



***The 23rd PPC Symposium on Petroleum,
Petrochemicals, and Polymers
and
The 8th Research Symposium
on Petrochemical and Materials Technology***

Co-organized by

***The Petroleum and Petrochemical College
Center of Excellence on Petrochemical and Materials Technology
Chulalongkorn University***

***At
Pathumwan Princess Hotel
Bangkok, Thailand***

***Tuesday May 23, 2017
8.30 – 17.30***

Conference Agenda

The 23rd PPC Symposium on Petroleum, Petrochemicals, and Polymers and The 8th Research Symposium on Petrochemical and Materials Technology

At Pathumwan Princess Hotel
Tuesday, May 23, 2017

| | | | | |
|---------------|--------------------------------|--|--|--|
| 8.30 – 9.00 | Registration at M Floor | | | |
| 9.00 – 9.15 | Conference Open | Welcoming and Reporting Prof. Suwabun Chirachanchai, Dean, The Petroleum and Petrochemical College Prof. Pramoch Rangsunvigit, Director, PETROMAT | | |
| | | Opening Address Prof. Emeritus Khunying Suchada Kiranandana, Chairperson, University Council, Chulalongkorn University | | |
| 9.15 – 10.15 | | Group Photograph / Break | | |
| 10.15 – 10.45 | | Keynote I : Dr.Santi Kulprathipanja : UOP, A Honeywell Company, USA | | |
| 10.45– 11.00 | | Keynote II : Dr. Taweesak Bunluesin : Esso Company Limited, Thailand | | |
| 11.00 – 12.00 | | Break out into 4 parallel technical sessions | | |
| | | Ballroom 1 | Ballroom 2 | Jamjuree 1 |
| | 11.00 - 11.20 | Prof. Hiroshi Tamura : Kansai University, Japan | NUS, Singapore : Assoc. Prof. Praveen Linga Asst. Prof. Yan Ning | “Industry 4.0 : Technology Platforms” By PETROMAT |
| | 11.20 – 11.40 | Prof. Daniel Crespy : VISTEC, Thailand | | |
| | 11.40 - 12.00 | Dr. Kajornsak Faungnawakij NANOTEC, Thailand | | |
| 12.00 – 13.30 | Lunch / Poster Set Up | | | |

| | | | | |
|---------------|---|--|---|---|
| 13.30 – 14.00 | Conference Open | Keynote III : Prof. Anuvat Sirivat : Chulalongkorn University, Thailand | | |
| 14.00 – 14.30 | | Keynote IV: Asst. Prof. Thongthai Witoon : Kasetsart University, Thailand | | |
| | | Break out into 2 parallel technical sessions | | |
| | | | Jamjuree 1 | Jamjuree 2 |
| 14.30 – 15.30 | | 14.30 - 14.45 | Wissawin Kunchornsup Polymer Engineering and Processing | Natchanon Angsutorn Process and System Engineering |
| | | 14.45 - 15.00 | Sathaphorn O-suwankul Polymer Engineering and Processing | Nicharat Manmuanpom Smart and Advanced Materials |
| | 15.00 - 15.15 | Pornpetch Hattakijvilai Surfactant, Separation and Environment | Naruphohn Dararatana Smart and Advanced Materials | |
| | 15.15 - 15.30 | Noppa Peawsuphon Renewable Energy | Dr. Kriengsak Wongpromrak Plastics Institute of Thailand | |
| 15.30 – 17.00 | Break / Poster Presentations & Evaluation by Reviewers | | | |
| 17.00 – 17.30 | Awards Presentation / Recognition | | | |

Poster set up at 12.30 p.m (after morning session)

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Welcome Message



The Petroleum and Petrochemical College (PPC) graduated the first Master Degree students in 1994 and at that time the PPC set up the 'Poster Presentation', later on so-called 'PPC Symposium', as the stage for the students to deliver their research achievements to the public.

The annual PPC-symposium becomes known to the Petrochemical and Polymer society as it represents the current development in the areas of Petrochemical and Polymer of the country.

The symposium has got the joint organization, the PETROMAT Center of Excellence, to co-organize the symposium and become PPC-PETROMAT Symposium since 2010. This makes the PPC- PETROMAT Symposium includes Chulalongkorn University, Kasetsart University, Silpakorn University, and Suranaree University of Technology.

For this year, PPC- PETROMAT Symposium has 15 oral presentations in the morning session and 8 oral presentations in the afternoon session, and 95 poster presentations in the evening session.

It is the honor of the PPC and PETROMAT to have the keynote speakers and the invited speakers from industries and academia as follows, Dr.Santi Kulprathipanja, UOP, A Honeywell Company, USA , Dr. Taweesak Bunluesin, Esso (Thailand) Company Limited, Prof. Dr. Anuvat Sirivat, Chulalongkorn University, Thailand, Asst. Prof. Dr. Thongthai Witoon, Kasetsart University, Thailand, Prof. Dr. Hiroshi Tamura, Kansai University, Japan, Assoc. Prof. Dr. Daniel Crespy, Vidyasirimedhi Institute of Science and Technology (VISTEC), Thailand, Dr. Kajornsak Faungnawakij, National Nanotechnology Center, National Science and Technology Development Agency (NSTDA), Thailand, Assoc. Prof. Dr. Praveen Linga and Asst. Prof. Dr. Yan Ning National University of Singapore, Dr. Kriengsak Wongpromrat, Plastics Institute of Thailand, Mr. Somboon Pitayarangsarit, the Federation of Thai Industries, and Mr. Wiroom Tanthapanichakoon, Global R&D Co.,Ltd.

I have to say that the PPC-PETROMAT Symposium 2017 will never be real without the sponsors which are, Gold sponsors: Esso (Thailand) Public Company Limited, Thai Oil Public Company, Verasuwan Company Limited, SCG Chemicals Company Limited, and PTT Exploration and Production Public Company (PTTEP); Silver sponsors which are: BASF (Thailand) Limited, PTT Public Company Limited (PTTPLC), PTT Global Chemical Public Company Limited (PTTGC), the Thailand Research Fund (TRF), Center of Conductive and Electroactive Polymers (CEAP) and the National Nanotechnology Center, National Science and Technology Development Agency (NSTDA); and Bronze sponsors which are: Praxair (Thailand) Company Limited and Plastics Institute of Thailand.

On the occasion of Celebrating Chulalongkorn University's Centenary, the PPC is pleased to contribute its leadership in research to the society by promoting advanced instrument techniques to all people in the field as the post-conference program. The program is supported by Bruker Biospin AG, COAX Group Corporation Limited, LMS Instrument Company Limited, Crest Nanosolution (Thailand) Company Limited, Bara Scientific Company Limited, Leco Instruments (Thailand) Company Limited, Labtech Engineering Company Limited, ULVAC (Thailand) Limited, Horiba (Thailand) Limited, and Hollywood International Company Limited. The booth exhibitors include Design Alternative Company Limited, M.J. Bangkok Valve & Fitting Company Limited, and Becthai Bangkok Equipment & Chemical Company Limited.

On behalf of the PPC, I would like to express my sincere appreciation to all of the sponsors who really make the PPC-PETROMAT Symposium 2017. I hope the Symposium answers the PPC mission to the Chulalongkorn University, that is, "the World Class PPC"

Professor Suwabun Chirachanchai
Dean of The Petroleum and Petrochemical College

Professor Pramoch Rangsunvigit
Director of Center of Excellence on Petrochemical and
Materials Technology

Co-organized by





Keynote & Invited Speakers

Co-organized by



Keynote & Special Lectures

Keynote Lecture



Dr. Santi Kulprathipanja

Director, Southeast Asia Research & Development
UOP, A Honeywell company, USA



Dr. Taweesak Bunluesin

Refinery Business Support and Controls Manager
Esso (Thailand) Public Co., Ltd, Thailand



Prof. Dr. Anuvat Sirivat

Conductive and Electroactive Polymers
Chulalongkorn University, Thailand



Asst. Prof. Dr. Thongthai Witton

Kasetsart University, Thailand

Special Lecture & Invited Speakers



Prof. Dr. Hiroshi Tamura

Faculty of Chemistry, Materials and Bioengineering,
Kansai University,
Japan



Assoc. Prof. Dr. Daniel Crespy

Vidyasirimedhi Institute of Science and Technology
(VISTEC), Thailand

Keynote & Special Lectures



Assoc. Prof. Dr. Praveen Linga

Department of Chemical and Biomolecular Engineering,
National University of Singapore,
Singapore



Asst. Prof. Dr. Yan Ning

Department of Chemical and Biomolecular Engineering,
National University of Singapore,
Singapore



Dr. Kriengsak Wongpromrat

Plastics Institute of Thailand,
Thailand



Dr. Kajornsak Faungnawakij

National Nanotechnology Center,
National Science and Technology Development Agency (NSTDA),
Thailand

Conference & Post-Conference Organizing Committee

| | |
|-----------------------------------|-----------------------------------|
| Prof. Suwabun Chirachanchai | Assoc. Prof. Thanyalak Chaisuwan |
| Assoc. Prof. Siriporn Jongpatiwut | Prof. Pramoch Rangsunvigit |
| Prof. Apanee Luengnaruemitchai | Assoc. Prof. Hathaikarn Manuspiya |
| Ms. Kaewjai Khumvilaisak | Mr. Suwichan Thongtam |
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Asst. Prof. Chanin Panjapornpon

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Dr. Maythee Saisriyoot

Dr. Nuttapol Pootrakulchote

Dr. Nuttapon Rangton

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Kasetsart University

Assoc. Prof. Duangdao Aht-ong

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Prince of Songkla University

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| Asst. Prof. Tarinee Nampitch | Kasetsart University |
| Asst. Prof. Visit Vao-Soongnern | Suranaree University of Technology |
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| Dr. Tanate Danuthai | PTT Research and Technology Institute |
| Dr. Kansiri Pakkethati | Maharakham University |
| Dr. Thanasat Sooksimuang | National Metal and Materials Technology Center |
| Dr. Thitiporn Suttikul | King Mongkut's University of Technology North Bangkok |

Sessions

- **Catalysis** CA
- **Renewable Energy** RE
- **Surfactant, Separation and Environment** SE
- **Process and System Engineering** PS
- **Biomedical and Green Polymers** BG
- **Polymer Engineering and Processing** PP
- **Smart and Advanced Materials** SM
- **Conductive and Electroactive Polymers** CP

Participation Institutes

- | | |
|--|--|
| <ul style="list-style-type: none"> ➤ Chulalongkorn University, Thailand | <ul style="list-style-type: none"> • Department of Chemical Technology • Department of Chemistry • Department of Materials Science • Program of Petrochemistry and Polymer Science • The Petroleum and Petrochemical College • Center of Excellence on Petrochemical and Materials Technology (PETROMAT) |
| <ul style="list-style-type: none"> ➤ Kansai University, Japan | <ul style="list-style-type: none"> • Faculty of Chemistry, Materials and Bioengineering |
| <ul style="list-style-type: none"> ➤ National University of Singapore, Singapore | <ul style="list-style-type: none"> • Department of Chemical and Biomolecular Engineering |
| <ul style="list-style-type: none"> ➤ UOP, A Honeywell Company, USA | |
| <ul style="list-style-type: none"> ➤ National Nanotechnology Center, National Science and Technology Development Agency (NSTDA), Thailand | |
| <ul style="list-style-type: none"> ➤ Plastics Institute of Thailand | |
| <ul style="list-style-type: none"> ➤ Kasetsart University, Thailand | <ul style="list-style-type: none"> • Department of Chemical Engineering |
| <ul style="list-style-type: none"> ➤ Thammasat University, Thailand | <ul style="list-style-type: none"> • Faculty of Science and Technology |
| <ul style="list-style-type: none"> ➤ Rajamangala University of Technology Thanyaburi, Thailand | <ul style="list-style-type: none"> • Department of Materials and Metallurgical Engineering |
| <ul style="list-style-type: none"> ➤ Ramkhamhaeng University, Thailand | <ul style="list-style-type: none"> • Department of Materials Technology |
| <ul style="list-style-type: none"> ➤ Vidyasirimedhi Institute of Science and Technology (VISTEC), Thailand | <ul style="list-style-type: none"> • Department of Chemical Engineering • Department of Materials Science and Engineering |
| <ul style="list-style-type: none"> ➤ King Mongkut's University of Technology North Bangkok, Thailand | <ul style="list-style-type: none"> • Department of Industrial Chemistry |
| <ul style="list-style-type: none"> ➤ Rajamangala University of Technology Srivijaya, Thailand | <ul style="list-style-type: none"> • Petroleum Technology Program, Faculty of Industrial Education and Technology |



Oral Presentation Topics

Keynote Speakers : 10.15-10.45

KS-I

Innovation in Industrial R&D

Dr. Santi Kulprathipanja

Director, Southeast Asia Research & Development
UOP, A Honeywell Company, USA

Keynote Speakers : 10.45-11.00

KS-II

Outlook for Energy: Journey to 2040

Dr. Taweesak Bunluesin

Refinery Business Support and Controls Manager
Esso Company Limited, Thailand

Keynote Speakers : 13.30-14.00

KS-III

Applications of Conductive and Electroactive Polymers

Prof. Dr. Anuvat Sirivat

Conductive and Electroactive Polymers
The Petroleum and Petrochemical College, Thailand

Keynote Speakers : 14.00-14.30

KS-IV

Rational design of Cu-based Catalysts for Methanol Synthesis from CO₂ Hydrogenation

Asst. Prof. Dr. Thongthai Witoon

Kasetsart University, Thailand

Ballroom 1 : 11.00-11.20

IS-I

Novel Hemostat using Chitinous Sponge and Its Mechanism of Action

Prof. Dr. Hiroshi Tamura

Faculty of Chemistry, Materials and Bioengineering, Kansai University, Japan

Ballroom 1 : 11.20-11.40

IS-II

Programming Release Profiles in Polymer Nanomaterials

Assoc. Prof. Dr. Daniel Crespy

Department of Materials Science and Engineering, Vidyasirimedhi Institute of Science and Technology

Ballroom 1 : 11.40-12.00

IS-III

Spinel Nanostructures and Their Applications in Catalysis

Dr. Kajornsak Faungnawakij

National Nanotechnology Center, National Science and Technology Development Agency (NSTDA) Thailand

Ballroom 2 : 11.00-11.20

IS-IV

Energy Recovery from Natural Gas Hydrates: Prospects and Challenges

Assoc. Prof. Dr. Praveen Linga

Department of Chemical and Biomolecular Engineering, National University of Singapore

Ballroom 2 : 11.20-11.40

IS-V

Rational Control of Nano-scale Metal-catalysts for Chemicals from Biomass

Asst. Prof. Dr. Ning Yan

Department of Chemical and Biomolecular Engineering, National University of Singapore

Jamjuree 1 : 11.00-12.00

Industry 4.0 : Technology Platforms by PETROMAT



Jamjuree 1 : 14.30-14.45

PP-O-1

Informatic Concurrent Design Model (iCDM): Medical Mask Case Study

Wissawin Kunchornsup

The Petroleum and Petrochemical College, Chulalongkorn University

Jamjuree 1 : 14.45-15.00

PP-O-2

Bio-Based Polyethylene/ Rice Starch Composite

Sathaphorn O-suwankul

The Petroleum and Petrochemical College, Chulalongkorn University

Jamjuree 1 : 15.00-15.15

SE-O-1

Differentiation of Crude Oils, Fuel Oils, and Used Lubricating Oil Using Diagnostic Ratios

Pornpetch Hattakijvilai

The Petroleum and Petrochemical College, Chulalongkorn University

Jamjuree 1 : 15.15-15.30

RE-O-1

Potential Lipid Production of Oleaginous Yeast *Lipomyces Starkeyi* from Glucose and Xylose

Noppan Peawsuphon

Department of chemical Engineering, Faculty of Engineering, Kasetsart University

Jamjuree 2 : 11.00-11.10

CP-O-1

Shellac and Gelatin Blend Film for Controlled Drug Delivery Patches

Sumonman Niamlang

Department of Materials and Metallurgical Engineering, Rajamangala University of Technology Thanyaburi

Jamjuree 2 : 11.10-11.20

CP-O-2

Chemical Immobilization of Urease on Polypyrrole/polyethylenimine Hybrid Film and Application in Urea Biosensors

Wanlapa Natedungta

Department of Industrial Chemistry, King Mongkut's University of Technology North Bangkok

Jamjuree 2 : 11.20-11.30

CP-O-3

Methanol Sensor Fabricated from Conductive Polyindole

Katesara Phasuksom

The Petroleum and Petrochemical College, Chulalongkorn University

Jamjuree 2 : 11.30-11.40

CP-O-4

Electrical Conductivity Response of ZSM-5, Y, Mordenite, Ferrierite, 3A, 4A, 5A and 13X Zeolites towards Sulfur Dioxide

Pongpol Choeichom

The Petroleum and Petrochemical College, Chulalongkorn University

Jamjuree 2 : 11.40-11.50

CP-O-5

Electro-responsive material based on graphene nanoplatelets/ poly(lactic) acid composites

Natlita Thummarungsan

The Petroleum and Petrochemical College, Chulalongkorn University

Jamjuree 2 : 11.50-12.00

CP-O-6

Electromechanical Properties of P3HT/Carrageenan Hydrogel blend : Effects of Electric Field Strength and Type of Carrageenan

Nudchanart Tanusorn

The Petroleum and Petrochemical College, Chulalongkorn University

Jamjuree 2 : 12.00-12.10

CP-O-7

Preparation of Compliant Electrode with Multiwalled Carbon Nanotubes Filled Deproteinized Natural

Paweenuch Tangkitthanachoke

The Petroleum and Petrochemical College, Chulalongkorn University

Jamjuree 2 : 12.10-12.20

CP-O-8

Fabrication and Properties of Pectin Hydrogel for Electrically Controlled Drug Delivery

Sirivipa Mongkolkitikul

The Petroleum and Petrochemical College, Chulalongkorn University

Jamjuree 2 : 14.30-14.45

PS-O-1

Heat Exchanger Network Retrofit on Gas Separation Plant No.5 (GSP5) in Thailand

Natchanon Angsutorn

The Petroleum and Petrochemical College, Chulalongkorn University

Jamjuree 2 : 14.45-15.00

SM-O-1

Preparation of Nitrogen Enriched Carbons with Ultra-Micro Porous Structure from Polybenzoxazine Precursor for CO₂ Capture

Nicharat Manmuanpom

The Petroleum and Petrochemical College, Chulalongkorn University

Jamjuree 2 : 15.00-15.15

SM-O-2

Synthesis of Smart Polymer/corrosion Inhibitor Conjugates

Naruphorn Dararatana

Department of Materials Science and Engineering, Vidyasirimedhi Institute of Science and Technology

Jamjuree 2 : 15.15-15.30

Industry Transformation Center (ITC) : Platform to Connect Industry with Technology

Dr. Kriengsak Wongpromrat

Plastics Institute of Thailand



Poster Presentation Topics

Catalysis (CA)

CA-P-1 Kinetic Monte-Carlo Simulation of Methane Steam Reforming to Synthesis Gas Over Ni Catalyst

Teetuch Plianwong

The Petroleum and Petrochemical College, Chulalongkorn University

CA-P-2 Crystal-Plane Effect of Ceria on the Activity of Cu/CeO₂ for Oxidative Steam Reforming of Methanol

Sivinee Petchakan

The Petroleum and Petrochemical College, Chulalongkorn University

CA-P-3 Catalytic activity of Ni_xSn_y Intermetallics

Anchernsiri Noomnual

The Petroleum and Petrochemical College, Chulalongkorn University

CA-P-4 Catalytic Activity in Biodiesel Production using Cu loaded on mesoporous CeO₂-ZrO₂

Wasupon Wongvitvichot

The Petroleum and Petrochemical College, Chulalongkorn University

CA-P-5 Study on Energy Storage Ability of ZnO/TiO₂ for Photocatalytic Degradation of Isopropanol

Ratchawan Jarumanee

The Petroleum and Petrochemical College, Chulalongkorn University

CA-P-6 Bio-chemicals from Conversion of Bio-ethanol using Various Single Oxides

Nattapron Siribanluehan

The Petroleum and Petrochemical College, Chulalongkorn University

CA-P-7 Possibility of Using a Newly-Synthesized LDH-based Oxide Catalyst for Glycerol Conversion to Valuable Chemicals

Pitsinee Thongkun

The Petroleum and Petrochemical College, Chulalongkorn University

CA-P-8 Possibility of Using a Newly-synthesized LDH-based Oxide Catalyst for Glycerol Hydrogenolysis and Dehydrogenation

Nichaphat Jittangkoon

The Petroleum and Petrochemical College, Chulalongkorn University

CA-P-9 Possibility of Using a Newly-Synthesized LDH-Based Oxide Catalyst for Catalytic Bio-Ethanol Conversion

Napatsorn Makoknoi

The Petroleum and Petrochemical College, Chulalongkorn University

CA-P-10 Oxidative Dehydrogenation of Ethane to Ethylene over Molybdenum Based Catalysts

Supakorn Samangain

The Petroleum and Petrochemical College, Chulalongkorn University

CA-P-11 Effects of Posttreatment Steaming on Catalytic Performance of Modified HZSM-5 Catalysts for the Conversion of *n*-Pentane to Aromatics

Chaninwut Kalajuck

The Petroleum and Petrochemical College, Chulalongkorn University

CA-P-12 Methylation of Toluene with Methanol using Modified HZSM-5 Catalysts: Effect of Steaming

Weerachit Pulsawas

The Petroleum and Petrochemical College, Chulalongkorn University

CA-P-13 Shape Effect of Ceria on the Activity of Au/CeO₂ for Preferential CO Oxidation

Mike Carltonbird

The Petroleum and Petrochemical College, Chulalongkorn University

CA-P-14 Development of Catalysts for Ethane Epoxidation Reaction

Kingsuda Mahunee

The Petroleum and Petrochemical College, Chulalongkorn University

CA-P-15 The Stability of the Palladium-Magnesium Supported on Silica Catalysts for Partial Hydrogenation of Biodiesel

Jakrapong Jitjamnong

Petroleum Technology Program, Faculty of Industrial Education and Technology, Rajamangala University of Technology Srivijaya

CA-P-16 Steam Reforming of Acetic Acid over Ni/Ceria-Zirconia Mixed Oxide based Catalysts

Panumard Kaewmora

The Petroleum and Petrochemical College, Chulalongkorn University

CA-P-17 Deoxygenation of Palm Oil to Bio-hydrogenated Diesel over Pd/Al₂O₃ Catalyst Using Microscale-based Reactor

Raviporn Nernrimnong

The Petroleum and Petrochemical College, Chulalongkorn University

CA-P-18 Production of Biojet Fuel from Palm Fatty Acid Distillate over Core-shell Catalyst

Chanakran Homla-or

The Petroleum and Petrochemical College, Chulalongkorn University

CA-P-19 Synthesis of Cyclic Poly(ϵ -caprolactone) Using Aluminum(III) Complexes

Pisanu Pisitsopon

Department of Chemical Engineering, Vidyasirimedhi Institute of Science and Technology (VISTEC)

CA-P-20 Novel Cyclic Carbonate-based Organic Molecules via CO₂ Fixation

Suriyaporn Pornpraprom

Vidyasirimedhi Institute of Science and Technology

CA-P-21 Activity Comparison of NiMo/ γ -Al₂O₃ Catalysts Promoted by Cu and Ce for Hydrodeoxygenation of Guaiacol

Patiphat Sangnikul

Department of Chemical Technology, Faculty of Science, Chulalongkorn University

Renewable Energy (RE)

RE-P-1 Effect of Co-solvent on Ionic Liquid Pretreatment of Napier Grass

Chanitpak Anupapwisetkul

The Petroleum and Petrochemical College, Chulalongkorn University

RE-P-2 Production of Hydrogen from Biodiesel Wastewater by Steam Reforming over Ni-Based Catalyst

Atiporn Jinyayoon

Petrochemistry and Polymer Science Program, Faculty of Science, Chulalongkorn University

RE-P-3 Assisted Methane Hydrate Formation with the Addition of Promoters

Chutikan Jaikwang

The Petroleum and Petrochemical College, Chulalongkorn University

RE-P-4 Three-stage ASBR for H₂ and CH₄ Production: Micronutrient Transport

Kornpong Vichaitanapat

The Petroleum and Petrochemical College, Chulalongkorn University

RE-P-5 Biobutanol Production by Immobilized *Clostridium beijerinckii* JCM 8026 onto Pretreated Napier Grass

Inthanon Doolayagovit

The Petroleum and Petrochemical College, Chulalongkorn University

RE-P-6 Separate Production of H₂ and CH₄ from Ethanol Wastewater using Two-stage UASB System

Songphol Jaikeaw

The Petroleum and Petrochemical College, Chulalongkorn University

RE-P-7 Pulse Electrodeposition of Pt-Co Catalyst onto Glassy Carbon for Oxygen Reduction Reaction to use in PEMFC

Jittima Sriwannaboot

Department of Chemical Technology, Faculty of Science, Chulalongkorn University

RE-P-8 Biogas Production from Food Scraps of Rajamangala University of Technology Srivijaya

Napaphat Samanwong

Petroleum Technology, Faculty of Industrial Education and Technology, Rajamangala University of Technology Srivijaya

RE-P-9 Effect of Cassava Starch Ratio on Biomass Pellet Fuel from Rubber Tree

Nonlapan Khantikulanon

Petroleum Technology Program, Faculty of Industrial Education and Technology, Rajamangala University of Technology Srivijaya

RE-P-10 Catalytic cracking of Waste fish oil on Magnesium oxide in Batch reactor

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RE-P-11 Methane Adsorption by Carbon Molecular Sieve Derived from Polycarbonate and Polyethylene

Jakchai Thawornwatthanasirikul

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RE-P-12 Graphene/Carbon Black Counter Electrode for Perovskite Solar Cell

Nutsuda Bunyoo

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SE-P-1 Novel Surfactant Systems for Foam Assisted Enhanced Oil Recovery (EOR) by Adding Nanoparticles

Pattamas Rattanaudom

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SE-P-2 Solubility of Carbon Dioxide in Amine Blend: Effect of Cyclics and Aromatics

Channarong Wongboonma

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SE-P-3 Improvement of Enhanced Oil Recovery (EOR) by Foam Flooding in Porous Media

Kanyarat Tantiht

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SE-P-4 Development of environmentally friendly formulation for corrosion resistance of galvanized steel sheet

Ajala Praneedsuranon

Program of Petrochemistry and Polymer Science, Faculty of Science, Chulalongkorn University

SE-P-5 Solid-Polymer Mixed Matrix Membranes for Gas Separation: Silicone Rubber Membranes with Activated Carbon Adsorbed Liquid Additives

Panita Chultheera

The Petroleum and Petrochemical College, Chulalongkorn University

SE-P-6 Material Flow Analysis (MFA) Study for Sustainable Management of PVC Wastes in Thailand (Phase III)

Wikanda Khomchu

The Petroleum and Petrochemical College, Chulalongkorn University

SE-P-7 Upgrading of Petroleum Residue by Nitrogen Doping for CO₂ Adsorption

Nattha Chalermwat

The Petroleum and Petrochemical College, Chulalongkorn University

SE-P-8 Microemulsion Formation of Semi-solid Fats and Vegetable Oils Based on HLD Concept for Cleaning Applications

Siriluk Jariyawattanarat

The Petroleum and Petrochemical College, Chulalongkorn University

SE-P-9 Effect of Methane Adsorption on the Cyclic Adsorption and Desorption of Carbon Dioxide on Coconut Shell Activated Carbon

Suwadee Uttaraphat

The Petroleum and Petrochemical College, Chulalongkorn University

SE-P-10 Influence of Butanol/Ethanol Blend Ratios in Palm Oil/Diesel based Microemulsion Biofuels using Alcohol Ethoxylate Surfactant - Phase Behaviors and Fuel Characteristics

U-Larak Peson

The Petroleum and Petrochemical College, Chulalongkorn University

SE-P-11 Investigation of Dispersants for Water-in-Oil Emulsion Stabilization for Simulated Waxy Crude Oil

Methasit Lukkanasiri

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Process and System Engineering (PS)

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Tunya Ketjuntiwa

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PS-P-2 Life Cycle Assessment of Wood-based Refused-Derived Fuel Production and Utilization in Thailand

Thunyatorn Pukkrueapun

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PS-P-3 Intensification of Ethylene Glycol Production Process

Apiwit Wisutwattana

The Petroleum and Petrochemical College, Chulalongkorn University

PS-P-4 Improvement of Life Cycle Assessment Software and its Applications

Yodsathorn Chavewanmas

The Petroleum and Petrochemical College, Chulalongkorn University

PS-P-5 Numerical Simulation of One-dimensional Model in Direct Methanol Fuel Cell

Warunkarn Jantaraka

The Petroleum and Petrochemical College, Chulalongkorn University

PS-P-6 Multi-period Heat Exchanger Network Retrofit under Fouling Effects.

