



Department of Chemistry, Faculty of Science
Chulalongkorn University

RESEARCH HIGHLIGHTS

2017 - 2019





PREFACE

DEPARTMENT OF CHEMISTRY IS ONE OF THE FOUR FOUNDING DEPARTMENTS IN THE FACULTY OF SCIENCE EVER SINCE THE ESTABLISHMENT OF CHULALONGKORN UNIVERSITY IN 1917. OVER THE PAST CENTURY, IT HAS PRODUCED HIGHLY-QUALIFIED CHEMISTS, INTERNATIONAL PUBLICATIONS ON FRONTIER RESEARCH, AND A NUMBER OF INNOVATIVE TECHNOLOGIES.

ON BEHALF OF THE DEPARTMENT OF CHEMISTRY, I WOULD LIKE TO TAKE THIS OPPORTUNITY TO THANK BOTH FORMER AND CURRENT FACULTY MEMBERS FOR THEIR HARD WORKS, TIRELESS DEDICATION AND TREMENDOUS CONTRIBUTIONS TO A NUMBER OF IMPORTANT SCIENTIFIC BREAKTHROUGHS AND SIGNIFICANT IMPROVEMENTS OF WORKING ENVIRONMENTS IN THE RESEARCH CIRCLE DURING THE PAST CENTURY. THIS CAN BE WITNESSED FROM AN EVER-INCREASING NUMBER OF PEER-REVIEWED PUBLICATIONS IN LEADING INTERNATIONAL SCIENTIFIC JOURNALS ESPECIALLY IN THE PAST 20 YEARS.

ENTERING THE NEW CENTURY, THE DEPARTMENT TAKES UP FUTURE CHALLENGE OF ESTABLISHING NEW INTEGRATIVE CURRICULA THAT CAN WELL HARMONIZE WITH GLOBAL RESEARCH TREND, NAMELY GREEN AND SUSTAINABLE CHEMISTRY, CHEMICAL BIOLOGY, AND CHEMISTRY OF ADVANCED MATERIALS PARTICULARLY FOR BIO-RELATED APPLICATIONS AND ALTERNATIVE ENERGY. IT IS OUR ON-GOING EFFORT TO FURTHER EXPAND AND STRENGTHEN INDUSTRIAL LINKAGES AS WELL AS INTERNATIONAL COLLABORATION. THE KEY ELEMENTS TO THE SUCCESS OF RESEARCH DEVELOPMENT, BEING ABLE TO HAVE ESCALATING NUMBERS OF PUBLICATION IN INTERNATIONAL SCIENTIFIC JOURNALS CLASSIFIED IN QUARTILE 1 AND TIER 1 IS ALSO OUR CHALLENGING FUTURE COMMITMENT.

THIS RESEARCH HIGHLIGHTS HAS BEEN PUBLISHED AS AN INTRODUCTORY GUIDELINE TO WHICH RESEARCH AREAS THAT OUR FACULTY MEMBERS ARE CURRENTLY UNDERTAKEN AND THEIR PUBLICATIONS IN THE YEAR 2017-2019. MORE COMPREHENSIVE DETAIL AND UPDATED PUBLICATION LIST OF EACH FACULTY MEMBER CAN BE EASILY REACHED ON-LINE VIA INTERNATIONAL SCIENTIFICALLY ACCEPTABLE DATABASES.

Vudhichai Parasuk

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HEAD OF DEPARTMENT OF CHEMISTRY

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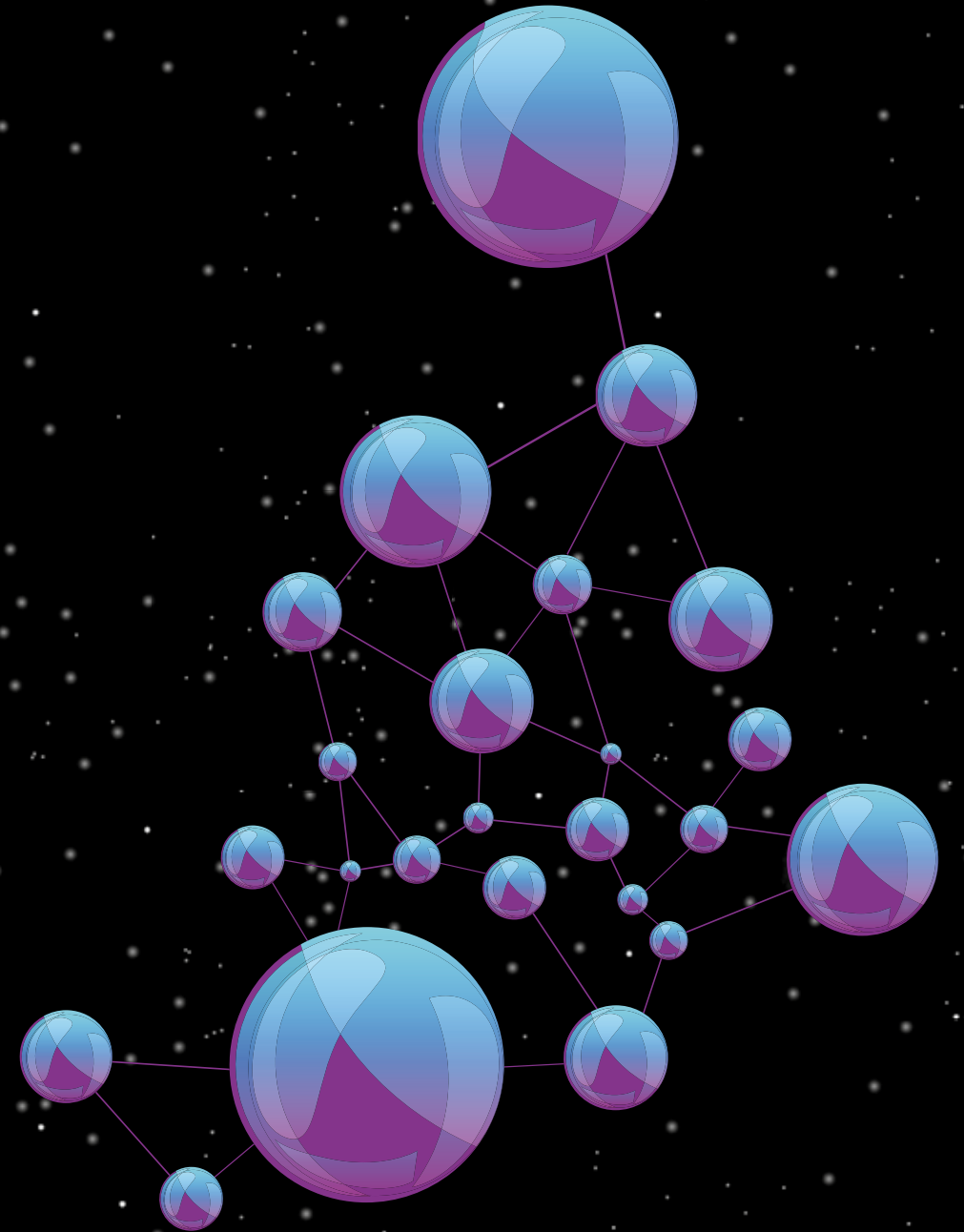
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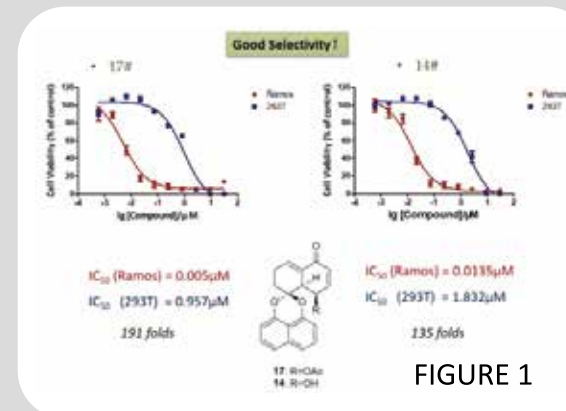
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Natural products from both fungi and medicinal plants and their bioactive potential including action mechanism study.

Thailand Toray Science Foundation Science & Technology Research Grant, 2012

Our group has been working on the isolation, characterization and biological activities, particularly cancer-related activities of both novel and known natural products from both mangrove forest-associated fungi and medicinal plants. It is because of the great biodiversity of the mangrove community. For fungal strains, the OSMAC (one strain-many compounds) approach has recently been used in our group to activate metabolic pathways to get metabolic products with rich variety of structures by systematic alteration of easily accessible cultivation parameters including the change of medium type, medium composition and culture conditions. A very good example is an edophytic *Rhytidhysterium rufulum*. It was found mangrove forest-associated when the fungus was cultured in SDB medium at neutral (7) and acidic (5) pH, a number of different metabolites were obtained; however, they are still the same skeleton structure, spiro bisnaphthalene derivative. Most importantly, the compound with two α,β -unsaturated ketone moieties displayed promising activity on various cancer cell lines, particularly blood cancer Ramos cells with good selectivity (Figure 1).



Another example from mangrove forest-associated plant is rotenoid from *Derris trifoliata* (Figure 2). 12a-Hydroxyrotenone (2) exhibited potent inhibition on both cell growth and migration of HCT116 colon cancer cells. Moreover, the compound displayed promising anti-angiogenic activity in both ex vivo and in vitro assays, as well as it mainly functions by suppression of endothelial cells (ECs) proliferation and tube formation, but has no effect on ECs migration. This study firstly provides the evidence that compound 2 has high potency on HCT116 cancer migration and anti-angiogenic activity, demonstrating that 2 might be a potential agent or a lead compound for cancer therapy.

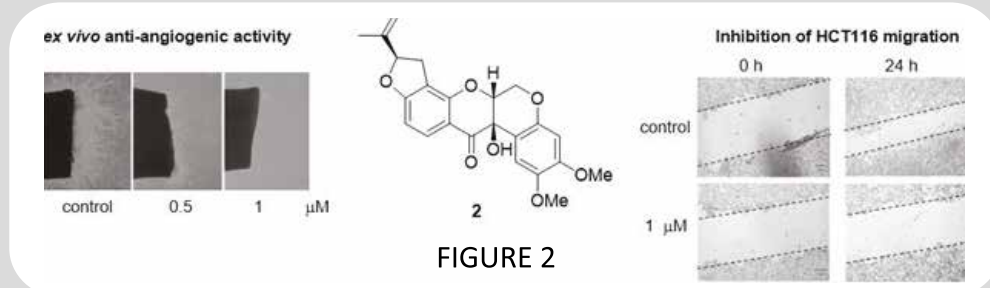


FIGURE 2

1. Hanthanong, S.; Choodej, S.; Teerawatananond, T.; Pudhom, K. "Rearranged clerodane diterpenoids from the stems of *Tinospora baenzigeri*" *J. Nat. Prod.* **2019**, 82, 1405-1411.
2. Choodej, S.; Pudhom, K.; Yamauchi, K.; Mitsunaga, T. "Inhibition of melanin production by sesquiterpene lactones from *Saussurea lappa* and their analogues" *Med. Chem. Res.* **2019**, doi:10.1007/s00044-019.
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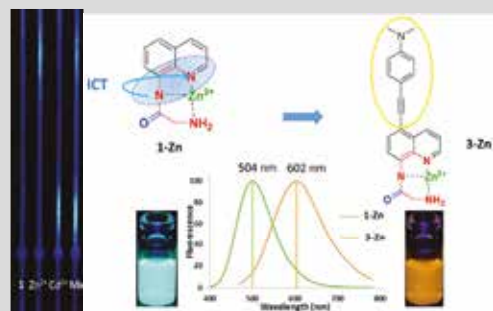
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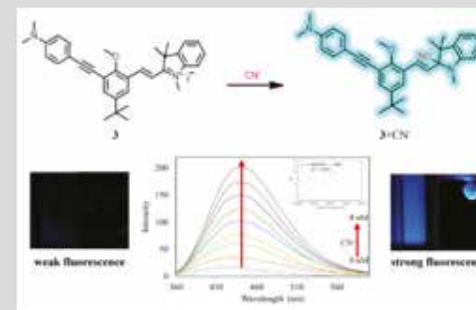
Organic materials: We utilize skills and knowledge in organic synthesis, supramolecular chemistry and spectroscopy to develop various π -conjugated compounds as colorimetric and fluorescence sensing materials. The materials of our current interests are polydiacetylenes, phenylene-ethynylene and quinoline derivatives.

- National Distinguished Researchers
Office of the National Research Council of Thailand (NRCT), 2014
- Outstanding Research Work
Office of the National Research Council of Thailand (NRCT), 2010
- The Wiley-CST Award for Outstanding Publication
Global publisher John Wiley & Sons Inc., 2009
- Young Scientist Award
Science and Technology Foundation under Royal Patronage, 2002



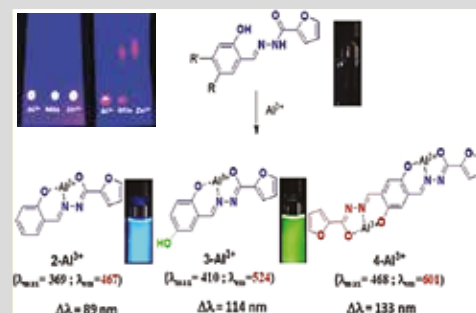
A fluorescent sensor for simultaneous detection of Cd^{2+} and Zn^{2+} :

The derivative of aminoquinoline containing glycine (1) exhibits selective fluorescence “turn-on” signals upon binding with Cd^{2+} and Zn^{2+} . The ligand is used as a fluorescent visualizing agent in simultaneous detection of Cd^{2+} and Zn^{2+} separated by paper chromatography. The conjugation emission color of the ligand can be readily tuned with retaining selectivity. Ligand 1 thus represent a simple sensing platform for Cd^{2+} and Zn^{2+} detection. (*Journal of Luminescence* **2018**,198, 59-67)



A fluorescent sensor for CN^- detection in water:

fluorescent turn-on cyanide probe is developed based on benzylidenes containing methylindolium group. Compound **3** shows strong blue fluorescent response selectively to CN^- . The optimized sensing system based on this compound gives limit of detection of CN^- in aqueous media at subnanomolar level. The naked eye detection of CN^- at submicromolar level is also possible using a paper-based and gel-based sensing system incorporated with this compound. (*Journal of Hazardous Materials* **2017**, 329, 255-261)



Fluorescence sensors for dual detection of Al^{3+} and Zn^{2+} :

The series of salicylidenehydrazides are developed for selective turn-on sensors based on metal chelation-enhanced fluorescence (CHEF) inhibiting the nonradiative PET and ESIPT. These compounds can detect Al^{3+} in aqueous solution with large Stokes shifts up to 133 nm and emission colors varying from blue to orange. With simple chromatographic separation on filter paper, both Al^{3+} and Zn^{2+} can be simultaneously detected (*ACS Sensors* **2016**, 1, 144-150).





