ powder had a pure perovskite with the particle size about 372 to 459 nm. Then the CZ nanocrystals were mixed with the metal oxides such as $BaCO_3$, $CaCO_3$, ZrO_2 and TiO_2 by mixed oxide method. The phase structure, microstructure and electrical properties of BCZT ceramic were investigated as a function of particle size and concentration of CZ. Finally, results indicated that the excellent ferroelectric, dielectric and piezoelectric properties were obtained at the proper CZ nanocrystals content.

AP-15

Tuning the Band Gap of ZnO Thin Films by Mg Doping

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Keywords: Magnesium, Zinc oxide, Band gap

Structural, morphological, optical and electrical properties of magnesium (Mg) doped zinc oxide (ZnO) films prepared by ultrasonic spray pyrolysis technique on microscope glass substrate, have been studied in terms of Mg doping content. The precursors solutions of Mg doped ZnO films were prepared from zinc acetate dihydrate ($Zn(CH_3OO)_2 \cdot 2H_2O$) and magnesium acetate tetrahydrate ($(CH_3COO)_2Mg \cdot 4H_2O$) acted as dopant. The compositions of these solutions were fixed at 0.02 M of $Zn(CH_3OO)_2.2H_2O$ and the atomic percentage ratio of Mg/Zn was varied from 0 to 20 at.%. All films showed hexagonal wurtzite structure of ZnO and transmittance was higher than 80%. From AFM images, the morphology of the films showed homogeneous structure/texture with small grain size of approximately 50 nm. While Mg^{2+} ions did not change conductivity of ZnO films due to the partial substitution of Zn^{2+} ion by the same valence Mg^{2+} ion.

AP-16

Antibiotics Impregnated Hydroxyaptite for Localized Bone Tuberculosis Treatment: Influences of Solvent and Loading Techniques on Total Drug Content

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Keywords: Hydroxyapatite, Bone Tuberculosis, Rifampicin, Solution Impregnation

Chemotherapy for bone tuberculosis treatment typically comprises the systemic administration of drugs by oral or injection means together with debridement and cleaning of the infected bone area. Typically, patients have to take drugs daily for the duration from several months to one year. This drug administration can hamper patient lifestyle and lead to the problem of patient compliance and poor adherence to administration schedules which can cause therapeutic failure and contribute to the development of MDR strains. The use of carrier to provide local, sustained, and high concentrations of drugs to the area of infection is thought to be a new way to eradicate and suppress the infectious process without systemically exposing patients to toxic side effects and may decrease the drug administration duration. In this study, three dimensional printed microporous nano-hydroxyapatite porous hydroxyapatite was employed as a carrier to be impregnated with antibiotics for localized bone tuberculosis treatment. Apart from delivering antibiotics to the infected bone area, hydroxyapatite acts as a bone graft which can fuse with bone so there is no need to remove from the body and also aid the bone healing process. Rifampicin drug was experimentally loaded into hydroxyapatite using two types of solvents, namely methanol or N-methyl-2-pyrrolidone, and various solution impregnation techniques aiming to maximize the total drug content in the samples. It was found that the use of two steps vacuum loading technique could impregnate the greatest amount of drug in the hydroxyapatite sample when using methanol as a solvent. When using N-methyl-2-pyrrolidone as a solvent, one step vacuum loading technique with 10 % solution level gave the greatest amount of the impregnated drug. Comparing between using two solvents, the use of methanol could impregnate greater amount of drug in the sample than using N-methyl-2-pyrrolidone.

AP-17

Effect of $SrTiO_3$ Nano-crystals on the Electrical Properties of $Na_{0.47}K_{0.47}Li_{0.06}NbO_3$ Ceramics by Seed Induced Method

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Keywords: Lead-free ceramics; seed induced method; electrical properties

A solid-state reaction method was used to fabricate ceramics. The phase formation of ceramic with binary phase, ternary phase or more were randomly form. The properties of ceramics could not be controlled. In this work, study the influence of heterogenous nano-crystalline on electrical properties of lead free $Na_{0.47}K_{0.47}Li_{0.06}NbO_3$ (NKLN) ceramics by adding of $SrTiO_3$ nano-crystals to be used as the initial phase of reaction. In order to modify the electrical properties of NKLN ceramics. The Lead-free piezoelectric ceramics were synthesiszed by seed induced method. The $SrTiO_3$ nano-crystals used as seeds were prepared by molten salt synthesis. The seed content was varied from 0 to 10.0 mol%. The investigation has been reported on the microstructure and the electrical properties. Effect of the seed crystal on electrical properties will be discussed.

AP-18

Synthesis and Structural Studies of Nanowires Composite Materials from Rice Husk Ash by Metalorthermic Processes

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Keywords: Nanowires composite materials, Rice husk ash, Metalothermic processes.

Nanowires composite materials were synthesized from rice husk ash using by two metalothermic processes. The rice husk ash and carbon charcoal were mixed with Mg and Sn metals by various ratios and heated at 700°C and 1000°C under atmosphere of nitrogen gas. The synthesized products were studied by scanning electron microscope (SEM) and X-rays diffraction (XRD) technique. SEM images showed the structures of nanowires composite materials with diameter around 50-300 nm and length of 10-20 μm. XRD patterns indicated the crystal structures of composite materials consisting of Si, MgO, Mg_2SiO_4 phase and SiC, SnO_2 phase.

AP-19

Effect of Hydroxyapatite Bioceramic Bodies on Subcutaneous Soft Tissue Reaction of Laboratory Rats

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Keywords: Hydroxyapatite, Solid state reaction, Subcutaneous tissue, Biocompatibility

Hydroxyapatite (HA) is widely used in bioceramic materials for bone grafting. HA scaffolds were synthesized using solid-state-reaction method. Scaffolds were prepared by milling the elements of $CaCO_3$ and $NH_4H_2PO_4$ powders. The obtained powder was pressed with uniaxial pressing into disc shape with the dimension of 4 mm in thickness and 16.5 mm in diameter under pressures 3 MPa and then sintering the samples at difference temperatures from 1100 to 1300 °C for 3 hours. This research aimed to produce phase HA scaffolds to find out the effects of sintering temperature on phase contents, density, porosity, hardness and bending strength, and to use optimized condition samples study with laboratory rats' soft tissue to evaluate the soft tissue response to the samples. Thirty-two healthy adult non specific genders of Wistar rats were used in this study. Optimized, sintered samples were cut and lathed into cylindrical shape. Sixty-four samples of optimized condition were implanted and left in subcutaneous tissue for 3, 7, 14, 21, 30, 45, 90 and 180 days. XRD, XRF, Archimedes technique, Vickers hardness and bending strength as well as light microscopy were used for analysis. The results of optimized condition showed bodies of sintered sample at 1300 °C for 3 hours had highest content of 91.02 % HA phase, and the remaining phases of 4.51 % β-TCP and 4.47 % CaO, its bulk density and strength increased with increasing temperature, the highest bulk density of 2.006 ± 0.033 g/cm^3, hardness of 30.02 ± 3.23 HV, bending strength of 9.07 ± 1.15 MPa. Sample reactions to soft tissues at 180 days were mild inflammatory cells, absence of cellular infiltration, presence of calcification, and absence of displacement of ceramic components into surrounding host tissue. Our results concluded the samples were nontoxic to and biocompatible with subcutaneous tissue.