Supapol Rangfak

The Petroleum and Petrochemical College, Chulalongkorn University

PS-P-7 The Systematic Screening Methodology for Surfactant Flooding Chemicals in Enhanced Oil Recovery

Cholathis Cholpraves

The Petroleum and Petrochemical College, Chulalongkorn University

PS-P-8 Optimization for Cryogenic Carbon Dioxide Capture and LNG Processes by Shaft Work Targeting and Mathematical Programming

Orakotch Padungwatanaroj

The Petroleum and Petrochemical College, Chulalongkorn University

PS-P-9 Optimal Supply Chain Design for Captured CO₂ with Stochastic Programming.

Narut Suchartsunthorn

The Petroleum and Petrochemical College, Chulalongkorn University

PS-P-10 Effect of Bead Size and Centrifugation on Asphaltene Deposition

Kimchhay Lao

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PS-P-11 Investigation of Asphaltene Aggregation Kinetics in the Presence of Water-in-oil Emulsion

Penpitcha Roengsamut

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PS-P-12 Effects of Cyclone Vortex Finder on Solid Separation Using Computational Fluid Dynamics Simulation

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Biomedical and Green Polymers (BG)

BG-P-1 Low Temperature Bioplastic for Medical Application

Anisara Runthod

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BG-P-2 Degradation of Organic Solvent-saturated Chitin Hydrogel by Plasma in Liquid

Thanadon Kaewyoo

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BG-P-3 Chitosan Scaffold from A Single Water-based Multi-functional Carboxylic Acid System

Pornchanok Suwattanachai

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BG-P-4 Surface Modification of Cotton Fabric by DBD Plasma Treatment for Preparation of Cotton Fabric-reinforced Bacterial Cellulose Composites Containing Gelatin

Kamonwan Thongthanoppakun

The Petroleum and Petrochemical College, Chulalongkorn University

BG-P-5 Electrospinning Carbonized Hybrid Metal Nano-fiber Composite for Electrochemical Applications in Biosensor

Teeraseth Ariyathanakul

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BG-P-6 Preparation of Thermo-responsive Hydrogel from Gellan Gum and Methylcellulose for using as Advanced Wound Dressing

Nattakarn Wankama

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BG-P-7 Preparation and Characterization of Nanospheres loaded PLGA/Ciprofloxacin Hydrochloride for Used as Extended Anti-bacterial Drug Release

Chasuda Choipang

The Petroleum and Petrochemical College, Chulalongkorn University

BG-P-8 Synthesis of Novel Photomediated Silver Nanoprisms via a Light-induced Transformation Reaction for Use as Anti-bacterial Wound Dressing

Lalitpun Chatchawanwirote

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BG-P-9 Preparation and Properties of Chitosan Derivatives/Starch Foam for Use as Oral Wound Dressings

Nalintorn Jungprasertchai

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BG-P-10 Synthesis of Quaternized Kappa-carrageenan for Transdermal Delivery

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BG-P-11 OPN Immobilization on Surface-grafted Poly(acrylic acid) Brushes to Promote Osteoblast Adhesion and Proliferation

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BG-P-12 Bacterial Cellulose Membrane Immobilized with Plant-derived Osteopontin for Bone Tissue Regeneration

Nichapa Klinthoophamrong

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BG-P-13 Fabrication of Poly (vinyl alcohol) / Chitosan Nanoweb loaded Ampicillin for Antibacterial Purpose

Chayonan Chathathum

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BG-P-14 Microencapsulation of Eugenol in Polyelectrolyte Complexes of Chitosan and Alginate

Chamaiporn Supachettapun

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BG-P-15 Stimuli-Responsive Polysaccharide Nanomaterials

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Department of Materials Science and Engineering, School of Molecular Science and Engineering, Vidyasirimedhi Institute of Science and Technology

BG-P-16 Crystallization of Polymers under Nanoconfinement

Niyom Yupaporn

Department of Materials Science and Engineering, School of Molecular Science and Engineering, Vidyasirimedhi Institute of Science and Technology

BG-P-17 Facile Fabrication of Cellulosic Textiles with Durable Antibacterial Properties Using Soy Protein Isolate and Silver Nanoparticles

Sudarat Srisod

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Polymer Engineering and Processing (PP)

PP-P-1 Novel Green Vulcanization of Natural Rubber Latex Masterbatch

Jirapan Wuttisakchaikul

The Petroleum and Petrochemical College, Chulalongkorn University

PP-P-2 Effect of ZnO nanoparticles on cure behavior of the EPDM rubber

Nuttiya Sa-nguansak

The Petroleum and Petrochemical College, Chulalongkorn University

PP-P-3 Multi-branched polylactide ionomer: a simple approach to fine tune packing structure of PLA

Thanphisit Thongsima

The Petroleum and Petrochemical College, Chulalongkorn University

Smart and Advanced Materials (SM)

SM-P-1 Modified Poly(High Internal Phase Emulsion) with Clay for CO₂ Capture Application

Chonnikarn Choochavalit

The Petroleum and Petrochemical College, Chulalongkorn University

SM-P-2 Preparation of Nitrogen Enriched Hierarchically Nanoporous Carbon from Polybenzoxazine for Methane Storage

Norawit Kaewpornmongkol

The Petroleum and Petrochemical College, Chulalongkorn University

SM-P-3 Removal of Alkaline Earth Metals by Using Polybenzoxazine and Carbon-based Nanoporous Materials

Chanapon Pongteeraporn

The Petroleum and Petrochemical College Chulalongkorn University

SM-P-4 Fabrication of Nanoporous Carbon as Electrodes for Supercapacitors

Pitchuda Suwannasarn

The Petroleum and Petrochemical College, Chulalongkorn University

SM-P-5 The Study of Ion Sorption Performances of Stoichiometric and Non-toichiometric Polyelectrolyte Complexes.

Pha-sita Plengplung

The Petroleum and Petrochemical College, Chulalongkorn University

SM-P-6 Starch-g-PLA in one pot process: The use as a compatibilizer for PLA/TPS blends and the development of external stimuli responsive fiber

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The Petroleum and Petrochemical College, Chulalongkorn University

SM-P-7 Functionalized Agricultural Packaging

Preedawan Duangchan

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SM-P-8 Surface Modification of PolyHIPE using Solution Plasma Process for CO₂ Adsorption

Mookyada Mankrut

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SM-P-9 Development of Polyelectrolytes Complex Membrane for Supercapacitors

Pisut Wijitsettakun

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SM-P-10 Porous Polystyrene Surface Grafted with Poly(N-isopropylacrylamide) Brushes

Piriya Chailom

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SM-P-11 Electronic Structures of Graphene Nanoflakes Adsorbed on Pyrene

Thanawit Kuamit

Computational Chemistry Unit Cell, Department of Chemistry, Faculty of Science, Chulalongkorn University

SM-P-13 Synthesis and Hybridization Property of Peptide Nucleic acid-Functionalized Monomer

Ruttiyakorn Donthongkwa

Organic Synthesis Research Unit, Department of Chemistry, Faculty of Science, Chulalongkorn University

SM-P-14 Immobilization of heavy metal ions by fly ash-based geopolymer

Ronnachai Pliansakul

Research Unit of Advanced Ceramics, Department of Materials Science, Chulalongkorn University

SM-P-15 Computational Calculation of Carbon Dioxide Capture in Metal Organic Framework

Pavee Pongsajanukul

Computational Chemistry Unit Cell (CCUC), Department of Chemistry, Chulalongkorn University

SM-P-16 Deposition of YSZ Thin Films on Powder-Injection Anodes by Electrophoretic Deposition Technique

Sirima Chauoon

Research Unit of Advanced Ceramics, Department of Materials Science, Faculty of Science, Chulalongkorn University

SM-P-17 Graphene Oxide Modified Screen-printed Carbon Electrode for the Simple and Sensitive Electrochemical Determination of Carbofuran Residue in Oranges

Apapond Jirasirichote

Department of Chemistry, Faculty of Science, Chulalongkorn University

SM-P-18 Innovation Whitening Cream Containing Kojic-Acid /Gold Nanoparticles

Kasem Payuhadechapipat

Technopreneurship and Innovation Management program, Chulalongkorn University

SM-P-19 Colorimetric Sensing of Glyphosate Using Silver Nanoparticles Synthesized in the Presence of Tannic Acid

Thanawan Ritthichai

Department of Materials Science, Faculty of Science, Chulalongkorn University

SM-P-20 Colloid-electrospinning for Materials with Antibacterial Properties

Arjaree Jobdeedamrong

Department of Materials Science and Engineering, School of Molecular Science and Engineering, Vidyasirimedhi Institute of Science and Technology



Oral Sessions

C*atalysis*

G*reen E***n***ergy*

S*urfactant, Separation and E***n***vironment*

P*rocess and S***y***stem Engineering*

B*iomaterial and G***r***een Polymers*

P*olymer Engineering and P***r***ocessing*

S*mart and Advanced M***a***terials*

C*onductive and Electroactive P***o***lymer*

Invited Speakers

IS-I

Novel Hemostat using Chitinous Sponge and Its Mechanism of Action

Hiroshi Tamura

Faculty of Chemistry, Materials and Bioengineering, Kansai University, Japan

Several chitinous sponges are evaluated as hemostat because chitinous compound is biocompatible and biodegradable. Since high blood absorption property and excellent handling are required for hemostat, we have developed a new methodology to control uniform pore size and structure for chitinous sponge. The chitinous sponge was prepared using amorphous chitin dissolved in aqueous gluconic acid solution, followed by the frozen process and freeze-dried process, and finally sterilization by gamma rays (developing code: K-191). The hemostatic potency, blood absorption, and handling capability were evaluated in an animal study. As a result, high blood absorption of the sponge, excellent handling in surgical operations, and also significant hemostatic potency of K-191 were obtained. Moreover, in order to elucidate the hemostatic mechanisms of the hemostat, K-191, cotton, and collagen hydrochloride (Avitene®) were contacted to human platelet rich plasma (PRP), and platelet factor 4 (PF-4) and β -thromboglobulin (β -TG) released from activated platelets were measured. PF-4 and β -TG were increased significantly in K-191 compared with cotton, and collagen hydrochloride. Therefore, one of the action mechanisms of K-191 was expected as platelet aggregation by the sponge.

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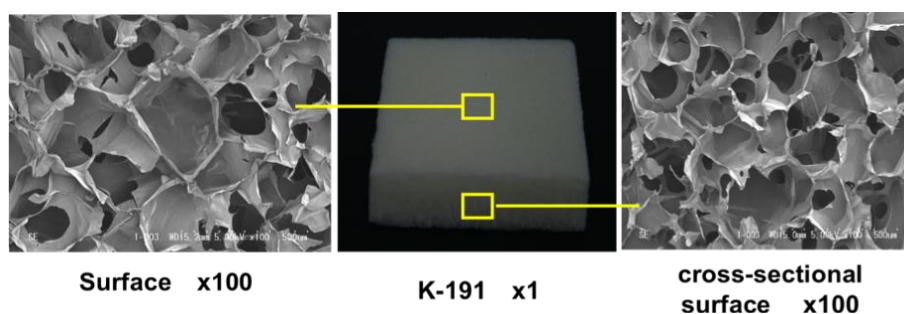


Fig. 1 SEM images of chitinous sponge (K191).

Invited Speakers

IS-II

Programming Release Profiles in Polymer Nanomaterials

Daniel Crespy

Department of Materials Science and Engineering, School of Molecular Science and Engineering, Vidyasirimedhi Institute of Science and Technology

The controlled release of payloads such as self-healing agents, corrosion inhibitors, fertilizers, pesticides, and drugs is of utmost importance in the field of sustainable chemistry. Indeed, it is suitable for prevent unwanted and uncontrolled of such substances that are normally harmful for the environment.

We discuss here how to design polymer materials that offer programmed release profiles for different applications. The release pattern of nanocontainers was controlled by internal microphase separation of block copolymers or by co-encapsulation of simple salts. Furthermore, approaches involving higher degree of structural hierarchy are discussed such as responsive nanocontainers in responsive fibers.

Invited Speakers

IS-III

Energy Recovery from Natural Gas Hydrates: Prospects and Challenges

Praveen Linga

Associate Professor, Department of Chemical and Biomolecular Engineering, National University of Singapore

Clathrate hydrate science has evolved over the centuries from a mere academic curiosity to being a nuisance to oil and gas industry (flow assurance) and now is being seen as a future energy resource (natural gas hydrates deposits). Large amounts of methane exist in the earth in the form of natural gas hydrates (NGH), an ice-like substance with hydrocarbon molecules trapped within by water cages. The amount of carbon stored as NGH is more than twice the carbon content present in all fossil fuels combined. Thermal stimulation, depressurization or a combination of both these methods are the approaches likely to be applied to recover natural gas. There are specific challenges like sand and water management during energy production that needs to be overcome/mitigated to sustain methane production from NGH. Thus, there is an overwhelming need to pursue research and development at laboratories in order to develop knowhow to exploit this huge resource in the future. In this work, the state-of-the-art experimental work on methane production from natural gas hydrates carried out at the NUS will be summarized and future directions and challenges will be outlined.

Keywords: Natural gas hydrates; energy recovery, fiery ice, depressurization

Invited Speakers

IS-IV

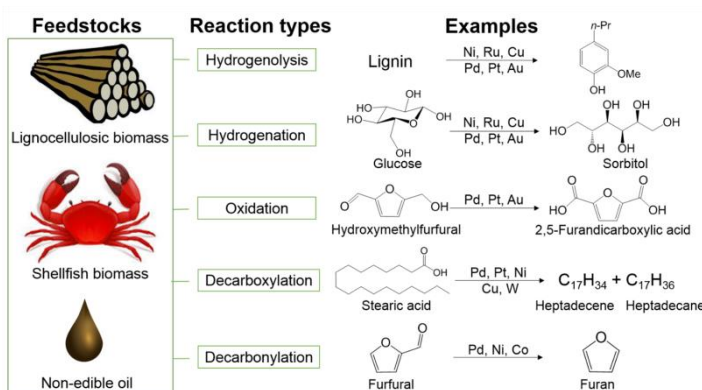
Rational Control of Nano-scale Metal-catalysts for Chemicals from Biomass

Ning Yan

Department of Chemical and Biomolecular Engineering, National University of Singapore

Biomass offers a wide range of starting materials for value-added chemicals and fuels, however, components in biomass feedstock bristle with functional groups, reducing their stability to withstand high temperatures usually used to process petrochemicals. Therefore, de-functionalization, in particular deoxygenation under mild reaction conditions over highly effective catalysts is of central importance. Such a requirement fits well with the advantages of nano-scale metal-catalysts, which have proven properties in promoting hydrogenolysis, hydrogenation, and decarboxylation reactions under mild condition.

In recent years, we have demonstrated in a series of studies that the conversion of lignocellulose, lipids, and chitin can be effectively catalyzed by well-defined nano-metal catalysts (see Scheme 1).^[1-5] The type of metal, size, composition, and surface modification are all key parameters to achieve desired transformations. In some cases, multiple reaction steps are needed, hence multifunctional systems could be developed to promote a one-pot reaction in a cascade manner.



Scheme 1 Major biomass conversion routes via metal catalysed reactions.

Invited Speakers

IS-V

Spinel Nanostructures and Their Applications in Catalysis

Kajornsak Faungnawakij

National Nanotechnology Center (NANOTEC), National Science and Technology Development Agency (NSTDA)

Various forms of spinel nanostructures, including nanoparticles, nanopore, and nanofibers, have been developed. The spinels have been applied in various catalysis systems while the catalytic performance of the spinels strongly depends on the chemical formulation and structural properties. The catalysis over spinels such as steam reforming of methanol, ethanol and dimethyl ether, methanolysis and deoxygenation of bio-based oils, and hydrogenolysis of glycerol has been intensively studied, and the results will be shown and discussed during the symposium.

Renewable Energy

RE-O-1

Potential Lipid Production of Oleaginous Yeast *Lipomyces Starkeyi* from Glucose and Xylose

Noppa Peawsuphon, Anusith Thanapimmetha, Maythee Saisriyoot, Penjit Srinophakun *

* Department of chemical Engineering, Faculty of Engineering, Kasetsart University

This study evaluates the capability of oleaginous yeast *Lipomyces starkeyi* to synthesize the microbial lipids using glucose and xylose as its sole carbon source individually. Firstly, the effect of inoculum concentration (4%, 6%, 8% and 10% v/v) was determined by using glucose as carbon source at 30 g/L. Secondly, the glucose concentration (40, 60, 80 and 100 g/L) was varied to get the highest cell dry weight. Finally, the cultivation of *L. starkeyi* was performed to enhance the growth at higher glucose concentration of 60 g/L. After that, the cultivation was carried out 60 g/L of xylose and the cell dry weight was compared. From the result, 10% of inoculum concentration was an optimum content for effectiveness of yeast. 40 g/L of glucose was the best concentration for cultivation and gave 14.1 g/L at 84 hrs. The initial glucose and xylose of 60 g/L gave the highest cell dry weight at 18.3 g/L and 15.2, respectively and the lipid content will be reported.

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Surfactant, Separation and Environment

SE-O-1

Differentiation of Crude Oils, Fuel Oils, and Used Lubricating Oil Using Diagnostic Ratios

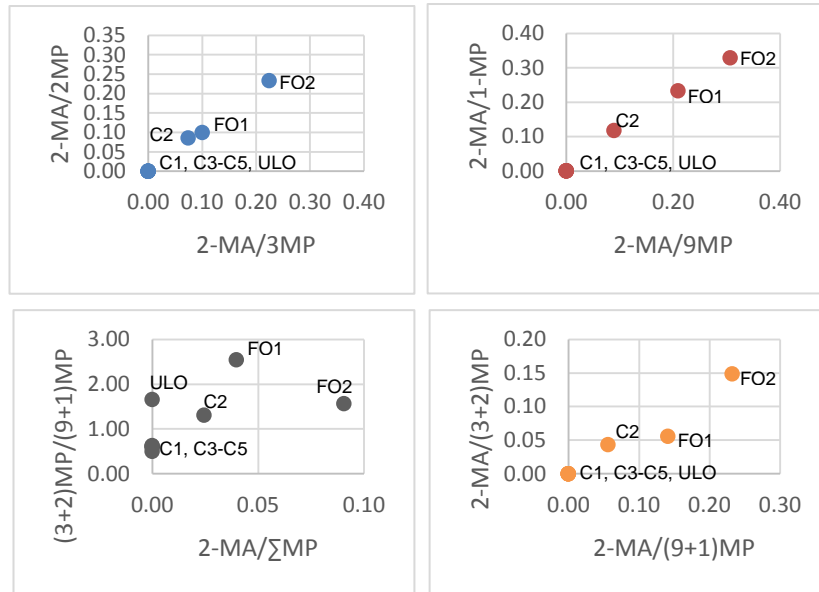
Pornpetch Hattakijvilai^a, Siriporn Jongpatiwut^{a,b}

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^{b)} Center of Excellence on Petrochemical and Materials Technology

Oil spills in marine are probably come from crude oil, fuel oil which is used as ship fuel and also used lube oil (ULO) by accidentally happened according to a leakage or maybe, in some cases, purposefully discharged to the sea. Normally, fuel oil is produced from the heavy fraction of crude oil which gives the similar properties. Consequently, it cannot be concluded the source of the spill wherever its origin from crude oil or fuel oil. Therefore, gas chromatography technique called NORDTEST is a common method for identify the source oils. In this work, crude oils, fuel oils and used lube oil were characterized using GC-FID and GCxGC TOFMS. The statistical method will be applied to differentiate crude oils, fuel oils and ULO that are typically used in Thailand. The results from double ratio plots of alkyl-anthracene and alkyl-phenanthrenes showed a positive method to distinguish crude oils and those two refined products.

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Double ratio plots based on alkyl-anthracene and alkyl-phenanthrenes of crude oils, fuel oils and used lube oil

Process and System Engineering

PS-O-1

Heat Exchanger Network Retrofit on Gas Separation Plant No.5 (GSP5) in Thailand

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^{a)} The Petroleum and Petrochemical College, Chulalongkorn University

^{b)} PTT Public Company Limited

As the global energy cost has been fluctuated and likely continues to increase over a long term, energy conservation is one of the most common concerns in industries. Although various mathematical programming methods for heat exchanger network (HEN) retrofit have been studied and proposed for more than 20 years, determining retrofit designs for industries remains a challenge. Most of them have limitations on computational time and feasibility due to their mathematical difficulties, and their solutions also cover mostly on heat exchanger modification and relocation, or repiping which are non-practical and uneconomical. This work presents a HEN retrofit method for industrial application relying on mathematical optimization which has the specific retrofit concepts. The mathematical model is based on the stage-wise model which is robust and easy to use. In this work, its capability has been enhanced to meet requirements of an industrial case of GSP no.5, and its performance has been technically improved by advantages of the retrofit concepts. The proposed retrofit method has been applied to the actual data of GSP no.5 to maximize net present value (NPV) of a retrofit design. All of required data for the optimization has been well prepared in this work. The processes of GSP no.5 were simulated by commercial process simulation software, Aspen HYSYS. The retrofit solution from the optimization has also been validated in Aspen HYSYS to ensure its practical operation and the precise economic evaluation. As the result, the proposed retrofit method provided a solution with good economic values. These retrofit concepts are more practical and attractive to industrial cases because they avoid opportunity loss due to heat exchanger elimination and major engineering works in implementation.

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Polymer Engineering and Processing

PP-O-1

Informatic Concurrent Design Model (iCDM): Medical Mask Case Study

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Multidisciplinary research is an ideal for innovating products, however it seems simultaneously create struggles in practical during inter-disciplinary communications. Concurrent Design Model (CDM) is one of the frameworks to facilitate through three essential considerations: Function (Fu); Ergonomics (Er); Formal (Fo) what are primarily dealing with product performance; product-user interactions; and sense-of-beauty on the product, respectively. In this study, medical mask is a case study, as representative of healthcare products. Both materialist and designer have been initially started with the same methods of product experience survey: observation and interview; whereas the data analysis and interpretation made totally different development approaches. The materialist focused to explore possibilities of functioning development via statistical computing, sensing, image processing, and simulating informatics. On the other hand, the designer used the Design Ethnography methodology, a detailed observation, to understand the user experiences. The study developed in Thailand and in Portugal, counted with 19 participants: females and males, between 20 and 68 years old, with a spectrum of user experience. The materialist identified the Functional, Ergonomic and Formal aspects related to the mask performance; and the designer identified the steps to put the mask correctly and categorized the different types of difficulties observed on the use of this kind of mask, in two types: serious problems (addressing with priority) and common problems. Finally, to develop the final design, the materialist needs to implement informatic tools for systematically developing product functionality; whereas the designer needs to implement creative design methods and Kansei Engineering for supporting new formal solutions and emotional approaches. The final product would be visually evaluated in the FuErgFo plot, to reveal the different characteristics. Obviously, this study is plenty full of the deployment of informatics and innovative thinking methods, seems inducing “i-“ into traditional CDM, establishing informatic concurrent design model (iCDM).

Polymer Engineering and Processing

PP-O-2

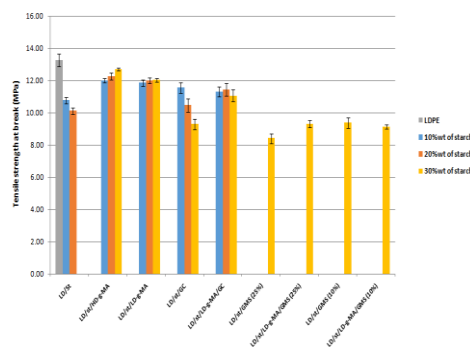
Bio-Based Polyethylene/ Rice Starch Composite

Sathaphorn O-suwankul^a, Kittima Bootdee^a, Manit Nititanakul^a

^{a)}The Petroleum and Petrochemical College, Chulalongkorn University

Starch/low density polyethylene composites have been widely studied because of their biodegradability. The properties of starch/LDPE composites were inferior to neat plastics because starch is immiscible in polyethylene because of the difference in their polarities. In this research, glycerol (GC) and glycerol monostearate (GMS) were used as plasticizer of starch. Polyethylene grafted maleic anhydride (PE-g-MA) was used as a compatibilizer. Effect of rice starch content was varied (10, 20, and 30 %wt). The results showed that increasing amount of starch reduced tensile, flexural, and impact properties of materials. The PE-g-MA improved tensile, flexural and impact properties, except elongation at break of the materials. GC and GMS showed the improvement of flowability but they reduced the stiffness; therefore, they increased impact strength of the materials. The morphology from SEM images showed that PE-g-MA, GC, and GMS promoted compatibility between starch and LDPE matrix. The density results showed that the density were increased by PE-g-MA and GC but GMS did not show significant effect.