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Mucoadhesive biopolymers, Design and synthesis of anticancer agents from Thai Herbs, Drug Delivery systems.

Mucoadhesive polymers have been used for drug delivery as they can bind to mucosal membranes to extend the time that drug stays at target sites and thus contribute to the therapeutic advantage of the system. Our research aims to enhance mucoadhesive property of biopolymers, especially chitosan, pullulan and cellulose, for medicinal and pharmaceutical applications. We have designed biopolymers by attaching various functional groups (with or without thiol) and fabricating to particles with different shapes (micro/nano-scales). Recently we have developed techniques to fabricate spheres, flower-like and block/prism biopolymer particles and studied their formation mechanisms and properties.

Drug-resistance and cancer-specific drug are major problems in chemotherapy for cancer. Our research in this area focuses on finding new natural and synthetic compounds to overcome drug-resistance and improve cancer-specific activity. We have extracted many natural compounds, modified them, tested for cytotoxicity, design drug delivery carriers to specific delivery to the target using nanoparticles for example gold or selenium nanoparticles, finally studied their anticancer mechanism. One of our recent works finds that natural product derivatives showed strong Topoisomerase II inhibition and excellent in vitro cytotoxicity against paclitaxel/doxorubicin-resistant cells (NCI/ADR-RES), 20-fold higher than doxorubicin. The molecular mechanism induces G2/M arrest does not appear to be ROS or p53-mediated in NCI/ADR-RES cells.



RESEARCH
EMPHASIS



RESEARCH

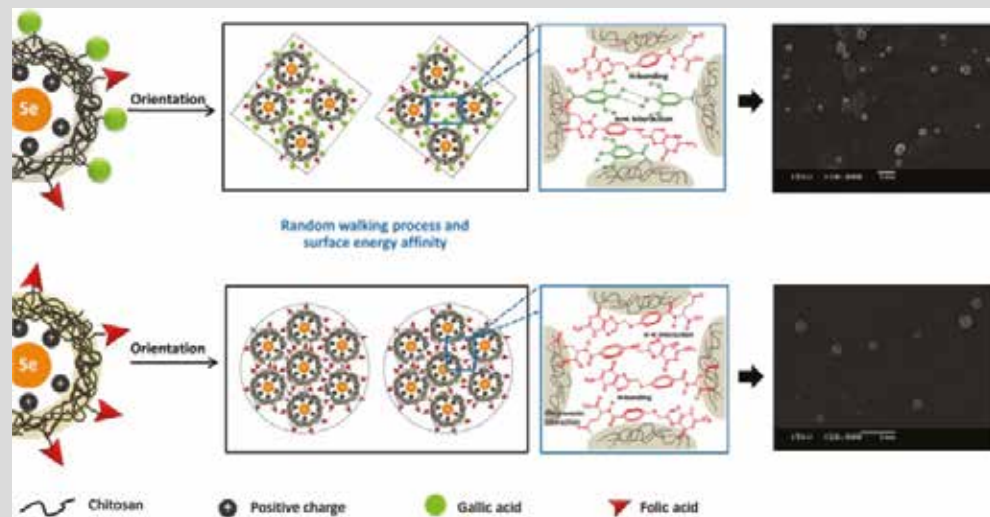


Fig. 1 Scheme of the proposed mechanism for the formation of cubic-like SeNPs as an anticancer drug delivery carrier.

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Electroanalytical Chemistry, Diamond Electrochemistry, Chemical and Biosensors, Electroanalytical Immunosensors, Microfluidic Devices, Flow-Based Systems, Paper-based sensors.

- 2020 - Thailand Inventor Award 2020, National Research Council of Thailand
- 2019 - Thailand Inventor Award 2019, National Research Council of Thailand
- 2018 The Thailand Outstanding Scientist Awards 2018, Foundation for the Promotion of Science and Technology under the Patronage of H.M. the King
- 2018 Outstanding Invention, Seoul International Invention Fair, Seoul, Korea
- 2018 Silver Prize, Seoul International Invention Fair, Seoul, Korea
- 2018 The 2017 TRF Outstanding Research Awards (Academic), The Thailand Research Fund
- 2016 CST Distinguished Chemist Award, Chemical Society of Thailand
- 2014 TRF Senior Research Scholar, The Thailand Research Fund
- 2014 Distinguished Research Unit Award, Ratchadaphiseksomphot Endowment Fund, Chulalongkorn University
- 2014 Silver Medal Award, Taipei International Invention Show & Technomart Invention Contest
- 2014 Honor of Invention, World Invention Intellectual Property Associations
- 2013 Chulalongkorn University Distinguished Researcher Award, (Chemical Science and Pharmacy), Faculty of Science, Chulalongkorn University
- 2013 Most Cited Research Publication Award of Physical Science, Ratchadaphiseksomphot Endowment Fund, Chulalongkorn University
- 2011 CST High Impact Chemist Award, Chemical Society of Thailand
- 2010 Chulalongkorn University Distinguished Researcher Award 2009, Ratchadaphiseksomphot Endowment Fund, Chulalongkorn University
- 2009 TRF-CHE-Scopus Researcher (Physical Science), The Thailand Research Fund, Office of the Higher Education Commission, and Elsevier Publishing
- 2008 JAFIA Scientific Award, The Japanese Association for Flow Injection Analysis (JAFIA), The Division of the Japanese Society for Analytical Chemistry



The focus of Professor Chailapakul's research is the design and application of cutting-edge sensors with interest for clinical diagnostics, environmental monitoring, and food safety applications.

Our research group pioneered novel detection platforms based on a paper devices. Two major types of detection methods; electrochemical detection and optical detection; are implemented with the novel sensing systems to open up new frontier and possibility for analytical detection. We also integrate such systems with flow-based techniques such as flow injection analysis, sequential injection analysis, liquid chromatography, and microfluidic devices to further enhance the performance of the sensor. Currently, we are broadening the potential use of the developed sensors to a smartphone technology for further exploit in remote sensing applications. System, Paper-based sensor.

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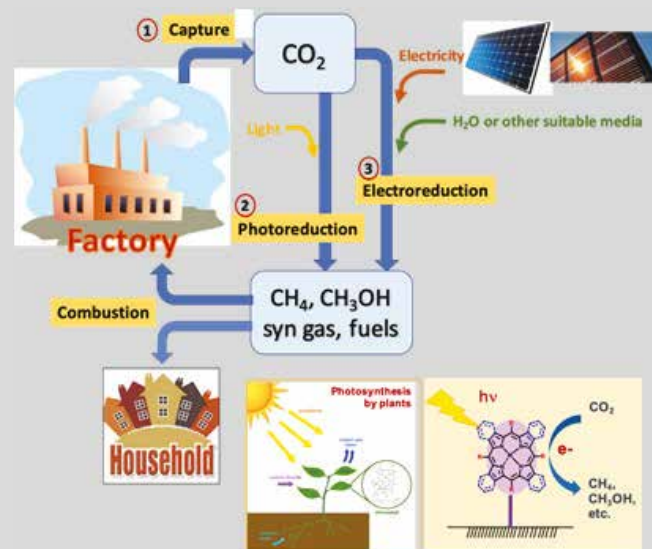


Development of organic photosensitizing materials for solar-driven energy conversion and storage applications

- "PTIT Awards 2019-2020" from Petroleum Institute of Thailand (PTIT)
- "Wiley-CST Award for Contribution to Green Chemistry": 2016
- "L'Oréal Thailand 'For Women in Science' Fellowship": 2014
- "ICTP prize 2013" from International Center of Theoretical Physics (ICTP)
- "Marie Curie International Incoming Fellowship (IIF)" under the 7th Framework Programme (FP7) of the European Commission: 2009-2010

Patchanita's research group continuously focuses mainly on design and synthesis of porphyrin and phthalocyanine materials for solar-driven energy conversion and optoelectronic applications, including solar cells, (photo)electrocatalysts, carbon dioxide conversion and energy storage systems. We are particularly interested in use of porphyrins and their oligopyrrole derivatives in combination with charge-transporting unit and co-absorbing unit to create efficient

light-harvesting and conducting systems for generating electrical current in solar cells and electrons for catalytic processes,



especially reduction of carbon dioxide. Moreover, great effort has been put to in-depth fundamental studies of the organic materials in order to provide a number of insights into structure-property relationship of these materials towards light-harvesting applications. To support the growth of the research in this field in Thailand and to enhance research competency of Thai scientists in creating our own frontier technology for light-exploiting production of alternative energy, our group has been involved in several national and international scientific networks through fruitful interdisciplinary collaboration and staff-exchange programs.

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POLKIT SANGVANICH

Professor

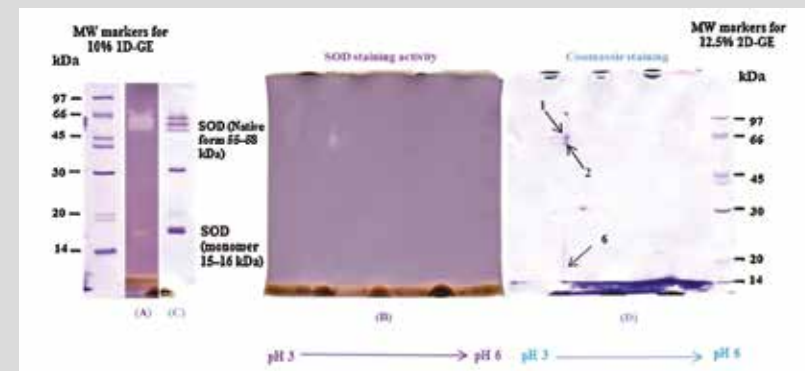
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Plant proteomics, Tandem Mass Spectrometry, Organic analysis

- International Scholar Exchange Fellowship (ISEF) Program, The Korea Foundation for Advanced Studies 2007
- Outstanding Young Scientist Faculty of Science, Chulalongkorn University 2008

Our research is based on the application of Mass Spectrometry. We seek the new bioactive compounds mainly in peptide or protein classes. The source of bioactive compounds are from medicinal herbs and microorganisms. The compounds were extract then precipitated prior to purification using either chromatography or gel electrophoresis. Biological activities were tested and compound was identified using mass spectrometry.



RESEARCH
EMPHASIS



HONORS
+ AWARDS



RESEARCH

(A)
 1 NATKAVCVLK GGGPVQOTIH FEAKGDTVVV TGSITGLTEG DNGFHVHFG
 51 DNTQGTISAG PHFNPLSKKH GGFKEERHY GDLGNVTADK NGVAIVDIVD
 101 PLISLSGEYS IIGRTAVVME KPDGLGRGN EESTKTUNAG GRACGGVIGI
 151 AK

(B)
 1 MVKAVAVLGS SEGVKGTIYF TQEGDGTTV TGSISGLKEG LNFHVHAGL
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 101 EQIFLTGPQS IIGRAVVVHA DPDGLGRGN ELSKSTQAG GRACGIIQL
 151 QG

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SANONG EKGASIT

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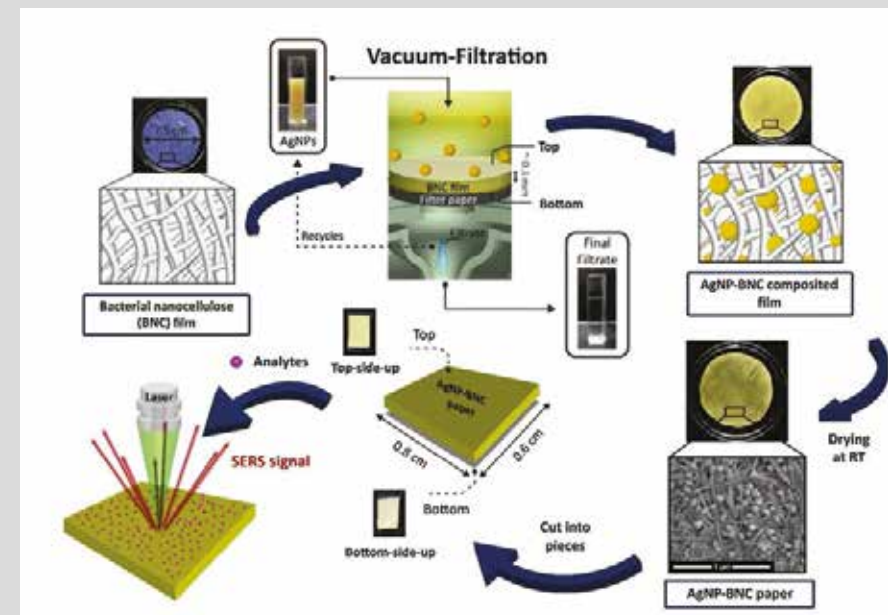
(1) Mobile sensors based on smartphone technology and their applications in chemistry, environment, education, industrial monitoring and cultural conservation, (2) Production of high value cellulosic materials (microcrystalline cellulose, nanocrystalline cellulose, and amorphous cellulose) from agricultural waste, and (3) Synthesis and applications of functional metal nanostructures.



- CST Award for Distinguished Contribution to Economic Advancement 2016
- The National Excellent Researchers awards 2012
- (Physical Sciences and Mathematics) Young Scientist Awards 1999

The nanomaterial researches involve studies of growth mechanisms, structural control protocols and characterization, and sensing applications of complex nanostructures. We have successfully developed processes for the fabrication of complex metal nanostructures and explore their applications as medical devices, chemical sensors, and colorimetric sensors. Some of our nanotechnologies have been transferred into industrial applications. We licensed our nanotechnologies to 5 companies who developed more than 10 nano-enable commercial products. Similarly, our smartphone sensor research has developed into commercial portable smartphone microscopes capable of taking high quality microscopic images. Based on our practical research programs with entrepreneur training, our former graduates have found 2 start-up companies commercializing products and services derived from their research findings.