AP-20

Phenol Removal from Wastewater Contaminated Using Activated Carbon/Zeolite Composite Coated with Titanium Dioxide

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Keywords: Phenol, NaA zeolite, activated carbon, titanium dioxide, water treatment.

Phenol and phenol compounds waste from many kinds of industries were toxic to water living and human even in ppm concentration. Lots of photocatalysts and adsorbents were applied for the low cost and good efficientcy wastewater management to reduce phenol concentration in water. In this work titanium dioxide, one of high efficiency photocatalyst which widely be used in water treatement, was coated on the fabricated adsorbent composite substrate. The composite substrate composed of activated carbon and NaA zeolite present high phenol adsorption because of high porosity and good ion exchange properties. Accordingly, the adsorption could promote the photocatalytic activity under UV irradiation. As the specimens were easily disposal after water treatment process it was a good choice for lower energy consumption. The composite substrate was easily fabricated by simple extrusion and fired under non oxidation atmosphere at 650°C for 3 hours. Then it was inserted with polyurethane foam to make it can be floated and swirled by wind near the surface of the water to get more UV excitation than that of in the deeper. Phenol concentration was followed by UV absorbance at 270 nm from UV-Vis spectroscopy. The XRD and SEM were used to study phase and morphology of the composite. The BET analysis provided the specific surface area of the prepared composite.

AP-21

The Effect of β-SiC Nanowires on the Properties of Mullite Composites

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Keywords: β-SiC Nanowires, Mullite Matrix Composite, Thermal Conductivity

To investigate the effect of adding β-SiC nanowires on the properties of the mullite composites, three different amounts of β-SiC nanowires (0.2, 10 and 20 wt%) were mixed with mullite powders and then were ball-milled for 16 h. After milling, the powder slurries were dried at 100°C and then ground into powders. Ground mixtures were put into the graphite mold with diameter of 50 mm. The assembly graphite mold was placed in the hot-pressing furnace chamber and sintered at the temperature of 1400^{o}C for 30 min with heating rate of 10^{o}C/min under Ar atmosphere and sintering pressure of 25 MPa. The disc-shaped sintered specimens with 50 mm in diameter and 10 mm in thickness were obtained. The characterization of physical, mechanical and thermal properties of composites was investigated. The results of relationship between thermal conductivity versus density of β-SiC/mullite composites have been demonstrated. Finally, β-SiC nanowires are expected to give rise to higher thermal conductivity in such composites.

AP-22

Influence of Silane Coupling Agent and Nano-Filler on the Properties of Dental Resin Composite Cements

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Keywords: Silane Coupling Agent, Nano-Filler, Dental Resin Composite, Dental Cement

Dental resin composite cements were prepared with simply mixing method of Part A and Part B. The material components in Part A were composed of Bis-GMA, TEDGMA, 4-META, SiO_2 nanopowders and BPO. The components in Part B were Bis-GMA, TEDGMA, 4-META, SiO_2 nanopowders and 2,2′-(4-methylphenylimino) diethanol. Before using SiO_2 nano-filler in the formulation of Part A and Part B, it had to be coated with 3-methacryloxypropyltrimethoxysilane (MPS) which served as a silane coupling agent. Therefore, the optimum amount of MPS (1, 1.2, 1.5 and 2 wt%) and SiO_2 nano-filler (20 and 30 wt%) used to fabricate the composites were investigated. The homogeneous mixture of Part A and Part B at mass fraction of 1:1 was formed into the bars shape with dimension of 25 mm x 2.0 mm x 2.0 mm and then cured under light source for 20 sec. Then flexural strength was performed using the universal testing machine. The result showed that composite with 30 wt% of salinized SiO_2 nanopowders by 1.5 wt% of MPS showed the highest flexural strength of 65 MPa which was accepted according to ISO 4049. This study could be concluded that using a proper amount of MPS to silanize SiO_2 nanopowders and increasing the amount of SiO_2 nanopowders significantly improved the flexural strength of dental resin composite cements.

AP-23

Effect of $TaSi_2$ Addition on the Densification and Mechanical Properties of ZrC-20 vol % SiC Composites Prepared by Spark Plasma Sintering

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Keywords: Zirconium Carbide, UHTC, Spark Plasma Sintering (SPS)

Abstract
Zirconium carbide (ZrC) is one of the most important ultra high temperature ceramic (UHTC) material due to its high melting temperature (3420°C), high hardness (25.5 GPa), low theoretical density (6.64 g/cm^3), with excellent corrosion and thermal shock resistance. Applications of monolithic ZrC at high temperatures are limited due to low fracture toughness and poor oxidation resistance. In order to improve these kind of UHTC materials a certain amount of SiC addition was found to be effective. However the mechanical properties of this type of materials needs further improvement.
In this particular work ZrC – 20 vol % SiC composites containing 0-9 vol % $TaSi_2$ as a sintering additive were prepared by spark plasma sintering at 1800°C for 3 min. dweling time under a pressure of 50 MPa. All samples were found to be fully densified under mentioned sintering conditions. A homogeneous and relatively coarser microstructure were observed in terms of the increasing amount of $TaSi_2$ addition. Additonally formation of (Zr, Ta)C solid solution formation was reactions between ZrC and $TaSi_2$ particles by means of increasing amount of TaSi2. The hardness of ZrC - SiC composites increased from 17.8 GPa to 19.85 GPa when the content of TaSi2 increased from 0 to 9 vol% and the fracture toughness of composites increased from 4.10 to 5.5 MPa·m$^{1/2}$.

AP-24

Effects of Preparation Process and Sintering Temperature on Mechanical Properties of Al_2O_3/ZrO_2 Micro-composite

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Keywords: Al_2O_3/ZrO_2 micro-composite, Spray drying process, Mechanical properties

Composite materials made of alumina and zirconia are increasingly used in several biomedical applications because of their biocompatibility and good mechanical properties. In the present work, Al_2O_3/ZrO_2 micro-composite particles were prepared by ball milling as well as by spray drying of Al_2O_3 and Y_2O_3–ZrO_2 powder. Then the composite particles were sintered at different temperatures between 1600 ºC and 1700 ºC. The effects of particle preparation process and sintering temperature were studied on the spatial distribution of ZrO_2 grains in Al_2O_3 matrix, grain sizes, and mechanical properties of composites. The mechanical properties depend on the particle preparation process. With spray-dried powder, ZrO_2 micro grains were more uniformly dispersed with in Al_2O_3 grains as well as at the grain boundaries in comparison with ball-milled powder leading to higher mechanical properties. Moreover the sintered samples with high bulk density were obtained by using the spray-dried composite particles sintered at 1700 ºC.