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Tensile strength at break of LDPE/rice starch composites

Smart and Advanced Materials

SM-O-1

Preparation of Nitrogen Enriched Carbons with Ultra-Micro Porous Structure from Polybenzoxazine Precursor for CO₂ Capture

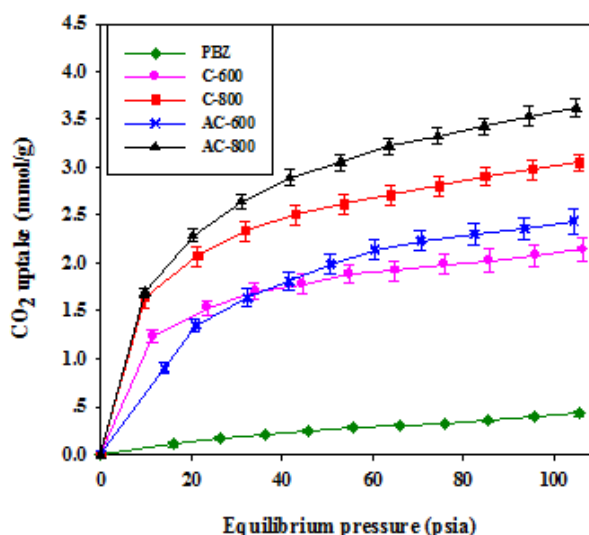
Nicharat Manmuanpom^{a,b}, Stephan Thierry Dubas^{a,b}, Sujitra Wongkasemjit^{a,b}, Thanyalak Chaisuwan^{a,b}

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^{b)} Center of Excellence on Petrochemical and Materials Technology

Nitrogen enriched carbons with ultra-micro porous structure have been successfully prepared for CO₂ adsorption by pyrolysis of polybenzoxazine (PBZ) precursor which is a high-nitrogen containing polymer. The resulting carbon materials have high surface area with pore size in a range of ultra-micropore (less than 0.8 nm). In addition, the suitable nitrogen types which are pyridone-N and pyridine-N were found on the surface, characterized by XPS technique. The very high CO₂ capture of 3.59 mmol/g (30 °C, 7 bar) was achieved from nitrogen enriched carbon prepared by pyrolysis of PBZ at 800°C and activation with CO₂ gas at 900°C. Moreover, the CO₂ uptake has not reached the plateau region yet even at 7 bar. The capacities of CO₂ dominated by physisorption of micropore to capture CO₂ gas and chemisorption of acid-base interaction between nitrogen and acidic CO₂ gas. Furthermore, carbons from this work have interconnected porous structure which come from phase separation process during sol-gel synthesis and this pore structure is available to adsorb CO₂ gas at high pressure for storage application enabling them as an excellent candidate for portable gas storage tank in vehicles and other applications.

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CO₂ adsorption of carbons derived from polybenzoxazine at 30°C

Smart and Advanced Materials

SM-O-2

Synthesis of Smart Polymer/corrosion Inhibitor Conjugates

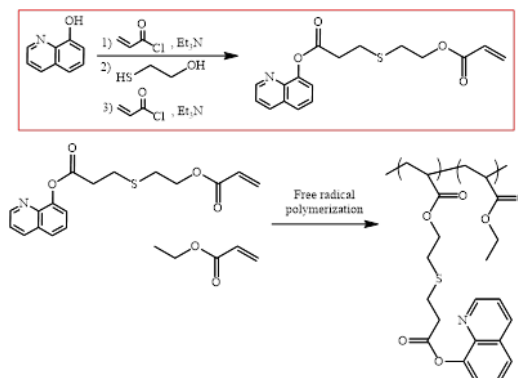
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The annual cost of corrosion in the world and in Thailand is estimated to be about 2.2 trillion and 13.2 billion dollars, respectively. Metal corrosion is a major issue in many fields such as transportation, infrastructure industrial and manufacturing. Herein we introduce a new type of corrosion-protective system. We designed and fabricated a smart

polymer for protecting metal against corrosion. The acrylate derivative of 8-hydroxyquinoline (8HQ), a corrosion inhibitor (CI), modified with an acid-labile 3-thiopropionate bond was synthesized. Then, the ethyl acrylate modified 8-HQ was copolymerized with ethyl acrylate by radical polymerization. The overall synthesis of the polymer conjugate is shown in Scheme 1. The release behavior of 8HQ from the prepared copolymer was studied in acidic (pH 3.5) and neutral media (pH 7).

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Schematic procedure for the synthesis of the conjugates.

Conductive and Electroactive Polymers

CP-O-1

Shellac and Gelatin Blend Film for Controlled Drug Delivery Patches

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Controlled drug delivery system is the system which can deliver amount and rate of drug to human blood circulation at effective and controllable level. During the last 40 years, transdermal drug delivery system (TDDs) was developed and interested as the suitable, ease and effective drug delivery system. Hydrogel played the important role as TDDs matrix but the short shelf-life and low mechanical properties are its limitations. The gelatin hydrogel was selected as hydrogel matrix. Shellac, natural resin from female lac bug, was selected to blend with gelatin hydrogel to improve the mechanical properties. The purpose of this study was to prepared of hydrogels from shellac and gelatin for gallic acid transdermal drug delivery patches by used the mixing ratio of gelatin and shellac at 100:0, 90:10, 80:20, 70:30 w/w respectively and study the gel swelling properties and drug release. The maximum sensitivity to percentage of swelling of gelatin hydrogels in the mixing ratio of shellac at 0% or pure gelatin was swelling about 904 %. The maximum release characteristics of the gallic acid from the gallic acid-loaded gelatin hydrogels. The experiments were carried out in the buffer medium pH 7.4 at the temperature 37°C of gelatin hydrogels in the mixing ratio of shellac at 30% drug released about 90 mg. The prepared gelatin hydrogels transdermal drug delivery patches can used to transdermal drug delivery systems.

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Conductive and Electroactive Polymers

CP-O-2

Chemical Immobilization of Urease on Polypyrrole/polyethylenimine Hybrid Film and Application in Urea Biosensors

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A novel potentiometric urea biosensor has been developed via covalent immobilization of urease on the polypyrrole/polyethylenimine (PPy/PEI) hybrid film. Polypyrrole (PPy), one of the most widely used conducting polymers in sensing application, has been used as a transducer. However, lack of free amino group (-NH₂) is a serious hindrance of PPy for covalent immobilization with enzyme urease. In this paper, the pH responsive-PPy surface was modified by plasma polymerization of polyethylenimine (PEI), leading to lots of free amino group on the surface. Urease was subsequently immobilized on the PPy/PEI hybrid film by covalent bonding with glutaraldehyde. Potentiometric responses of the PPy/PEI hybrid film showed the sensitivity of 56.15 mV/pUrea ($r^2 > 0.99$) over the urea concentration ranging from 0.5 mM to 10 mM (pUrea 2.0-3.3). The response time was approximately 30 s, reaching 90% steady-state potential value. The PPy/PEI hybrid film has been characterized by X-ray Photoelectron Spectroscopy (XPS) showing the signal of -N= to confirm covalent bonding of glutaraldehyde with free amino group. Leaching test revealed that the PPy/PEI hybrid film showed minimal urease leaching out of the film during measurement, indicating that the PPy/PEI hybrid film can be a great alternative urea biosensor.

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Conductive and Electroactive Polymers

CP-O-3

Methanol Sensor Fabricated from Conductive Polyindole

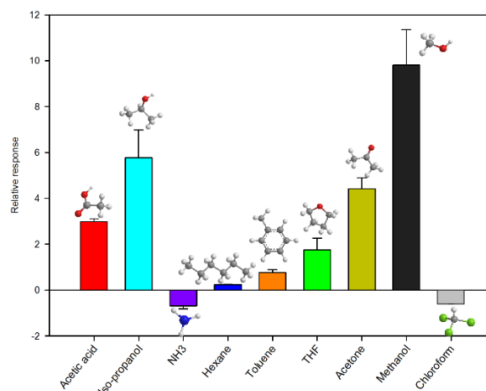
Katesara Phasukom^{a,b}, Anuvat Sirivat^{a,b}

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b) The Petroleum and Petrochemical College, Chulalongkorn University

The highly sensitive methanol sensing material with completely reversible response was fabricated from conductive polyindole (PI_n). The PI_n based sensor was exposed to 9 different organic vapors and the electrical conductivity change was monitored. The highest electrical conductivity response was from methanol because it possesses a relatively high dielectric constant and high hydrogen bonding interaction with PI_n. Moreover, the effect of doping mole ratio of HClO₄/indole was investigated in this work. The suitable doping mole ratio, PI_n/FeCl₃, was at 10:1. The irreversible interaction between methanol and the conductive polymer was confirmed by Fourier transform infrared spectroscopy. The sensitivity of methanol sensor for dPI_n/FeCl₃ 10:1 was 5.271 ppm⁻¹ with the limit of detection as 0.048 ppm.

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Relative responses of the dPI_n/FeCl₃ based sensor exposed to 9 different organic vapors at room temperature.

Conductive and Electroactive Polymers

CP-O-4

Electrical Conductivity Response of ZSM-5, Y, Mordenite, Ferrierite, 3A, 4A, 5A and 13X Zeolites towards Sulfur Dioxide

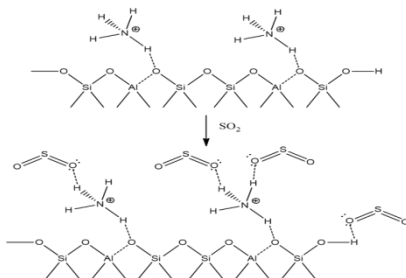
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This work is an attempt to search for the highly selective sensing materials for sulfur dioxide (SO₂). The response of the zeolites towards SO₂ was investigated through the change in electrical conductivity under SO₂ exposure under the effects of the zeolite type (framework), cation types, and Si/Al ratio. The zeolites were characterized by BET, FT-IR and AAS techniques. Among all zeolites, the ZSM-5 zeolite with the Si/Al ratio of 23 {NH₄⁺ZSM-5 (23)} showed the highest positive response towards SO₂ with fully reversibility. The cyclic response and the effect of SO₂ concentrations were also investigated. The relative response linearly increased with the increasing SO₂ concentrations. In addition, the pristine NH₄⁺ZSM-5 (23) zeolite was ion exchanged with metal chloride solution (NaCl, MgCl₂ or AlCl₃) to study the effects of valence of ions on the ion exchange process. The interactions among the zeolites and the SO₂ molecules were investigated and verified via infrared spectroscopy.

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Proposed mechanism of the interaction between SO₂ and NH₄⁺ZSM-5 (23) zeolite.

Conductive and Electroactive Polymers

CP-O-5

Electro-responsive material based on graphene nanoplatelets/ poly(lactic) acid composites

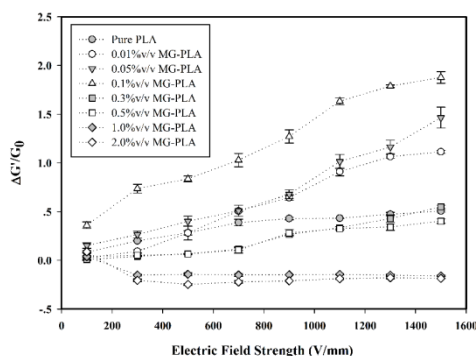
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Poly(lactic) acid (PLA) composite films incorporated with graphene nanoplatelets (grade M, MG) as a nanofiller were prepared by solvent casting method. The electromechanical properties and deflection of virgin PLA and MG-PLA compsite films were investigated under the effects of graphene concentration and electric field strength. The 0.1%v/v MG-PLA composite film possesses the highest storage modulus sensitivity ($\Delta G'/G'_0$) value of 1.88 at an electric filed strength of 1500 V mm⁻¹. When the graphene concentration was larger than 0.5% v/v, the $\Delta G'/G'_0$ of the MG-PLA composite films exhibited negative values at high electric field strength. In the deflection experiment, the bending distance and dielectrophoresis force increased monotonically with increasing electric field strength. The virgin PLA possessed the highest dielectrophoresis force at an electric filed strength of 550 V mm⁻¹ relative to those of the MG-PLA composite films.

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The storage modulus responses ($\Delta G'$) of MG-PLA composite films with various graphene concentrations at fixed strain of 0.02%, frequency of 100 rad/s, and temperature of 300 K.

Conductive and Electroactive Polymers

CP-O-6

Electromechanical Properties of P3HT/Carrageenan Hydrogel blend : Effects of Electric Field Strength and Type of Carrageenan

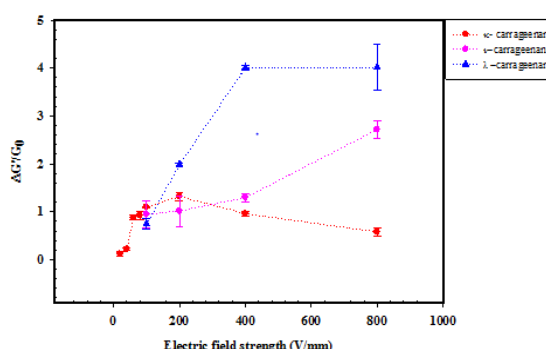
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Actuator is a mechanical device that can change electrical energy into mechanical energy. It produces a large deformation under activated energy. In this work, the synthesis of poly(3-Hexylthiophene)(P3HT) was carried out under the effects of oxidant concentration and dodecylbenzene sulfonic acid (DBSA) concentration. The P3HT synthesized by Iron(III) chloride (FeCl₃) and DBSA was obtained with particles with sphere-fibril shapes showing the highest electrical conductivity of 71.01 S/cm. The P3HT was added as a dispersed phase to improve the electrical and electromechanical properties of the carrageenan hydrogels. The electromechanical properties of carrageenan hydrogel were studied as functions of electric field strength and carrageenan type, namely the κ , i , and λ -carrageenans. The numbers of the charged sulfated groups per carrageenan repeating unit of the κ -carrageenan, i -carrageenan, and λ -carrageenan are one, two and three sulfated groups, respectively. The electromechanical response of the carrageenan increased with increasing ester sulphate group; it provided the storage modulus sensitivity of 4.0 under applied electric field strength of 800 V/mm.

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the storage modulus sensitivity ($\Delta G'/G'_0$) of 0.97%v/v κ -carrageenan, i -carrageenan, and λ -carrageenan hydrogels, measured at strain 0.03%, frequency 100 rad/s, 300 K

Conductive and Electroactive Polymers

CP-O-7

Preparation of Compliant Electrode with Multiwalled Carbon Nanotubes Filled Deproteinized Natural

Paweenuch Tangkitthanachoke^{a,b}, Anuvat Sirivat^{a,b}

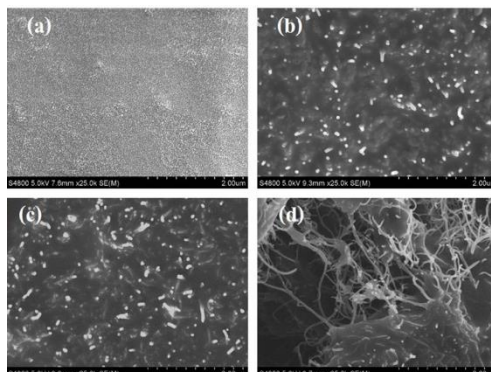
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^{b)}The Petroleum and Petrochemical College, Chulalongkorn University

Compliant electrode is known as a stretchable electronic devices which can retain good electrical conductivity under deformation. Compliant electrodes from MWCNTs and DPNR were prepared by using a UV-curing process. The Triton X-100/MWCNTs volume ratio of 15.6 was used for dispersing the MWCNTs at various MWCNTs concentrations. The investigation of mechanical and electrical properties were carried out by a melt rheometer in a tension mode. The 3% v/v MWCNTs/DPNR composite possessed the optimum conditions with the Young's modulus value of 1.27×10^6 Pa) and a high electrical conductivity value of 1.03 S/cm). Under the same experimental conditions, a commercial compliant electrode named Danfoss exhibited the Young's modulus and electrical conductivity values of 7.56×10^6 Pa and 2.54×10^{-2} S/cm, respectively, which were inferior to the present 3% v/v

MWCNTs/DPNR composite. Moreover, the composite film retained good electrical behaviors under 100% strain due to the intimate compatibility between the MWCNTs and the elastomer matrix.

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SEM images of a) crosslinked-DPNR, MWCNTs/DPNR composites at various MWCNTs: b) 1% v/v; c) 3% v/v; and d) 5% v/v.

Conductive and Electroactive Polymers

CP-O-8

Fabrication and Properties of Pectin Hydrogel for Electrically Controlled Drug Delivery

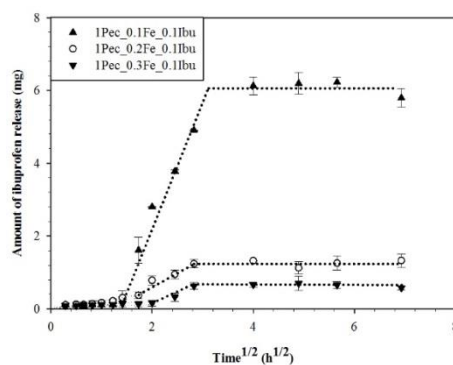
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Transdermal drug delivery system (TDDS) is the alternative route to transport drug molecule to a systematic circulation through the human skin. The major advantage of TDDS is the ability to avoid the first-pass metabolism. However, TDDS has certain limitations: the level of drug permeated across the skin is low, and the drug size has an adverse effect on the permeation. To improve these limitations, the electrical potential was utilized. Hydrogels from a biomaterial, pectin was used in drug delivery application due to its non-toxicity, biocompatibility, and similarity to biological tissues. Therefore, this work attempted to design a transdermal patch consisting of ibuprofen as a model drug and pectin hydrogel as a matrix. The effects of the crosslinking agent type, crosslinking ratio, mesh size, and electric potential were investigated. The diffusion coefficients and the release mechanisms of the ibuprofen from the pectin hydrogels were determined by using a modified Franz-Diffusion cell in an MES buffer solution of pH 5.5, at a temperature of 37 °C, for 48 h. The amount of ibuprofen release was analyzed by the UV-Visible spectrophotometry. The data showed the amount of ibuprofen released increased with increasing mesh size and electric potential.

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Amounts of ibuprofen released from ibu-loaded pectin hydrogels versus time^{1/2} at various crosslinking ratios of FeCl₂, pH 5.5, 37 °C.



Poster Sessions

Catalysis

Renewable **E**nergy

Surfactant, Separation and **E**nvironment

Process and **S**ystem Engineering

Biomedical and **G**reen Polymers

Polymer Engineering and **P**rocessing

Smart and Advanced **M**aterials

Conductive and Electroactive **P**olymer

Catalysis (CA)

CA-P-1 Kinetic Monte-Carlo Simulation of Methane Steam Reforming to Synthesis Gas Over Ni Catalyst

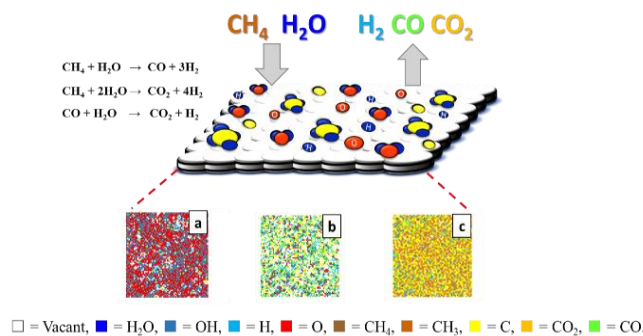
Teetuch Plianwong^a, Boonyarach Kitiyanan^{a*}, Robert M. Ziff^b

^{a)}The Petroleum and Petrochemical College, Chulalongkorn University

^{b)}Department of Chemical Engineering, University of Michigan

The methane steam reforming reaction over nickel surface is investigated by using kinetic monte-carlo (KMC) simulation technique. This simulation model is based on the Langmuir–Hinshelwood mechanism, and used the Random Selection Method (RSM) for algorithm of KMC simulation. The kinetic rate constants of elementary reactions are used to determine the probability of each possible reaction pathway for the overall reaction. The influence of pressure and temperature on the adsorption and surface elementary step reactions are also included in the rate constants. The effect of feed concentration of methane (CH₄), steam (H₂O) and temperature are investigated by performing the KMC simulation. The fractional coverage of the adsorbed species, selectivity of CO, and CO₂ and the production rates of H₂, CO, and CO₂ are evaluated at steady state as functions of feed concentration and reaction temperature. From the simulation results, the mole fraction of methane (y) in gas phase reveals a range of active window between y₁ and y₂, where y₁=0.3 and y₂=0.6 at 823 K. Outside of this range, the surface is mostly covered by O*, C* and CH₃*. The results from KMC study show similar trend with the experimental data reported by other research groups.

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Kinetic model of methane steam reforming over nickel catalyst and snapshot of catalyst surface for (a) y_{CH₄} = 0.2, (b) y_{CH₄} = 0.4, (c) y_{CH₄} = 0.8

CA-P-2 Crystal-Plane Effect of Ceria on the Activity of Cu/CeO₂ for Oxidative Steam Reforming of Methanol

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Oxidative steam reforming of methanol (OSRM) reaction is intensively considered in hydrogen production by using Cu catalysts. Different shapes of ceria (CeO₂) supports, which are single-crystalline and uniform nanorods, nanocubes and mixed-shape of cubic CeO₂, were selectively prepared by a hydrothermal method at temperatures 120 °C, 160 °C and 180 °C, respectively. The CuO/CeO₂ catalysts were prepared by deposition-precipitation method (DP). This research focused on the effect of ceria shape as a support for copper-based catalyst on the catalytic performance and a function of Cu loading in the OSRM reaction. The results show that CuO/CeO₂ exhibit a higher activity the CeO₂ support due to the strong interaction between CuO and ceria. Their activity and selectivity will be evaluated and the catalysts will be characterized by temperature-programmed reduction (TPR), X-ray diffraction (XRD), and X-ray photoelectron spectroscopy (XPS).

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CA-P-3 Catalytic activity of Ni_xSn_y Intermetallics

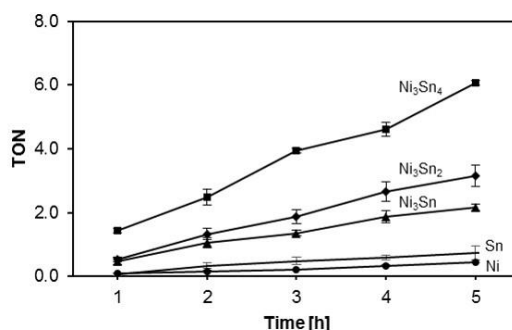
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Ni_xSn_y intermetallics were prepared via mechanical alloying to obtain Ni₃Sn, Ni₃Sn₂, and Ni₃Sn₄ by using various ratios of Ni/Sn. The intermetallics were characterized by XRD and FE-SEM-EDX elemental maps to determine crystallography information and composition uniformity, respectively. Catalytic activity of these intermetallic catalysts was studied on selective hydrogenation of α , β -unsaturated aldehyde (cinnamaldehyde) using formic acid as proton and hydride donor to obtain cinnamyl alcohol which is widely used in perfume and personal care product industries. The optimal conditions, including solvent, time, temperature, and type of Ni_xSn_y intermetallic catalysts, were investigated. It was found that Ni₃Sn₄ intermetallic showed the best activity and selectivity to cinnamyl alcohol under atmospheric pressure at 60 °C for 3h in tetrahydrofuran solvent. All products were detected by GC-FID.

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Plot of TON versus time using various types of Ni_xSn_y intermetallics, Ni, and Sn powder; 5 mmol cinnamaldehyde, 25 μ l per 5 min, 60 °C

CA-P-4 Catalytic Activity in Biodiesel Production using Cu loaded on mesoporous CeO₂-ZrO₂

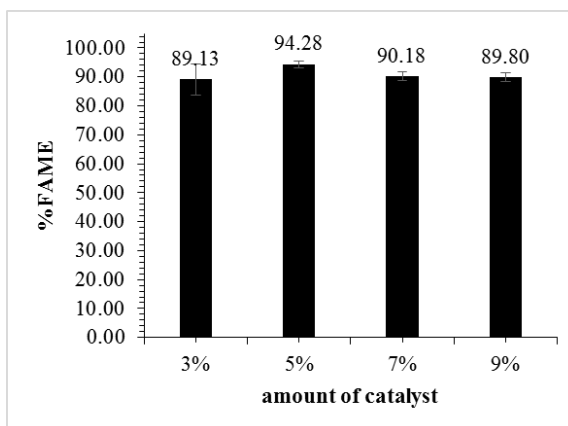
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Cu loaded on mesoporous CeO₂-ZrO₂ support as acid catalyst was successfully prepared by deposition-precipitation method. The synthesized catalysts treated with sulfuric acid by wet-impregnation showed a good efficient activity for esterification reaction in biodiesel production. Mesoporous CeO₂-ZrO₂ support was first synthesized via nanocasting process using MCM-48 as a hard template. All catalysts characterized by N₂ adsorption-desorption and XRD to confirm structure and dispersion of Cu on the support exhibited high surface area around 176 m²/g with 3.6 nm pore size. Moreover, the XRD result indicated that Cu species were well dispersed on mesoporous CeO₂-ZrO₂ support. The catalyst activity was evaluated in esterification reaction using oleic acid and methanol via microwave technique to produce fatty acid methyl ester (FAME). The suitable conditions giving high %FAME of 94.3% are following: 2 M sulfuric acid for treating 5 wt% of catalyst, 12:1 molar ratio of methanol to oleic acid, 1.5 h reaction time at 60 °C reaction temperature.

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Effect of catalyst content on %FAME using 2.0 M SCu-MSP CZ and SCuCZ at 60 °C and 12:1 methanol:oleic acid

CA-P-5 Study on Energy Storage Ability of ZnO/TiO₂ for Photocatalytic Degradation of Isopropanol

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The photocatalytic degradation of isopropanol under UV irradiation was studied by using p-n junction of ZnO/TiO₂ photocatalysts prepared by sol-gel technique. Their energy storage ability was tested with their photocatalytic activity where there was no UV illumination. That was investigated by illumination the system with UV light for 2 h and off for 2 h until 8 h. The composition and surface structure of the catalyst were characterized by X-ray diffraction (XRD), scanning electron microscope (SEM), surface area analyzer, and particle size analyzer. The change in the isopropanol concentration was observed by using gas chromatography. The result showed that the degradation efficiency of the ZnO doped on TiO₂ layer films was higher than the single-TiO₂ thin film, about 74.0% and 48.0%, respectively. Moreover, acetone was found during the photocatalytic degradation process of isopropanol. The effects of isopropanol solution pH, ZnO loading, and ZnO calcination temperature were studied. ZnO calcined at 600 °C and 77 mol% at natural pH was suitable for both photocatalytic activity and energy storage. The photocatalytic degradation rates of isopropanol for the first and second illumination were about 21.0% and 20.8%, respectively. With no illumination, the highest degradation of isopropanol was about 14.8%.

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CA-P-6 Bio-chemicals from Conversion of Bio-ethanol using Various Single Oxides

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Bio-ethanol is mainly produced by the fermentation process from biomass materials. Although mostly used as biofuels, it can be also used for the production of value-added chemicals such as acetaldehyde, acetone, 1,3-butadiene, and 1-butanol. The catalytic conversion of bio-ethanol can be generally divided into two pathways; dehydration and dehydrogenation. In this work, the catalytic conversion of bio-ethanol was investigated using MgO, CuO and ZnO as basic oxide catalysts, aiming to investigate the production of bio-chemicals from bio-ethanol conversion. The gaseous products were analyzed using GC-FID, and the liquid products were analyzed using GC-MS/TOF. It was found that MgO, CuO, and ZnO enhanced the dehydrogenation of ethanol. The major components in the oils were oxygenate compounds, which consisted of aldehydes, esters, and ethers, such as acetaldehyde, crotonaldehyde, ethyl acetate, and 1,1-diethoxyethane. The results indicated that MgO gave the highest selectivity to acetaldehyde.