High sensitivity chemical sensor based on SERS technique was fabricated by depositing silver nanoparticles (AgNP) onto bacterial nanocellulose (BNC) film before drying into a thin nanopaper. The transparent and flexible AgNP-BNC nanopaper was employed as SERS substrate for detection of pesticides on fruit skins.



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2. Nootchanat, S.; Jaikandee, W.; Yaiwong, P.; Lertvachirapaiboon, C.; Shinbo, K.; Kato, K.; Ekgasit, S.; Baba, A., Fabrication of Miniature Surface Plasmon Resonance Sensor Chips by Using Confined Sessile Drop Technique. ACS Applied Materials and Interfaces 2019, 11 (12), 11954-11960.





3. Gatemala, H.; Tongsakul, D.; Naranaruemol, S.; Panchompoo, J.; Ekgasit, S.; Wongravee, K., Synthesis of silver microfibers with ultrahigh aspect ratio by galvanic replacement reaction. *Materials Chemistry and Physics* 2019, 237.
4. Pienpinijtham, P.; Vantasin, S.; Wong-U-Ra, O.; Kitahama, Y.; Ekgasit, S.; Ozaki, Y., Local structural changes in graphene oxide layers induced by silver nanoparticles. *Physical Chemistry Chemical Physics* 2018, 20 (33), 21498-21505.
5. Pienpinijtham, P.; Thammacharoen, C.; Naranitad, S.; Ekgasit, S., Analysis of cosmetic residues on a single human hair by ATR FT-IR microspectroscopy. *Spectrochimica Acta - Part A: Molecular and Biomolecular Spectroscopy* 2018, 197, 230-236.
6. Lertvachirapaiboon, C.; Pienpinijtham, P.; Wongravee, K.; Ekgasit, S., Optical Properties of Individual Aragonite Plates from Nacre. *ChemistrySelect* 2018, 3 (41), 11700-11704.
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8. Wong-u-ra, O.; Ekgasit, S.; Wongravee, K., Phase transferring of silver nanoparticles to organic solvents using modified graphene oxide as carrier. *Materials Chemistry and Physics* 2017, 199, 348-355.
9. Pangdam, A.; Wongravee, K.; Nootchanat, S.; Ekgasit, S., Urchin-like gold microstructures with tunable length of nanothorns. *Materials and Design* 2017, 130, 140-148.
10. Pangdam, A.; Nootchanat, S.; Lertvachirapaiboon, C.; Ishikawa, R.; Shinbo, K.; Kato, K.; Kaneko, F.; Ekgasit, S.; Baba, A., Investigation of Gold Quantum Dot Enhanced Organic Thin Film Solar Cells. *Particle and Particle Systems Characterization* 2017, 34 (11).
11. Nootchanat, S.; Pangdam, A.; Ishikawa, R.; Wongravee, K.; Shinbo, K.; Kato, K.; Kaneko, F.; Ekgasit, S.; Baba, A., Grating-coupled surface plasmon resonance enhanced organic photovoltaic devices induced by Blu-ray disc recordable and Blu-ray disc grating structures. *Nanoscale* 2017, 9 (15), 4963-4971.

SIRIRAT KOKPOL

Professor

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Computer Aided Drug Design, Molecular Modeling, Quantum Calculations, Photoinduced Electron Transfer in Protein.



- Rachadaphiseksomphot Endowment Fund Award for Research Work, 1987 (graduate thesis)
- Rachadaphiseksomphot Endowment Fund Award for Research Work, 1990
- Professorship Foundation Award, Faculty of Science, Chulalongkorn University, 1995
- Faculty of Science Alumni Association Award, Chulalongkorn University, 2008
- Chemistry Alumni Club Award, Chulalongkorn University, 2010
- Junlamongkut Award, Faculty of Science, Chulalongkorn University, 2010



The rates of photoinduced electron transfer (PET) from nearby aromatic amino acid to the excited flavin molecule of wild type and mutated type in different proteins have been studied by combining molecular dynamic simulation and an electron transfer theory.

1. Nueangaudom, A., Lugsanangarm, K., Pianwanit, S., Kokpol, S., Nunthaboot, N., Tanaka, F., Seiji Taniguchi and Haik Chosrowjan, "Comparative Study on the Mechanism of Photoinduced Electron Transfer from Tryptophan 168 to Excited Flavin in T169S and Wild-type Pyranose 2-Oxidase". ACS Omega, 2019, 4(1), 593-605.
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**SUPASON
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Biomaterials; Dissolvable microneedles; Drug delivery; Bio-Inks

Excellent Research Award from the Thailand Research Fund 2015



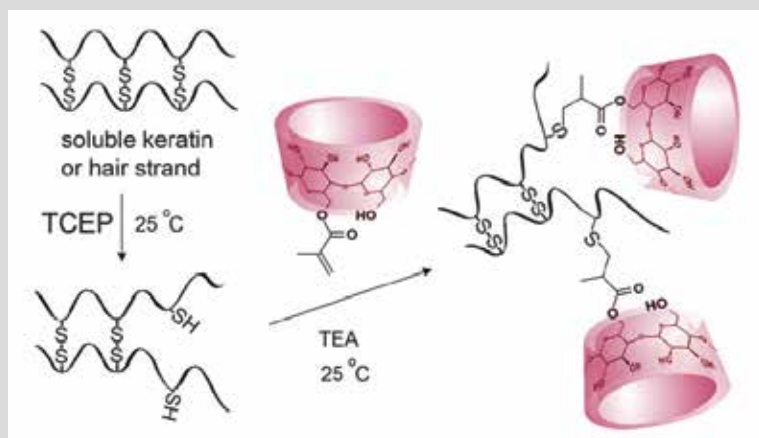
- Dissolvable microneedles with instant needle detaching features

Here we venture into biomaterials that can give us desired mechanical strength, appropriate sustained drug release behaviour, satisfied engineering ease, and biocompatibility. Works also extend into application in aesthetics, diagnostics, therapeutics and prophylactics. We focus in chemistry of the materials, but also reach into biology, medicine and engineering through extensive collaborations.

- Bio-Inks

Here we venture into biomaterials that can give us ability to form three-dimensional network with great cell compatibility. Our works involve polymer design, synthesis, characterization, and then expands into cellular biology through collaboration.





1. Wanichwecharungruang, S.; Rujwaree, T.; Sansureerungsikul, T.; Banlunara, W.; Asawanonda, P. A dissolvable microneedle. PCT International Patent Application No.PCT/TH2019/000031. 2019.
2. Limcharoen B, Toprangkobsin P, Kröger M, Darvin M E, Sansureerungsikul T, Rujwaree T, Wanichwecharungruang S, Banlunara S, Lademann J, Patzelt A. Microneedle-facilitated Intradermal Proretinal Nanoparticles delivery. *Nanomaterials*. *In press*
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SUPAWAN TANTAYANON

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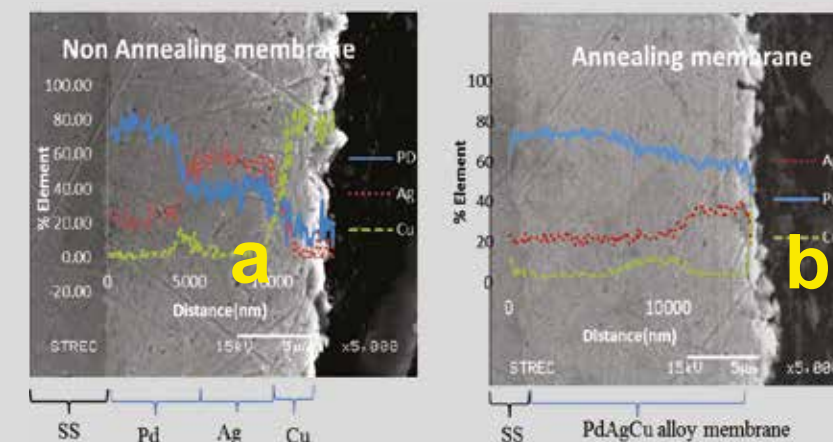
Syntheses and industrial applications based on Green Chemistry concept, using the renewable resources, recycling, waste reduction and energy saving.



- 2018 IUPAC CCE Distinguished Contribution to Chemical Education Award.
- 2017 FACS Award for Distinguished Contribution to Chemical Education
- 2017 CST Award for Distinguished Contribution to Chemical Education
- 2015 FACS Fellow, Federation of Asian Chemical Societies.
- 2013 Honorary Fellow, Singapore National Institute of Chemistry
- 2017-2020 President, Council of Science and Technology Professionals
- 2011-2013 President, Federation of Asian Chemical Societies
- 2005-2011 President, Chemical Society of Thailand
- 2001-2003 President, Pacific Polymer Federation
- 1997-2003 President, Polymer Society of Thailand



Our research focuses on the syntheses and development of useful materials for certain applications from renewable resources or wastes, and solving problems with the low-cost method. Due to the increasing demand for hydrogen as a clean energy source, a feedstock, or as an intermediate and specialty chemical in coming years, we have paid much attention on the transformation of methane and carbon dioxide, which are greenhouse gases, to hydrogen and carbon monoxide via dry reforming reaction. In addition, we have developed the methods of the preparation of palladium and palladium-based alloy membranes. This is a challenge for us in finding the economically efficient enrichment processes in order to achieve high purity hydrogen suitable for further usages.



1. Sumrunronnasak, S., Tantayanon, S., and Kiatgamolchai, C. (2017) "Influence of layer compositions and annealing conditions on complete formation of ternary PdAgCu alloys prepared by sequential electroless and electroplating methods", *Materials Chemistry and Physics*, 1, 98-103.
2. Singto, S., Supap, T., Idem, R., Tontiwachwuthikul, P., and Tantayanon, S. (2017) "The Effect of Chemical Structure of Newly Synthesized Tertiary Amines Used for the Post Combustion Capture Process on Carbon dioxide (CO₂): Kinetics of CO₂ Absorption Using the Stopped-Flow Apparatus and Regeneration, and Heat Input of CO₂ Regeneration", *Energy Procedia*, 114, 852-859.
3. Singto, S., Tantayanon, S., Zoto, C.A., and Connors, R.A., (2018) "Syntheses and Photophysical Properties of Diaminotetraphenylporphyrins and their Corresponding Polyimides", *Journal of Molecular Structure*, 1154, 114-130.
4. Majumdar, R., Tantayanon, S. and Bag, B.G. (2018) "Synthesis of palladium nanoparticles with leaf extract of *Chrysophyllum cainito* (Star apple) and their applications as efficient catalyst for C-C coupling and reduction reactions", *International Nano Letter*, 7, 267-274, <https://doi.org/10.1007/s40089-017-0220-4>.
5. Chotirach, M., Tungasmita, S., and Tungasmita, D.N. and Tantayanon, S., (2018) "Titanium nitride promoted Ni-based SBA-15 catalyst for dry reforming of methane", *International Journal of Hydrogen Energy*, 43, 21322-21332.
6. Chotirach, M., Tungasmita, S., Tungasmita, D.N., and Tantayanon, S., "Synthesis and Characterizations of TiN-SBA-15 Mesoporous Materials for CO₂ Dry Reforming Enhancement", *Journal of Pure and Applied Chemistry* (in press).



SUPOT HANNONGBUA

Professor

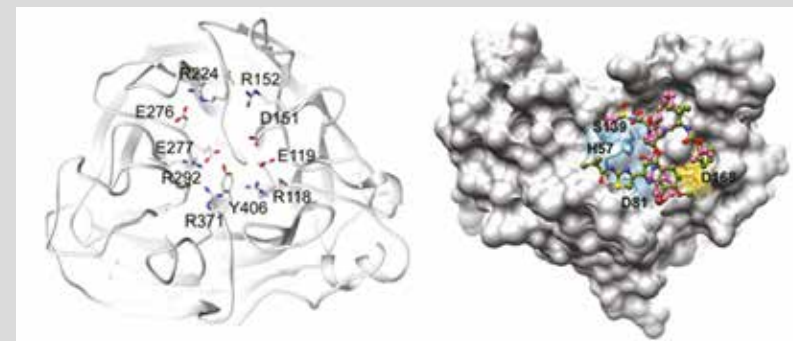
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Computer-aided drug design and molecular modeling on nanomaterials.

Our research group has mainly focused on the application of computational techniques in screening and designing bioactive compounds toward biological

inhibitors as pharmaceutical lead compounds. Molecular dynamics simulation has been applied to investigate the binding interaction of current drugs and/or lead compounds with their drug targets such as viral influenza neuraminidases and hepatitis C virus protease. Currently, we are exploring drug screening of antiviral agents against a novel coronavirus 2019 (SARS-CoV-2) from various databases.



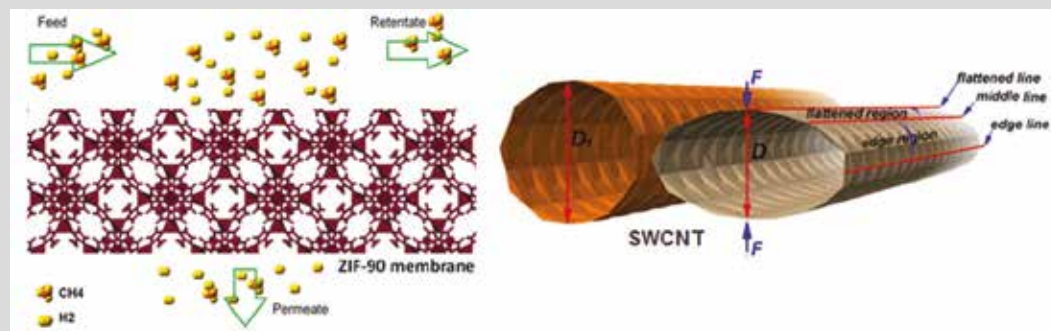
In addition to molecular modeling on biological systems, we have also interested in nanomaterials such as zeolitic imidazolate framework serving as gas storage and gas separation. Other related nanoparticles including single-walled carbon nanotubes, graphene oxide and biocompatible cyclodextrins have also been studied.