AP-25

Effect of Milling Time on the Properties of BYF Doped PZT Energy Harvesting Ceramics by High Energy Ball Milling.

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Keywords: Energy Harvesting**,** Figure of Merit, Piezoelectric Voltage Coefficient, Piezoelectric Charge Coefficient.

Recently, Lead Zirconate Titanate (PZT) has been attracted for energy harvesting (EH) devices because of their excellent piezoelectric properties at the morphotropic phase boundary (MPB). The EH devices require high energy density related to high figure of merit (FOM: g_{33} x d_{33}). As a result, the improvement of piezoelectric voltage coefficient (g_{33}) and piezoelectric charge coefficient (d_{33}) to better energy density property obtained should be searching for. Therefore, PZT-BYF system was chosen for piezoelectric energy harvester by focusing to study on the composition of 0.99PZT-0.01BYF (0.99Pb(Zr0.53Ti0.47)O_3-0.01Bi (Y0.7Fe0.3)O_3). In this study, PZT and BYF systems were calcined separately and then 0.99PZT-0.01BYF powder were prepared by solid state method and mixed via high energy ball-milling in various milling time (2, 4, 10 and 16 h). The effect of milling time on the physical and electrical properties, figure of merit and microstructure were investigated.

AP-26

The Synthesis of Ru/NiO Nanoparticles with Gas-sensing Properties

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Keywords: *NiO, Ruthenium, Chemical precipitation, Gas sensor*

Nickel oxide (NiO) and 0.25–1.00 wt.%Ru-loaded nickel oxide nanoparticles (Ru/NiO-NPs) were prepared by chemical precipitation/impregnation method. Nickel (II) chloride hexahydrate ($NiCl_2 \cdot 6H_2O$), sodium hydroxide (NaOH) and ruthenium (III) acetylacetonate ($Ru(acac)_3$ were used as starting precursors. The crystalline phase, morphology and size of the nanoparticles were characterized by X-ray diffractometer (XRD), scanning electron microscopy (SEM) and transmission electron microscopy (TEM), respectively. The XRD data showed that the particles were highly crystalline and the peak can be confirmed to be the face centered cubic structure of NiO with the JCPDS files No. 78–0429. The crystallite size of NiO nanoparticles were in the range of 7–10 nm. The SEM image showed nanoparticles have clear spherical morphologies. Ru addition to NiO samples were verified by EDS mode. The specific surface area of the nanoparticles was measured by nitrogen adsorption (BET analysis). The C_2H_5OH-sensing performances in terms of sensor response and selectivity were optimized by varying Ru concentration. The optimal sensing film (1.00 wt.%Ru/NiO) showed a high sensor response of 2000 ppm of C_2H_5OH at the operating temperature 350°C. In addition, 1.00 wt.%Ru/NiO sensing film exhibited much higher C_2H_5OH selectivity against H_2S, NO_2, SO_2 and NH_3 compared with unloaded one. After the sensing tests, SEM and EDS techniques were used for characterization of sensitive film.

AP-27

Comparison of milling techniques of 0.98PZT-0.02BYF Piezoelectric ceramic for energy harvester

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Keywords: Piezoelectric Energy Harvesting, Figure of Merit, PZT-BYF, High energy ball milling

Nowadays, the concept of harvesting energy from the environment, for example, thermal, wind, sun, vibration and human activities is much of interest. PZT is one of the materials which show an ability to harness vibration energy and then change to electrical energy. Therefore, the PZT ($Pb(Zr_{0.53}Ti_{0.48})O_3$) doped with 0.02 mol% BYF ($Bi(Y_{0.7}Fe_{0.3})O_3$) piezoelectric ceramics has been studied to improve the figure of merit ($d_{33}*g_{33}$). The PZT and BYF powder systems were prepared by solid state reaction with calcination temperature of 800 and 850 ^{o}C for 2 h, respectively. XRD results showed that both powders exhibited pure perovskite phase for PZT and single phase of BY without pyrochlore phase. Then, the two calcined powders (PZT and BYF) were mixed according to the composition of 0.02 mol% BYF doped PZT by two different milling techniques called conventional ball-milling (CBM) and high energy ball-milling (HBM) for 10 h. The expectation of the particle size distribution will differ after CBM or HBM and thus affect the electromechanical properties and figure of merit ($d_{33}*g_{33}$). Consequently, the aim of this study was to investigate the effect of the two different mixing methods (CBM and HBM) of 0.98PZT-0.02BYF ceramics on the physical and electrical properties, figure of merit and microstructure.

AP-28

A Facile Method for Preparation of $La_{0.5}Sr_{0.5}MnO_3$ Material by Atmospheric-Pressure Plasma Jet

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Keywords: atmospheric-pressure plasma jet, $La_{0.5}Sr_{0.5}MnO_3$ (LSM551), fast oxidation process, nanopowder preparation

Atmospheric-pressure plasma jet (APPJ) method was employed to deposit $La_{0.5}Sr_{0.5}MnO_3$ (LSM551) material. LSM551 material for APPJ process was prepared via precursor solution of nitrate salts. X-ray diffraction (XRD) and scanning electron microscopy (SEM) analyses revealed LSM551 is a tetragonal perovskite structure with spherical shaped. The particle size distribution by dynamic light scattering (DLS) is obtained with an average size of 50.79 nm. Total reflection x-ray fluorescence spectroscopy (TXRF) confirmed the chemical compositions of APPJ-prepared LSM551 powder are 24.66 at. %, 25.90 at. % and 49.44 at. % for La, Sr and Mn, respectively. Optical emission spectroscopy (OES) showed the reactiveness of oxygen species as the major oxidative agents for the metal oxide formation in APPJ process. Based on the material characterization, TXRF and OES observation, APPJ process is an effective and a fast oxidation process for nanopowder preparation.