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CA-P-7 Possibility of Using a Newly-Synthesized LDH-based Oxide Catalyst for Glycerol Conversion to Valuable Chemicals

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Mg₂Al-layered double hydroxide (LDH) was first prepared by the co-precipitation method. After calcination, a layered double oxides (LDO) was formed. The Mg₂Al-LDO was characterized by BET, XRF, XRD, STA-FTIR, NH₃-TPD, and CO₂-TPD. The catalytic activity was tested on liquid phase glycerol conversion at 275 °C for 2 h, and the liquid product was next analyzed using GC-TOF/MS. From BET method, the surface area increased from 83.2 m² g⁻¹ to 310.7 m² g⁻¹ after calcination. The catalytic activity results showed that 68% conversion was achieved for Mg₂Al-LDO while the non-catalytic reaction gave only 45% conversion. In addition, Mg₂Al-LDO was found to effectively transform glycerol to valuable products, like 1,3-dioxolane and 1,2-propandiol, 56% and 22% selectivity, respectively, whereas the non-catalytic case effectively transformed glycerol to 89% selectivity of diglycerol.

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CA-P-8 Possibility of Using a Newly-synthesized LDH-based Oxide Catalyst for Glycerol Hydrogenolysis and Dehydrogenation

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Glycerol is a low-value byproduct from biodiesel production. Therefore, it is important to convert glycerol into highly valuable products. The hydrogenolysis of glycerol and glycerol dehydrogenation are possible ways of glycerol conversion into useful chemicals, and can proceed by using acid and base catalysts, respectively. Thus, Layered double oxide (LDO) catalysts, which can promote both acid and base-catalyzed reactions, may have potential as the catalysts for this work. The research objectives were to determine possibility of using a newly-synthesized LDH-based oxide catalyst for glycerol hydrogenolysis and dehydrogenation, and to study the effect of acid-base properties of Mg₂Al-LDO in order to design an optimal catalyst. From the results of the reaction without a catalyst at various reaction time-on-stream, it was found that the glycerol conversion was 8.6% at 5 hours. Using Mg₂Al-LDO, both glycerol conversion and yield of hydrogenolysis product increased to 58.0% and 22.9%, respectively, because of the high density of acid and basic sites of the catalyst, which governed both hydrogenolysis and dehydrogenation. Thus, the LDH-based oxide catalyst can possibly drive both glycerol hydrogenolysis and dehydrogenation simultaneously.

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CA-P-9 Possibility of Using a Newly-Synthesized LDH-Based Oxide Catalyst for Catalytic Bio-Ethanol Conversion

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Bio-ethanol is a renewable energy that can be produced by crop and biomass fermentation process. Nowadays, bio-ethanol is used as an additive for blending in engine fuels such as gasohol, E10, E20, and E85. Moreover, ethanol can be converted to valuable chemicals such as hydrogen, hydrocarbon, C₃-C₄ olefins, and other chemicals (acetaldehyde, crotonaldehyde, butyraldehyde, crotyl alcohol, 1-butanol, 1,3-butadiene, and 1-hexanol). The aim of this research work was to study the conversion of bio-ethanol to valuable chemicals using a newly synthesized Mg₄Al-LDH derived oxide catalyst prepared by co-precipitation method. The catalyst was characterized by using XRD, XRF, BET, NH₃-, and CO₂-TPD, and tested in a plug flow fixed bed U-tube reactor at 400 °C, 9.468 gEtOH/gcat-h and atmospheric pressure. The liquid product (non-aqueous phase) was analyzed using GC-MS. The gaseous product was analyzed using GC-FID for the concentration of hydrocarbons (C₁-C₄). As a result, it was found that Mg₄Al-LDO gave 62.4 % conversion of bioethanol. The major components in the gaseous and non-aqueous product were ethylene and 1-butanol, respectively, meaning that the MgAl-LDO catalyst can drive both ethanol dehydration and dehydrogenation pathways.

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CA-P-10 Oxidative Dehydrogenation of Ethane to Ethylene over Molybdenum Based Catalysts

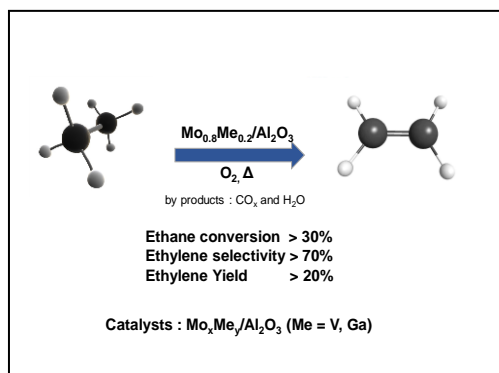
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Molybdenum based catalysts with second metal (V and Ga) supported on alumina (γ -Al₂O₃) were studied for oxidative dehydrogenation of ethane to obtain ethylene. The catalysts, Mo-Me/Al₂O₃ (Me = V, Ga) mixed oxide catalysts at the ratio Me/Mo+Me (varying from 0 to 1), were prepared by using incipient wetness impregnation technique with total metal loading fixed at 20% by wt. The catalysts were investigated for their activity toward the reaction at temperature of 400, 450 and 500 °C under atmospheric pressure. The reaction was carried out in a fixed-bed reactor with feed ratio of 20% ethane to 10% oxygen balanced by helium. The W/F ratio (W = catalyst weight, F = total feed flow rate) was fixed at 0.54 g.s.cm⁻³. In addition, the catalysts were characterized by several techniques, such as BET surface area analysis and XRD. Among the tested catalysts, the Mo_{0.8}V_{0.2}/Al₂O₃ catalyst provides relatively high ethylene yield (>20%) at 500 °C. Nonetheless, the ethylene selectivity is decreased with increasing V/Mo+V ratio while the CO selectivity is increased.

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The reaction scheme of oxidative dehydrogenation of ethane to ethylene over molybdenum based catalysts

CA-P-11 Effects of Posttreatment Steaming on Catalytic Performance of Modified HZSM-5 Catalysts for the Conversion of *n*-Pentane to Aromatics

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The primary economic aim of petrochemical manufacturers is to maximize the value added of products. Therefore, one of the reasonable routes being recently interesting is to convert the excess low-valued C₅ fraction into high-valued aromatic products. This thesis studied the effect of HZSM-5 modification including Ga Ion-exchange, silylation, and steaming on their catalytic performance in aromatization of *n*-pentane. The steaming was achieved by different conditions. The physical and chemical properties of catalysts were characterized by N₂ physisorption, XRD, XRF, NH₃-TPD, IPA-TPD, TPO and TPR techniques. Catalytic activity was tested in a continuous flow fixed-bed reactor at 500 °C, atmospheric pressure, and WHSV of 5 h⁻¹. After the modifications the XRD pattern indicated the the highly dispersed gallium and the relative catalysts crystallinity can be seen without any change after silylation and steaming. The steaming step dislodged fraction of aluminum from the framework to aluminium extra framework (EFAl) and generated the mesopore volume. The acidity of the catalyst exhibited a decrease in the number of Bronsted acid sites and an increase in Lewis sites corresponding to AlO⁺ species resulted in increasing of aromatics selectivity. The modified catalysts showed the higher performances in aromatics selectivity, and *p*-xylene selectivity than the parent HZSM-5.

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CA-P-12 Methylation of Toluene with Methanol using Modified HZSM-5 Catalysts: Effect of Steaming

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Toluene produced from both catalytic reforming and cracking of naphtha is surplus and lower in value when compared with other produced aromatics, e.g., benzene, xylenes, etc. To augment a more value of toluene, methylation of toluene with methanol is a promising route to convert toluene into xylenes. HZSM-5-based catalysts have been used for this reaction because of its superior properties in shape selectivity and proper catalytic activity. In this study, the modified HZSM-5 catalysts were utilized for such a reaction aiming toward higher *p*-xylene selectivity. The parent HZSM-5 was synthesized by hydrothermal treatment with SiO₂/Al₂O₃ molar ratio of ca. 200 and then modified by two modification methods; (i) chemical liquid deposition (CLD) with tetraethyl-orthosilicate (TEOS) and (ii) dealumination with steam. Under the following reaction conditions; a constant temperature of 450 °C, atmospheric pressure, WHSV of 12 h⁻¹, and T/M molar ratio of 4:1, the toluene conversion and *p*-xylene selectivity attained at 365 min on stream were 11.65% and 71.26%, respectively, for the parent HZSM-5 catalyst whereas were 8.91% and 84.73%, respectively, for the modified one.

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CA-P-13 Shape Effect of Ceria on the Activity of Au/CeO₂ for Preferential CO Oxidation

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Hydrogen is an energy carrier and considered as the main source for on-board hydrogen in Proton Exchange Membrane Fuel Cell applications. However, the anode of fuel cells can be poisoned by carbon monoxide (CO) in hydrogen stream produced from reforming. Ceria (CeO₂) has been regarded as an interesting support for many reactions including preferential CO oxidation due to its unique properties. The morphology of ceria is one of the important factors that significantly affects the properties such as reactive exposed-crystal plane for reaction, surface area and oxygen storage capacity (OSC) including metal dispersion of catalyst. Gold-based catalyst has been considered as a potential catalyst for preferential CO oxidation. Recently, it was reported that the catalytic activity of Au catalysts strongly depended on the shape of ceria. In the present work, hydrothermal method was used to synthesize ceria in different shapes. The effect of ceria (rod, cube, polyhedron, and octahedron) morphology will be investigated and characterized by many techniques.

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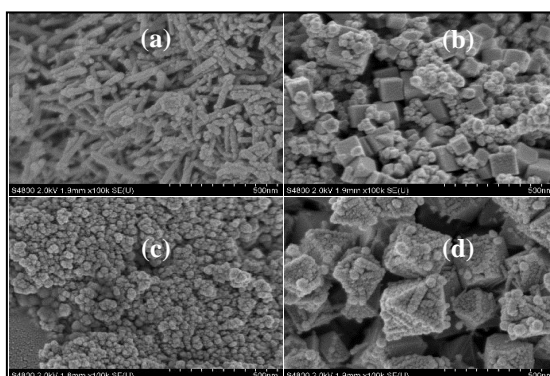


Figure 1 SEM images of CeO₂ in various shapes (a) Rod, (b) Cube, (c) Polyhedron, and (d) Octahedron.

CA-P-14 Development of Catalysts for Ethane Epoxidation Reaction

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Ethylene oxide (EO) is an important intermediate in the manufacture of several petrochemical products such as ethylene glycol, surfactants, thickener, ethanolamine glycol, polyglycol ether, lubricants, plasticizers, and solvents. EO is commercially produced through the partial oxidation of ethylene using air or oxygen over Ag catalysts loaded on a low-surface-area α -Al₂O₃ support. However, Ethylene is mainly produced by the steam cracking of hydrocarbons, which is considered as a high energy consumption process. It is of a great interest to develop a new EO production process from ethane. This study aims to improve the selectivity and yield of ethylene oxide for ethane epoxidation reaction. Ag catalysts on α -Al₂O₃ and SrTiO₃ supports were preliminary tested to find out the Ag optimum loads on both support for EO production. An optimum feed molar ratio of ethane to oxygen and reaction temperature for the ethane epoxidation reaction were studied. Among the various catalysts, the 17.5 wt% Ag/SrTiO₃ exhibited good performance to produce EO, with a EO yield of 0.07% and EO selectivity of 0.004% under the studied condition of a C₂H₆ to O₂ molar ratio of 4:1, a space velocity of 6000 h⁻¹ and a reaction temperature of 275 °C. The catalysts were characterized by several techniques including x-ray diffraction (XRD), field emission scanning electron microscopy (FE-SEM), brunauer-emmett-teller surface area analyzer (BET), atomic adsorption spectrophotometer (AAS), transmission electron microscopy (TEM), temperature programmed desorption (TPD), and x-ray photoelectron microscopy (XPS).

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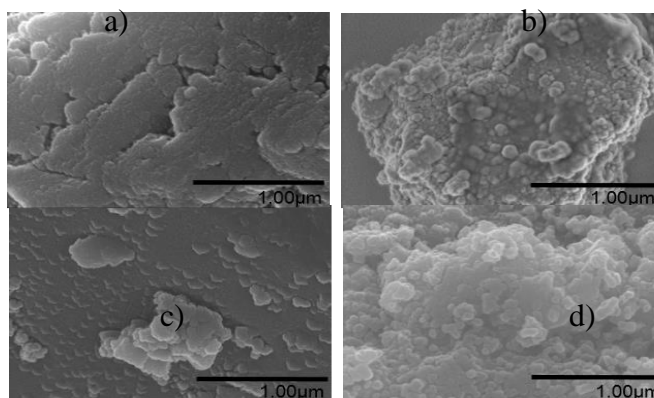


Figure SEM images a) α -Al₂O₃ b) SrTiO₃ c) 17.5 wt% Ag/ α -Al₂O₃ d) 17.5 wt% Ag/SrTiO₃

CA-P-15 The Stability of the Palladium-Magnesium Supported on Silica Catalysts for Partial Hydrogenation of Biodiesel

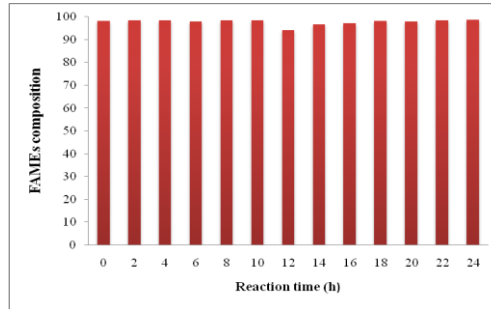
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Fatty acid methyl ester (FAMES) has emerged as one of the most potential renewable energy for petroleum derived diesel. The main drawbacks of biodiesel consisted of lower oxidative stability and poorer cold flow properties. Therefore, partial hydrogenation of polyunsaturated FAMES to *cis*-monounsaturated compound can substantially increase fuel quality. This research was studied on stability of the bimetallic catalysts for partial hydrogenation of FAMES. Biodiesel derived from soybean oil was used as a feedstock. The partial hydrogenation was carried out on palladium-magnesium catalysts supported on silica. The catalysts were prepared by incipient wetness impregnation. The metal loading was 1 wt.% for palladium and 4 wt.% for magnesium and they were characterized by using GC, XRD, and BET. The reaction of the partial hydrogenated biodiesel was performed at 4 bar hydrogen pressure, 80 °C temperature. The results indicated that at 10 h of reaction time exhibited the highest the amount of *cis*-monounsaturated. Since, it could convert both triunsaturated and diunsaturated after that it slightly decreased. It means that, the amount of *trans*- monounsaturated content also increased together with the increased of *cis*-monounsaturated content.

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FAMEs composition of biodiesel after 24 h of reaction time in hydrogenation reaction. Reaction conditions : 80 °C, 4 bar, 150 ml/min of H₂ flow rate, 1000 rpm of stirring rate, 1 wt.% of Palladium and 4 wt.% of Magnesium loading catalysts.

CA-P-16 Steam Reforming of Acetic Acid over Ni/Ceria-Zirconia Mixed Oxide based Catalysts

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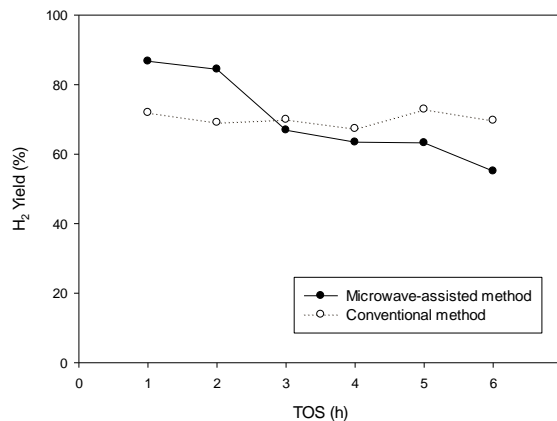
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Typically, bio-oil derived from biomass by fast pyrolysis contains both oil and aqueous phases. Of some valuable chemicals in the aqueous phase, acetic acid is the majority of constituents which cannot be used as fuel. To utilize such chemicals, reforming them with steam to produce hydrogen with high selectivity over effective catalysts is purposed. Albeit, nickel-based catalysts have been used for steam reforming of acetic acid, they seem to be rapidly deactivated reflecting their inefficient performance. It was proposed that Ce_{1-x}Zr_xO₂ mixed oxide as catalyst support might alleviate this problem with the anticipation of enhancing hydrogen yield. Nevertheless, numerous studies showed that catalyst preparation methods play a vital role in catalytic activity and performance of mixed oxide catalysts. In this work, Ce_{0.75}Zr_{0.25-x}Ni_{2x}O₂ catalysts(x=0-0.25) were prepared by urea hydrolysis using a microwave-assisted treatment. The obtained catalysts were tested for steam reforming of acetic acid at a temperature of 650°C and atmospheric pressure. The catalyst prepared by microwave-assisted treatment has a higher surface area and a smaller crystallite size. In spite of its rapid deactivation, the microwave-prepared catalyst with which Ni was incorporated in the ceria-zirconia lattice exhibited a much higher hydrogen yield at initially one to two hours on stream compared to the conventional one.

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The catalytic activity as a function of TOS of the catalysts prepared by conventional and microwave-assisted methods.

CA-P-17 Deoxygenation of Palm Oil to Bio-hydrogenated Diesel over Pd/Al₂O₃ Catalyst Using Microscale-based Reactor

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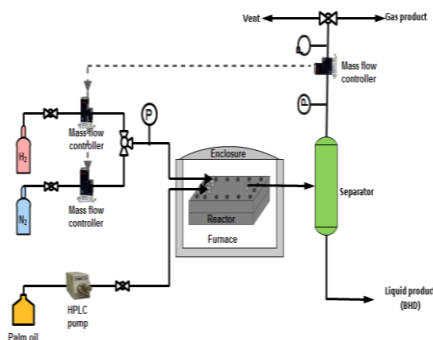
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Generally, the petroleum-based diesel leads to several global problems. Hence, bio-hydrogenated diesel (BHD) derived from renewable resources becomes more attractive because of the compatibility with petroleum-based diesel due to its structure like petroleum-based diesel. BHD can be produced from triglyceride feedstocks which are converted into BHD by hydroprocessing involving the deoxygenation reaction in the presence of hydrotreating catalyst. Normally, the BHD production is carried out in a conventional fixed-bed reactor giving limitation of mass and heat transfer. Thus, microscale-based reactor turns to be more interesting due to the higher heat and mass transfer, lower pressure drop and lower quantity of catalyst comparing with conventional fixed-bed reactor. In terms of catalysts, Al₂O₃ support which is the conventional support for hydrotreating catalysts has high surface area, high thermal stability, and also inexpensive cost. In this work, Pd/Al₂O₃ will be prepared and tested for BHD production from palm oil in microscale-based reactor. In addition, the appropriate catalyst coating on stainless steel plates of microscale-based reactor i.e. dip-coating by suspension solution, dip coating by sol-gel solution, and electrophoretic deposition will be investigated. Moreover, the catalysts will be characterized by various techniques.

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The schematic of BHD production using microscale-based reactor.

CA-P-18 Production of Biojet Fuel from Palm Fatty Acid Distillate over Core-shell Catalyst

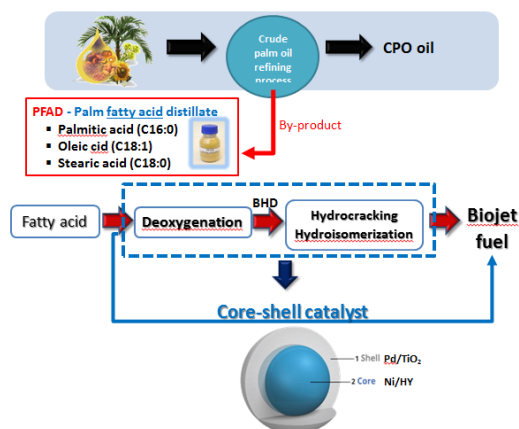
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Biojet fuel known as aviation bio-fuel is an alternative green energy used to power the aircrafts due to reducing environmental pollution. Biojet fuel can be derived from bio-based feedstock which is renewable resources such as palm fatty acid distillate (PFAD). Generally, biojet fuels can be produced via deoxygenation reaction in order to remove oxygenated compounds in the fatty acid molecules then followed by hydroprocessing which involves hydrogenation, hydrocracking and hydroisomerization reactions. The heterogeneous catalyst is used to convert PFAD into saturated paraffins in the range of jet fuels using the design of core-shell catalyst to do both steps of deoxygenation and hydroprocessing reactions. In terms of catalyst, Pd/TiO₂ is exhibited high efficiency in deoxygenation process. In addition, Ni/HY is considered for hydroprocessing of jet fuel production. In this work, the Ni/HY^{core}-Pd/TiO₂^{shell} catalyst is prepared and used to convert PFAD into bio-jet fuels in a continuous flow fixed-bed reactor and maximize the conversion and selectivity. Furthermore, the effect of space velocity is varied to satisfy the yield of bio-jet fuels. The characteristic of catalysts will also be determined.

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The figure shows pathway to convert PFAD to valuable product.

CA-P-19 Synthesis of Cyclic Poly(ϵ -caprolactone) Using Aluminum(III) Complexes

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Poly(ϵ -caprolactone) is one of the most promising biodegradable polymer because it can solve the problem of excess plastic waste issue. To develop more advanced materials, changing the polymer topology is one common way to deal with. Cyclic polymers have received significant attention because they have different physical properties compared to their linear counterparts. Cyclic polymers can be efficiently made from ring-opening polymerization (ROP) using metal alkoxide complexes as a catalyst. Herein, two aluminum complexes containing salicylaldimine ligands were synthesized and polymerized with ϵ -caprolactone via solution polymerization. Cyclic poly(ϵ -caprolactone) is investigated in this study.

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CA-P-20 Novel Cyclic Carbonate-based Organic Molecules via CO₂ Fixation

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CO₂ is a main contributor to global warming. The transformation of CO₂ into useful materials or value-added chemicals is regarded as a viable strategy to reduce net CO₂ emissions. The cycloaddition reaction of CO₂ to epoxides is an atom economic reaction that can take place under mild conditions and produces cyclic carbonates as useful solvents and chemical intermediates. Most of the work on this reaction has been limited to the preparation of a relatively small selection of carbonate products starting from commercial epoxides. Efforts to prepare cyclic carbonates from functionalized epoxides have been scarce and non-systematic. In this study, we envisage a strategy that employs α,β -unsaturated carbonyl compounds as precursors to epoxides that undergo carbonation with CO₂ using binary catalytic systems (Lewis acid and nucleophile) developed in our laboratories. In this way, we could produce unprecedented examples of functionalized cyclic carbonate-based compounds that could act as synthetic precursor of novel diols and carboxylic acids. Moreover, we were able to show that the application of organocatalytic systems using natural compounds as hydrogen bond donors, compared to metal based catalysts, could lead to a significant improvement of the cycloaddition process yield and selectivity when applied to functionalized epoxides.

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CA-P-21 Activity Comparison of NiMo/ γ -Al₂O₃ Catalysts Promoted by Cu and Ce for Hydrodeoxygenation of Guaiacol

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Bio-oil obtained from biomass pyrolysis is not appropriate for using as fuel since it has high corrosiveness and instability due to its large amount of oxygenated compounds derived from decomposition of lignin, cellulose and hemicellulose. Hydrodeoxygenation (HDO) can be catalyzed by using NiMo/ γ -Al₂O₃ or CoMo/ γ -Al₂O₃, but these catalysts promote coke deposition on their surface. Since Ce could inhibit the coke formation on the catalyst surface for the autothermal carbon dioxide reforming of methane and Cu could promote the alkanes production during HDO of esters, the aim of this research was to study the effects of Ce- and Cu-promoters on the carbon resistance and efficiency of NiMo/ γ -Al₂O₃ catalyst for HDO of guaiacol (GUA) used as a model compound of bio-oil. When HDO of GUA was conducted under 10 bar initial H₂ pressure and 300 °C for 1 h, the results showed that NiMo/ γ -Al₂O₃ catalyst promoted by 4 wt% Cu (NiMoCu/ γ -Al₂O₃) could inhibit the coke formation (6.58 wt%) and also improve the HDO efficiency to achieve 38.2% GUA conversion, whilst unpromoted one showed higher amount of coke (9.40 wt%) formed on the catalyst surface with 28.2% GUA conversion. Therefore, this was the Cu-promoter could act as both coke inhibitor and catalyst activity improver for NiMo/ γ -Al₂O₃ in HDO.

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Renewable Energy (RE)

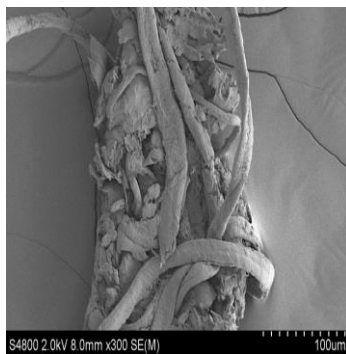
RE-P-1 Effect of Co-solvent on Ionic Liquid Pretreatment of Napier Grass

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Pretreatment is the process for breaking down lignin barrier in lignocellulosic biomass, which mainly consists of cellulose, hemicellulose, and lignin in a complicated structure. Ionic liquids are known as green solvents for chemical pretreatment, which have received attention in dissolving lignocellulosic biomass under mild conditions. It was reported that the combination use of appropriate ionic liquid (ILs) and organic co-solvents can significantly increase the solubility of lignocellulose due to the addition of a co-solvent could reduce the ionic liquid viscosity, thus increasing the biomass pretreatment efficiency. Napier grass from Saraburi province can be used to produce fermentable sugars for direct conversion to butanol via Acetone-Butanol-Ethanol (ABE) fermentation. This research focused on the effect of co-solvent, dimethyl sulfoxide (DMSO), during the ionic liquid with co-solvent ([EMIM][OAc]/DMSO) pretreatment under microwave irradiation on the reducing sugar yield. Moreover, microwave as a heat source was applied in this work due to its advantages over the conventional heating in terms of super heating, internal heating, selective heating, and rapid heating.

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FE-SEM images of Napier grass pretreated with [EMIM][OAc]/DMSO pretreatment at 300x magnification.