RESEARCH
EMPHASIS



RESEARCH



1. Khuntawee, W.; Kunaseth, M.; Rungnim, C.; Intagorn, S.; Wolschann, P.; Kungwan, N.; Rungrotmongkol, T.; Hannongbua, S. Comparison of Implicit and Explicit Solvation Models for Iota-Cyclodextrin Conformation Analysis from Replica Exchange Molecular Dynamics. *Journal of Chemical Information and Modeling* **2017**, 57, 778-786.
2. Chokbunpiam, T.; Fritzsche, S.; Caro, J.; Chmelik, C.; Janke, W.; Hannongbua, S. Importance of ZIF-90 Lattice Flexibility on Diffusion, Permeation and Lattice Structure for an adsorbed H_2/CH_4 Gas Mixture – A Re-Examination by Gibbs Ensemble Monte Carlo and Molecular Dynamics Simulations. *Journal of Physical Chemistry C* **2017**, 121, 10455-10462.
3. Kongkaew, S.; Rungrotmongkol T.; Punwong C.; Noguchi H.; Takeuchi F.; Kungwan N.; Wolschann P.; Hannongbua S., Interactions of HLA-DR and Topoisomerase I Peptide Modulated Genetic Risk for Diffuse Cutaneous Systemic Sclerosis, *Scientific Reports* **2019**, 9, 745.
4. Phanich J.; Threeracheep S.; Kungwan N.; Rungrotmongkol T.; Hannongbua S., Glycan binding and specificity of viral influenza neuraminidases by classical molecular dynamics and replica exchange molecular dynamics simulations, *Journal of Biomolecular Structure & Dynamics* **2019**, 37, 33549-3365.
5. Hotarat W.; Rungnim C.; Wolschann P.; Kungwan N.; Rungrotmongkol T.; Hannongbua S., Encapsulation of alpha-mangostin and hydrophilic beta-cyclodextrins revealed by all-atom molecular dynamics simulations, *Journal of Molecular Liquids* **2019**, 288, 110965.

THAMMARAT AREE

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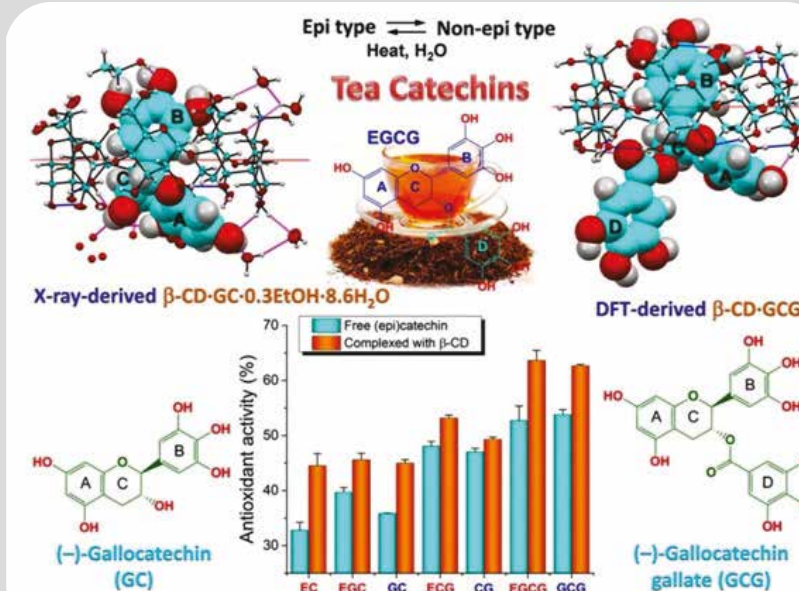
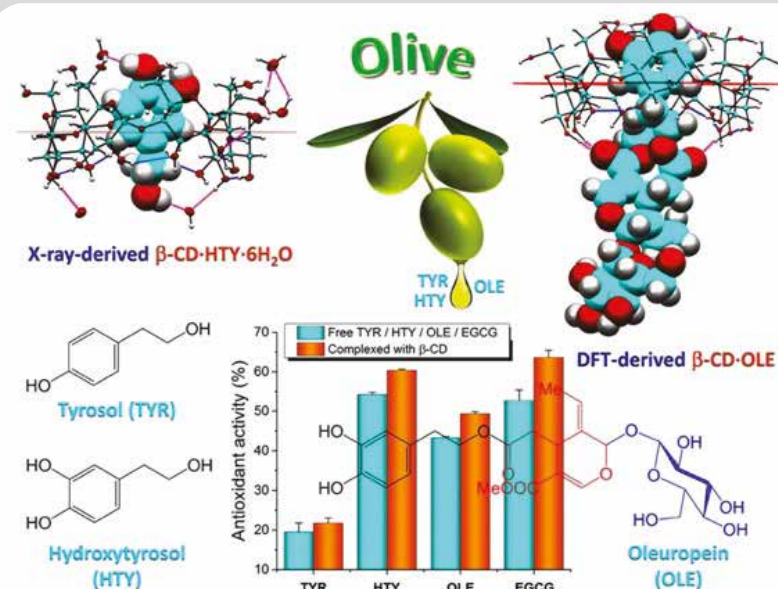
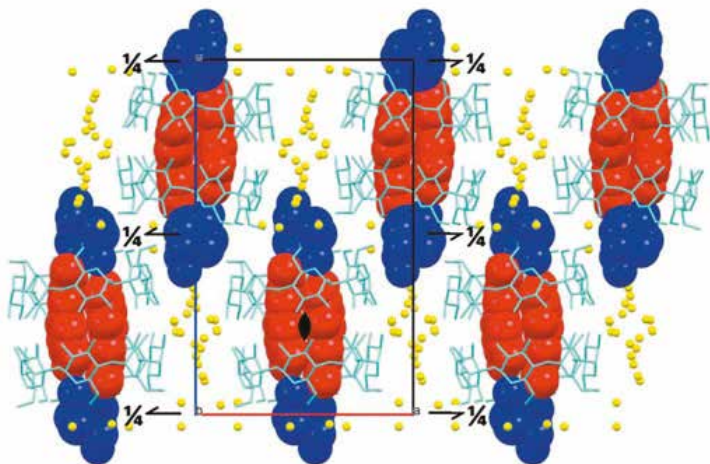


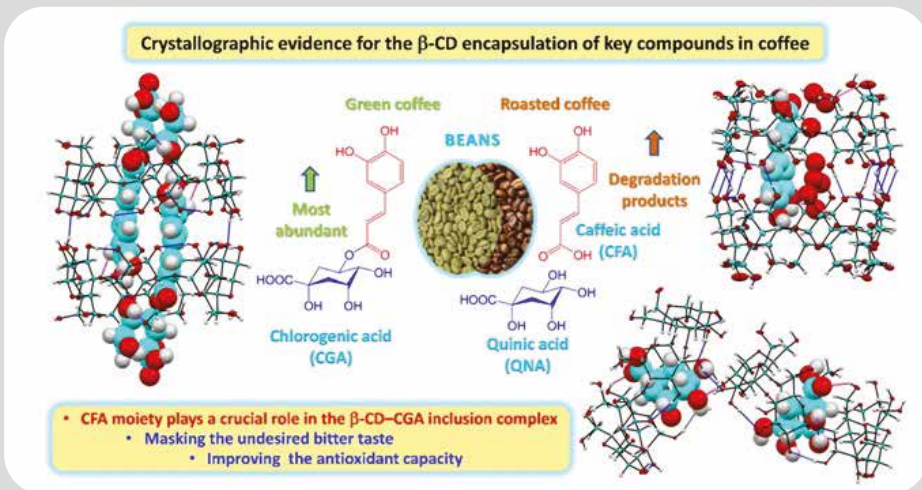
Crystallography, molecular modeling



- Outstanding Research Award, Chulalongkorn University 2014
- The Most Cited Research Publication Award for Physical Science and Mathematics Faculty of Science, Chulalongkorn University 2019

My research focuses on single-crystal X-ray diffraction analysis of i) cyclodextrin encapsulation of functional foods (e.g., catechins and epicatechins in tea, polyphenols in coffee and olive), ii) bioactive natural and synthesized compounds, and iii) supramolecular inorganic-organic frameworks. Moreover, theoretical calculations have also been performed for atomistic insights into the structure-property relationship of complexation.





1. Kumar, S.; Sharma, R. P.; Venugopalan, P.; Aree, T. Effect of differently substituted methoxybenzoates on the supramolecular assemblies of three $[\text{Cu}(\text{N-hyden})_2](\text{o-/m-/p-methoxybenzoate})_2$ complexes: Synthesis, spectroscopic characterization and single crystal structure determination. *Polyhedron* **2017**, 133, 213–221.
2. Aree, T.; Jongrungruangchok, S. β -cyclodextrin encapsulation elevates antioxidant capacity of tea: A closing chapter on non-epicatechins, atomistic insights from X-ray analysis, DFT calculation and DPPH assay. *Carbohydr. Polym.* **2018**, 194, 24–33.
3. Aree, T.; Jongrungruangchok, S. Structure-antioxidant activity relationship of β -cyclodextrin inclusion complexes with olive tyrosol, hydroxytyrosol and oleuropein: Deep insights from X-ray analysis, DFT calculation and DPPH assay. *Carbohydr. Polym.* **2018**, 199, 661–669.
4. Aree, T. Inclusion complex of β -cyclodextrin with coffee chlorogenic acid: New insights from a combined crystallographic and theoretical study. *Acta Cryst.* **2019**, C75, 15–21.
5. Aree, T. Understanding structure and thermodynamics of β -cyclodextrin encapsulation of chlorogenic, caffeic and quinic acids: Implications for enriching antioxidant capacity and masking bitterness in coffee. *Food Chem.* **2019**, 293, 550–560.

THAWATCHAI TUNTULANI

Professor

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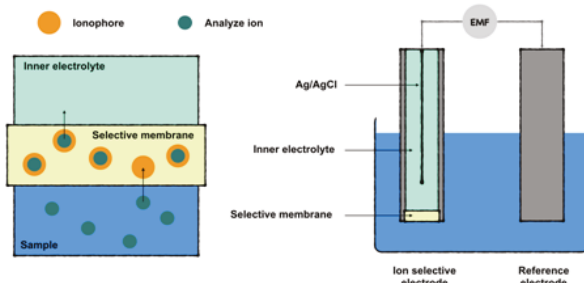




Supramolecular chemistry based on studies of ion recognition and ion sensing using optical and electrochemical techniques such as UV-vis and fluorescence spectrophotometry, ion-selective electrodes and optodes.

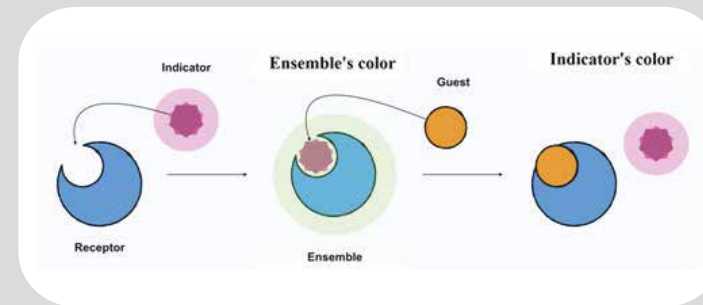
- Thailand Outstanding Scientist Award 2014
- Thailand Distinguished Researcher Award 2007

Our group has synthesized many receptor molecules and studied their properties of ion recognition. We can prepare ionophores that selectively bind metal ions such as Ag^+ and Cd^{2+} in high yields, and the ionophores can be used to prepare membrane ion selective electrodes (ISE). With advancement of nanotechnology, we can fabricate the first coated-wire Ag-ISE on the paper. The Ag-ISE can be used as a detector for glucose and DNA hybridization using Ag nanoparticles as redox marker. Recently, we can employ ion exchange polymeric membranes using the concept of ISE for fabrication of a paper-based ferrous ion sensor. Currently, we are exploring new interesting anion selective ionophores such as layer double hydroxides for using as ion carrier in anion selective electrodes.



Our group also involves in indicator displacement assay (IDA) research. IDA provides the most simple, convenient and increasingly popular approach to the naked-eye ion detection.

We are currently exploring use of IDA techniques for detection of saccharide and other biologically relevant species.



In addition, our group has collaborations with other research groups in the area of metal quantum dots and metal nano clusters and their applications in detection of toxic metal ions and biologically relevant molecules.

1. Teerasarunyanon; R.; Watchasit, S.; Suksai, C.; Tuntulani, T.; Ruangpornvisuti, V. "UV-vis and theoretical studies on an ensemble of dinuclear Cu(II) complex of anthracene-based tripodal tetramine with pyrogallol red for cyanide detection and species distribution in aqueous solution" *Inorg. Chem. Commun.* **2019**, 108, 107502.
2. Chaiendoo, K.; Sooksin, S.; Kulchat, S.; Promarak, V.; Tuntulani, T.; Ngeontae, W. "A New Formaldehyde Sensor from Silver Nanoclusters Modified Tollens' Reagent" *Food Chem.* **2018**, 255, 41-48.
3. Boonmee, C.; Promarak, V.; Tuntulani, T.; Ngeontae, W. "Cysteamine-capped Copper Nanoclusters as a Highly Selective Turn-on Fluorescent Assay for the Detection of Aluminum Ions" *Talanta* **2018**, 178, 796-804.
4. Chaiendoo, K.; Tuntulani, T.; Ngeontae, W. "A Paper-based Ferrous Ion Sensor Fabricated from an Ion Exchange Polymeric Membrane Coated on a Silver Nanocluster-impregnated Filter Paper" *Mat. Chem. Phys.* **2017**, 199, 272-279.
5. Khonkayan, K.; Sansuk, S.; Srijaranai, S.; Tuntulani, T.; Saiyasombat, C.; Busayaporn, W.; Ngeontae, W. "New Approach for Detection of Chromate Ion by Preconcentration with Mixed Metal Hydroxide Coupled with Fluorescence Sensing of Copper Nanoclusters" *Microchim Acta* **2017**, 184, 2965-2974.