AP-29

Influence of Time, Temperature and Solution Refreshing on Rapid Biomimetic Coating of Calcium Phosphate Coating on Titanium

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Keywords: Calcium Phosphate, Biomimetic, Bioactive Coating, Coating Parameters

Surface modifications of titanium and its alloys to improve their cellular bioactivity were typically carried out to improve their biological performance during services. Bioactive calcium phosphate which renders the implant to bond directly to the bone is one of the approaches possibly employed to modify the surface of metallic materials. One of the recent promising techniques for producing such calcium phosphate coatings is the biomimetic approach which mimics the mineralization process of bone in nature by the used of saturated calcium phosphate solutions to induced the nucleation and precipitation of calcium phosphate crystals on the substrate. Several processing parameters could be varied and could affect the quality and quantity of such coating formation. The understanding of this relationship is; thus, of importance. In this study, the influence of coating temperatures, coating durations and the refreshment of coating solutions used in rapid biomimetic coating process on phase composition, amount and microstructure of the resulted coating on titanium substrate was investigated. It was found that all coatings similarly comprised octacalcium phosphate and hydroxyapatite as main phases and the microstructure consisted of sharp and interconnected plate-like crystals vertically grown on the surface of titanium. Generally, increasing coating duration increased the coating content in all cases. However, the effect of increasing coating temperatures was observed to depend on the types of coating solution employed. The use of non-refreshed solution resulted in the decrease in coating content with increasing coating temperatures. Conversely, the increase in coating amount with increasing coating temperature was seen when using refreshed solution. This could be related to the difference in nucleation and precipitation rate formed in rapid biomimetic coating process and the tendency of self-precipitation of coating solution as a result of the interplay between temperature and ionic strength of the solutions.

AP-30

Size Reduction of Titanium Dioxide to Obtain Nano Particles by the Solution Combustion Technique

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Keywords: Advanced Ceramics, Ceramic processing, Nanoparticle, Titanium dioxide,

High photocatalytic activity of nano particulate titanium dioxide has attracted worldwide attention. Synthesis techniques of the nano-particles, however, often require high energy supply or costly initial reagents. Solution combustion technique is an energy-effective technique capable of synthesizing nano-sized titanium dioxide powders. This research aimed at utilizing a less expensive initial reagent in synthesis of nanoparticulate titanium dioxide by the solution combustion technique. The research also examined effects of dissolving agents on chemical composition and particle sizes of the synthesized powders. A low-cost initial reagent, titanium dioxide with average particle size of 160 nanometer, was dissolved in sulfuric acid or dispersed in nitric acid prior to the combustion. Experimental results revealed that the pure anatase phase titanium dioxide was successfully obtained in powders prepared from both sulfuric acid and nitric acid. The average particle size of the powder prepared from sulfuric acid was 77 nanometers, while that of the powder prepared from nitric acid was 117 nanometers. The difference in particle sizes was attributed to solubility of the initial reagent in the acid. Complete dissolution of initial reagent in sulfuric acid was the main factor attributed to finer particle size

AP-31

Effect of $SnCl_4$ Concentration on Transparent and Conducting Undoped Tin Oxide Thin Films

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Keywords: Tin oxide, Optical transmission, Hall effect, X-ray photoelectron spectroscopy.

Ultrasonic aerosol pyrolysis technique has been successfully used for deposition of highly transparent undoped tin oxide thin films. The morphological, structural, optical and electrical properties as well as electronic structures of the films for different concentrations of $SnCl_4$ used as the precursor were investigated. FE-SEM displayed the substrate surfaces were uniformly covered with the film. XRD analysis showed that the films were textured nanocrystalline films in the tetragonal phase and present random orientation. The optical transmission spectra of all films revealed transmittance of more than 95% in the visible region. The lowest resistivity of 2.03×10^{-2} Ω cm was obtained for the films deposited at 0.2 M $SnCl_4$ concentration. From Hall effect measurements, the carrier concentration was 4.71×10^{20} cm^{-3} and mobility was 27.0 $cm^2/V.s$. X-Ray photoelectron spectroscopy (XPS) was used to measure the components and electronic structures of the films. The XPS spectra of the O1S state suggested that oxygen vacancies promoted the electrical properties of the films.

AP-32

Effect of Solvents on Photocatalytic Activity of $BiVO_4$ under Visible-Light Prepared by Precipitation-calcination Process

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Keywords: bismuth vanadate, solvents, precipitation, visible-light responsive photocatalyst. Rhodamine B

The aim of this work was to study effect of solvents on the synthesis of $BiVO_4$ for visible-light responsive photocatalytic degradation of rhodamine B (RhB) dye. The precursors were prepared by dissolving $Bi(NO_3)$ in various solvents; ethylene glycol, glycerol or nitric acid, and $NaVO_4$ in sodium hydroxide. The homogenously mixed precursor solution was precipitated by adjusting pH at 7, then washed, dried and calcined at 500^{o}C. The obtained products were characterized for phase, morphology, surface area and optical properties by X-ray diffraction (XRD), scanning electron microscopy (SEM), BET surface area analysis and UV-vis spectroscopy, respectively. The photocatalytic activity was evaluated by degradation of RhB solution under visible-light (>420nm) irradiation. It was found that all samples consisted of only $BiVO_4$ in monoclinic form, which could respond to visible-light region (band gap energy about 2.3-2.5 eV.). The solvents did not play significant effect on morphology of $BiVO_4$, but affected on their crystal size and surface area which was responsible for the photocatalytic performance. It was obtained that $BiVO_4$ prepared by using nitric acid having the highest surface area showed the highest photocatalytic activity for degradation of RhB.

CP-01

The Experimental of Low Temperatures Color Slip for Decorative on Earthenware Bodies

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Keywords: Color Slip, Decorative, Earthenware.

The purpose of the study was to investigate the effects of dolomite body, frit and potassium feldspar on the properties of color slip for decorative method of color slip on earthen ware production. The characterization of raw material was analyzed by X-ray fluorescence(XRF). The experiment started with triaxial blend of dolomite body, frit and potassium feldspar in the defined ratio and then to painting of color slips on earthenware production. After that, firing specimens at 950 °C in oxidation atmosphere. Finally, the specimens were tested microstructure and physical properties. The results showed that the ratio of 50% dolomite body, 40% frit and 10% potassium feldspar were optimum properties for decorative on earthenware body. In color slip consisting of blue color added Cobalt oxide 1% ,Green colors added chromic oxide 10% , Gray color added manganese oxide 10% ,yellow color added stain 2225 10% and hazel color added ferric oxide 2 %.

CP-02

Powder Injection Molding of Mullite: The Study of Binder Dissolution Behavior during Debinding Step using Statistical Methods

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Keywords: statistical analysis, powder injection molding, Avrami equation, debinding

Generally, in powder injection molding (PIM), the polymer binder, which is mixed with the ceramic powder to produce the feedstock, is the composite binder that consists of major and minor binders. The major binder is commonly removed during debinding step while the minor binder is removed during sintering. To remove the major binder, solvent debinding is a method that is generally used because it can reduce the debinding time considerably. However, if this method is not properly executed, it will affect the final properties of the sintered product. Therefore, understanding the nature of the binder is a key to produce the quality products by using PIM.