RE-P-2 Production of Hydrogen from Biodiesel Wastewater by Steam Reforming over Ni-Based Catalyst

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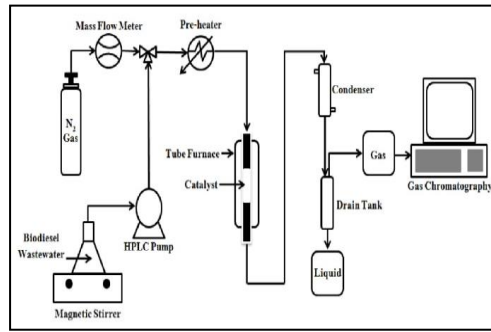
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Biodiesel is a renewable energy that can be used for diesel engine, which was interested in the present. The large amount of wastewater was generated during the biodiesel production process. The biodiesel wastewater consists of water, glycerol, methanol, ethanol and free fatty acid, which can be hazardous to the environment. Therefore, this research, the steam reforming of the biodiesel wastewater to hydrogen gas was studied over Ni-based catalysts. The catalysts were tested at 700°C with nitrogen gas flow rate of 10 SCCM (Standard Cubic Centimeter per Minute) in steam reforming reaction. The prepared catalysts were characterized by X-ray powder diffraction, Scanning electron microscope and N₂ adsorption and desorption technique.

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Schematic diagram of Steam reforming process.

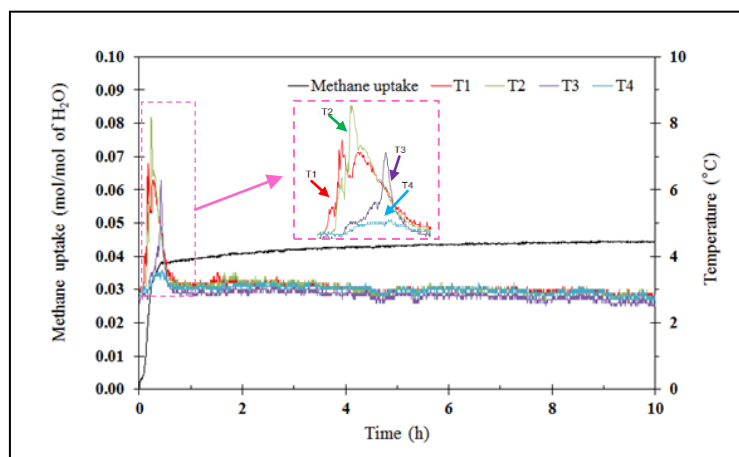
RE-P-3 Assisted Methane Hydrate Formation with the Addition of Promoters

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Natural gas hydrates play an important role in the largest reservoir of hydrocarbons on earth. The gas hydrates have received increasing attention in an excellent way of new technology for gas in large quantity storage and transportation. However, the use of methane hydrates has faced many challenges such as the slow formation rate, low growth rate during hydrate formation, and low conversion ratio of gas to solid hydrates leading to poor storage capacity. In this work, methane hydrate formation and dissociation in the presence of different cyclopentane (CP) and tetra-n-butyl ammonium bromide (TBAB) were investigated. The formation experiment was conducted in an unstirred system. The temperature was controlled between 2.5 and 4.0°C at 8 MPa. The hydrate dissociation experiment was performed after the completion of hydrate formation. The results showed that increasing the concentration of CP improved methane consumption. However, the methane consumption in the presence of CP was higher than TBAB.

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Typical methane consumption and temperature profiles during the methane hydrate formation experiments performed at 2.5 °C.

RE-P-4 Three-stage ASBR for H₂ and CH₄ Production: Micronutrient Transport

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A three-stage anaerobic sequencing batch reactor (ASBR) system was developed as a new anaerobic process of three-stage concept to separately produce hydrogen and methane from ethanol wastewater. The three ASBR system consisted of three units of ASBR connected in series which had liquid working volumes of 4, 6, and 20 L, respectively. The three-stage anaerobic sequencing batch reactor (ASBR) system was operated under mesophilic temperature (37 °C) and pH of the first reactor of 5.5. A recycle ratio of 1:1 (final effluent flow rate: feed flow rate) was fed to the first ASBR unit in order to minimize NaOH consumption for pH adjustment. Under the optimum COD loading rate of 18 kg/m³d based on the total ASBR volume, the micronutrient concentrations of Cu, Co, Mn, Ni, Fe, Zn and Mo were 0.07, 0.12, 2.19, 0.18, 30.21 and 0.4 mg/L in the first ASBR unit; 0.04, 0.1, 2.15, 0.11, 13.4, 0.34 and 0.47 mg/L in the second ASBR unit; and 0.04, 0.11, 0.56, 0.1, 4.77, 0.28 and 0.13 mg/L in the third ASBR unit, respectively. All of nutrients were significantly removed from the system by reacting with sulfide ions to form metal sulfides. Most nutrients of the three ASBR system seemed to be sufficient for bacterial activity.

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RE-P-5 Biobutanol Production by Immobilized *Clostridium beijerinckii* JCM 8026 onto Pretreated Napier Grass

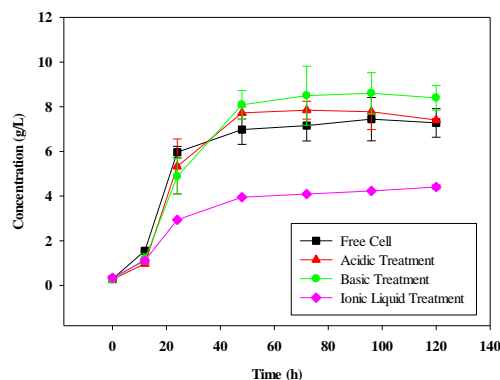
Inthanon Doolayagovit^a, Apanee Luengnaruemitchai^a, Ancharida Akaracharanya^b

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Napier grass is a lignocellulose material, composed of cellulose, hemicellulose, and lignin bound together in a complex structure. Prior to anaerobic digestion process, this lignocellulose material has to be pretreated to increase surface area and porous surface by various pretreatment methods; acid, alkali, and ionic liquid pretreatment. Production of butanol can be achieved via the Acetone-Butanol-Etanol (ABE) fermentation. However, Free cell fermentation has drawbacks in low cell productivity, density, toxicity on microorganisms and unstable system production. Cell immobilization on pretreated Napier grass has been introduced to enhance ABE fermentation as it can maintain cell growth, production, and stable in process operation. This paper aimed to compare both free cell and immobilized *Clostridium beijerinckii* JCM 8026 onto different pretreated Napier grass samples. The immobilization of basic treated Napier grass provides the highest butanol concentration (8.61 g/L). The fermentation period in the immobilized cell systems were thus almost 25% shorter than that in the free cell system. It was found that immobilized cell technology has a number of advantages over conventional systems; a shorter fermentation period, higher butanol concentration and productivity compared to free cell system.

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Butanol profiles of free cell and immobilized *Clostridium beijerinckii* JCM 8026

RE-P-6 Separate Production of H₂ and CH₄ from Ethanol Wastewater using Two-stage UASB System

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The objective of this study is to determine an optimum COD loading rate for both maximum production of hydrogen and methane from ethanol wastewater using a two-stage upflow anaerobic sludge blanket (UASB) system under mesophilic temperature (37°C) with a constant recycle ratio of 1:1 (final effluent flow rate : feed flow rate). The first (hydrogen) UASB unit having 4 L liquid holding volume was controlled at pH 5.5 but the second (methane) UASB unit having 24 L liquid holding volume has no pH control. The system was operated at different COD loading rates including 8, 13, 17 and 20 kg/m³ d based on total UASB working volume. The result showed that at the optimum COD loading rate of 13 kg/m³ d, the produced gas from the hydrogen UASB unit had the hydrogen yield of 1.85 mL/g COD removed (or 0.57 mL/g COD applied) and the SHPR of 7.42 ml H₂/L_R d (or 0.33 ml H₂/g MLVSS d). The produced gas from the methane UASB unit mainly contained CH₄ and CO₂ without H₂ which were also consistent with the maximum methane yield of 407.00 mL/g COD removed (or 263.23 mL/g COD applied) and the SMPR of 2081.44 ml CH₄/L_R d (or 99.75 ml CH₄/g MLVSS d).

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RE-P-7 Pulse Electrodeposition of Pt-Co Catalyst onto Glassy Carbon for Oxygen Reduction Reaction to use in PEMFC

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Proton exchange membrane fuel cells (PEMFC) are energy conversion devices that convert chemical energy to electrical energy directly using hydrogen as a fuel. Since hydrogen can be obtained from renewable energy sources and is environmental friendly, PEMFC have a potential to solve the energy and environmental crisis. Practically, the performance of the PEMFC is limited by slow oxygen oxidation reaction (ORR). To overcome this, effective electrocatalysts are needed. Pt-Co alloy is usually used as the electrocatalyst for the ORR due to its higher activity for the ORR than Pt. In this study, we prepared Pt-Co alloys by pulse current (PC) and pulse reverse current (PRC) electrodepositions. The Pt-Co electrodeposits are then used to study the electrocatalytic activities. The effect of pulse parameters (peak current density, reverse current density and times of applied current, non-applied current and dissolution) on the chemical composition of the Pt-Co electrodeposited had been investigated. The pulse parameters were used to fine-tune the Pt-Co deposit composition to have a wide Pt:Co range, between Pt₁₆Co₈₄ and Pt₉₀Co₁₀. It was found that the Pt-Co alloys had higher ORR activities than Pt and the ORR activity was depended on the chemical composition of the Pt-Co alloys, where Pt₇₅Co₂₅ yielded the highest ORR activity.

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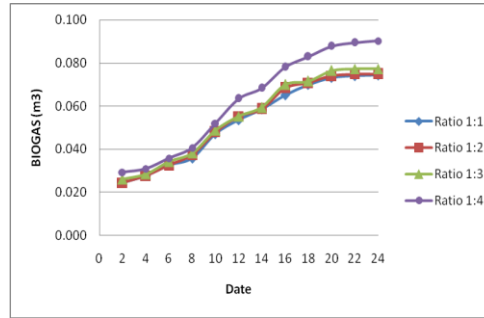
RE-P-8 Biogas Production from Food Scraps of Rajamangala University of Technology Srivijaya

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The objectives of this study aims to produce biogas for using as a renewable energy instead of liquid petroleum gas (LPG), reduce the food scrap in the RMUTSV food center and evaluate the appropriate ratio between food scrap and cow manure for biogas production. From the biogas fermentation experiment, in a ratio of 1:1, 1:2, 1:3 and 1:4 with a paddle for mixing to produce biogas for 24 days at room temperature, the volume of fermentation tank was 200 liters and the volume of biogas storage tank was 180 liters. It was found that the rate of biogas production accumulation with a ratio of food scrap and cow manure 1:1, 1:2, 1:3 and 1:4 were 0.074, 0.075, 0.077 and 0.090 m³ respectively. The ratio of 1:4 was producing a high volume of biogas which was 0.090 m³.

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The rate of biogas production accumulation with ratio of food scrap and cow manure

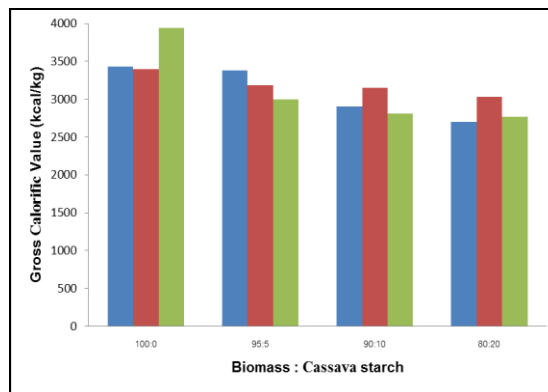
RE-P-9 Effect of Cassava Starch Ratio on Biomass Pellet Fuel from Rubber Tree

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Biomass is abundant and renewable resources for biomass pellet fuel. This research focused on the effect of cassava starch and physical properties on pellet fuel from biomass. The raw materials were used in the present study were rubber leaves, rubber branch, and rubber wood sawdust. The feedstock was washed to remove impurity. After that, they were dried in an oven at 103 °C for 24 h to remove moisture. Next, they were made to produce pellets sample by hydraulic machine at room temperature. The producing process is simplified without a preheating process. Pellets were prepared by combination between biomass and cassava starch as a coupling agent ratio of 100:0, 95:5, 90:10, and 80:20, respectively. The result shown that the maximum calorific value was found 3,945 kcal/kg in rubber wood sawdust : cassava starch (100:0) combination. The lowest value of volatile matter (%w/w) and moisture content (%w/w) were displayed of rubber wood sawdust : cassava starch (100:0) was 4.93 and 2.84, respectively. Therefore, rubber wood sawdust : cassava starch (100:0) is potential candidates to produce pellet fuel.

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Gross calorific value (kcal/kg) of biomass (rubber leaves, rubber wood sawdust, and rubber branch) pellet : cassava starch (100:0, 95:5, 90:10, and 80:20)

RE-P-10 Catalytic cracking of Waste fish oil on Magnesium oxide in Batch reactor

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This research work catalytic cracking of waste fish oil on magnesium oxide in a batch reactor, volume 70 ml. The process was performed at 420 - 500 °C, reaction time 30 - 60 minutes, initial hydrogen pressure 1 - 5 bars and amount of catalyst ranging from 1 - 5 % by weight. The two level factorial experimental designs were performed to investigate the effect of variables of oil yield on product yield. The product oil was analyzed by simulated distillation gas chromatography (DGC). From design-expert program, it was found that reaction of used waste fish oil on magnesium oxide catalyst is temperature of 500 °C, reaction time 60 minutes, initial hydrogen pressure 5 bars and using 1 %wt catalyst. The product was shown in 62.00 %wt gas, 24.40 %wt oil, 13.60 % of solid and 87.16 % of conversion. This liquid product was analyzed by simulated distillation gas chromatography which was composed of 32.02 % of naphtha, 13.58 % of kerosene, 26.10 % of diesel, 8.09 % of gas oil and 20.21 % of long residue.

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RE-P-11 Methane Adsorption by Carbon Molecular Sieve Derived from Polycarbonate and Polyethylene

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The adsorption of methane by carbon molecular sieves (CMS) were investigated at 35 and 45 °C by volumetric apparatus with the pressure range from 0 to 800 psia. CMS was prepared from polymer precursors such as polycarbonate (PC) and polyethylene terephthalate (PET) by carbonization under nitrogen inert atmosphere and activation by CO₂ at temperature 700, 800 and 900 °C. The yield of carbon molecular sieve decreased with increasing carbonization and activation temperature. The methane adsorption capacity at 35 °C of CMS derived from PC is 2.82 mmol CH₄/g. The methane adsorption of the sample from PC is higher than those obtained from PET for the same carbonization and activation. It is interesting to note that the CMS from 700 °C carbonization and activation of PC is higher than the samples obtained from 800 and 900 °C carbonization and activation. As expected, methane adsorption at 35 °C is higher than that at 45 °C for all samples. BET surface area and pore analysis and Field Emission Scanning Electron Microscopy (FE-SEM) were used to characterize the physical properties and relate to the adsorption capacity.

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RE-P-12 Graphene/Carbon Black Counter Electrode for Perovskite Solar Cell

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Counter electrodes (CEs) of perovskite solar cell (PSC) are usually prepared by thermal evaporation of noble metals such as Au or Ag under high vacuum condition. The replacement of costly metallic CEs by carbon material has attracted recent attentions to lower the price of this kind of high-efficiency bulk heterojunction organometallic halide photovoltaic cell based on NH₂CH=NH₂PbI₃ light harvester. This research has investigated the synthesis of graphene by exfoliated electrochemical method which was conducted by applying bias voltage in range of 0–8 V to the pure graphite electrodes submerged in the 0.5 M sulfuric solution. The graphene powder having surface resistance of 10.4 ohm/square was obtained with high carbon-content as confirmed by XRD and SEM results. PSC test devices was fabricated on FTO glass substrate by layering thin films of different materials in following order: compact layer / electron transport layer / insulating layer / hole transport medium / Graphene. Controlled amount of carbon black nanoparticles was added to graphene layer to enhance the interfacial contact. Formamidinium lead iodide (FAPbI₃) perovskite was then synthesized using sequential step and was penetrated through carbon electrode into inner layers to generate the bulk heterojunction. Finally, the devices have been tested and the photovoltaic characteristics including photo-conversion efficiency have been reported.

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Surfactant, Separation and Environment (SE)

SE-P-1 Novel Surfactant Systems for Foam Assisted Enhanced Oil Recovery (EOR) by Adding Nanoparticles

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A major concern of surfactant assisted foams in enhanced oil recovery application is the foam stability. Recently, the foam stability has been drastically improved using nanoparticles. Since adhesion energy of nanoparticles at interface is larger than adsorbed surfactant molecules, nanoparticles can provide steric barrier to foam film rupture. This study, the ability and stability of foam prepared by hydrophobic silica nanoparticle (SiO₂) /anionic surfactant systems, mixed C15-Internal Olefin Sulfonate (C15-IOS) were examined through foam column test. Alkane oils with varying alkyl chain length were used to characterized foam behaviors. The results showed that the presence of oil dramatically decreased foam ability and stability and more stable foam was obtained by the SiO₂/mixed IOS system, compared with the mixed IOS alone. For foam systems containing alkane oils, the highest resistance of foam to collapse was apparent at the highest concentration of SiO₂ in the absence of brine. The contradictory result was found in the presence of brine that the foam systems with lower SiO₂ concentrations had higher foam stability. The interactions of surfactant and nanoparticle on foam quality were discussed regarding to spreading coefficient. This findings bring an insight understanding applying for nanoparticles stabilized foams for oil field applications.

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SE-P-2 Solubility of Carbon Dioxide in Amine Blend: Effect of Cyclics and Aromatics

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Carbon dioxide (CO₂) is the most unavoidable anthropogenic greenhouse gases (GHGs) contributing to the global warming. Capture of CO₂ through chemical absorption using amine solution is the most reliable and economical post-combustion processes. However, uses of individual amine present some drawbacks. Blended amine solution has been introduced to combine the advantages of each amine solvent. The properties of amine depend on the structure. Therefore, the effect of different structure of amine was studied for screening the amine in a blended system. In this work, cyclic and aromatic amines were investigated for the CO₂ capture activities including equilibrium solubility, initial absorption rate, initial desorption rate, heat duty, heat of absorption, and basicity of amine (pKa). The results show cyclic amines have a good potential as a promotor for blended amine. However, aromatic amines show incapable of doing due to the resonance stability. The effect of different substitution group (-OH, -CH₃, -NH₃) on CO₂ absorption was also investigated. Cyclic amine substituted by -NH₃ group shows the highest potential for promotor. Moreover, the selected cyclic amine was blended with conventional amine MDEA to improve the CO₂ capture performance. The blended system helps to improve CO₂ capture performance. More results will be presented.

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SE-P-3 Improvement of Enhanced Oil Recovery (EOR) by Foam Flooding in Porous Media

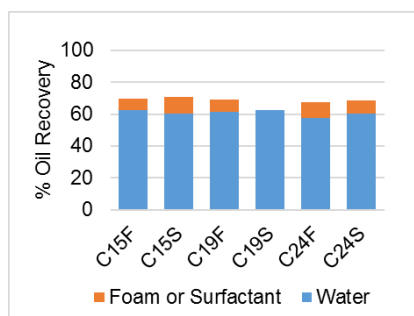
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A new and challenging technology of enhanced oil recovery (EOR) is foam flooding. Due to the special characteristic of foam can improve oil recovery by increasing sweep and displacement efficiency. Internal olefin sulfonate (IOS) with different carbon chain lengths, i.e. C15-18, C19-23 and C24-28, were employed to investigate their ability to enhance oil recovery in a sand pack flooding apparatus. Two flooding techniques, namely foam and surfactant flooding, were conducted to compare the oil removal efficiency. The condition was performed at atmospheric pressure and room temperature with presence of brine condition. The results indicated that these three surfactants can additionally recovered more oil at 5-10% of OOIP. Both foam and surfactant flooding techniques gave similar amount of additional oil; however, the surfactant flooding required higher quantities of the surfactant solution and gave slower oil breakthrough from the sand pack (i.e. about 4-5 PV of the solution injection) compared to the foam flooding.

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Oil production by foam and surfactant flooding with different chain length of Internal olefin sulfonate (IOS)

SE-P-4 Development of environmentally friendly formulation for corrosion resistance of galvanized steel sheet

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This research studies corrosion resistance of galvanized steel sheets coated by environmentally friendly coating formulations. Each coating formulation contains a silane coupling agent, i.e.: 3-glycidoxypropyl trimethoxy silane or GPTMS, a resin and a metal additive. Two types of metal additives, namely compound A containing Zirconium and compound B containing Vanadium were used at different concentrations of 1%, 3% and 5%nv. Galvanized steel sheets were coated by the prepared coating formulations using the barcoat technique. Subsequently, the coating was cured in an oven. The obtained coating films were characterized by the Scanning Electron Microscopy (SEM) and potentiostatic technique. The corrosion resistance of coated galvanized steel sheets was evaluated by the Salt Spray Test (SST) in 5%(w/w) NaCl. The results indicate that the formulation containing GPTMS with metal additive compound A at 5%nv concentration improved anti-corrosion performance significantly.

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SE-P-5 Solid-Polymer Mixed Matrix Membranes for Gas Separation: Silicone Rubber Membranes with Activated Carbon Adsorbed Liquid Additives

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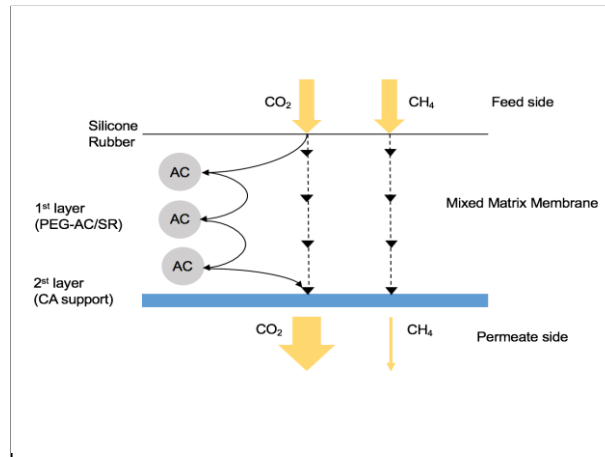
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Membrane separation process has been regarded as an alternative to conventional separation techniques due to its low capital costs and high energy savings. The removal of CO₂ from natural gas is important for diminishing the pipeline blockage and corrosion as well as maintaining a high heating value of gas stream. Mixed matrix membranes

(MMMs) have been developed for CO₂/CH₄ separation to enhance the membrane performance through permeability and selectivity by solution-coating method. MMMs composed of silicone rubber and different liquid additives such as polyethylene glycol (PEG), Triton x-100, and cetyl trimethylammonium bromide (CTAB) coating on various porous polymer supports such as polypropylene (PP), cellulose acetate (CA), and polyethersulfone (PES) were investigated. PEG emulsified silicone rubber MMMs showed superior gas separation performance to cellulose acetate membranes. However, the MMMs possessed a limited stability resulting from the undesirable PEG leakage. To stabilize the MMMs, PEG was then incorporated into activated carbon (AC) prior to adding into the silicone rubber. From the results, the amount of PEG incorporation had a negative effect on permeability but selectivity. It was found that the MMM consisting of 1 wt% PEG and 5 wt% AC in silicone rubber yielded a superior performance for CO₂/CH₄ separation.

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Facilitated transport of CO₂ and CH₄ with activated carbon on cellulose acetate support membranes (PEG-AC/SR/CA).

SE-P-6 Material Flow Analysis (MFA) Study for Sustainable Management of PVC Wastes in Thailand (Phase III)

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Polyvinyl chloride (PVC) is one of the most commonly used plastics in worldwide. In Thailand, PVC products are used for consumption more than 400,000 tons annually. In previous studies, Material Flow Analysis (MFA) model was developed to estimate the quantity and route of PVC wastes in Thailand using annual production data as an input in the model along with average service life time of each product. Furthermore, the primary data were collected from recycle shops and landfill sites were used to estimate the amount of PVC wastes generated and recycled on yearly basis in Thailand. For developing MFA model, this requires further investigation in the phase III. In this phase, firstly, the MFA model was developed by considering consumer behaviour & economic decision. Moreover, Sheet and film was investigated in order to expand range of PVC products which covers about 93% of total PVC products in Thailand. In addition, the existing primary data were revised along with the new data were gathered from other recycle shops and converters. Finally, potential improvements of PVC waste management and suitable data collection system are proposed in order to promote environmentally friendly schemes for PVC production and utilization.

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SE-P-7 Upgrading of Petroleum Residue by Nitrogen Doping for CO₂ Adsorption

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Carbon dioxide (CO₂) is one of the anthropogenic greenhouse gases and it is the major contributor to global warming. Carbon adsorbent becomes a promising porous solid adsorbent to capture CO₂ at below 200 °C but it still gives low adsorption capacity. An introduction of nitrogen content on carbon adsorbents has been studied to improve their CO₂ adsorption capacity. In this research, petroleum residue (PR) had been selected as a carbon precursor and furfurylamine-based benzoxazine (BZ) was used as a nitrogen source. The effect of nitrogen doping ratio on petroleum residue (BZ:PR) was investigated with BZ:PR ratio of 0.7:1, 1:1, and 3:1. Then, the nitrogen-doped petroleum residue was produced via a thermal process followed by a physical activation using CO₂ at 900 °C. The preliminary results showed that increasing the nitrogen doping ratio can improve the CO₂ adsorption capacity. Carbon adsorbent with BZ:PR ratio of 3:1 exhibited the highest CO₂ adsorption capacities of ca. 2.16 mmol/g at 40 °C, 350 psia.

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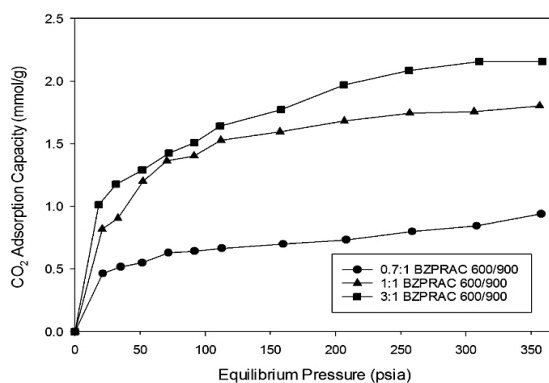


Figure 1 CO₂ adsorption isotherms of nitrogen-doped carbon adsorbents at 40 °C

SE-P-8 Microemulsion Formation of Semi-solid Fats and Vegetable Oils Based on HLD Concept for Cleaning Applications

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In water washing, some vegetable oils can form semi-solid crystalline. The formation of semi-solid fat or waxy soils results weak interactions between the oil and surfactant during cleaning process. In this study, the anionic extended surfactant (C₁₄₋₁₅-8PO-SO₄) systems were applied to form a middle phase microemulsion with various vegetable oils with the aim to improve the interaction of oil phase. The middle phase with high oil solubilization and low interfacial tension were formulated for semi solid fats removal. The addition of co-surfactant (alkyl polyglycol ether) in the mixed surfactant systems was also evaluated to observe the solubility enhancement. The Hydrophilic-Lipophilic Deviation (HLD) concept was conducted to estimate the required Cc and K parameter for examination the correlation with the experiment. The IFT measurement of formulated surfactant systems was evaluated at different salinities, surfactant concentrations to determine the optimum salinity. It was found that the extended surfactant system formed the middle phase microemulsion with coconut, soybean and palm oil at the optimum salinity of 7 wt%, 9 wt% and 8 wt% NaCl, respectively. For the system with co-surfactant, the middle phase microemulsion formed at lower optimum salinity.