TIRAYUT VILAIVAN

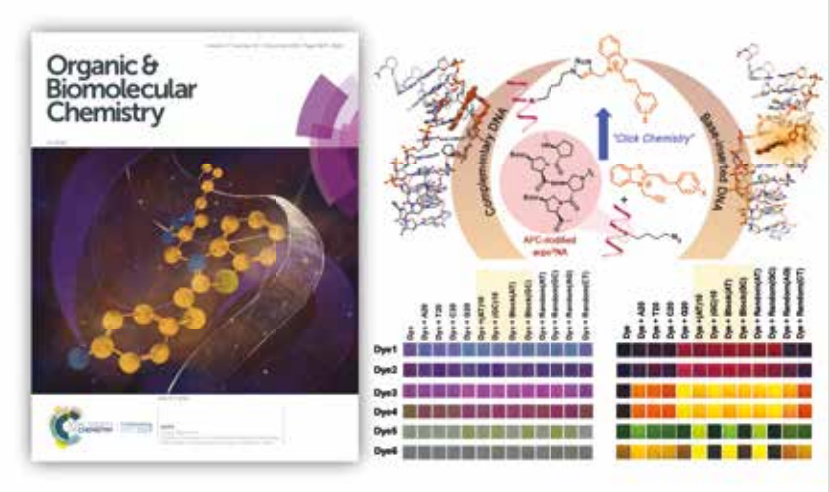
Professor

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Organic synthesis; catalysis; medicinal chemistry; sustainable chemistry;
DNA chemistry; peptide nucleic acid; molecular diagnostics

Thailand Outstanding Scientist 2014
Chemical Society of Thailand High Impact Chemist 2013
Thailand Distinguished Researcher (Chemistry & Pharmaceutical Sciences) 2007



Our recent research focuses on the development of a new class of cationic dyes that can bind to specific classes of nucleic acids and give distinct color and/or fluorescence change in response to the type of nucleic acid, base composition or secondary structure. These dyes can be used for the detection of nucleic acids or non-nucleic acid targets by using aptamers as signal transducers. In addition, these dyes are incorporated into peptide nucleic acid (PNA) with a conformationally constrained α/β -peptide backbone that showed excellent DNA binding affinity and specificity to develop fluorescence PNA probes that can change fluorescence in response to DNA hybridization.



RESEARCH
EMPHASIS + HONORS
+ AWARDS

RESEARCH



Other research interests of our group include 1) design, synthesis, properties and applications of nucleic conformationally constrained PNA 2) development of novel synthetic methodologies (focusing on catalysis and green processes) and 3) development of novel antimalarials based on dihydrofolate reductase inhibitors.

1. Ditmangklo, B.; Taechalertrpaisarn, J.; Siriwong, K.; Vilaivan, T. Clickable styryl dyes for fluorescence labeling of pyrrolidinyl PNA probes for the detection of base mutations in DNA. *Org. Biomol. Chem.* **2019**, *17*, 9712–9725.
2. Laopa, P.; Vilaivan, T. Cationic-polymer-functionalized zinc oxide quantum dots: Preparation and application to iron(II) ion detection. *ChemistrySelect* **2019**, *4*, 4251–4257.
3. Suraritdechachai, S.; Charoenpakdee, C.; Young, I.; Maher, S.; Vilaivan, T.; Praneenarat, T. Rapid detection of the antibiotic sulfamethazine in pig body fluids by paper spray mass spectrometry. *J. Agric. Food Chem.* **2019**, *67*, 3055–3061.
4. Kangkamano, T.; Numnuam, A.; Limbut, W.; Kanatharana, P.; Vilaivan, T.; Thavarungkul, P. Pyrrolidinyl PNA polypyrrole/silver nanofoam electrode as a novel label-free electrochemical miRNA-21 biosensor. *Biosens. Bioelectron.* **2018**, *102*, 217–225.
5. Vilaivan, T. Fluoreogenic PNA probes. *Beilstein J. Org. Chem.* **2018**, *14*, 253–281.
6. Pansuwan, H.; Ditmangklo, B.; Vilaivan, C.; Jiangchareon, B.; Pan-In, P.; Wanichwecharungruang, S.; Palaga, T.; Nuanyai, T.; Suparpprom, C.; Vilaivan, T. Hydrophilic and cell-penetrable pyrrolidinyl peptide nucleic acid via post-synthetic modification with hydrophilic side chains. *Bioconjugate Chem.* **2017**, *28*, 2284–2292.
7. Seankongsuk, P.; Vchirawongkwin, V.; Bates, R.W.; Padungros, P.; Vilaivan, T. Enantioselective synthesis of (2S,3S)-*epi*-oxetin and its incorporation into conformationally constrained pyrrolidinyl PNA with an oxetane backbone. *Asian. J. Org. Chem.* **2017**, *6*, 551–560.

VITHAYA RUANGPORNVISUTI

Professor

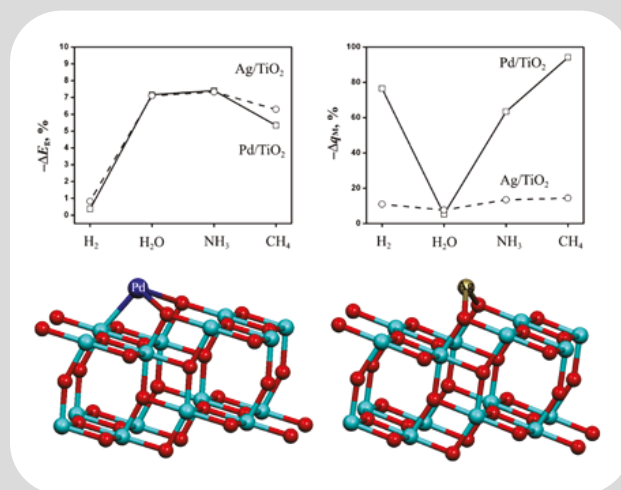
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Materials chemistry based on studies of adsorption of small molecules on surfaces of metal oxides (i.e. TiO_2 , ZnO , ZrO_2 and BeO and their doping derivatives), carbon nanomaterials i.e. graphene, carbon nanotube (CNT), their element-doped surfaces and metal organic frameworks (MOFs) such as zeolitic imidazolate frameworks (ZIFs) have been theoretically investigated. All studied materials have been assessed and analyzed in terms of gases storage, sensing materials and catalysts.

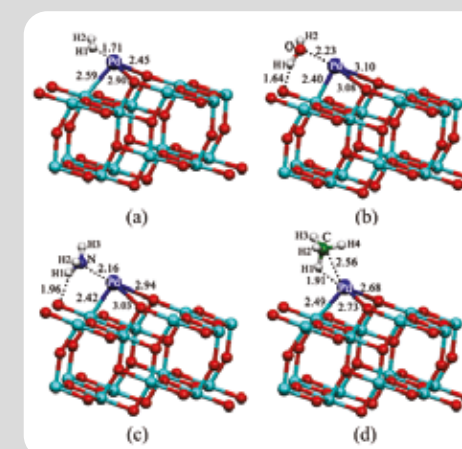
- Professor Award, Chulalongkorn University, 2016
- Most-Cited Paper Award, Faculty of Science, CU, 2010



The Pd- and Ag-doped anatase $\text{TiO}_2(101)$ surfaces were investigated and the binding energies of single atom of Pd (-2.15 eV) and Ag (-2.38 eV) on the anatase (101) surfaces, respectively denoted as Pd/TiO_2 and Ag/TiO_2 , were obtained. Binding sites for Pd and Ag atoms toward the TiO_2 surface atoms are three atoms (Ti_{5c} and two O_{2c} atoms) and two O_{2c} atoms of the $\text{TiO}_2(101)$

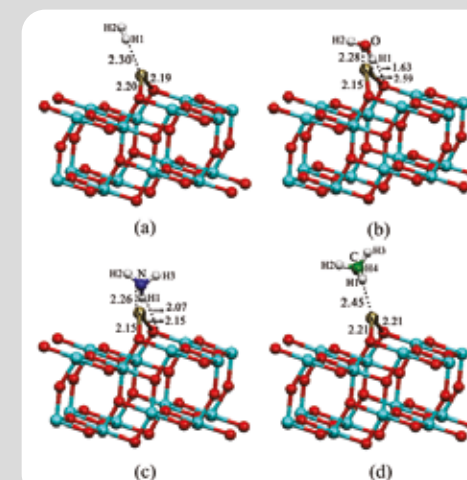
surface, respectively. Due to adsorptions of H_2 and hydrogen-containing (H_2O , NH_3 , and CH_4) gases on the Pd/TiO_2 and Ag/TiO_2 , adsorption abilities on the Pd/TiO_2 and Ag/TiO_2 are in decreasing orders: $\text{NH}_3 > \text{H}_2\text{O} > \text{H}_2 > \text{CH}_4$ and $\text{NH}_3 > \text{H}_2\text{O} > \text{CH}_4 > \text{H}_2$, respectively. Mulliken-charge transfers from the Pd and Ag atoms to adsorption atoms of the anatase $\text{TiO}_2(101)$ surface and the adsorption of hydrogen and hydrogen-containing gases to the Pd/TiO_2 and Ag/TiO_2 were observed. The Pd/TiO_2 and/or Ag/TiO_2 have high potentials to be NH_3 sensing materials based on the electric conductivity measurement. The Pd/TiO_2 has high potential to be CH_4 sensing device based on the electric conductivity and surface charge measurements.

The Pd/TiO_2 or Ag/TiO_2 can be applied as gas sensing materials for NH_3 detection using measurements of their electric conductivity. The Pd/TiO_2 has high potential to be CH_4 gas sensing material by electric conductivity and surface charge measurements.



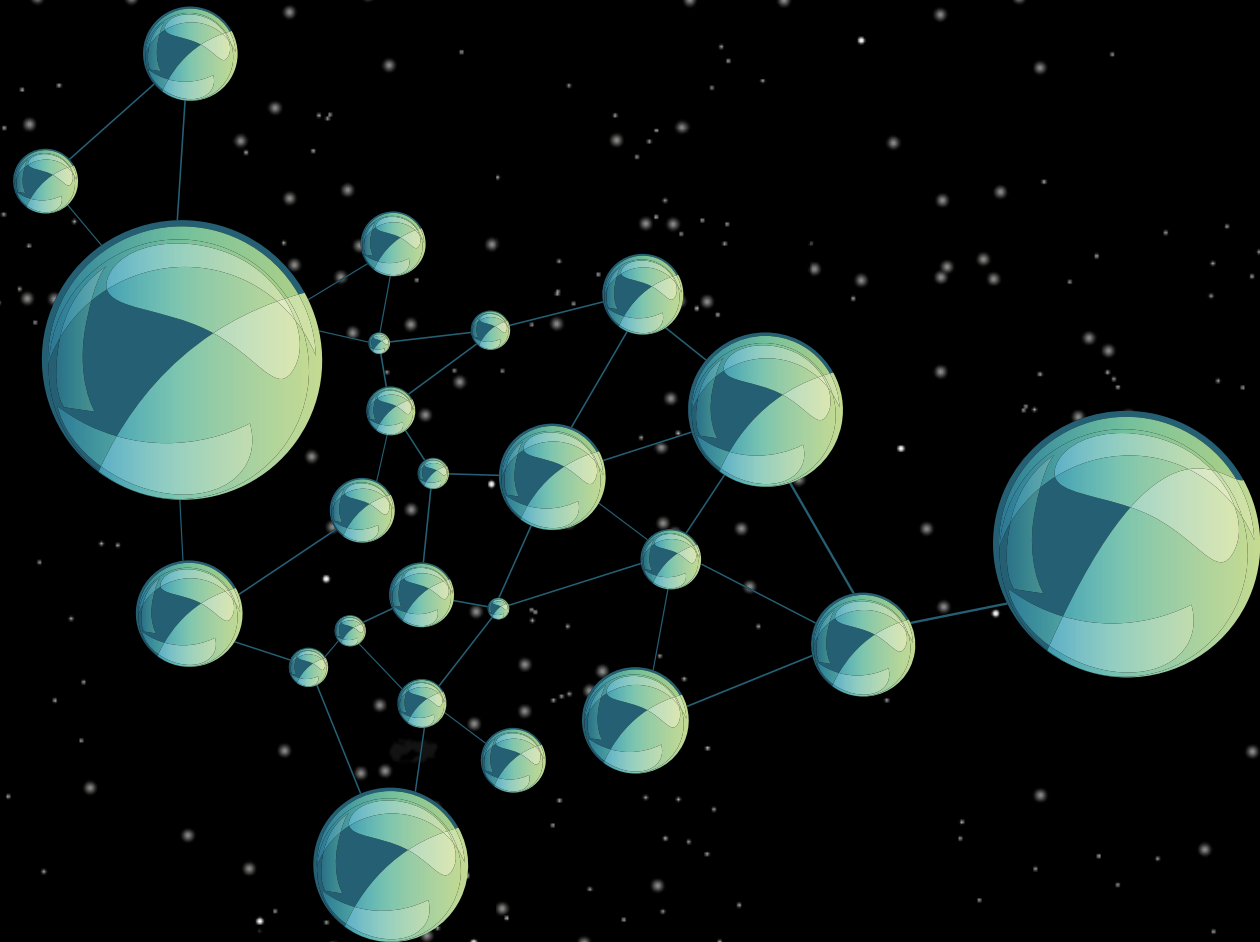
Optimized geometries of adsorption structures of (a) H_2 (b) H_2O (c) NH_3 and (d) CH_4 on the $\text{Pd/TiO}_2(101)$ surface. Atomic distances are in Å.

Optimized geometries of adsorption structures of (a) H_2 (b) H_2O (c) NH_3 and (d) CH_4 on the $\text{Ag/TiO}_2(101)$ surface.