Normally, statistical method is the tool for the industry to study the nature of their manufacturing process for quality control and assurance. Polyethylene glycol (PEG) is a water-soluble binder and the one used in this research work has the melting point about 45 ^{o}C. The purpose of this work is to use the statistical methods including linear regression and statistical hypothesis test to study the dissolution behavior of PEG during debinding step of the green products of mullite formed by PIM. Two systems of composite binders, having PEG as their major binder, were investigated: (1) the composite binder consisting of 78 wt% polyethylene glycol (PEG), 20 wt% polyvinyl butyral (PVB), and 2 wt% steric acid (SA), and (2) the composite binder consisting of 78 wt% polyethylene glycol (PEG) and 22 wt% polyvinyl butyral (PVB). The lab-scale plunger type PIM machine was used to prepare the green products (5×5×50 mm^3) consisting of mullite powder and the composite binder. The possible compositions of the green products that could be prepared by this machine were 50, 52, and 54 vol% mullite (50, 48, and 46 vol% binder). The debinding was done by soaking the green products in the warm water at 40 or 60 ^{o}C to remove PEG. The rest of the binder in the as-leached samples was removed during sintering. At level of significance 0.05 for statistical analysis, the dissolution behavior of PEG can be fitted with Avarami equation. From the Avarami equation obtained from each experimental condition, the dissolution rate of PEG was determined from the time required for 50% dissolution. Then, the results showed that the dissolution rate of PEG was independent of the parameters used in this study including vol% of binder in the green products, water temperatures for debinding, and composite binder systems.

CP-03

Powder Injection Molding of Mullite: The Study of Mechanical and Physical Properties of the Sintered Products using Statistical Methods

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Keywords: statistical analysis, powder injection molding, flexural strength, density

Mullite is an aluminosilicate compound having high thermal shock resistant due to its low thermal expansion coefficient and low thermal conductivity. Moreover, mullite also has good mechanical strength at high temperature and good chemical stability. Thus, mullite is commonly used in high-temperature applications such as kiln furniture. To produce the products made from mullite, powder processing is a method that is commonly used. Powder injection molding (PIM) is a powder processing method used to produce the complex-shape products. There are many parameters that can affect the properties of the products made by this method. In the industry, statistical method is the tool to study the effect of the production parameters on the quality of their final products.

Therefore, the aim of this work is to propose the application of statistical methods (linear regression and statistical hypothesis test) to analyze the effect of parameters used in powder injection molding including sintering temperature and the feedstock composition on the flexural strength and density of the sintered specimens of mullite prepared by powder injection molding (PIM) and using the composite binder consisting of 78 wt% polyethylene glycol (PEG) and 22 wt% polyvinyl butyral (PVB) for molding. The lab-scale plunger type PIM machine was used to prepare the specimens. The feedstock compositions were 50 to 54 vol% mullite, and the sintering temperatures were 1300 and 1400 ^{o}C. At level of significance 0.05 for statistical analysis, feedstock composition did not affect both flexural strength and density of the sintered specimens. For sintering temperature, the specimens sintered at 1400 ^{o}C have the greater density. However, the flexural strength of the specimens sintered at 1300 ^{o}C and 1400 ^{o}C are statistically similar.

CP-04

Preparation, Characterization, and Catalytic Performance of Zn-SBA-15 Catalysts

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Keywords: Tranesterification, Solvothermal, Mesoporous silica, Zn-SBA-15

The series of Zn-SBA-15 catalysts with 0.5wt% to 7wt% Zn content have been synthesized by solvothermal impregnated of Zn acetate in ethanol on mesoporous silica SBA-15 platelets in order to maximize the methyl ester selectivity in transesterification reaction. The properties of these catalyst were characterized by N_2 adsorption-desorption isotherm, NH_3 temperature-programmed desorption, SEM, and XRD. The results showed that the ordered mesoporous structure of SBA-15 was remained with specific surface areas above 500 $m^2.g^{-1}$ and a narrow pore size distribution observed with the mean pore size around 60 Å after Zn modification. The strength of the acid sites and total acid amount of Zn-SBA-15 catalysts is varied with number of Zn loadings. The synthesized Zn-SBA-15 catalyst was tested for catalytic activity in transesterification of crude Jatropha oil. It was found that at 200 ^oC for 2 h reaction of the Zn-SBA-15-p catalysts with acid capacities of 0.36-1.29 mmol H+/g-catal gave 68-98 wt% of FAME yields and 0.4-1.4 wt% of FFA yields which are comparable to the pure ZnO.

CP-05

Analytical study of ancient pottery from the archaeological site of Ban Bo Suak from Nan province, Thailand

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Keywords: Ancient pottery, XRF, Middle layer, Engobe

Abstract: Ban Bo Suak pottery was analyzed by X-ray fluorescence (XRF), X-ray diffraction (XRD) and microstructure was observed by a scanning electron microscope (SEM). The basic raw mineral materials of four sites, JQA.SH, FQB.SH, PQC.SH and NQD.SH, were clay, feldspar, quartz and ashes glaze. Those minerals, feldspars could turn into glassy state at 1200 ºC, and then underwent physical–chemical reactions with clay and quartz. As a result, they made the body and glaze compacted and turned into stoneware at high temperature. SEM images of surface showed the middle layers between glaze and body for JQA.SH and FQB.SH. The decoration techniques were glazed and slip layer between bodies and glaze (engobe).

CP-06

Effect of Borax on Lightweight Material from Cullet and Fly Ash

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Keywords: Lightweight, Cullet, Fly ash, Borax

This work investigated the recycling of fly ash waste and cullet as the raw material for lightweight bodies produced by heat treatment and using sodium silicate as the binder. Different amount of borax were mixed with fly ash and cullet, and put into the block in dimension 10x10x2 cm^3. The lightweight material thus produced were then sintered at temperature of 800 ºC. Density, compressive strength and thermal conductivity were determined. Borax showed a positive sintering effect on the porosity of lightweight material during the heat process and reducing the fireproof property of fly ash. The compressive strength of lightweight material diminished with the reduction of density and thermal conductivity. Lightweight material manufactured with 15% of borax showed the lowest density and thermal conductivity accompanied by the highest compressive strength. The test results indicated that using fly ash and cullet as the raw material with borax could obtain the lightweight material, thus enhancing the possibility of its reuse in a sustainable way.

CP-07

Rate of Reaction and Mechanical Properties on Calcined Kaolin-based Geopolymer

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Keywords: Geopolymer, Kaolin, Plaster, Compressive strength

This paper aimed at investigation calcined kaolin-based geopolymer that could be an alternative to ordinary Portland cement (OPC) by applying geopolymerization process. Geopolymer slurry was prepared from calcined kaolin and alkali activators consist with 10 M NaOH and Na_2SiO_3 solution. The samples were casted in 5×5×5 centimeters cubic shape and then cured at room temperature. Parameters of the present processing are amount of water, plaster, and the reactivity rate of monomer. The reactivity rate of raw materials and compressive strength of geopolymer was tested after cured for 3, 7, 14, 28 days. Various techniques such as SEM, XRD and compressive strength test were employed to characterize the samples. SEM results confirmed that the geopolymerization process incessant after adding water, lead to homogenous structure. An improvement of the mechanical property was observed. The present process has therefore a high potential to increase the efficiency of production line.