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SE-P-9 Effect of Methane Adsorption on the Cyclic Adsorption and Desorption of Carbon Dioxide on Coconut Shell Activated Carbon

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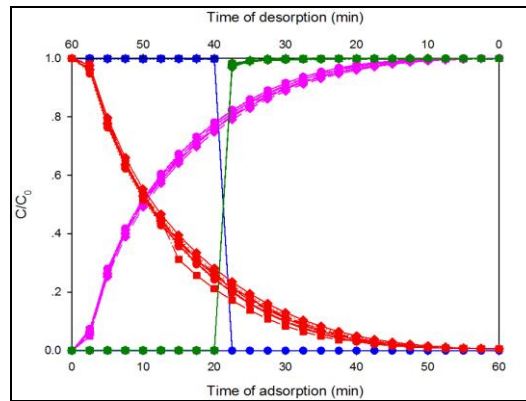
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Adsorbed Natural Gas (ANG) technology based on natural gas adsorption in porous materials at relatively 3.5-4 MPa and at room temperature is challenging. In this work, cyclic adsorption and desorption of carbon dioxide and methane by using coconut shell activated carbon (CSAC) was investigated. For every cycle, pure carbon dioxide was fed into the packed bed column for one hour in the adsorption step. After that, the desorption step started by using pure methane for one hour. The cycle was repeated for ten times. The same results were shown in all cycles. In the adsorption step, carbon dioxide was adsorbed on the CSAC, and the breakthrough time was around 20 minutes. For the desorption step, methane slowly adsorbed on the CSAC while carbon dioxide continually desorbed out. After one hour of desorption step, carbon dioxide remained on the CSAC around 1-2 percent of the initial concentration. It can be concluded that, methane can adsorb on the CSAC that fully contained carbon dioxide in many repetition of adsorption and desorption.

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Adsorption and desorption of carbon dioxide and methane for 10 cycles, (Blue) CH₄, (Green) CO₂ for adsorption step, (Pink) CH₄, and (Red) CO₂ for desorption step.

SE-P-10 Influence of Butanol/Ethanol Blend Ratios in Palm Oil/Diesel based Microemulsion Biofuels using Alcohol Ethoxylate Surfactant - Phase Behaviors and Fuel Characteristics

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The vegetable oils based reverse micelle microemulsions, known as microemulsion biofuels, have been increased in attention for biofuel production. This work aims to formulate microemulsion biofuels containing palm oil/diesel blend as a nonpolar phase, and ethanol/butanol, as a polar phase. The nonionic alcohol ethoxylate surfactant containing polyethylene oxide group (EO1) was selected as a stabilizing agent. A pseudo-ternary phase diagram was conducted to determine an isotropic region in the phase behavior of microemulsion systems. The ability of butanol added for reducing the phase separation and amount of surfactant required to form the microemulsified fuels was explored. Together with, the effect of cosurfactant structure, straight chain (1-octanol) and branch chain alcohol (2-ethyl-1-hexanol) were investigated systematically through their phase behaviors. The fuel properties (i.e., kinematic viscosity,

density, heating value) were examined and compared with neat biofuels. The results suggested that the percentage of surfactant used to stabilize the microemulsion decreased with increasing butanol fraction in the mixture of butanol/ethanol blend. The microemulsion with branching structure in cosurfactant required more surfactant to formulate the microemulsions. The addition of butanol to palm oil/diesel blended with ethanol affecting fuel properties was noted.

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SE-P-11 Investigation of Dispersants for Water-in-Oil Emulsion Stabilization for Simulated Waxy Crude Oil

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One of the most challenging problems in petroleum pipeline transportation is wax deposition. Waxy crude oil can deposit in pipeline in winter when the ambient temperature drops below 20°C. Crystallization of waxes causes plugging problem and operation has to stop for pipeline cleaning. Thus, in this research, the appropriate dispersants are investigated. Various types of dispersant, which are alkyl alcohol ethoxylate series (AE-EO₁, AE-EO₃, AE-EO₅, and AE-EO₉) and C₁₆₋₁₈ fatty alcohol polyalkylene glycol ether (MARLOX[®] RT 42 and 63), are used for stabilizing and dispersing of waxes in oil. Water-in-oil emulsion is simulated via mixing mineral oil with paraffin wax, brine and dispersant. Moreover, the optimum weight percentage of appropriate dispersant and brine is investigated. Phase behavior can be used to describe the types of microemulsion. Hydrophilic-lipophilic deviation (HLD) model is a tool for emulsion type verification. In addition, emulsion stability, viscosity, interfacial tension and morphology of emulsion with different effects are also studied.

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Process and System Engineering (PS)

PS-P-1 Kinetic Study of Wax Deposition using Cold Finger Apparatus

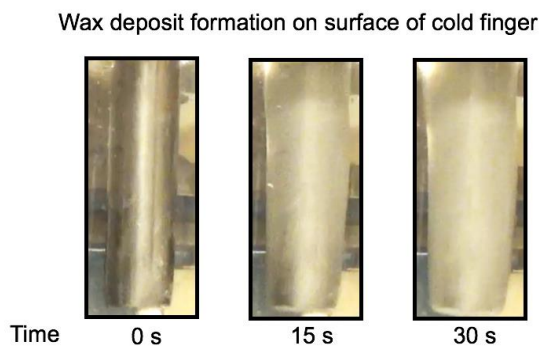
Tunya Ketjuntiwa^a, Claudio Vilas Boas Favero^b, Luqman Mahir^b, R.G. Larson, H.S. Fogler^b Pomthong Malakul^a

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The formation of the incipient layer of wax deposit when waxy oil is exposed to a cold surface is studied. Using a cold-finger apparatus, the evolution of deposit thickness is monitored with a video camera, allowing one to resolve the deposit layer formation from inception up to long times where deposit thickness no longer grows. Characterization of wax deposits shows that incipient layer has identical composition to waxy oil, indicating that deposit is not formed by a diffusion process. Modeling shows deposit formation at the investigated conditions cannot be explained by a diffusion process.

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PS-P-2 Life Cycle Assessment of Wood-based Refused-Derived Fuel Production and Utilization in Thailand

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Wood-based Refused-Derived Fuels (RDF) become one of the important alternative energy derived from biomass feedstock. This research investigates on a comparative life cycle assessment (LCA) of Wood-based RDFs and fossil energy. The LCA methodology is a standard frame work of ISO14040 which allows comparing environmental impacts of those two fuels as described in terms of CO₂ equivalent. The scope of this study focuses on production and utilization of Wood-based RDFs in Thailand by compilation and evaluation the inputs, outputs and potential environmental impacts of a product. The inventory data are gathered from four representative factories that pass the criteria of Department of Industrial works, Thailand. The first two factories are wood pellet RDF producers, the others are the RDF consumers. The system boundary is performed through cradle-to-grave analysis. The impact assessment is conducted using SimaPro, life cycle analysis's software. The environmental impacts of wood-based RDFs will be revealed together with the CO₂ emissions reduction strategies will be addressed for future sustainable biomass to energy production.

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PS-P-3 Intensification of Ethylene Glycol Production Process

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Ethylene glycol is important to many petrochemical chains such as polyester fiber and antifreeze production. This can be confirmed from the high demand of this chemical that keeps increasing. In this work, phenomena-based process intensification is considered in order to determine an intensified and more sustainable design of the ethylene glycol production process. Three main stages of the sustainable design framework are applied. In Stage-1, ethylene glycol base case design is obtained which consists of ethylene oxidation and ethylene oxide hydration processes. This design is verified through a computer simulation to obtain mass balance and energy balance data. After that, economic factors, sustainability metrics and environmental impacts of the base case are analyzed to identify the process “hot spots” and bottlenecks in the second stage. In Stage-3, more sustainable design is generated by breaking down the base case design into tasks and phenomena scales then the process is recombined again into an alternative design that matches the targets, thereby reducing the process hot-spots, bottlenecks and limitations. As a result, the membrane separation was suggested and added to the ethylene glycol production process (See Figure 1) to help reduce the process energy consumption for 54.51 percent.

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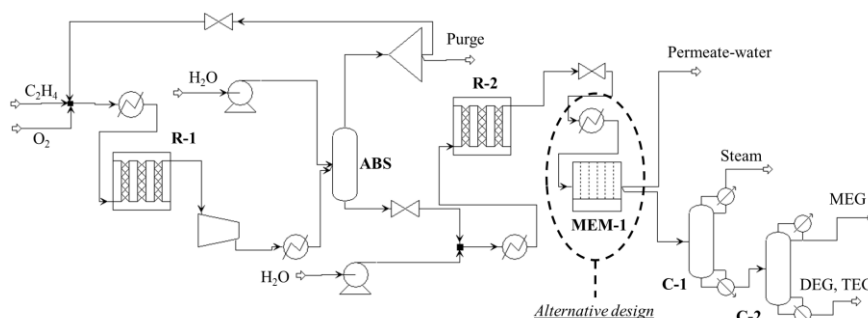


Figure 1. the improvement of ethylene glycol production process

PS-P-4 Improvement of Life Cycle Assessment Software and its Applications

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Due to the growth of industrial technology, environmental awareness has become the important for developing chemical process designs. Life Cycle Assessment (LCA) is a technique which analyses environmental impacts through the entire life cycle of products and/or processes, which is an important key to identify the environmental hotspot and make more informed decision for process design. For this purpose, LCSoft has been developed with ability to perform LCA and integrate with other process design tools such as process simulation software (PROII/ASPEN), economic analysis tool (ECON), and sustainable process design tool (SustainPro). Also, several interpretation features are available, for example, sensitivity analysis, alternative comparison, and eco-efficiency evaluation. More specifically in this paper, new version of LCSoft has been presented with improvements in terms of performance and application range. The development framework consists of four tasks: (1) new pathway and improvement for LCIA calculation; (2) extension of the LCI database; (3) development & introduction of new LCSoft features, parameter sensitivity analysis, normalization, and data quality indicator; (4) validation of the integrated software. The assessment results for para-xylene production by toluene methylation are compared with LCA software, SimaPro, as a case study. The results show that LCSoft provide reliable calculations with systematic analysis and features to help sustainable process design very efficiently.

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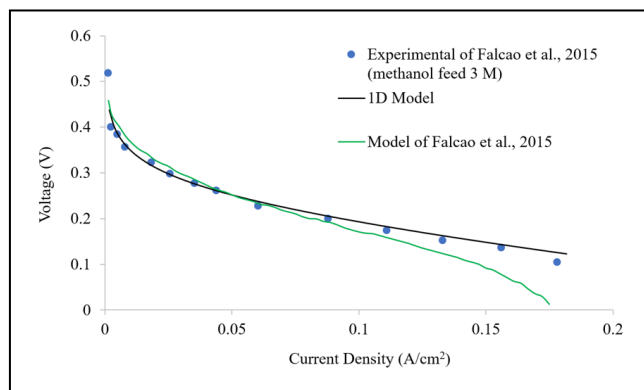
PS-P-5 Numerical Simulation of One-dimensional Model in Direct Methanol Fuel Cell

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Recently, petroleum based energy sources are diminished quickly as the fossil fuel energy consumption increases. The Direct Methanol Fuel Cell (DMFC), one of many fuel cell types, has attracted much attention due to environmental concern, low cost, and ease of usage, when compared with the energy sources derived from the fossil fuel. In this work, an unsteady-state, one-dimensional numerical simulation was constructed and used to predict the DMFC performance by using a numerical simulation under the effects of operating conditions and sensitivity analysis on the cell performance. The results were then compared with the experimental data from previous work and a steady-state model. It was shown that an unsteady-state, one-dimensional model provided more closer results with experimental data than the steady-state, one-dimensional model did. The sensitivity analysis of parameters was investigated to improve the fuel cell performance by optimizing related parameters and design variables. The results showed that the cell voltage increased with increasing the cell temperature and operating pressure. The optimal conditions of DMFC were 363 K and 3 atm. An important conclusion of this work is that the DMFC simulation is significantly useful to find the optimal design for and the operation of DMFC.

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Comparison between the present model predictions and those proposed by Falcao et al., 2015 with the experimental Falcao et al., 2015 at high methanol feed concentration.

PS-P-6 Multi-period Heat Exchanger Network Retrofit under Fouling Effects.

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Heat exchanger networks (HENs) are important to industrial because they manage heat transfer between hot and cold process streams, resulting in reduction of operating cost. The accumulation of fouling deposits on heat transfer surface area of exchanger causes more energy usage. In order to decrease extra utilities cost, regarding fouling with multi-period in HEN is proposed to HEN retrofit. The model of HEN retrofit represented here is based on stage-wise superstructure by Yee and Grossmann (1990) with non-isothermal mixing assumption. In order to solve large-scale problems, the sequential initialization techniques by complex mixed integer nonlinear programming (MINLP) are required. There are four main initialization steps; MILP, NLP, MINLP and relocation steps. The multi-period HEN retrofit is to find the HEN design consuming optimal hot and cold utilities and operating under fouling-accumulation periods of twelve months before annual cleaning.

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PS-P-7 The Systematic Screening Methodology for Surfactant Flooding Chemicals in Enhanced Oil Recovery

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The framework for systematic screening of surfactant consists of 4 steps. First, two case studies are defined as problem, one is the case study from the lab result, another is from literature. Then, the Hydrophilic-Lipophilic Deviation (HLD) value is selected as the main target property for surfactant injection and its value needs to be closed to zero to create the middle-phase microemulsion that gives the lowest interfacial tension of the oil-water system. After that, the characteristic curve (Cc), which is one of the parameters in HLD equation, is modeled by the group contribution technique. The group contribution model for anionic surfactants gives an relative error of 3.5. While the model for nonionic surfactants still has very high relative error which is 15.2. The results show that both models can be used to qualitatively predict the Cc values that give HLD values with consistent results with the interfacial tension from experiment. Other properties such as cloud point, boiling point and melting point also used as target properties. Finally, all candidates are screened to find those that match the target properties for each case study. The screening results for both cases agree well with the experimental results.

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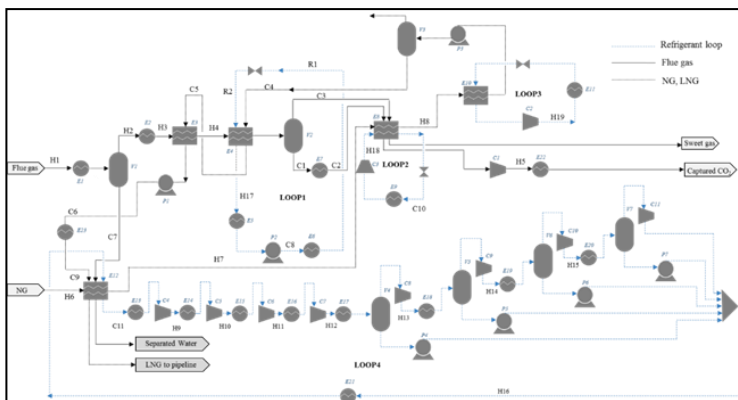
PS-P-8 Optimization for Cryogenic Carbon Dioxide Capture and LNG Processes by Shaft Work Targeting and Mathematical Programming

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Nowadays, low-temperature process; which is called sub-ambient condition; plays a fundamental role in many industrial processes using refrigeration system. To deal with sub-ambient condition, large amount of energy is required for shaft work and operating cost. The combination of pinch and exergy analysis helps identify the potential to minimize shaft work in low-temperature process because the strength point of this method is that all process stream properties of temperature, enthalpy, and exergy are considered as a graphical presentation. In this research, there are two approaches of energy minimization which are shaft work targeting by graphical method (Linnhoff, 1992) and mathematical programming by using Non-Linear Programming model (NLP) (Colmenares and Seider, 1989). Cryogenic carbon capture and liquefied natural gas (LNG) process (Fazlollahi, 2015) is chosen as a base case of this work because LNG is worthy utilized as a refrigerant for capturing carbon dioxide in exhausted flue gas from power plant. According to the result, shaft work is reduced comparing with base case, by using both methods.

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Cryogenic carbon capture and LNG process

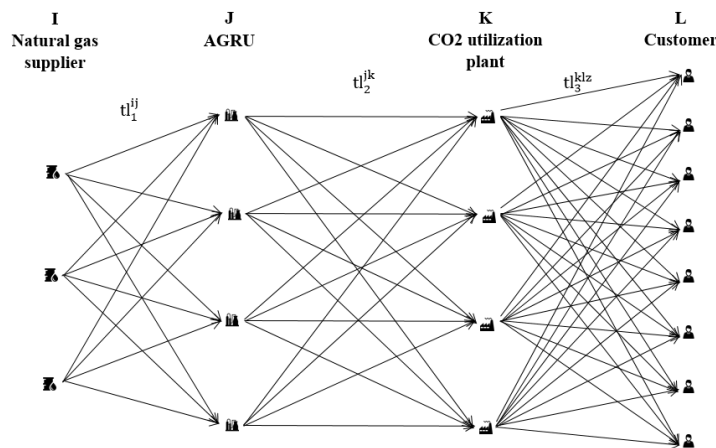
PS-P-9 Optimal Supply Chain Design for Captured CO₂ with Stochastic Programming.

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Currently, the emission of carbon dioxide (CO₂), a major greenhouse gas and causing global warming, becomes a serious issue for many industries. Acid gas removal unit (AGRU) is used for removing CO₂ and H₂S from raw natural gas. After that, the CO₂ utilization is required for producing value-added products from captured CO₂. Mathematical programming has been applied to resolve problems of captured CO₂ distribution formulated as a supply chain. This supply chain consists of raw natural gas sources, acid gas removal processes, industries or manufacturers for CO₂ utilization; and end-use customers. Since there is uncertainty in feed stream composition, the utility and operating costs will be dramatically changed. To face with this challenge, stochastic programming, which takes into account uncertain factor, will help design the efficiently optimal CO₂ supply chain. This study proposes stochastic programming for CO₂ supply chain through CO₂ capturing process using mix-integer nonlinear programming (MINLP) in order to minimize overall costs under uncertainty in composition of raw natural gas. The proposed programming is compared with deterministic programming under uncertain factors, and the result shows that, this proposed programming gives a better opportunity than deterministic programming in term of operating decision in less transportation cost, operating cost and penalty cost, significantly.

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CO₂ supply chain diagram

PS-P-10 Effect of Bead Size and Centrifugation on Asphaltene Deposition

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The goal of this investigation is to assess validity of two aspects of the packed bed asphaltene deposition methodology and model. The first aspect is on the validity of the mass-transfer coefficient used in the deposition model with respect to bead size in packed bed; the second aspect is on the relationship between the concentration of unstable asphaltenes, the method to measure this concentration, and the deposition rate. In the first part, it was observed that the deposition rate increases as the bead size decreases, as is predicted by the mass-transfer correlation used. In the second part, results indicate that concentration of unstable asphaltenes based on long time centrifugation of fresh oil-heptane mixture is the appropriate scaling for asphaltene deposition rate, instead of aged oil-heptane mixtures.

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PS-P-11 Investigation of Asphaltene Aggregation Kinetics in the Presence of Water-in-oil Emulsion

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Water-in-oil emulsions (or water droplets in oil) are very common in petroleum production and they are undesirable due to the fact that these emulsions increase pumping and transportation expenses, corrode pipes and also jeopardize downstream refinery catalysts. They are naturally formed by asphaltene, a hydrocarbon component found in petroleum liquid. However, many researches claimed that not all of the asphaltene particles are responsible for stabilizing emulsions; only a small portion of asphaltene called interfacially active asphaltene (IAA) could induce asphaltene aggregation and, afterwards, emulsion formation processes. In order to investigate and characterize this fraction of asphaltene, the primary goal is to separate IAA. With centrifugation method, the water droplets along with IAA are settled down at the bottom. Followed by the study of asphaltene behavior as a function of time, an experimental technique, detection time, developed by Tabish (2009) is utilized as a standard procedure for investigating the asphaltene aggregation behavior. The results from the studies show that the removal of IAA exhibited an exceptional interfacial phenomenon and affect the asphaltene aggregation kinetics. The asphaltene-detected time increases and can be described as a linear trend with increasing the times of centrifugation.

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PS-P-12 Effects of Cyclone Vortex Finder on Solid Separation Using Computational Fluid Dynamics Simulation

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Biomass and fossil fuels are conventional fuels which are combusted for electricity production in various industries. Inorganic compound commonly found in ash is associated with the product gas after combustion. The device that is widely used to separate the ash out of product gas is cyclone, making use of centrifugal and gravity forces, due to the simple construction, low maintenance cost, and high reliability. Since conventional cyclone separators cannot separate solid particles with a high performance, the separation of particles in different novel cyclone shapes have been studied via three-dimensional computational fluid dynamics (CFD). The parameters in consideration is the diameter of gas outlet (vortex finder). The RNG $k-\epsilon$ model is used for flow analysis behavior inside the cyclone. The computational meshes are approximately 170,000-200,000 cells. Then, the simulation results have been compared with the experimental results from *Azadi et al.* (2010). It has been found that decreasing the diameter of vortex finder by 10% comparing with Stairmand cyclone will increase the collection efficiency by about 1.4%.

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Biomedical and Green Polymers (BG)

BG-P-1 Low Temperature Bioplastic for Medical Application

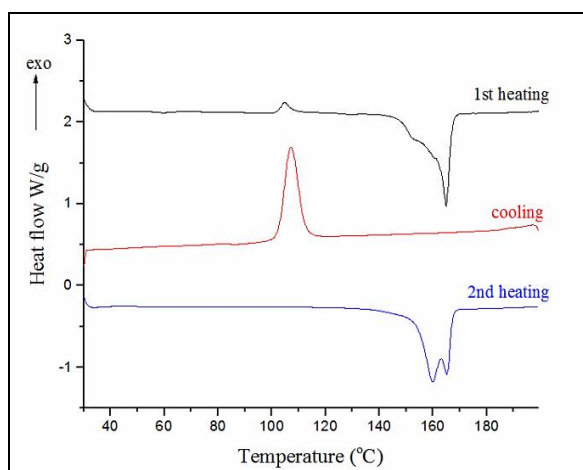
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Polymers have been widely applied in health rehabilitation as substitutes for plaster to correct and support body structures after surgery because they are lighter, easily molded and can be removed for cleaning and patient bathing. Most of the splinting materials today are referred to as low temperature thermoplastics (LTTPs) because it can be activated at low heat (45-70°C). Poly(lactic acid) (PLA) is one such polymer with biodegradability, biocompatibility, good mechanical properties, processability and widely used as biomedical materials. However, PLA is still pretty brittle for using in some applications. In this study, PLA is synthesized for the low temperature splinting materials by bulk ring opening polymerization in the presence of Sn(Oct)₂ as catalyst and cardanol as plasticizer. The effects of plasticizer content, polymerization time, and polymerization temperature on the glass transition temperature, molecular weight, percentage of yield and percentage of monomer conversion are investigated. In addition, the physical and mechanical properties of poly(lactic acid) impregnated polyester net for splinting materials are also investigated.

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DSC curve of the synthesized PLA with cardanol content 3 wt% at 160°C for 8 h

BG-P-2 Degradation of Organic Solvent-saturated Chitin Hydrogel by Plasma in Liquid

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A discharge of plasma in liquid, so called solution plasma, was used to reduce molecular weight of chitin hydrogel dispersed in a dilute salt solution. In this study, chitin was prepared from squid pen. It is known that chitin has intense hydrogen bonding interaction in its structure, leading to its high crystallinity and low solubility. To overcome this obstacle, chitin in the form of hydrogel was prepared by dissolving chitin in CaCl₂-saturated methanol, followed by precipitation of chitin solution in water. The remaining hydrogen bonding interaction in chitin hydrogel was further disrupted by submersion of chitin hydrogel in various organic solvents, i.e. DMSO, DMS and ethanol. It was found that DMF-saturated chitin hydrogel had the lowest crystallinity and could undergo degradation by solution plasma in a dilute KCl solution. The effects of KCl concentration and plasma treatment time on molecular weight reduction of DMF-saturated chitin hydrogel were investigated. It was found that not only molecular weight of the degraded chitin

but also the yield of water-soluble product of degraded chitin was influenced by KCl concentration and plasma treatment time. It might be concluded that solution plasma could be applied to produce water-soluble chitooligosaccharide from DMF-saturated chitin hydrogel dispersed in KCl solution. Moreover, anti-cancer activity against lung cancer cells of the water-soluble chitooligosaccharides was evaluated.

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BG-P-3 Chitosan Scaffold from A Single Water-based Multi-functional Carboxylic Acid System

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Chitosan (CS) is a potential material for scaffold fabrication due to the versatile properties such as anti-microbial activity, biodegradability, biocompatibility, and hemostasis. The most known preparation of CS scaffold is related to the hydrogelation in acetic acid with dialdehyde crosslinker, following by lyophilization. This scaffold obtained has to face with the problems of acids odor as well as toxicity. To our idea, the multi-functional carboxylic acids are the alternative solvents as they are odorless and they also form ionic interaction with amino groups on CS chains. It is expected that at that time they provide dual functions of (i) proton donor to protonate CS for the dissolution, and (ii) crosslinker to give amide and/or ester bond through the conjugating reaction. Here, we originally report about obtaining CS scaffold from a single water-based multi-functional carboxylic acid system without the use of the additional crosslinker. The work covers the hydrogels and the consequent scaffolds prepared from various types of multi-functional carboxylic acids including their physical and mechanical properties, morphologies, cell viability, and other related performances.

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BG-P-4 Surface Modification of Cotton Fabric by DBD Plasma Treatment for Preparation of Cotton Fabric-reinforced Bacterial Cellulose Composites Containing Gelatin

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The cotton fabric-reinforced bacterial cellulose composites (BC/cotton fabric composites) containing gelatin on the fabric were fabricated for wound care application. The surface of cotton fabric was pre-treated with dielectric barrier discharge (DBD) plasma before soaking in a gelatin solution in order to accomplish the deposition of gelatin onto the cotton fabric. The uniformity of gelatin deposited on the surface of cotton fabric was examined by color straining using amido black 10B. The gelatin content in the cotton fabric was calculated from the percent nitrogen content determined by elemental analyzer and X-ray photoelectron spectrophotometer (XPS). Moreover, the scanning electron microscope (SEM) images of BC/cotton fabric composites containing gelatin revealed that the presence of gelatin in the plasma-treated cotton fabric led to denser network structure of BC, more fibers inter-linked between each layer of BC and more uniformity of pore-sized structure of BC. It might be concluded that DBD plasma treatment could enhance the interaction between cellulose in cotton fabric and gelatin, leading the higher amount of gelatin deposited in the cotton fabric and gelatin on the cotton fabric made the surface of cotton fabric preferable for the growth of the bacteria, resulting in more fiber production.