1. Teerasarunyanon, R.; Watchasit, S.; Suksai, C.; Tuntulani, T.; Ruangpornvisuti, V. "UV-vis and theoretical studies on an ensemble of dinuclear Cu (II) complex of anthracene-based tripodaltetramine with pyrogallol red for cyanide detection and species distribution in aqueous solution" *Inorg. Chem. Commun.* **2019**, *108*, 107502.
2. Kaewruksa, B., Vchirawongkwin, V., Ruangpornvisuti, V. "Adsorption of propane and propylene in zeolitic imidazolate framework ZIF-8 pore: periodic SCC-DFTB method" *Adsorption* **2018**, *24*, 691–701.
3. Panta, R., Nanthamathee, C., Ruangpornvisuti, V. "Adsorption of hydrogen and hydrogen-containing gases on Pd- and Ag-single atoms doped on anatase TiO₂ (1 0 1) surfaces and their sensing performance" *Appl. Surf. Sci.* **2018**, *450*, 112–121.
4. Tabtimsai, C., Ruangpornvisuti, V., Tontapha, S., Wanno, B. "A DFT investigation on group 8B transition metal-doped silicon carbide nanotubes for hydrogen storage application" *Appl. Surf. Sci.* **2018**, *439*, 494–505.
5. Pipornpong, W., Phunnarungsi, S., Ruangpornvisuti, V. "DFT investigation on adsorption of di-, tri- and tetra-atomic gases on Sc-doped ZnO sodalite like cage for gas sensing purpose" *Mater. Chem. Phys.* **2018**, *217*, 63–73.
6. Panta, R.; Ruangpornvisuti, V. "Adsorption of hydrogen molecule on noble metal doped on oxygen-vacancy defect of anatase TiO₂(101) surface: Periodic DFT study" *Int. J. Hydrogen Energy* **2017**, *42*, 19106–19113.

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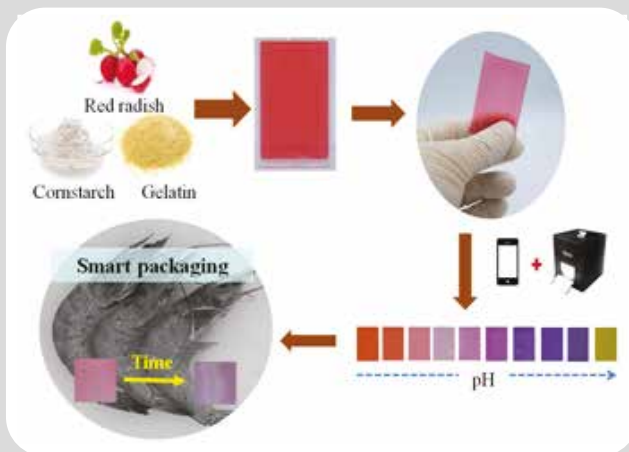


Biocompatible sensors, Trace element analysis, Environmental analysis,
Chemical treatment of waste and wastewater



Outstanding Lecturer Award from Chulalongkorn University, 2016
Chulalongkorn University Research Unit Award
(Environmental Analysis Research Unit), 2013

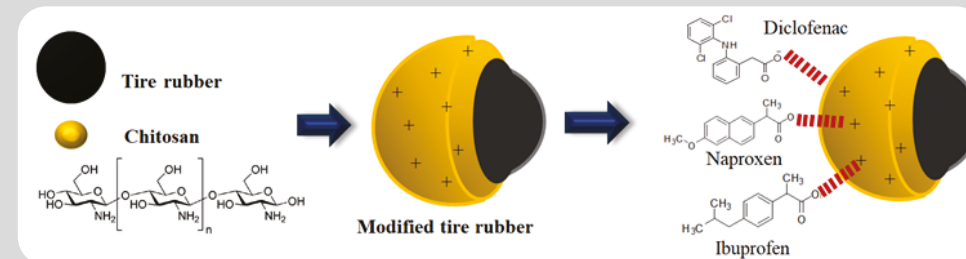
Our Environmental Analysis Research Unit (EARU) has been working on developing analytical methods for analysis of pollutants/contaminants in the environment, water, wastewater and food. Our research also focuses on the development of treatment technology of hazardous wastes and the environmental assessment methodology for waste disposal.



My research direction focuses on the visual and colorimetric detection of heavy metal ions and the speciation analysis and pre-concentration of metal species in wastewater and environmental samples, and the treatment of wastewater using co-precipitation, adsorption, and extraction methods.



Our group has collaborations with other research groups in the area of trace metal analysis in particulate matters and airborne and has continuously received research grant from industrial sectors in chemical wastewater treatment and environmental analysis and monitoring.



1. Chayavanich, K., Thiraphibundet. P., Imyim, A. Biocompatible film sensors containing red radish extract for meat spoilage observation, *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy*, **2020**, 226, 117601.
2. Phasuphan, W., Praphairaksit, N., Imyim, A. Removal of ibuprofen, diclofenac, and naproxen from water using chitosan-modified waste tire crumb rubber, *Journal of Molecular Liquids*, **2019**, 294, 111554.
3. Anekthirakun, P., Imyim, A. Separation of silver ions and silver nanoparticles by silica based-solid phase extraction prior to ICP-OES determination, *Microchemical Journal*, **2019**, 145, 470-475.
4. Sarntanayoot, P., Fuangswasdi, S., Imyim, A. Iron nanoparticle-modified water treatment residues for adsorption of As(III) and As(V) and their cement-based solidification/stabilization, *International Journal of Environmental Science and Technology*, **2019**, 16(8), 4285-4292.
5. Phattamajintatamrong, N., Puanngam, M., Imyim, A. Speciation analysis of arsenite, arsenate and dimethylarsenic acid using silica-based columns and ICP-OES, *Current Analytical Chemistry*, **2017**, 13(2), 137-143.





***BUNCHA
PULPOKA***

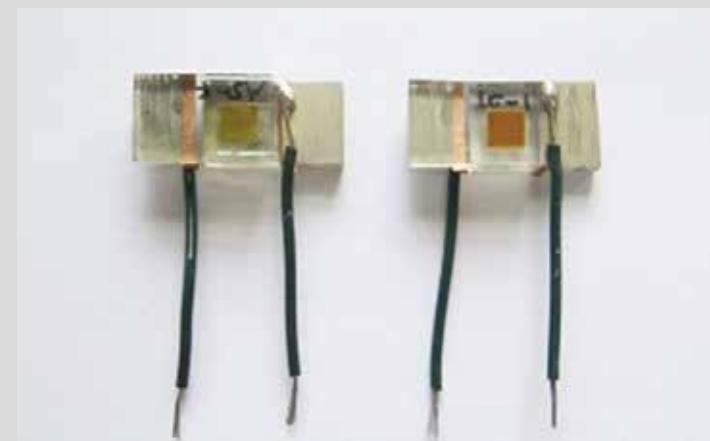
Associate Professor

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- Selective cation, anion and ion-pair receptors and sensors
- Metal organic frameworks (MOFs) for gas capture and catalyst
- Dye-sensitized solar cells



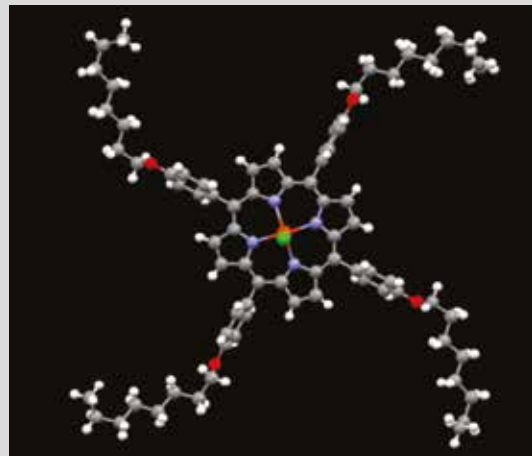
Using sophisticated designs and simple synthesis for desired molecular frameworks incorporated signaling units, highly specific cation, anion or ion-pair sensors could be achieved. Based on calix[4]arene family, many selective sensors were developed for selective detection of heavy metal ions and halide ions.



RESEARCH
EMPHASIS



RESEARCH



The use of macromolecules to construct advance materials for alternative energy is one of our current researches. The development of dyes based on bipyridylporphyrin ruthenium complexes is aimed to enhance the performance of dye-sensitized solar cells (DSSCs). Metal organic frameworks (MOFs) constructed by using 1,3-alternate calix[4]arenes and porphyrins are aimed to store hydrogen, capture of carbon dioxide or catalyst conversion of carbon dioxide to useful chemicals or water splitting to produce hydrogen gas. Porphyrin based soft materials incorporated with spin-crossover property is one of our ongoing projects.

1. Kampaengsri, S., Wanno, B., Tuntulani, T., Pulpoka, B., Kaewtong, C. "Gold sensing with rhodamine immobilized hydrogel-based colorimetric sensor", *Environ. Technol.*, **2019**, (in press).
2. Taweetanavanich, T., Wanno, B., Tuntulani, T., Pulpoka, B., Kaewtong, C. "A pH optical and fluorescent sensor based on rhodamine modified on activated cellulose paper", *J. Chin. Chem. Soc.*, **2019**, 66, 493–499.
3. Kaewtong, C., Kampaengsri, S., Tuntulani, T., Pulpoka, B. "A solvatochromic-based sensor for chromium(iii) in real systems", *New J. Chem.*, **2018**, 42, 9930-9934.
4. Kaewtong, C.; Kampaengsri, S.; Singhana, B.; Pulpoka, B. "Highly selective detection of Au³⁺ using rhodamine-based modified polyacrylic acid (PAA)-coated ITO", *Dyes Pigm.*, **2017**, 141, 277-285.

FUANGFA UNOB

Associate Professor

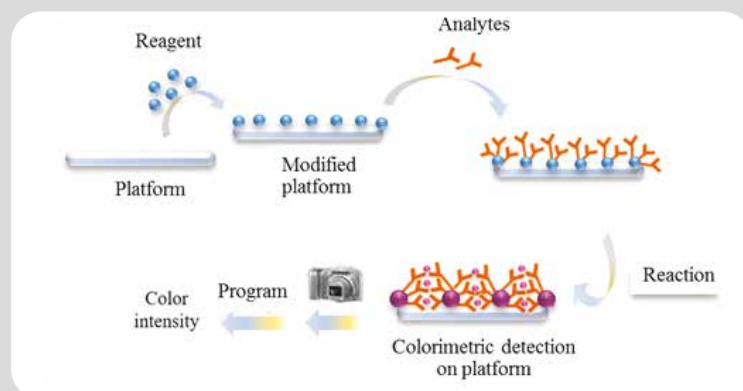
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Sensing platforms and methods for detection of toxic substance and biomarker molecules, Material synthesis for water treatment and application as sensors

We develop analytical methods and sensors for detection of toxic substances and biomarker molecules for the analysis of food samples, environmental samples, and biological samples. Simple sensing platforms including paper based platform and thread-based platform with specific surface modification are used in combination with colorimetric reaction with analytes or nanoparticles (gold nanoparticles and silver nanoparticles) for sample analysis. Another approach is based on the colorimetric detection on the surface of materials such as functionalized silica and hydroxyapatite for the analysis of trace biomolecules in samples.



Our research group is also working on the synthesis of various materials including mesoporous materials, metal organic frameworks (MOFs), biopolymer and its composites. With a proper surface modification, the materials can be used for different purpose such as removal of toxic substances, recovery of nanoparticles from water, and application as solid phase for the extraction of metals or biomolecules for further analysis.



1. Praselia, R.; Fuangswasdi, S.; Unob, F. "Silver nanoparticle-supported hydroxyapatite as a material for visual detection of urinary cysteine" *Anal. Methods* **2019**, *11*, 2888-2894.
2. Pongkitdachoti, U.; Unob, F. "Simultaneous adsorption of silver nanoparticles and silver ions on large pore mesoporous silica" *J. Environ. Chem. Eng.* **2018**, *6*, 596-603.

KANET WONGRAVEE

Associate Professor

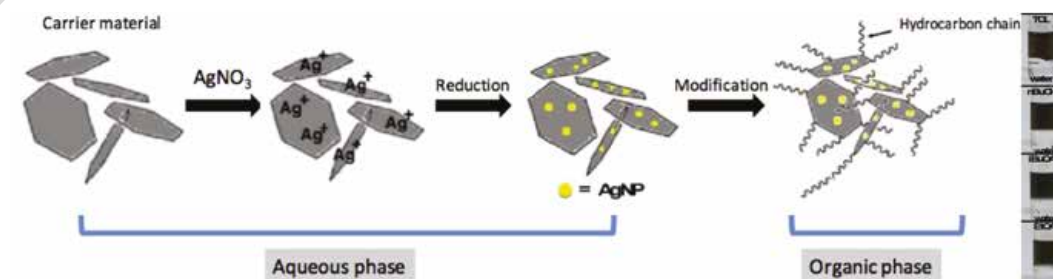
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The applications and developments of analytical devices on spectroscopic techniques. Fabrication of fancy nano/micro materials using chemical reaction for scale-up for industrial applications. Development of chemometrics algorithms and pattern recognition methods on analytical devices for archeological, food and gemology analysis.

- Outstanding new research award from Chulalongkorn University : 2014
- Outstanding new lecturer award from Chulalongkorn University : 2014
- Outstanding new research award from Faculty of Science, Chulalongkorn University: 2014

In recent years, fancy structures of precise metal in nano/micro-scale have been successfully fabricated using rapid and simple chemical reaction. The proposed reactions involve economical reactants and enable to scale up for industrial application. An innovative phase transferring process of anisotropic silver nanoparticles (AgNPs) from aqueous to a wide range of organic solvents was proposed. The anisotropic AgNPs were transferred to the organic solvents by using graphene oxide (GO) modified with oleylamine (OAM). The composite of AgNPs with GO-OAM were uniformly dispersed in the organic solvents for at least 18 h after sonication.