CP-08

Utilization of Coal Bottom Ash as a Raw Material for Stoneware Ceramics

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Keywords : Coal bottom ash, Stoneware ceramics, Mechanical property

In this research, the coal bottom ash from Mae Moh Power Plant, Lampang, Thailand, which contained mainly SiO_2 and Al_2O_3, was used as one of the raw materials together with the commercial stoneware clay for stoneware ceramic process. The mixtures of the coal bottom ash and commercial stoneware clay with the ratios of 0:100, 10:90, 20:80, 30:70, 40:60, 50:50, 60:40, 70:30, 80:20, 90:10 and 100:0, were ball milled and oven dried at 100°C. After that, the dried powder was uniaxially pressed into a die with the pressure of 170 MPa in order to form pellets. The optimum sintering temperature was determined by sintering the pellets in range of the temperature between 1150°C to 1250°C with the heating rate of 5°C/min. The microstructures and the phase structures of the sintered samples were investigated using SEM and XRD techniques, respectively. In addition, Modulus of rupture (MOR) was measured in order to study the effect of coal bottom ash on the mechanical property of ceramics. The results showed that the ceramic samples at all ratios sintered at 1200°C had the minimum water absorption, maximum strength and bulk density. The results showed that the increase amount of coal bottom ash gave rise to the higher strength of the ceramics.

CP-09

Utilization of Expanded Perlite as a Source of Silica for Synthesizing Wollastonite by Solid State Reaction

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Keywords: perlite, eggshell, wollastonite, solid state reaction

Naturally occurring volcanic glass in the form of the expanded perlite consist of 72.59wt% silica was used as a staring material together with the calcined eggshell in order to explore the wollastonite formation via solid state reaction. The mixing molar ratios of $CaO:SiO_2$ were carried out from 1:0.8 to 1:1.4, calcined in the range of 600 - 1100^oC for 2 - 5 hours. The XRD results confirm the formation of wollastonite ($CaSiO_3$) started at 800^oC, and increasing of calcination temperature favoured the formation of gelehnite ($Ca_2Al_2SiO_7$) associated with wollastonite. The morphology characterized by SEM clearly show tiny needle-like shape of primary wollastonite on the surface of agglomerate particles. The $CaO:SiO_2$ ratio of 1:1.4 which calcined at 1100 ^oC for 5 hours was found to be the most appropriate molar ratio in the case of using the calcined eggshell and expanded perlite as starting materials.

CP-10

Synthesis of Lightweight Aggregate from By-product of Paper Industrial for Concrete Application

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This research was aimed to study the production of lightweight aggregate from fly ash, which is an unused by-product from paper industrial. This work emphasized on the effects of raw material compositions, especially the ratio between clay and fly ash and processing conditions, to the lightweight properties. In this study, the ratio of clay to fly ash of 90: 10, 80: 20, 70: 30 and 60: 40 % by weight, and sintering temperatures of 1,190, 1,200 and 1,210 °C were examined. It was found that the amount of fly ash directly affected to increase porosity of lightweight aggregate as well as sintering temperature. The appropriate characteristic of the lightweight aggregate was found at the ratio of clay to fly ash at 80: 20 % by weight with at the sintering temperature of 1210°C. The values of density, water absorption and compressive strength were 1.66 g/cm^3, 0.55 %, and 25 MPa, respectively. To evaluate the performance of lightweight aggregate in construction applications, the lightweight aggregate was partially used as a replacement of the coarse aggregate in concrete. The ratio of lightweight aggregate to coarse aggregate was 0: 100, 50: 50 and 100: 0 % by weight. A hundred percent of lightweight aggregate replacement showed the ultimate properties of concrete with 1,780 g/cm^3 of density, 3.55 % of water absorption, 40.94 MPa of compressive strength and 0.771 W/m.K of thermal conductivity, which had more than 25 % by weight reduction while keeping a similar compressive strength to an ordinary concrete. This study revealed that the lightweight aggregate could be applied into structural concrete because it was able to reduce work load and increase safety factor of construction.

Keywords : Fly ash, Clay, Lightweight Aggregate

CP-11

Effect of Talc on phase Formation and Mullite Morphology of Different Thailand Clays

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Keywords: Clay, Mullite, Morphology, Sinterbility.

The study on characterization i.e. chemical and mineralogical composition, thermal decompisition and particle size distribution of different clays in Thailand was investigated. Different clay from Narathivas, Ranong and Lampang province showed alterative Al/Si ratios in order to their localities. The addition of talc up to 5 wt% was effected on the phase formation, morpholigy that capable to improve mullite in clay. The results revald that mullite were major phase in sitering and also fourd cirdierite which formed during expense of the other phases with containing of 5 wt% of talc. SEM exhibited role of talc in the grain growth of mullite and also showed the formation of pseudohexagonal cordierite.

CP-12

Development of the Common Brick Product to the Properties Fulfilled the Requirements of Thai Community Product Standard.

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Keywords: Clay, Development, Brick.

The objective of the study was to characterize and the properties of common brick made by Small and Micro Enterprise Community clay brick making group in San Bun Reung village, Lampang province for development of the common brick product. The characterizations of raw material were analyzed by particle size, chemical and mineral analyses. The water-min and water-max, blending, aging and press-ability were developed in forming process. The shrinkage, water absorption, bending strength and compressive strength of common brick were tested. The results showed that the properties of common bricks after firing temperature at 900°C. In common brick had a shrinkage of 6.5% and water absorption of 15.8%. The common brick resistance of bending 102 kg/cm^2 and compressive strength at 220 kg/cm^2. The common brick produced by the community achieved the requirements of Thai Community Product Standard (TCPS 601/2547).

CP-13

The Fabrication of Refractory Cordierite from Aluminium Buff Mixture

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Keywords: cordierite, refractory, aluminium buff, linear thermal expansion coefficient

The aim of this work is to propose the utilization of aluminium buff from aluminium part manufacturer as a raw material for cordierite batch composition. The powder mixtures were compacted by uniaxial pressing. The green compacts were sintered at temperature in the range 1300-1400°C for 2 hours in air. The physical properties were characterized by Archimedes method and dilatometry. Phase analysis was done by X-ray diffraction (XRD). The XRD analysis showed the major phase was cordierite along with sapphirine as a secondary phase. The lowest linear thermal expansion coefficient of 2.5×10^{-6} $°C^{-1}$ was achieved from the specimen sintered at 1375 °C.

CP-14

Effect of Sodium Silicate and Used Gypsum Mold Additions on Properties of Lightweight Fired Clay Brick

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Keywords: Lightweight, Clay Brick, Recycle Gypsum Mold, Coagulation.