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BG-P-5 Electrospinning Carbonized Hybrid Metal Nano-fiber Composite for Electrochemical Applications in Biosensor

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Dopamine (DA) is an essential neurotransmitter that controls the mammalian central nervous system, therefore irregular DA levels can cause such various diseases as Parkinson's disease, Alzheimer's disease, and mental illness. Screen-printed carbon electrode (SPCE), a type of electrochemical technique, has been used to detect DA because possesses high sensitivity, low cost, and rapid detection rate. Modification surface of SPCE at working electrode is necessary to enhance charge transfer properties for extending limit of detection by using conductive material. In this study, the conductive material, that is used to modify electrode surface, is carbon nanofibers and its composites incorporating with metal nanoparticles. Poly(vinyl pyrrolidone), PVP, is electro-spun and used as a precursor to turn into carbon nanofibers and metal nanoparticles that are used to enhance electrochemical properties of carbon nanofibers is Co. Additionally, ruthenium (Ru) and zinc (Zn) are incorporated to study electrochemical behavior as well. The electrochemical behavior was examined by cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), and X-ray diffraction (XRD) were used to characterize the morphology and physical properties of carbonized composite nanofibers.

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BG-P-6 Preparation of Thermo-responsive Hydrogel from Gellan Gum and Methylcellulose for using as Advanced Wound Dressing

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Cavity wound is one of the complexity of clinical managements. In general, the wound care process still use soaked gauze for dressing and packing cavity wound. This approach is point to be concern for patient because it is uncomfortable to the wound site. However, *In-situ* hydrogel formation that undergo sol-gel transitions response to temperature has been growing interest. In this study, the thermo-responsive injectable hydrogel for using as cavity wound dressing was prepared by physical blend of gellan gum (GG) and methylcellulose (MC) in aqueous solution. The presence of the rheological property of the blend was observed by a stress-controlled rotational rheometer. The results revealed that GG/MC blends exhibit a board linear viscoelastic region, which require an applied stress larger than 100 Pa to break the network of structure. Not only the gelation temperature but also gelation time of those can be tuned by GG and/or MC concentrations. Besides, FT-IR technique was used to confirm the occurrence of a specific chemical reaction and *in-vitro* cytotoxicity test on human fibroblast cells via MTT assay was also evaluated to prove that can be used in human tissue.

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BG-P-7 Preparation and Characterization of Nanospheres loaded PLGA/Ciprofloxacin Hydrochloride for Used as Extended Anti-bacterial Drug Release

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Pressure ulcers are areas of damage to skin and underlying tissue caused by continuous pressure or friction on part of the body which are the most common problems that found in chronic wound. In this study, a hydrogel dressing loaded with poly (lactic-co-glycolic acid) or PLGA nanospheres containing ciprofloxacin hydrochloride (fluoroquinolone antibiotic) prepared by water in oil in water technique, can be used for a treatment for this type of wound since not only the drug can inhibit the bacteria in the wound site but also the flexible hydrogel can absorb a pressure force generated from a body that could make the wound more severe. In this research, morphology, size, entrapment efficacy, kinetics of release and stability of nanospheres are systematically studied. Therefore, PLGA/Ciprofloxacin hydrochloride nanospheres prepared with various ratios were blended in hydrogel matrixes which were optimized with the suitable mechanical properties. In addition, the antibacterial activity of hydrogel against *E.coli* and *S.aureus* are determined as a percentage of bacterial reduction at 24 hours. Also, a cytotoxicity test of material is performed by using mouse fibroblast (L929) cell as a model to verify that developed dressing can be safely used on human and animal skins.

BG-P-8 Synthesis of Novel Photomediated Silver Nanoprisms via a Light-induced Transformation Reaction for Use as Anti-bacterial Wound Dressing

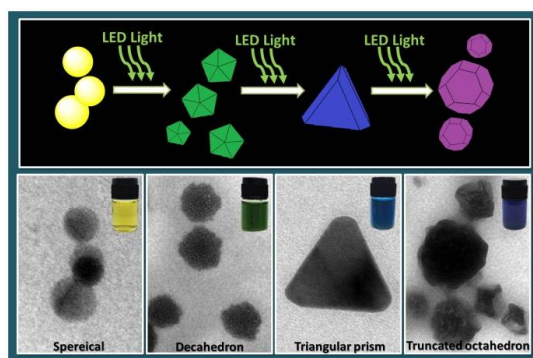
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Silver nanoprisms are useful for medical applications as an antimicrobial agent due to their large surface area hence providing better contact with microorganisms. Yet, they are toxic to mammalian cells. To alleviate this problem, synthesis of silver nanoprisms via the light-induced transformation reaction with 530 ± 20 nm LED light is purposed. Under the proper conditions, this reaction is controllable and exceptionally efficient with high transformation yields. Additionally, it is ecofriendly which excluded the hazards from the use of harmful oxidizing agents. The synthesized photomediated silver nanoprisms (PAGNPrs) were characterized by Transmission electron microscopy (TEM), X-ray Diffractometer (XRD) and UV-visible spectroscopy. The antibacterial effect of the PAGNPrs against *Escherichia coli*, *Pseudomonas aeruginosa*, *Enterococcus faecalis* and *Methicillin-resistant Staphylococcus aureus* (MRSA) by determining both MIC and MBC is reported. The results obtained from various characterizations revealed that PAGNPrs were in spherical, decahedron, triangular prism and truncated octahedron shape. The MIC and MBC of the synthesized photomediated silver triangular nanoprisms was found to be optimum at 2.5 mM which is considered very low when compare to the commercial silver-containing dressing in the market. Moreover, the synergistic activity of the PAGNPrs with bacterial celluloses (BC) against above mentioned bacteria have better antibacterial effect as compare with pure bacterial cellulose. Thus, the photomediated silver triangular nanoprisms can be used as the remarkably effective antibiotics wound dressings.

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Synthesis of effective antibacterial silver nanoprisms via the light-induced transformation reaction.

BG-P-9 Preparation and Properties of Chitosan Derivatives/Starch Foam for Use as Oral Wound Dressings

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Tooth extraction is general surgery in the mouth. After tooth extraction, patient must bite gauze to take pressure and absorb the excess of blood to stop bleeding. This way can stop bleeding and create blood clotting about 30 minutes to 1 hour up to the pressure and blood clotting time for each healthy person but for most of children and older who do not have sufficiency pressure to stop bleeding that can cause of excessive bleeding. Moreover, a stiff gauze can damage the wound site after removing blood clotting and start bleeding again. So, hemostatic foam has been interesting material that can be used to stop bleeding and also absorb the pressure at the wound site. In this study, foam was prepared by a blending of Starch with carboxymethyl chitosan (CMCs) by using glyoxal as a crosslinking agent. Starch is chosen for this study due to that it is inexpensive, bio-degradable and bio-compatibility to the human cell. CMCs also have a hemostatic property and excellent water absorption. Physical and chemical properties of foams; compressive modulus, water uptake and stability were optimized to reach a target properties of oral surgical

wound dressings. In addition, *in vitro* cytotoxicity on human fibroblast cells by MTT assay was also studied to verify that it can be used in human tissue.

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BG-P-10 Synthesis of Quaternized Kappa-carrageenan for Transdermal Delivery

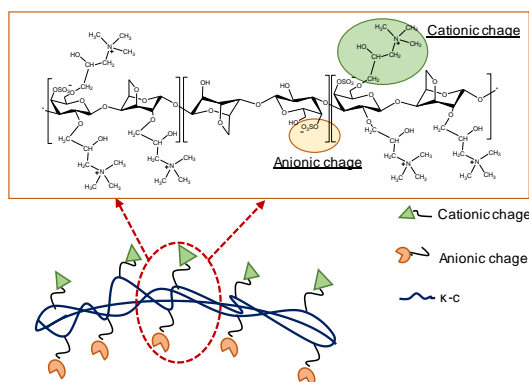
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The kappa-carrageenan (κ -C) is naturally occurring anionic polysaccharide from marine red algae. κ -C is widely used in transdermal delivery systems because of its good mucoadhesive polymers, non-toxicity, biodegradability and biocompatibility. However, the κ -C is not electrostatically attracted to the anionic surfaces of skin and low solubility. In contrast, the functionalization of κ -C with cationic charged can improve its binding to keratinized surfaces of skin and enhance its solubility. So, the aim of this study was to synthesize amphoteric κ -C by quaternization of κ -C with q188 for enhancement solubility for transdermal delivery. The amphoteric κ -C was synthesized by varying concentration from 10 to 75% (v/v) of q188 at 70 °C for 2 h. The synthesized q188- κ -C was confirmed by ¹H NMR and FT-IR. The highest degree of quaternized (%DQ) 50% was found in 25% (v/v) q188 addition. Which was calculated from ¹H NMR analysis. The preliminary study of cytotoxicity of κ -C and q188- κ -C showed non-cytotoxic to mouse normal cells (L929) by MTT assay. Moreover, the solubility of the q188- κ -C was 69±0.01% higher than that of κ -C at pH 7.4 which presented 11±0.03% solubility. Thus, this quaternized q188- κ -C can be used for transdermal delivery base with amphoteric κ -C and enhance water solubility.

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Scheme 1 Synthesis of pathway amphoteric κ -C

BG-P-11 OPN Immobilization on Surface-grafted Poly(acrylic acid) Brushes to Promote Osteoblast Adhesion and Proliferation

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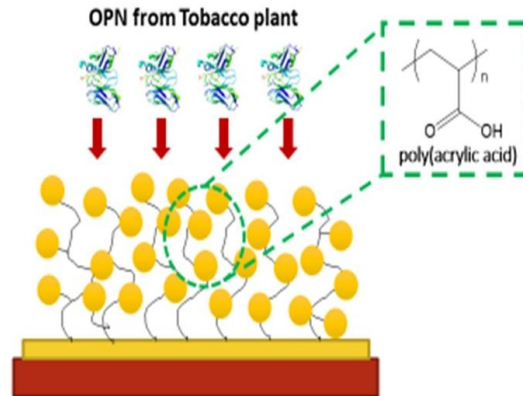
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In this research, glass substrates were grafted with poly(acrylic acid) (PAA) brushes via surface-initiated reversible addition-fragmentation chain transfer (RAFT) polymerization. ¹H NMR analysis of PAA formed in solution indicated that the polymerization was well-controlled. Osteopontin (OPN) extracted from Tobacco plant was then immobilized on the surface-grafted PAA brushes (SiO₂/Si-OPN) using EDC/NHS as coupling agents. Stepwise surface modification was verified by water contact angle measurements, Fourier transform-infrared spectroscopy (FT-IR) and x-ray photoelectron spectroscopy (XPS). MC-3T3-E1 cells cultured on the SiO₂/Si-OPN were better spreading than

those on pristine glass substrate. Moreover, polymerase chain reaction (PCR) analysis indicated that expression levels of the following genes, namely collagen I (Coll I), alkaline phosphatase (ALP), osteocalcin (OCN), osterix (Osx), Runt-related transcription factor 2 (Runx 2) of MC-3T3-E1 cells on the SiO₂/Si-OPN were higher as compared with those on pristine glass substrates. These results indicated that OPN immobilization on surface-grafted poly(acrylic acid) brushes can promote osteoblast adhesion and differentiation implying that OPN can potentially be used for bone tissue engineering applications.

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OPN Immobilization on surface-grafted PAA brushes

BG-P-12 Bacterial Cellulose Membrane Immobilized with Plant-derived Osteopontin for Bone Tissue Regeneration

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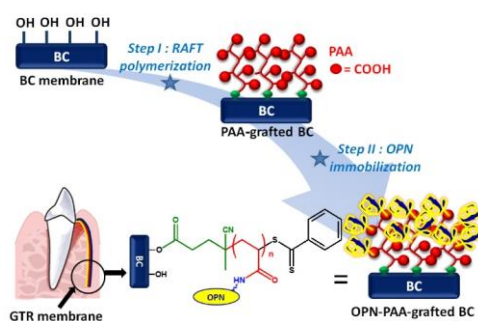
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Bone defects resulted from trauma, surgery, or infection remains a major health problem. Guided Tissue Regeneration (GTR) is reported as one of the commonly used barrier membrane to induce regeneration by isolating the bone defect from the surrounding connective tissue and providing spaces for new bone formation. Bacterial cellulose membrane (BC) is recognized as a potential barrier due to its sufficient mechanical strength, biocompatibility, and ease for surface functionalization. Here in this research, plant-produced osteopontin (OPN) was selected to be immobilized on BC surface in order to promote cell adhesion and osteogenic differentiation. BC was first surface-grafted with poly(acrylic acid) (PAA) brushes via reversible addition fragmentation chain transfer (RAFT) polymerization. OPN was subsequently immobilized on the PAA-grafted BC via amidation reaction between carboxyl groups of PAA and amino groups of OPN. Attenuated total reflection-Fourier transform infrared spectroscopy (ATR-FTIR) was used to verify the success of stepwise modification. Cell adhesion and osteogenic differentiation of human mesenchymal stem cells (hMSCs) cultured on OPN-PAA-grafted BC were confirmed by immunofluorescent staining and quantitative real-time polymerase chain reaction (qPCR). Our results suggest that OPN-PAA-grafted BC has a potential to promote bone tissue regeneration.

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BC surface-grafted with PAA (step I) followed by OPN immobilization (step II) to be developed into a GTR membrane.

BG-P-13 Fabrication of Poly (vinyl alcohol) / Chitosan Nanoweb loaded Ampicillin for Antibacterial Purpose

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Poly (vinyl alcohol) (PVA) and chitosan were formed into electrospun nanoweb for wound healing and antibacterial purpose. Nanoweb was prepared from 10 wt% of PVA and 9 wt% of chitosan solution with volume ratio of 20:1. Ampicillin sodium salt was added and homogeneously mixed into PVA / chitosan solution before electrospinning. The process parameters such as applied voltage, working distance, and duration for crosslinking with glutaraldehyde vapor were studied. The nanoweb was characterized using SEM, and FTIR. The antibacterial activity was also investigated using disk diffusion method. The results showed that nanoweb was composed of nanofibre with diameter 0.2-0.3 μm . The obtained products significantly inhibited growth of *Staphylococcus aureus* and *Acinetobacter lwoffii*. PVA / chitosan nanoweb loaded with ampicillin was expected to be used as wound dressing.

Key words: PVA/chitosan nanoweb, Ampicillin, Antibacteria, wound dressing

BG-P-14 Microencapsulation of Eugenol in Polyelectrolyte Complexes of Chitosan and Alginate

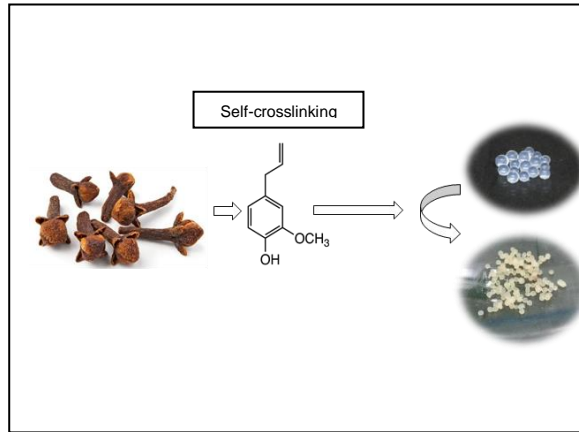
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Eugenol is the one of essential oils which has a good antimicrobial, antifungal and antioxidant properties. Moreover, eugenol usually uses in many applications such as in food industry and cosmetic pharmaceuticals industry. However, eugenol is volatile unstable and is degraded easily by oxidation, heating and light. Alginate and chitosan also use in several applications in drug delivery, film coating or food packaging because of their biocompatibility and nontoxicity. The purpose of this study was to encapsulate eugenol by using alginate and chitosan as polyelectrolyte complex microspheres form by ionic gelation method. The particle size, shape and encapsulation efficiency (EE) were studied by scanning electron microscopy (SEM), UV-visible spectroscopy (UV-Vis), respectively. The SEM images of obtained beads were showed a regular distribution and spherical shape with the size range of 1 μm . From UV-Vis spectra showed the encapsulation efficiency between 45 and 55%. Moreover, investigated the functional group of the alginate-chitosan polyelectrolyte complexes in form of beads by using fourier transform infrared spectroscopy (FT-IR). Furthermore, studied antimicrobial properties of eugenol and their exhibited a significant reduction antimicrobial effect.

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BG-P-15 Stimuli-Responsive Polysaccharide Nanomaterials

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We report here the preparation of stimuli-responsive polysaccharides nanomaterials. In a first step, dextran and chitosan were modified by simple chemical methods and characterized to determine their degrees of substitution. The polysaccharides were functionalized with tertiary amine groups so that they became responsive to CO₂ and acid/base. The polysaccharide derivatives were processed in the form of nanocapsules and nanofibers by the miniemulsion and the electrospinning techniques, respectively.

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BG-P-16 Crystallization of Polymers under Nanoconfinement

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The crystallinity of polymers is playing a very important role on properties such as mechanical barrier properties. We are interesting here to investigate the influence of polymer crystallinity on the release of payloads encapsulated in nanoparticles and nanocapsules. For this, we confined the crystallinity of polymers by preparing nanoparticles with the miniemulsion-solvent evaporation technique. It was found that the crystallinity decreased by increasing confinement, i.e. decreasing the diameter of nanoparticles and thickness of the nanocapsules shells. The observation was verified for polycaprolactone and polyamide 6 nanoparticles.

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BG-P-17 Facile Fabrication of Cellulosic Textiles with Durable Antibacterial Properties Using Soy Protein Isolate and Silver Nanoparticles

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Faculty of Science and Technology, Thammasat University

This work highlights a facile, effective method for the fabrication of antibacterial cellulosic fabrics (rayon). Soy protein isolate (SPI, 50-100 ppm) was used as a reducing agent, as well as a stabilizer, for the synthesis of silver nanoparticles (AgNPs). Glutaraldehyde (GA) cross-linking of SPI at room temperature resulted in durable coatings of AgNPs on the rayon fabric. The synthesized AgNPs were roughly spherical with a mean diameter of 11 nm. Antibacterial testing (AATCC 100-2004) against *Escherichia coli* and *Staphylococcus aureus* indicated that while untreated rayon showed no bactericidal activity, all treated fabrics exhibited excellent antibacterial properties (99.99% bacterial reduction), even after 50 washing cycles. Chemical finishing of rayon fabrics can thus successfully impart excellent antibacterial properties, be energy efficient and convenient requiring only one aqueous finishing stage with low chemical loadings, and be achieved using simple equipment under mild conditions.

Keywords: Antibacterial textile, biomaterial, cellulose, rayon, silver nanoparticle, soy protein

Polymer Engineering and Processing (PP)

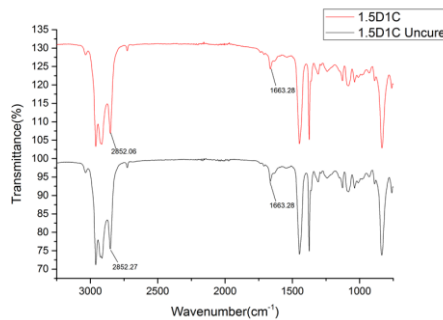
PP-P-1 Novel Green Vulcanization of Natural Rubber Latex Masterbatch

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To improve mechanical properties of natural rubber was modified by using peroxide Vulcanization at 170 degree celcies with the cardanol as a co-curing agent in variation 0, 1, 3, 5 percentage of cardanal and dicumyl peroxide is fixed at 1.5 percentage. The resulting of both different content that effect on vulcanization time, mechanical properties and crosslink density. The goal of this work was investigated the best properties of bio-cured natural rubber or improving in mechanical properties. The vulcanization time were determined by using moving die rheometer. Fourier transform infrared spectroscopy showed the progressive removal of double bond in molecule of natural rubber. The crosslink density of green vulcanization natural rubber was determined by equilibrium swelling technique. Mechanical properties of the sample were determined by using universal testing machine. The results revealed an increase in percentage of cardanal enhanced the mechanical properties.

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The FTIR spectra of 1.5D1C NR cure and NR uncure.

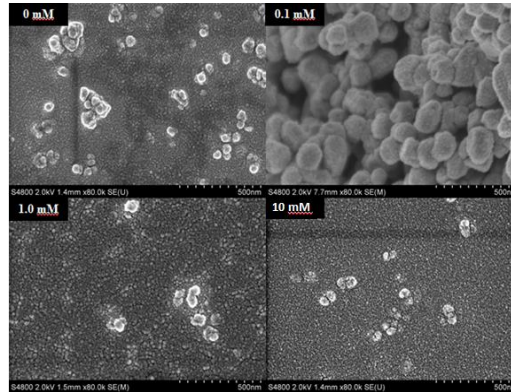
PP-P-2 Effect of ZnO nanoparticles on cure behavior of the EPDM rubber

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Ethylene-propylene-diene-monomer (EPDM) rubber is a synthetic rubber that has been used in a various applications. Many rubber industries mainly use an activator to promote the accelerator for vulcanization process. The most common activator is zinc oxide (ZnO). In order to study the morphology, particles size and dispersion of synthesized ZnO nanoparticles in rubber matrix and degree of vulcanization. In this work, ZnO nanoparticles will be prepared with polyelectrolyte (Alginic acid) as capping agent and filled in EPDM rubber. The performance of ZnO nanoparticles filled in EPDM rubber was studied by different techniques such as Scanning Electron Microscopy (SEM), optical microscope, X-Ray Diffraction (XRD) and Moving Die Rheology (MDR). From the results, when increased Alginic acid concentration, ZnO particles decreased from 46.58 to 17.74 nm. Synthesized ZnO by using 0.1 and 10 mM Alginic acid filled EPDM rubber used lowest scorch time. At 10 mM Alginic acid used slowest cure time. These results can confirm by different torque (M_H-M_L), at 10 mM Alginic acid, M_H-M_L was highest. M_H-M_L is can refer to cross-linked density, if high valued it means high cross-linked density also.

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Morphology of ZnO nanoparticles calcination at different concentration of Alginate acid

PP-P-3 Multi-branched polylactide ionomer: a simple approach to fine tune packing structure of PLA

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Ionomers are the polymers containing small amounts of ionic groups which their microstructure contain the hydrophilic and hydrophobic phases. The introduction of ionomers in the polymer matrices is a good approach to control packing structure of the polymers and as a consequence, several polymer properties, such as mechanical and thermal properties can be controlled. On the viewpoint of biodegradable polymers, polylactide(PLA) is the most promising and potential biodegradable resins because it has excellent properties especially, high modulus and strength which equivalent to petroleum-based polymers. However, PLA has limitations e.g. slow crystallization rate, brittleness and low melt strength which is related to its packing structure. Currently, several reports including ours proposed the star-PLA and multi-branched PLA to balance packing structure. The present work proposes the multi-branched PLA containing carboxylate terminals which we expect to obtain not only the role as additive for PLA to control packing structure but also the phase of ionomers to further fine tune the chain-chain interaction. The work also covers the studies on the packing structure and the related properties under effects of multi-branched PLA containing carboxylate terminals, especially, in the PLA blend systems.

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Smart and Advanced Materials (SM)

SM-P-1 Modified Poly(High Internal Phase Emulsion) with Clay for CO₂ Capture Application

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One of the most currently concerned environmental problems is air pollution which contains more than 60% of carbon dioxide (CO₂). Adsorption process using porous materials as an alternative material for CO₂ capture is used to minimize the increasing of CO₂ concentration released into the atmosphere. In this study, the porous poly(divinylbenzene) (poly(DVB)) was prepared with high internal phase emulsion (HIPE) technique, the CO₂ adsorption performance of the prepared poly(DVB)HIPE will be further enhanced with the addition of modified bentonite clay as an inorganic filler. The bentonite clay was modified with quaternary ammonium cation compound to serve as compatibilizer between the hydrophilic clay and the hydrophobic polymer. The modified bentonite clay, also known as organoclay would act as a reinforcing material to improve the mechanical properties, and the porous polymers filled with organoclay would also enhance CO₂ adsorption of the material. The results indicated that the presence of organoclay in poly(DVB)HIPE resulted in the enhancement of mechanical properties and CO₂ adsorption capacity when compared with neat poly(DVB)HIPE.

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SM-P-2 Preparation of Nitrogen Enriched Hierarchically Nanoporous Carbon from Polybenzoxazine for Methane Storage

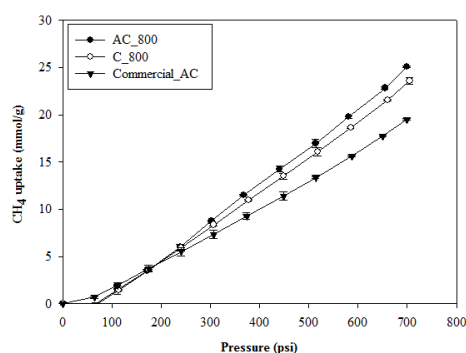
Norawit Kaewpornmongkol^a, Thanyalak Chaisuwan^{a,b}

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The adsorption of methane on a carbon based material, which was successfully obtained by carbonization followed by activation process of polybenzoxazine, has been studied within temperature-pressure range from 308 to 348 K and 0 to 700 psi. The adsorbent characterized by N₂ adsorption-desorption and SEM images to confirm pore structure of the adsorbents exhibited high surface area of 838 m²/g. A commercial activated carbon with the surface area of 493 m²/g was used to compare the methane adsorption efficiency. An elemental analysis technique was used to measure carbon (C), hydrogen (H) and nitrogen (N). The results indicated that the percentage of C, H, O and N was quite the same between before and after adsorption process. It can be proved that the adsorption of methane is only physical adsorption. For the adsorption test, it was found that the highest amount of methane as much as 25 mmol/g at 700 psi was adsorbed by the adsorbent from the activated carbon derived from polybenzoxazine. On the other hand, the amount of methane adsorbed on the commercial activated carbon was 19 mmol/g at 700 psi. Methane adsorption capacity increases with increasing of both micropore volume and surface area, confirming microporosity with interconnected porous structure plays an important role on methane adsorption capacity.

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The methane adsorption capacity of the adsorbents in the pressure range from 0 to 700 psi at 308 K

SM-P-3 Removal of Alkaline Earth Metals by Using Polybenzoxazine and Carbon-based Nanoporous Materials

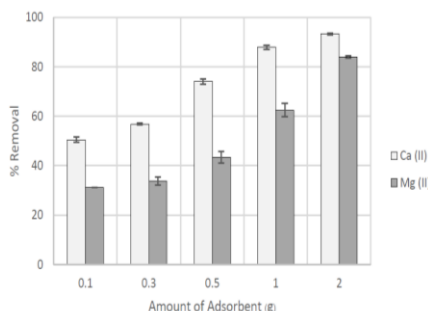
Chanapon Pongteeraporn^a, Sujitra Wongkasemjit^{a,b}, Thanyalak Chaisuwan^{a,b}

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Because of high demand of water consumption, the lack of water is an essential problem that need to be concerned. Using ground water is common in remote area in Thailand. However, Ca (II) and Mg (II), ions found in this type of water can cause some serious problems such as clogging of pipeline or failure of heat transfer in equipments in industrial machines. The objective of this work is to investigate the removal of alkaline earth metals, Ca (II) and Mg (II), from water by using polybenzoxazine and nanoporous carbon materials as anti-fouling adsorbents. The batch technique was carried out under the influences of pH, contact time and amount of adsorbent. The maximum percentages of metal removal were 93.25% for Ca²⁺ and 83.96% for Mg²⁺ respectively. The optimum condition was established at a basic condition, pH = 10, with 2.0 g. of adsorbent and equilibrated after 1 h. The results showed that the commercial activated carbon with high surface area could be an effective adsorbents to remove alkaline earth metals and the removal of Ca²⁺ was higher than that of Mg²⁺.