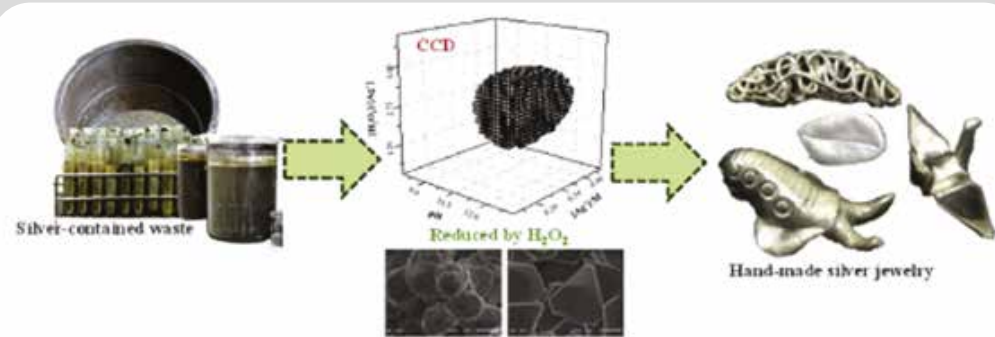
RESEARCH
EMPHASIS



HONORS
+ AWARDS

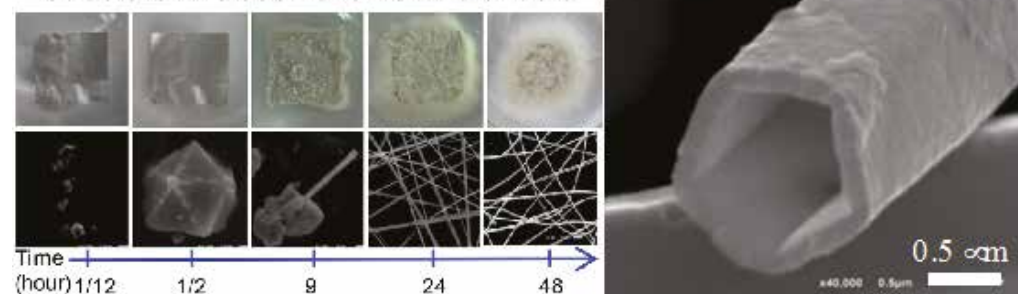


RESEARCH



A simple, rapid and environmental friendly process using H_2O_2 were developed for recovering high purity silver directly from industry and laboratory wastes. The morphological of the recovered silver could be selectively turned by an additional of capping agent. The silver microcrystal were obtained with no capping agent while the silver microplate were generated by adding PVP in the recovery process. The recovery method was performed on the 50 liters of silver-wasted (3-years research) and the recovered silver microcrystals could be recovered with 91.27%. Furthermore, the direct usage of the recovered silver microcrystals was applied as a raw material of silver clay for creating a set of wearable silver jewelries.

Structure Evolution of silver microfibers



The efficient galvanic replacement protocol for fabrication of pentagonal silver microfibers with ultrahigh aspect ratio ($\sim 6,600$) without employing any capping agent, surfactant and stabilizer was successfully developed. This process involve only sacrificial aluminum metal and silver nitrate solution. The structure of product was controlled by concentration of AgNO_3 though the kinetic growth transformation. The obtained microfibers possess nano-interception provides the formation of hotspots within a fiber bundle, thereby presenting a promising substrate for surface enhanced Raman scattering (SERS) and used as a template to generate hollow fiber (Pt in the case).

1. Gatemala, H., Tongsakul, D., Naranuruemol, S., Panchompoo, J., Ekgasit, S., Wongravee, K. "Synthesis of silver microfibers with ultrahigh aspect ratio by galvanic replacement reaction", *Materials Chemistry and Physics*, **2019**, 237, 121872.
2. Gatemala, H., Ekgasit, S., Wongravee, K. "High purity silver microcrystals recovered from silver wastes by eco-friendly process using hydrogen peroxide" *Chemosphere*, **2017**, 178, 249
3. Nootchanat, S., Lertvachirapaiboon, C., Amornkitbamrung, V., Uppachai, P., Ekgasit, S., Wongravee, K. "Shape evolution of 3D flower-like gold microstructures from gold nanosheets via oriented attachment" *Materials and Design*, **2017**, 125, 158-166.
4. Wong-u-ra, O., Ekgasit, S., Wongravee, K. "Phase transferring of silver nanoparticles to organic solvents using modified graphene oxide as carrier" *Materials Chemistry and Physics*, **2017**, 199, 348-355.



NARONG PRAPHAIRAKSIT

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Trace elemental analysis and environmental analysis based on spectrometric and spectroelectrochemical detection, Paper based analytical devices, Waste-water treatment.



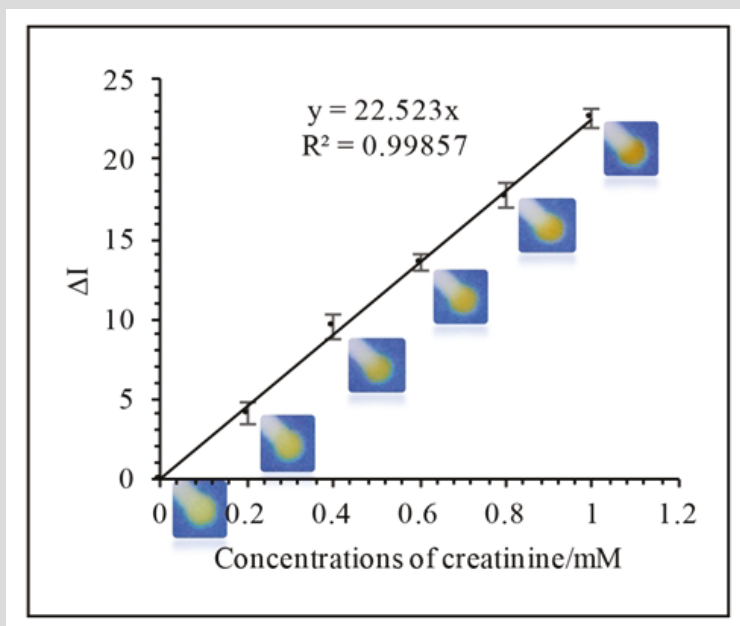
My recent research has been focused on developing microfluidic paper based analytical devices for the colorimetric detection of toxic heavy metals, contaminants as well as certain biomarkers in the environmental and biological samples. Some of the ongoing research involves the use of this device for the determination of creatinine in urine specimen. This low-cost and simple analysis is based on selective reaction between creatinine and reagents applied on the device which generates color that can be either visually detected or photographed and quantitatively determined via image processing software. Also of my particular interest is the utilization of waste materials through various modification processes for the purpose of removing toxic substances from the environment. Recent works include the use of chitosan-modified waste tire crumb rubber as an adsorbent for the removal of anti-inflammatory drugs contaminated in water.



RESEARCH
EMPHASIS



RESEARCH



1. Phasuphan W., **Praphairaksit N.**, Imyim A., Removal of ibuprofen, diclofenac, and naproxen from water using chitosan-modified waste tire crumb rubber, *Journal of Molecular Liquids*, 294 (2019) 111554.
2. Pungjunun K., Chaiyo S., **Praphairaksit N.**, Siangproh W., Ortner A., Kalcher K., Chailapakul O., Mehmeti E., Electrochemical detection of NO_x gas based on disposable paper-based analytical device using a copper nanoparticles-modified screen-printed graphene electrode, *Biosensors and Bioelectronics*, 143 (2019) 111606.
3. Sununta S., Rattanarat P., Chailapakul O., **Praphairaksit N.**, Microfluidic paper-based analytical devices for determination of creatinine in urine samples, *Analytical Sciences*, 34, 109-113, 2018.
4. Komenek S., Luesakul U., Ekgasit S., Vilaivan T., **Praphairaksit N.**, Puthong S., Muangsin N., Nanogold-gallate chitosan-targeted pulmonary delivery for treatment of lung cancer, *AAPS Pharm Sci Tech*, 18(4), 1104-1115, 2017.

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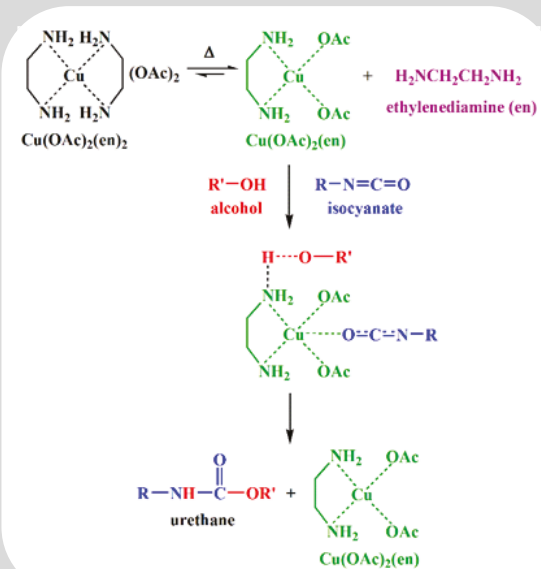


Synthesis of metal-amine complexes as new catalysts for the preparation of rigid polyurethane foams.

Polyurethane foams are one of the most rapidly developing areas in polymers due to their wide applications in rigid, semi-rigid, soft and flexible forms. Their density can be adjusted from 12 kg/m³ to 1000 kg/m³. The important applications of rigid polyurethane foams are insulations in many industrial branches, building engineering, refrigeration, heat engineering, etc. Thermal conductivity (in W/mK) of rigid polyurethane foam is in the range of 0.019 to 0.026, while that of mineral wool and polystyrene foam is in the range of 0.042 to 0.052 and 0.031 to 0.040, respectively. Rigid polyurethane foam of 5 cm in thickness has the same insulating effect as the polystyrene foam of about 10 cm in thickness.

Catalysts play an important role in the preparation of polyurethane foams. Good catalysts give the desired foaming reaction profile and foam properties. During the foaming process, polyols are reacted with polyisocyanates in the presence of blowing agents, silicone surfactants and catalysts. The general industrial catalysts are tertiary amines, which emit strong odor. The use of amine catalysts causes problems due to emissions of chemicals during the production of foams and worker exposure to these chemicals.

Our group has developed copper-amine complexes, namely $\text{Cu}(\text{OAc})_2(\text{en})_2$ and $\text{Cu}(\text{OAc})_2(\text{trien})$, as a new class of catalyst for the preparation of rigid polyurethane foams. .



Appearances of rigid polyurethane foams prepared from different catalysts



No catalyst DMCHA $\text{Cu}(\text{OAc})_2(\text{en})_2$ $\text{Cu}(\text{OAc})_2$ ethylenediamine (en)

The use of copper-amine complexes can improve working environment in RPUR foam processing because they have weak odor. These copper-amine complexes have comparable catalytic activity, namely cream time, gel time and tack-free time, to *N,N*-dimethylcyclohexylamine (DMCHA), which is a common commercial tertiary amine catalyst used in the preparation of rigid polyurethane foams. Free rise density and compressive strength of the rigid polyurethane foams prepared from copper-amine complexes are also comparable to those prepared from DMCHA.

The purified $\text{Cu}(\text{OAc})_2(\text{en})_2$ and $\text{Cu}(\text{OAc})_2(\text{trien})$ are obtained as a solid and a viscous liquid, respectively. New method for the preparation of $\text{Cu}(\text{OAc})_2(\text{en})_2$ and $\text{Cu}(\text{OAc})_2(\text{trien})$ as solutions in ethylene glycol was developed in order to improve the solubility of these copper complexes in the foam formulation and to obtain a more convenient procedure in the synthesis of copper-amine complexes.



purified $\text{Cu}(\text{OAc})_2(\text{en})_2$

$\text{Cu}(\text{OAc})_2(\text{en})_2$ solution in ethylene glycol



Sukkaneewat, B.; Sridaeng, D.; Chantarasiri, N. "Fully water-blown polyisocyanurate-polyurethane foams with improved mechanical properties prepared from aqueous solution of gelling/blowing and trimerization catalysts" *e-Poly-mers* 2019; 19(1), 277-289.





**PAITOON
RASHATASAKHON**

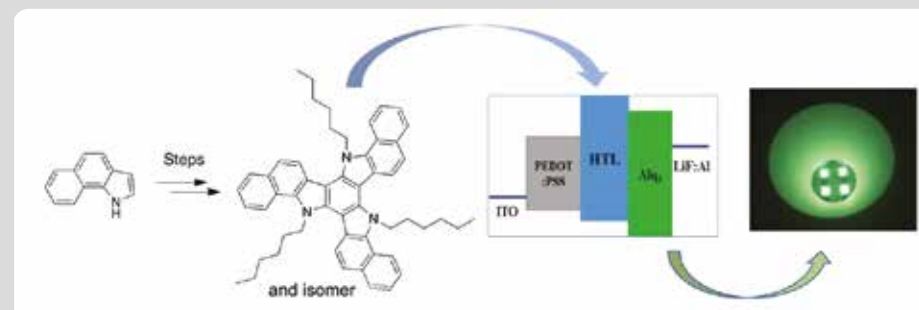
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Synthetic organic chemistry, Design and synthesis of fluorescent chemosensors and optoelectronic materials, Reaction optimization and scale-up.

- Wiley-CST Outstanding Publication Award 2010
- CST Citation Award 2013
- Grant for International Research Integration: Chula Research Scholar 2016
- Ernst-Mach Follow-up Grant by the Austrian Agency for International Cooperation in Education and Research 2018

My research group has been working on the design and synthesis of fluorescent chemosensors and optoelectronic materials from polyaromatic building blocks such as triphenylbenzene, truxene, perylene, and naphthalimide. For potential uses in food and environmental analysis, those building blocks are synthetically modified with selective receptors for heavy-metal ions, biological compounds, explosive chemicals, and proteins. The sensing mechanism and fluorescence properties of the signal transducer are also thoroughly investigated. In addition, we are also interested in the synthesis of new materials with potential applications in optoelectronic devices such as Organic Light-Emitting Diodes. Our approach is based on the combination of hole-transporting moiety such as triphenylamine or carbazole, with strongly fluorescent components such as pyrene or naphthalimide in order to obtain emissive material with superior properties.