Novel lightweight fired clay brick have been produced by firing mixtures of Ratchaburi pottery clay with sodium silicate and used gypsum mold as a deflocculant and coagulant, respectively. Ratchaburi pottery clay were mixed to be a paste with water content of 35-60 wt%. Sodium silicate solution (ceramic industrial grade) was added as 5-8 wt% and the mixtures were thoroughly mechanical stirred. Used gypsum mold was ground and sieved through 100 mesh and was added as 1-5 wt% into the pastes. Viscosity of mixtures was immediately risen up to be a clay dough. The clay dough was formed into a 5x5x5 cm^3 cubic shape in a steel mold. After drying in air for 24 h and in an oven at 100 ^oC for 24 h, samples were fired at 800-1000 ^oC for 30 min. Lightweight fired clay brick samples were fabricated with a density of 1.2 g/cm^3 by adding 5 wt% of sodium silicate solution and 5 wt% of used gypsum mold. The mechanical properties, phase composition and microstructure were discussed.

CP-15

Preparation of Porous Silicon Carbide Ceramic by In-Situ Carbothermal Reduction Method from Rice Husk Charcoal

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Keywords: Silicon Carbide, Rice Husk, Pyrolysis, In-Situ Carbothermal Reduction Bonding.

Silicon carbide ceramics were prepared by using carbonized rice husk as a raw material. In-situ reaction bonding and carbothermal reduction techniques were used together in the fabrication process. After carbonization process, the rice husk charcoal was ground then mixed with silicon metal powder and sintering additives powder. Various ratio of aluminum oxide and magnesium oxide were used as sintering additives. After that, mixed powder was shaped and then pyrolized under argon atmosphere by various temperature and soaking time. Main phase of the pyrolized samples are silicon carbide as a main phase and aluminum magnesium oxide as a secondary phase. Increasing pyrolysis temperature increases the samples shrinkage. Weight loss of pyrolized samples is the main reason for the sample's shrinkage. Weight loss is increased when increased pyrolysis temperature. Porosity of the samples is increased when pyrolized at lower temperature but not changed when pyrolized at higher than 1700 °C. The microstructures of pyrolized sample has a little change. Increasing amount of sintering additive is increasing the connecting between particles. Similar to the effect of temperature, increasing connecting of particles in the sample as a result in increasing pyrolysis temperature.

CP-16

Effect of Coarse Aggregate Replacement with Working Mold from Ceramic Industry in Lightweight Aggregate Concrete

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Keywords: lightweight aggregate concrete, working mold, compressive strength.

This research aims to determine the optimal ratio of lightweight aggregate concrete with deteriorated working mold as coarse aggregate. The sources of working mold are obtained from the ceramic industry in Thailand. Generally, the most working mold is handled by dumping which causes alkali soil and hydrogen sulfide gas on that area and its effect on environmental such as a global warming. The potential of working mold waste as a substitute for coarse aggregate in lightweight concrete has been investigated. The working mold partially replaced coarse aggregate in concrete at 0 25 and 50% respectively by weight of aggregate in the normal concrete. All concrete were tested for compressive strength, unit weight and water absorption at the age of 7 14 and 28 days. It was found that the concrete with working mold replacement of 25 and 50% by weight of aggregate achieve strength levels between 29 to 65% compared to the normal concrete. The unit weight of concrete with working mold were decreased by 8.9 to 20% of normal concrete and the water absorption were increased by 6 to 10% of normal concrete. This research indicates that the deteriorated working mold can be used to replace coarse aggregate in lightweight concrete.

CP-17

Evaluation of Electrostatic Charge of Inorganic Pigments Coated by Silanes for Laser Beam Printer

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Keywords: Inorganic pigment, Laser beam printer, Electrostatic charge, Developer, Silane, Porcelain.

Laser beam printer (LBP) have widely used not only in office to make documents but also in factory to make a transfer paper for porcelain coloring design due to improvement of an image quality and printing speed. LBP has six steps, which are charging, exposure, development, transfer, fusing, cleaning and discharge, for the printing product. In these steps, we focused on the development step for the source of submicron inorganic pigments. The toner is a negatively charged combination of inorganic particles. A control blade holds the toner at a micro size distance from the drum. The inorganic pigment then moves from the control blade to the more positively charged latent image on the drum. The image in static electricity needs to be developed – made visible. The developer introduces small particles of toner onto the static-charged surface of the drum. In this study inorganic pigments were coated by functional silanes to provide particles with the electrostatic charge. The coating thickness and kinds of silanes were changed to evaluate the electrostatic charge of coated pigments. After coating process, the electrostatic charge of inorganic pigments coated with silanes were evaluated by the Farady's device. We will introduce the effect of 3-(N-phenylamino)propyltrimethoxy silane and phenyl tris (methylethylketoxime) silane coating on the electrostatic charge of inorganic pigments.

CP-18

A Recovery Process of High CaO Fly Ash after Wet Condition and their Characterization

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Keywords: Fly ash, high CaO, wet condition, characterization

Fly ash, a pozzolanic and cementitious material, is known as a by-product from combustion of coal, the most widely used source to generate electricity. Class C fly ash with calcium oxide (CaO) greater than 20%, regarding ASTM C 618, has been generally utilized in concrete industry because of its great performance allowing the improved properties of concrete in terms of early strength, workability, cohesiveness, drying shrinkage, temperature rising, abrasion resistance, expansion and durability. The high CaO fly ash is known to rapidly harden when mixing with water, with prolonged mixing condition enabling them to be hardly recovered for use in cement application. A well preparation process is essentially required for such hardened material before its further use, while a set of designed characterization is also needed to evaluate its properties whether or not it is suitable to be used in the cement application. This work focuses on a study of recovery process of fly ash with high CaO composition of 20%. A systematic process of sample preparation, efficient grinding and drying has been proposed to recover the wet fly ash. Physical and chemical properties have been investigated. Mineralogical study reflecting the main components of anhydrite, quartz, magnetite, hematite, lime, portlandite, and calcite has been explained. To confirm their cementitious property, the collected fly ash samples after recovering from wet condition have been tested their basic specification in portland-cement concrete to obtain a useful insight into aspect of reuse possibility. The achieved results has demonstrated important evidence that fly ash after experiencing wet condition and undergoing a particular recovery process could be reused and utilized in their application of cement, upon the ASTM C 618.