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The removal of calcium and magnesium. (pH: 10; the amount of adsorbent: 2.0 g; time: 1 h; the constant stirring speed.)

SM-P-4 Fabrication of Nanoporous Carbon as Electrodes for Supercapacitors

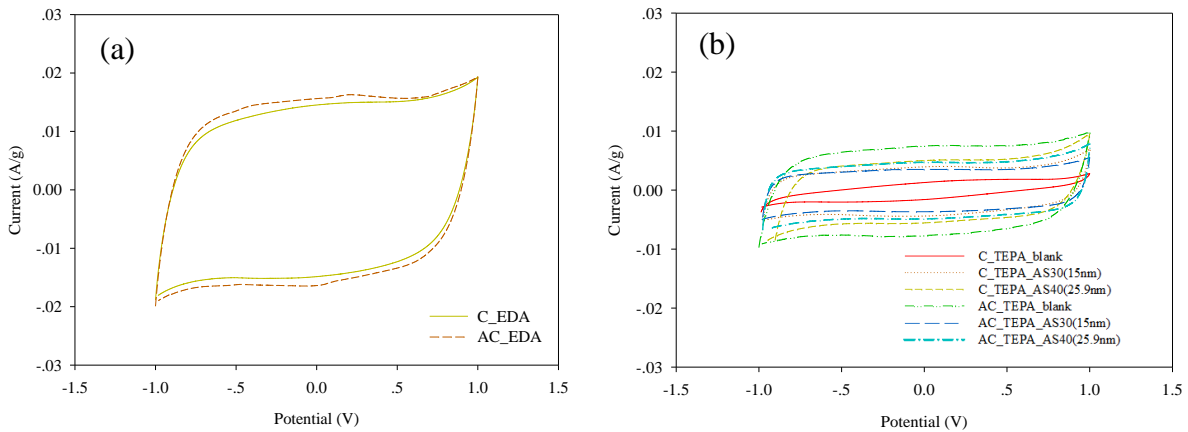
Pitchuda Suwannasarn^{a,b}, Sujitra Wongkasemjit^{a,b}, Thanyalak Chaisuwan^{a,b}

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Electrode material is a key element in determining the ability of energy storage for supercapacitors which should have high specific surface area (SSA) with an appropriate porous structure and also good conductivity. In this work, nanoporous carbons were prepared via pyrolysis and physical activation of polybenzoxazine which synthesized by using difference types of amine including ethylene diamine (EDA) and tetraethylenepentamine (TEPA) to study the pore structure and pore size distribution. In addition, silica nanoparticles were used as hard templates to create uniform mesoporous structure. The relationships between the specific capacitance and pore structure of the nanoporous carbon electrodes were investigated in 1.0 M of H₂SO₄. The results from both of non-template and templated-nanoporous carbons showed that CO₂ activation lead to better capacitive performances. At a scan rate of 1 mV/s, non-template nanoporous carbon showed the highest specific capacitance of 337.54 F/g due to its non-uniform mesopore size which appropriate for electrolyte ions to transfer into the pores. However, it was found that at higher scan rate the pore size has to be larger in order to facilitate ions in the pores. In this case, templated-nanoporous carbon from AS-40 silica nanoparticles showed the highest specific capacitance of 83.72 F/g at a scan rate of 25 mV/s due to its largest mesopore size from template facilitating the ion mobility.

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Cyclic voltammograms of non-template nanoporous carbons (a) and templated-nanoporous carbons (b) at a scan rate of 1 mV/s

SM-P-5 The Study of Ion Sorption Performances of Stoichiometric and Non-toichiometric Polyelectrolyte Complexes.

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In this study, the ion sorption performance of polyelectrolyte complexes (PECs) were observed by using negatively-charged dye and positively-charged dye. PECs were prepared in both stoichiometric and non-stoichiometric system with different concentration of salt and different ratio of poly(diallyldimethylammonium chloride) (PDADMAC), polycation, and poly(sodium-p-styrenesulfonate) (PSS), polyanion. After obtaining PECs, compression molding was used to compress PECs into films. The films were characterized by fourier transformed infrared spectrometer (FTIR), scanning electron microscopic (SEM) and CHN analyzer. Moreover, the amount of PDADMAC and PSS in the films were measured by the intensity of FTIR peaks. Sorption experiments were studied with methylene blue (MB), as positively-charged dye, and methyl orange (MO), as negatively-charged dye, in both single-solute and multisolute system. The concentration of dyes during the sorption experiments were determined via UV-vis spectrophotometry and the swelling of films before and after sorption experiments was also observed. The results showed that non-stoichiometric PECs were likely to transformed to stoichiometric PECs when the salt concentration was increased and non-stoichiometric PECs can be prepared when the concentration of salt is between 0.5 and 1.0 M NaCl. Non-stoichiometric PEC films with excess PDADMAC content are excellent sorbents for MO. Meanwhile, PEC films with excess PSS content are excellent for MB sorbents.

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Polyelectrolyte complex films before and after dye sorption experiments

SM-P-6 Starch-g-PLA in one pot process: The use as a compatibilizer for PLA/TPS blends and the development of external stimuli responsive fiber

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Poly(lactic acid) (PLA) is the most feasible biodegradable plastic to be substituted the commodity ones, however the limitations are cost and mechanical properties. Starch is a polysaccharide which is inexpensive and renewable. The way to apply starch in plastic products is to modify it to be thermo plastic starch by adding glycerol as a plasticizer. Thermoplastic starch (TPS) can be molten while the price is cheap, it is an ideal candidate additive to reduce cost. However, when considering TPS as additive for PLA to overcome the phase separation. Therefore, this work proposes the synthesis of starch-g-PLA in one pot reaction and fabrication of external stimuli responsive nanofibers. To our idea, starch-g-PLA is an initiator for lactide ring opening. Moreover, starch-g-PLA provides the hydroxyl groups to further functionalization with responsive molecules. Here, an introduction of pyrene fluorophore is considered. The present work demonstrates the starch-g-PLA functionalized with pyrene is further electrospun to obtain responsive PLA nanofiber. The presentation will include the preparation of starch-g-PLA in one pot reaction to use as a compatibilizer in PLA/TPS blending and the electrospinning condition to obtain nanofiber as well as fluorescence responsive properties.

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SM-P-7 Functionalized Agricultural Packaging

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Durian is the aroma overpowering and revolting. The persistence of its odour, which may linger for several days, So searching for the use of environmentally friendly products and new applications, The production of Active packaging and more specifically control aroma and antimicrobial packaging films are innovative concepts in food packaging. The influence of water vapour conditions on mass transport and barrier properties of carboxycellulose based films and coatings were studied in relation to surface and structural properties. Water contact angles, material swelling, barrier properties (PCO₂, WVP) and aroma diffusion coefficients were determined. The solvent nature and the presence of essential oils (vanilla and rosemary) influenced the surface and structural properties and then the barrier performance of activated carboxycellulose films. Increasing RH from 0% to 100% led to a significant increase in material swelling. The plasticization effect of water was more pronounced at high humid environment, while at low RH the matrix plasticization was induced by essential oils. The essential oils release from the carboxycellulose matrix was strongly influenced by RH. A temperature increase from 4 to 37 °C also had an impact on carvacrol diffusivity but to a lesser extent than RH.

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SM-P-8 Surface Modification of PolyHIPE using Solution Plasma Process for CO₂ Adsorption

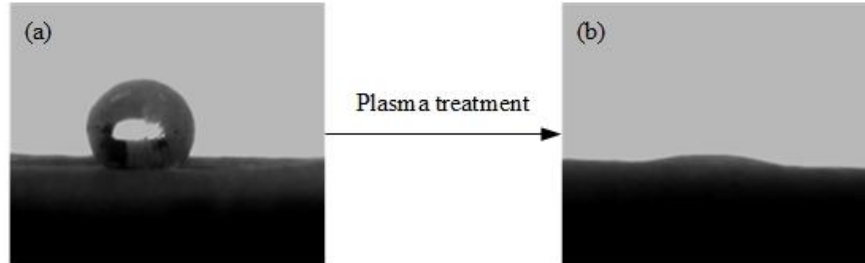
Mookyada Mankrut^a, Jitima Preechawong^a, Manit Nithitanakul^a

a) The Petroleum and Petrochemical College, Chulalongkorn University

High internal phase emulsion polymers (polyHIPEs) are highly porous polymers prepared by high internal phase emulsion (HIPE) technique. Because of their characteristics, i.e. high surface area and, high porosity with interconnecting pores, polyHIPE has been widely used in such applications as adsorbents, membranes, scaffolds in tissue engineering and, sensing materials. In this work, polyHIPE derived from divinylbenzene was prepared and the polyHIPE was modified with polyethyleneimine (PEI) by using solution plasma process. These modified polyHIPE will be then used as an adsorbent for CO₂ adsorption study. It was found that PEI-loaded materials have higher adsorption capacity, comparing with those of the unmodified polyHIPE support. This indicated the presence of amine groups on the surface of PEI-loaded materials. The existence of amine groups on the surface of samples was confirmed by fourier transform infrared spectroscopy (FTIR) and water contact angle measurement, which showed

that contact angle of samples decreases after surface modification. The use of scanning electron spectroscopy (SEM) to investigate the morphology of samples revealed that polyHIPEs showed an open porous structure with interconnecting pores.

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Static water sessile drops on the surface of (a) unmodified polyHIPEs and (b) PEI-modified polyHIPEs by solution plasma process.

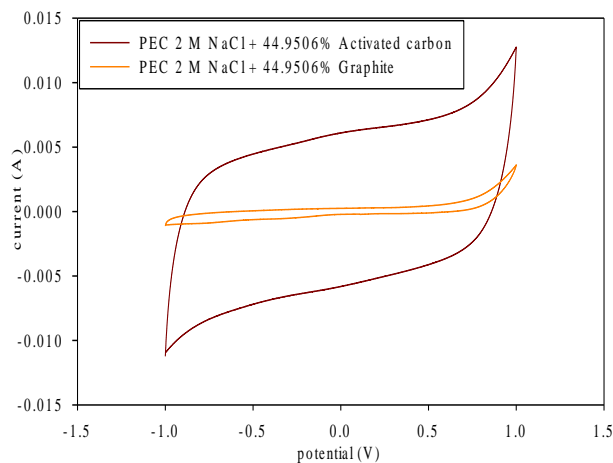
SM-P-9 Development of Polyelectrolytes Complex Membrane for Supercapacitors

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Supercapacitors (SCs) are electrochemical energy storage device that consist of two electrodes with a charge separator between them. In this work, polyelectrolyte complexes (PECs) based on graphite (PECs-G) and activated carbon (PECs-AC) were chosen as the flexible electrodes in SCs. PECs are formed by mixing poly(diallyldimethylammonium chloride)(PDADMAC) and poly(styrene sulfonate)(PSS). The performance of PECs was studied by different techniques such as cyclic voltammetry (CV), two-point probe, and electrical impedance spectroscopy (EIS). The results showed that PECs-AC has higher specific capacitance (C_{sp}) but lower conductivity than PECs-G. The C_{sp} and conductivity increased with the increasing amount of graphite or activated carbon content. Moreover, the C_{sp} is also increased with increasing concentration of electrolyte and the results varied with different types of electrolyte. PECs containing 2 M sodium chloride (NaCl) and 44.9506% AC shows the highest C_{sp} even though their conductivity is lower than PECs-G. The C_{sp} and the conductivity of the mentioned PECs are 50.52188 Fg^{-1} at scan rate 20 mV/s in 4 M KOH and 0.31531 S/cm, respectively.

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Cyclic voltammogram of PECs based on G and AC at scan rate 20 mV/s in 4 M KOH

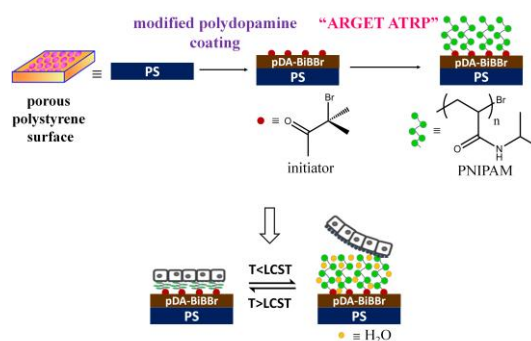
SM-P-10 Porous Polystyrene Surface Grafted with Poly(N-isopropylacrylamide) Brushes

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Porous polystyrene surface was prepared by casting a mixed solution of polystyrene (MW = 3×10^6 Da) and block copolymer of polystyrene and poly(acrylic acid) (PS₁₃₀-*b*-PAA₁₂) with 9:1 (w/w) on glass substrate via breath figure method. As monitored by SEM, the pore size can be controlled to be lower than 10 μm . Then, this surface was coated with polydopamine modified with bromoester compound (p-DA-BIBr) that functions as initiator for growing thermoresponsive poly(N-isopropylacrylamide) (PNIPAM) brushes via activators regenerated by electron transfer for atom transfer radical polymerization (ARGET ATRP). ¹H-NMR and GPC analysis of PNIPAM obtained in solution suggested that PNIPAM had degree of polymerization in a range of 100-400. The success of PNIPAM brushes grafting on porous substrate was confirmed by water contact angle and XPS analysis. The PNIPAM-grafted porous PS substrate is under ongoing investigation to determine its application as a substrate for cell sheet preparation. In principle, cell sheet can be non-enzymatically harvested upon decreasing temperature below the lower critical solution temperature (LCST) of PNIPAM (32°C). And the porous substrate should allow easy access of water molecules underneath the cell sheet so that the detachment can be accelerated.

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Grafting of PNIPAM on porous polystyrene surface.

SM-P-11 Electronic Structures of Graphene Nanoflakes Adsorbed on Pyrene

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Owing to its noble electronics platform, good thermal properties, extremely high surface area, and light weight, graphene has been a subject for large numbers of researches. As a result, graphene has been used in various applications. We have particularly interest in the electronic properties of graphene nanoflakes. Graphene nanoflakes (GNF) is the finite size graphene. Junghyun Lee et al found that electronic properties of graphene can be modified by noncovalent interactions with aromatic molecules through π - π interaction such as pyrene. In this work, we studied the effect of substituents of π -conjugated compounds on adsorption energies and electronic properties. Two different GNF models, hexagonal graphene nanoflakes (HGN) and rhomboidal graphene nanoflakes (RGN) were considered, Figure 1. We interested in semiconductor application of GNF. Pyrene and its derivatives can be doped to graphene making donor and acceptor semiconductor with can be used for diode. Pyrene derivatives with either an electron-withdrawing 1-nitropyrene (Py-NO₂) 1-pyrenesulfonic acid (Py-SO₃H), 1-pyrenecarboxylic acid (Py-CO₂H), and donating substituents groups 1-aminopyrene (Py-NH₂), 1-hydroxypyrene (Py-OH), 1-ethylpyrene (Py-CH₃) as adsorbates were investigated.

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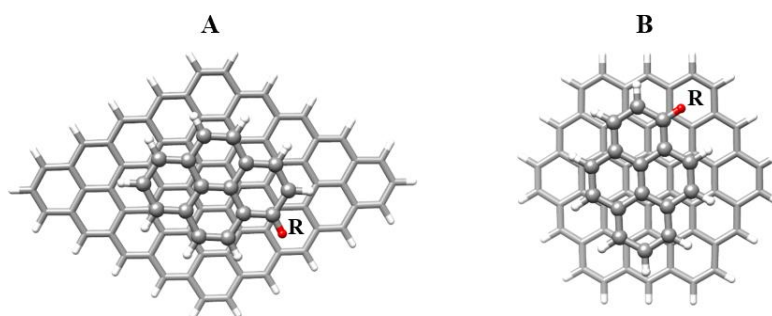


Figure 1. Schematic representation of RGN (A) and HGN (B) doped pyrene derivatives

R = CH₃, OH, NH₂ : electron donating groups
COOH, SO₃H, NO₂ : electron withdrawing groups.

SM-P-13 Synthesis and Hybridization Property of Peptide Nucleic acid-Functionalized Monomer

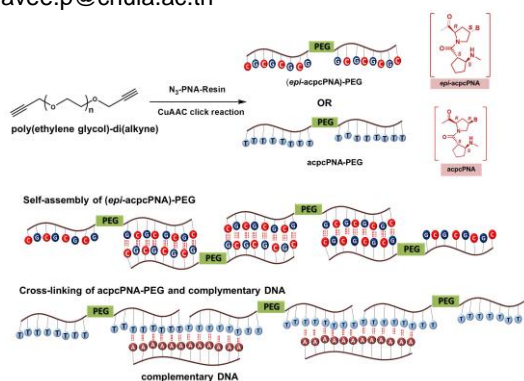
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Nucleobase-induced self-assembly interactions have gained much attention as potential non-covalent driving force for generating interesting nano-assembled structures. Pyrrolidinyl peptide nucleic acid (PNA) has been shown to not only recognize another strand of complementary nucleic acid but also undergoes self-pairing following the highly specific Watson-Crick base pairing rules. In this research, we investigated the chain extension induced by nucleobase interaction of poly(ethylene glycol) functionalized with peptide nucleic acid at both ends of the chain (PNA-PEG). PEGs with varied chain length were functionalized by PNA via copper(I)-catalyzed alkyne-azide cycloaddition (CuAAC) click reaction of poly(ethylene glycol)-di(alkyne) (PEG-di(alkyne)) and azide-modified PNA (N₃-PNA). PNA with (2'R,4'S)-prolyl/(1S,2S)-2-aminocyclopentanecarboxylic backbone (*epi*-acpcPNA) was chosen due to its self-pairing ability while PNA with (2'R,4'R)-prolyl/(1S,2S)-2-aminocyclopentanecarboxylic backbone (acpcPNA) was selected because it can hybridize with complementary deoxyribonucleic acid (DNA). The success of PNA-PEG synthesis was confirmed by MALDI-TOF mass spectrometry. Its hybridization property and secondary structure were investigated by UV-vis and circular dichroism (CD) spectroscopy, respectively. It is anticipated that this developed *epi*-acpcPNA and acpcPNA-based functionalized molecules can be used as building blocks of novel self-assembled nanostructures that can be regulated by temperature control or by the presence/absence of a DNA template.

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Synthesis and hybridization of PNA-PEG

SM-P-14 Immobilization of heavy metal ions by fly ash-based geopolymer

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With growing industry, the increasing environmental pollution and the increasing problems of heavy metal solid waste become more significant. Many techniques have been used to contain heavy metal by products safely. Cement-based technologies are applied to make and use in solidification/stabilization process. Furthermore, geopolymer is the one of material for good immobilization system for various hazardous wastes due to geopolymer material has properties as same as cement material such as high mechanical strength, high acid resistance, low permeability and long-term durability. Therefore, the effect of many factors on heavy metal immobilization capacity was investigated. Fly ash was mixed with alkali solution which was made from sodium hydroxide solution at concentration 10 Molar and sodium silicate solution. During mixing, $\text{Pb}(\text{NO}_3)_2$, $\text{Cu}(\text{NO}_3)_2$ and $\text{Cr}(\text{NO}_3)_3$ were added into geopolymer paste with the ratios of 0.1-0.5 by weight of all mixture. Then, geopolymer pastes were cured at room temperature for 7, 14 and 28 days. After that geopolymer samples were characterized mechanical property by using the universal testing machine. Phases, chemical compositions, morphology and a functional group of synthesized geopolymer were studied. Moreover, the efficiency of Pb^{2+} , Cu^{2+} and Cr^{3+} immobilization on geopolymer was determined by using the Toxicity Characteristics Leaching Procedure (TCLP).

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SM-P-15 Computational Calculation of Carbon Dioxide Capture in Metal Organic Framework

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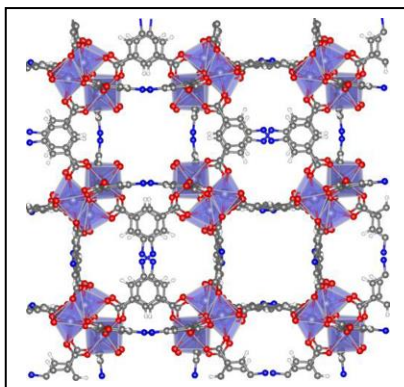
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Porous coordination polymers (PCPs) or metal organic frameworks (MOFs) have been reported to be a powerful materials because of their usability and applications. Components of this porous solid materials are metal cluster connected to organic molecules. Material of Institute Lavoisier-127 (MIL-127) being a subclass of metal organic framework which can be used for gas separation, gas storage and catalysis. In this work, we would like to gain insight into the behavior of carbon dioxide in MIL-127. Firstly, the calculated adsorption isotherm was compared with the experimental result to find out the suitable force field parameters. The radial distribution function and probability density distribution were calculated in order to elucidate how carbon dioxide capture in MIL-127.

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The structure of Material of Institute Lavoisier-127 (MIL-127) Metal Organic Framework.

SM-P-16 Deposition of YSZ Thin Films on Powder-Injection Anodes by Electrophoretic Deposition Technique

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In this study, 8 mol% yttria stabilized zirconia (YSZ) thin films were deposited by electrophoretic deposition technique on 50 wt% NiO-50 wt% YSZ anode substrates prepared by powder injection molding method. The YSZ suspension was prepared by (i) dissolving polyethylene glycol (PEG) in ethanol (ii) adding YSZ powder in the PEG solution and (iii) sonicating the suspension in an ultrasonic bath for 15 min. The applied voltages of 20-30 V at the deposition times of 30-180 s were used in the YSZ deposition process. The half-cells were then co-sintered at 1250-1400 °C in ambient atmosphere. The results showed that the higher film thickness was observed at higher deposition time and higher applied voltage. The effects of deposition conditions and co-sintering temperature on the microstructure and performance of the YSZ/NiO-YSZ half-cells were investigated by scanning electron microscopy and electrochemical impedance spectroscopy techniques. The optimum deposition conditions and the impedance spectrum results will be subsequently analyzed and reported.

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SM-P-17 Graphene Oxide Modified Screen-printed Carbon Electrode for the Simple and Sensitive Electrochemical Determination of Carbofuran Residue in Oranges

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Low cost, disposable graphene oxide modified screen-printed carbon electrodes (GO-SPCEs) were fabricated in our laboratory for the voltammetric determination of carbofuran. GO was synthesized via Hummer's method and then well mixed with carbon ink for screen-printing. The amount of GO was optimized. The surface morphology of the modified electrode was characterized by scanning electron microscopy (SEM) and energy dispersive X-ray (EDX) analysis. The active surface area of both unmodified and modified electrode were calculated by Randles-Sevcik equation using the obtained peak currents of $[\text{Fe}(\text{CN})_6]^{3-/4-}$. The electrochemical behavior of GO-SPCE towards carbofuran were studied by cyclic voltammetry (CV). This modified electrode provided the higher electrochemical signal of carbofuran when compared to an unmodified SPCE indicating the increased sensitivity of the system. Differential pulse voltammetry (DPV) was used for the determination of carbofuran. Under the optimized condition, GO-SPCE exhibited a wide linear range and a low detection limit for carbofuran detection. Furthermore, the proposed electrode were successfully applied to determine carbofuran residue in oranges with good recovery.

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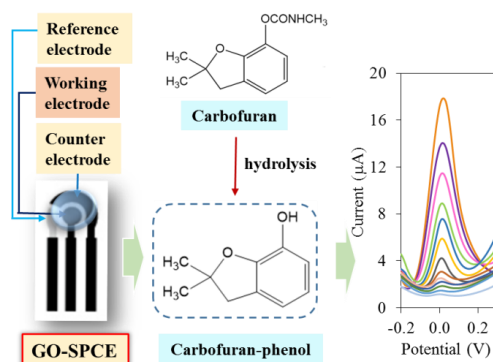


Fig. 1 Schematic of electrochemical detection of carbofuran based on graphene oxide modified SPCE.

SM-P-18 Innovation Whitening Cream Containing Kojic-Acid /Gold Nanoparticles

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The purpose of this study was to evaluate the efficacy of nano-skin care product containing the combination between naturally extracted kojic acid and gold nanoparticles (AuNPs). Moreover, the search initially reveals that kojic acid reduces dullness and helps brighten the skin. In this research, the ratios of kojic acid and gold nanoparticles (AuNPs) at 1-3 % (w/w) were studied. The chemical and physical properties of AuNPs-kojic acid were characterized by UV-Vis and TEM. Then, ten subjects were studied to assess the antiwrinkle efficacy and other skin benefits of the nano-skin care product containing the combination between naturally extracted kojic acid and gold nanoparticles (AuNPs). AuNPs-kojic acid was decreased the melanin, as well as delaying the melanogenesis. This study intends to demonstrate that the combination AuNPs-kojic acid can be a huge advantage to a cosmetic industry.

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SM-P-19 Colorimetric Sensing of Glyphosate Using Silver Nanoparticles Synthesized in the Presence of Tannic Acid

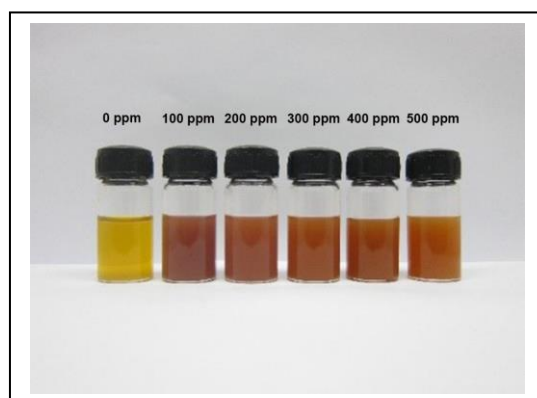
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Glyphosate is an herbicide widely used in Thailand. The contamination of glyphosate especially in water is increasingly concerned. In this research, the glyphosate traces were detected by the naked-eyes based on the color change of the silver nanoparticles colloids which were synthesized at pH 6.0 using tannic acid as a reducing agent and a stabilizer. The synthesis was operated at room temperature under UV radiation for 60 minutes. The formation of the spherical silver nanoparticles was confirmed by TEM and UV-Visible absorbance at 430 nm. After adding glyphosate, the colors of the silver nanoparticles colloids changed from yellow to red-orange. Their absorbance peaks shifted from 430 nm to 630 nm depending on the amount of glyphosate. This suggests the ability of silver nanoparticles for glyphosate sensing.

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Color changes of silver nanoparticles colloids before and after adding various amounts of glyphosate.

SM-P-20 Colloid-electrospinning for Materials with Antibacterial Properties

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Electrospinning is a technique that can be used to create nanofibrous non-wovens from organic and inorganic materials. Nanoparticles embedded in fibers can be prepared by the so-called colloid-electrospinning. Herein, we first synthesized silica nanocapsules by a sol-gel process in miniemulsion to encapsulate different antibacterial agents. Afterwards, the nanocapsules were spun to produce non-wovens with antibacterial properties.

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