CP-19

Carbon Structure Synthesized from Coconut Coir and their Properties

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Keywords: Coconut Coir, Carbon, Sintering, Thermal Conductivity

Thailand is known the sixth largest coconut producer of the world with 1.5 million tons of annual coconut production, regarding data from the Office of Agricultural Economics of Thailand 2011. A large amount of coconut wastes has been generated upon the efficient utilization of coconut in many manufacturing industries, leaving behind a huge amount of coconut coir to be discarded and leading to environmental problems. This work presents a utilization of coconut coir in synthesizing carbon from coconut coir, with a modified process leading to a controllable properties of carbon structure. A further study on mixing carbon and silicon and their properties has been investigated, with an aim to achieve informative data upon the carbon/Si composite composition for further use as crucible in foundry application. The coconut coir has been fired in a designed chamber in nitrogen atmosphere, with sintering temperature varied from 600 ºC to 1500 ºC. The synthesized carbon has been subject to characterization their C, H, N composition by CHN analyzer. The crystallographic and morphological studies have been performed by X ray diffraction and scanning electron microscopy, respectively. The result has shown that the maximum percentage of carbon composition is obtained by the sintering temperature of 1000 ºC. Selected from this sintering condition, the carbon powder has been mixed with silicon in different ratios ranging from 5 to 15 wt.%, following by milling, dry pressing, cold isostatic pressing at 350 MPa, and sintering at 1500 ºC. The sintered composite sample has exhibited the improved thermal conductivity to the regime of 6 W/m.K. Relation of density and porosity of the composite material is to be described.

CP-20

Effect of Quartz Addition on the Properties of Clay Body for Trakuan Pottery

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Keywords: Quartz; Clay body; Pottery

This research shows effect of quartz addition on the properties of clay body for Trakuan pottery. Quartz was used in mixtures with clay body for making Trakuan pottery. We investigate changes of shrinkage, water absorption, and flexural strength of clay body mixtures when quartz is added in the ratio of 5-30 wt% and fired at 800, 1000, and 1200 °C. The results show that the additions of quartz over 5 wt% decrease shrinkage and flexural strength values but increase water absorption of fired clay bodies. Quartz with the ratio of 5 wt% is optimal to use in preparation of Trakuan clay bodies.

CP-21

An Efficient Photocatalyst Material TiO_2 for Degradation of Organic Pollutant in Wastewater

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Keywords: Cumene hydroperoxide (CHP), TiO_2 P-25, Reusable, Long durability

Titanium dioxide (TiO_2) photocatalyst is widely used in environmental applications especially in air and water pollution treatments. Cumene hydroperoxide (CHP) is predominantly used in producing of phenol. However, CHP, starting reactant cannot be completely converted to phenol, thus CHP contaminated in wastewater from phenol plants as a result. Not only CHP was found in wastewater but also dimethyl phenyl carbinol (DMPC) and acetophenone (ACP) were also adulterated. These organic substances are highly toxic especially CHP. This research aimed at producing a reusable photocatalyst for organic wastewater treatment degradation. TiO_2 Degussa P-25, well know photocatalyst, was coated on a supporting material (porous glass bead, ECOLITE®) by granulation technique and calcium aluminate cement (AC) was used as binder, (EC+AC+15wt%TiO_2 P-25). Photocatalytic activity of EC+AC+15wt%TiO_2 P-25 was evaluated by investigation of the degradation activity of 2,000 ppm CHP standard solution and CHP contaminated in wastewater (~900 ppm) under UV light irradiation. It was found that CHP in both cases was completely degraded within 4 hours. Moreover EC+AC+15wt%TiO_2 P-25 showed a long durability and reusable for CHP degradation with 7 cycles run.

CP-22

Red Loess Development as Raw Materials for Clay-Based Ceramics

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Keywords: Khon Kaen loess, clay-based ceramics, rice husk, charcoal

Loess–red clay section is located around 5 km north off the downtown Khon Kaen Province. Sampling locations of this loess source are found in Khon Kaen University main campus. Non-plastic fine grained Khon Kaen loess mainly consists of silt-size silica with less than 3% of total clay minerals. Since loess is considered challenging in engineering relevance, its failure possibility is one of most important characteristic needs to be cautiously resolved to fabricate reliable foundations or suitable mitigation schemes for existing destabilized structures. The loess pH determinations are in the range of neutral to weakly acid. Its grain size distribution by sieve analysis can be reported as well-graded samples, and the soil texture is loamy sand and sandy loam. Structural network of red ferric oxide-clay loess can stabilize strength of green bodied as of clay-based ceramics when fined grain silica is reduced. Loess containing amount of silica sand is water washing by gravity vortex. The clay-based loess is gained more clay minerals up to 45% after the treatment. Chlorite-montmorillonite mixed clay is the dominant clay minerals. Good strength and highly contraction is found after firing process to 1,000-1,100^{o}C. Mixing black rice husk ash (B-RHA) and charcoal (1:1 ratio) can decrease its body contraction. Besides, the apparent density and compressive strength of the loess clay with B-RHA is greater than mixing with (B-RHA + charcoal) and clay alone for 10%. Thus, Khon Kaen loess is remarkably possibility to develop as raw materials for clay-based ceramics.

CP-23

Porous Geopolymer using Aluminium Dross and Aluminium Powder as Foaming Agents

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Keywords: Geopolymer, Aluminium dross.

Geopolymer is an ecofriendly processing materials because it consumed less energy. To improve the thermal conductivity, the foaming agents were added. In this study, Aluminium powder and Aluminium dross were introduced by adding with different weight percent to raw materials. The effect of sodium silicate to sodium hydroxide and solid to liquid ratios were investigated. The weight ratios of sodium silicate solution to 10 molar sodium hydroxide solution (Na_2SiO_3:NaOH) of 1.5 and 2.5 were used. The weight ratios of solid to liquid were 0.72, 0.86, and 1.03. Geopolymer samples were cured at room temperature for 7, 14, 21, and 28 days. The physical properties such as compressive strength, thermal conductivity and bulk density were measured. The thermal conductivity and bulk density were analyzed at 28 days curing. The results show that the compressive strength, bulk density and thermal conductivity intend to decrease while increasing amount of foaming agents. The sample that composed of 1.5% Aluminium dross, Na_2SiO_3:NaOH ratio 2.5, and solid to liquid ratio 0.86 had compressive strength of 11.76 MPa which was higher than Thai industrial standards for autoclaved aerated lightweight concrete elements (TIS. 1505-2541). In addition thermal conductivity of sample was 0.27 W m^{-1} K^{-1}. For sample that using Aluminium powder as foaming agent, the sample that composed of 0.7% Aluminium had compressive strength of 15.27 MPa and thermal conductivity of 0.27 W m^{-1} K^{-1}.

GP-01

Preparation and Characterization of Bioactive Glass/Polycaprolactone Composites for Bone Tissue Engineering

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Keywords: Composites, Bioactive glass, Blending, Melting.

Bioactive glass (BG) was synthesized using the conventional melting. BG/ polycaprolactone (PCL) composites with different BG contents (0 wt%-40 wt%) were prepared by a melt blending and thermal injection moulding technique. The influence of BG addition on the structural and mechanical properties of the prepared glass-ceramics was studied with XRD, SEM FTIR and the bioactive properties of these materials were characterized. The elastic modulus and tensile strength of the BG/PCL composites were improved with increasing BG content. The samples were soaked in simulated body fluid (SBF) for 14 days. The apatite was form on the surface layer of glass-ceramics and it increases with the BG content was increased.

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