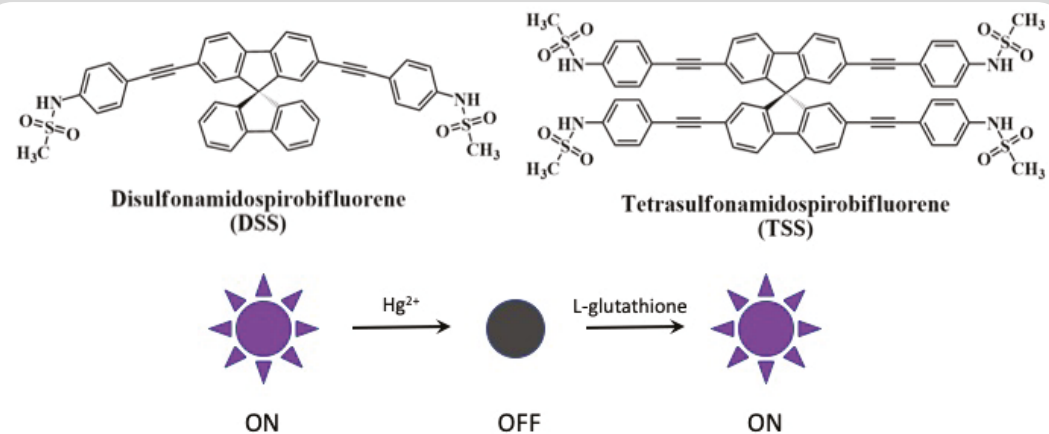
RESEARCH
EMPHASIS



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RESEARCH



With my previous experience in the field of chemical process development for high-value fine chemicals, I am also interested in optimization of reaction parameters. From the retrosynthetic analysis to the evaluation of synthetic routes based on material costs and safety, the most economic and environmentally friendly route can be selected. The Design and Analysis of Experiments can be used to statistically investigate the key reaction factors along with their levels in order to pinpoint the optimal conditions leading to the most efficient synthetic process and scalable purification procedure.



- 8 Examples, 10 to 29 % isolated yields
- User-friendly and safe reagent
- Mild reaction conditions
- Applicable to benzoindole and *N*-alkylindoles

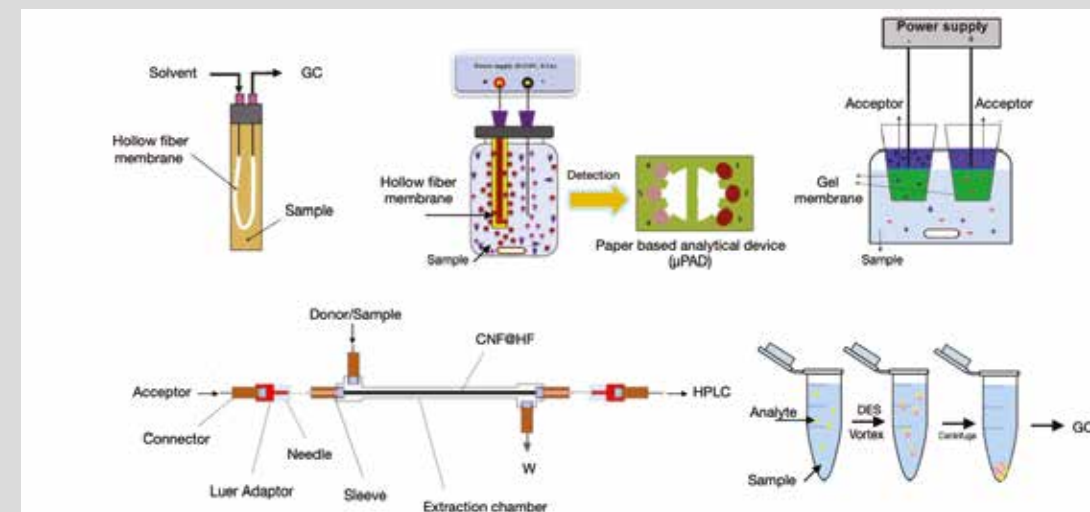
1. Chooppawa, T.; Namuangruk, S., Yamamoto, H.M., Promarak, V., Rashatasakhon P. Synthesis, characterization, and hole-transporting properties of benzotriazatruxene derivatives, *Journal of Materials Chemistry C*, **2019**, 7, 15035-15041.
2. Silpcharu, K., Sukwattanasinitt, M., Rashatasakhon, P. Novel sulfonamidospirobifluorenes as fluorescent sensors for mercury(II) ion and glutathione, *RSC Advances*, **2019**, 9, 11451-11458.
3. Sam-ang, P., Silpcharu, K., Sukwattanasinitt, M., Rashatasakhon, P. Hydrophilic truxene derivative as a fluorescent off-on sensor for copper(II) ion and phosphate species, *Journal of Fluorescence*, **2019**, 29, 417-424.
4. Vongnam, K., Aree, T., Sukwattanasinitt, M., Rashatasakhon, P. Amidoquinoline-salicylaldehyde dyads as highly selective turn-on fluorescent sensors for zinc(II) ions, *ChemistrySelect*, **2018**, 3, 3495-3499.
5. Wongsilarat, C., Namuangrak, S., Prachumrak, N., Sudyoadsuk, T., Promarak, V., Sukwattanasinitt, M., Rashatasakhon, P. Solution processed blue-emitting and hole-transporting materials from truxene-carbazole-pyrene triads, *Organic Electronics*, **2018**, 57, 352-358.
6. Boonsri, M., Vongnam, K., Namuangruk, S., Sukwattanasinitt, M., Rashatasakhon, P. Pyrenyl benzimidazole-isoquinolinones; Aggregation-induced emission enhancement property and application as TNT fluorescent sensor, *Sensors and Actuators, B: Chemical*, **2017**, 248, 665-672.
7. Toworakajohnkun, N., Sukwattanasinitt, M., Rashatasakhon, P. *N*-Bromosuccinimide mediated synthesis of triazatruxenes from indoles, *Tetrahedron Letters*, **2017**, 58, 4149-4152.





Green analytical chemistry; liquid phase microextraction (LPME) using hollow fiber membrane, electromembrane extraction, and dispersive liquid liquid microextraction; analytical devices; flow based analytical systems and chromatographic separation.

Our researches focus on developing of new platforms of liquid phase microextraction (LPME) techniques based on green analytical chemistry concept; i.e., hollow fiber membrane supported liquid extraction, electromembrane extraction and dispersive liquid liquid microextraction. Incorporation of LPME with paper based analytical devices and flow based analytical systems and use of ionic liquid and deep eutectic solvent as a green solvent in LPME are also interested.





1. Tabani, H.; Dorabadi Zare, F.; Alahmad, W.; Varanusupakul, P., Determination of Cr(III) and Cr(VI) in water by dual-gel electromembrane extraction and a microfluidic paper-based device. *Environmental Chemistry Letters* 2019, 18, 187-196.
2. Alahmad, W.; Varanusupakul, P.; Kaneta, T.; Varanusupakul, P., Chromium speciation using paper-based analytical devices by direct determination and with electromembrane microextraction. *Analytica Chimica Acta* 2019, 1085, 98-106.
3. Tabani, H.; Shokri, A.; Tizro, S.; Nojavan, S.; Varanusupakul, P.; Alexovič, M., Evaluation of dispersive liquid-liquid microextraction by coupling with green-based agarose gel-electromembrane extraction: An efficient method to the tandem extraction of basic drugs from biological fluids. *Talanta* 2019, 199, 329-335.
4. Kaneta, T.; Alahmad, W.; Varanusupakul, P., Microfluidic paper-based analytical devices with instrument-free detection and miniaturized portable detectors. *Applied Spectroscopy Reviews* 2019, 54, 117-141.
5. Worawit, C.; Cocovi-Solberg, D. J.; Varanusupakul P.; Miró, M., In-line carbon nanofiber reinforced hollow fiber-mediated liquid phase microextraction using a 3D printed extraction platform as a front end to liquid chromatography for automatic sample preparation and analysis: A proof of concept study. *Talanta* 2018, 185, 611-619.
6. Alahmad, W.; Tungkijanansin, N.; Kaneta, T.; Varanusupakul, P., A colorimetric paper-based analytical device coupled with hollow fiber membrane liquid phase microextraction (HF-LPME) for highly sensitive detection of hexavalent chromium in water samples. *Talanta* 2018, 190, 78-84.
7. Tabtimhin, C.; Varanusupakul, P., "Fiber optic sensor based on surface plasmon resonance spectroscopy for determination of atrazine," *Proceedings of Pure and Applied Chemistry International Conference* 2018, 69-73.
8. Atikarnsakul, U.; Varanusupakul, P.; Alahmad, W. Isolation of chromium(VI) from aqueous solution by electromembrane extraction. *Analytical Letters* 2017, 51, 983-997.

PATTARA THIRAPHIBUNDET

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- Searching for cholinesterase inhibitors from Thai medicinal plants for Alzheimer treatment.
- Improve physical and chemical properties of active compounds by encapsulation.
- Food innovation.



- The Outstanding Dissertation Award by National Research Council of Thailand (NRCT) 2004
- Cerebos Award 2009
- Silver medal for the innovation "Aroma and herb flakes for food and beverage products" by Brussels Innova 2015



Thailand is an abundant country of herbal resources. Nowadays, herbs or medicinal plants have long been used as drugs, food and cosmetics. Our group beyond "Natural Product Research Unit" was set up and active compound searching is being conducted with the aim of realizing the full benefit of using Thai medicinal plants. Unfortunately, most active compounds possess poor stability and poor bioavailability due to low water solubility which limits their use as drug or cosmetic ingredients. Moreover, some of them have a very astringent and bitter taste.



Natural and fresh herb



Aroma oil



To circumvent these drawbacks, encapsulation would appear to be a promising approach. Thus, searching for new active compounds is attractive and improving their properties are also our goals.

1. Sichaem, J.; Ruksilp, T.; Sawasdee, P.; Khumkratok, S.; Tip-pyang, S. "Chemical Constituents of the Stems of *Spatholobus parviflorus* and Their Cholinesterase Inhibitory Activity" *Chemistry of Natural Compounds*. **2018**, 54(2), 356-357.
2. Kor-arnan, T.; Rojpitikul, T.; Phuwapraisirisan, P.; Pornpakakul, S.; Thiraphibundet, P. "Amyloid- β aggregation inhibitors from *Clerodendrum inerme* L. Gaertn" *Maejo International Journal of Science and Technology*. **2019**, 13(2), 139-147.



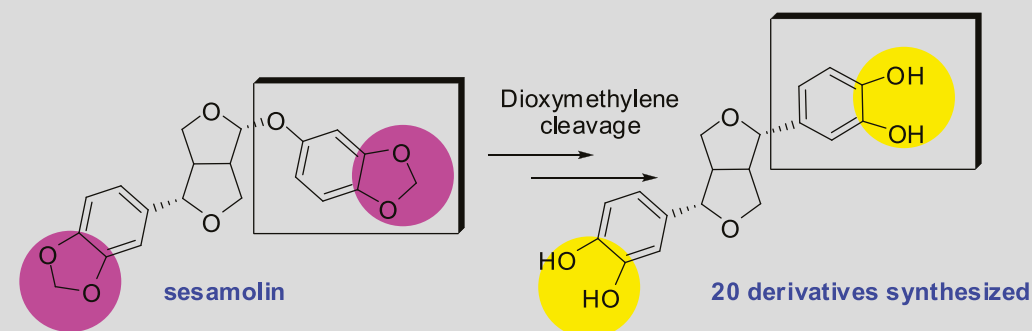
PREECHA PHUWAPRAISIRISAN

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Natural products and synthesis of glucosidase inhibitors for diabetes therapy.

- Chulalongkorn University Young Researcher Award 2008
- Recipient, Thailand Toray Science Foundation (TTSF) Research Grant 2009
- Chulalongkorn University Excellent Research Award 2015



Sesame lignans have been recognized as bioactive compounds regulating lipid and metabolic profiles of human and mammals. Although sesame lignans named sesamin and sesamol have been widely investigated for their beneficial effects in human health, the *in vitro* experiments have demonstrated

SESAMUM INDICUM

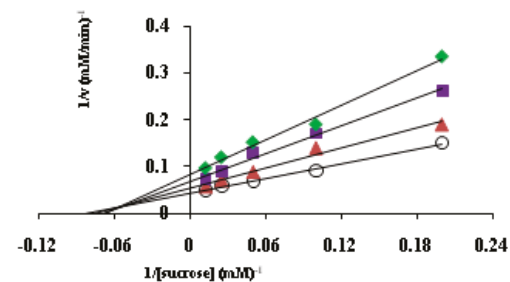


contradictory results to those of *in vivo* models. Our group hypothesized that sesamin and sesamol are possibly metabolized into the potential active metabolites by oxidative cleavage of dioxymethylene moiety ($-O-CH_2-O-$). To prove this assumption and get insight into the mechanism underlying the bioactivity, we synthesized a series of sesame lignans starting from naturally available sesamin.



The lignans having catechol moiety revealed 10-20 times more potent inhibition against α -glucosidases than their starting precursors. The kinetic study and molecular modeling of the most potent inhibitors also gave the insight into the mechanism underlying the inhibition.

This finding gives an alternative approach to modify the structures of natural abundant but inactive compounds to highly improved bioactive products.



1. Worawalai, W.; Doungrachitkul, T.; Rangubpit, W.; Taweecat, P.; Sompornpisut, P.; Phuwapraisirisan, P. "Furofuran Lignans as a New Series of Antidiabetic Agents Exerting α -Glucosidase Inhibition and Radical Scavenging: Semisynthesis, Kinetic Study and Molecular Modeling" *Bioorg. Chem.* **2019**, 87, 783-793.
2. Ramadhan, R.; Worawalai, W.; Phuwapraisirisan, P. "New Onoceranoid Xyloside from *Lansium parasiticum*" *Nat Prod. Res.* **2019**, 33, 2917-2924.
3. Worawalai, W.; Sompornpisut, P.; Wacharasindhu, S.; Phuwapraisirisan, P. "Quercitol: From a Taxonomic Marker of the Genus *Quercus* to a Versatile Chiral Building Block of Antidiabetic Agents" *J. Agric. Food Chem.* **2018**, 66, 5741-5745.
4. Ramadhan, R.; Kusuma, I.W.; Amirta, R.; Worawalai, W.; Phuwapraisirisan, P. "A New 4-Arylflavan from the Pericarps of *Horsfieldia motleyi* Displaying Dual Inhibition against α -Glucosidase and Free Radicals" *Nat Prod. Res.* **2018**, 32, 2676-2682.
5. Kustiawan, P.M.; Lirdprapamongkol, K.; Palaga, T.; Puthong, S.; Phuwapraisirisan, P.; Svasti, J.; Chanchao, C. "Molecular Mechanism of Cardol, Isolated from *Trigona incisa* Stingless Bee Propolis, Induced Apoptosis in the SW620 Human Colorectal Cancer Cell Line" *BMC Pharmacol. Toxicol.* **2017**, 18, 32.

SANTI TIP-PYANG

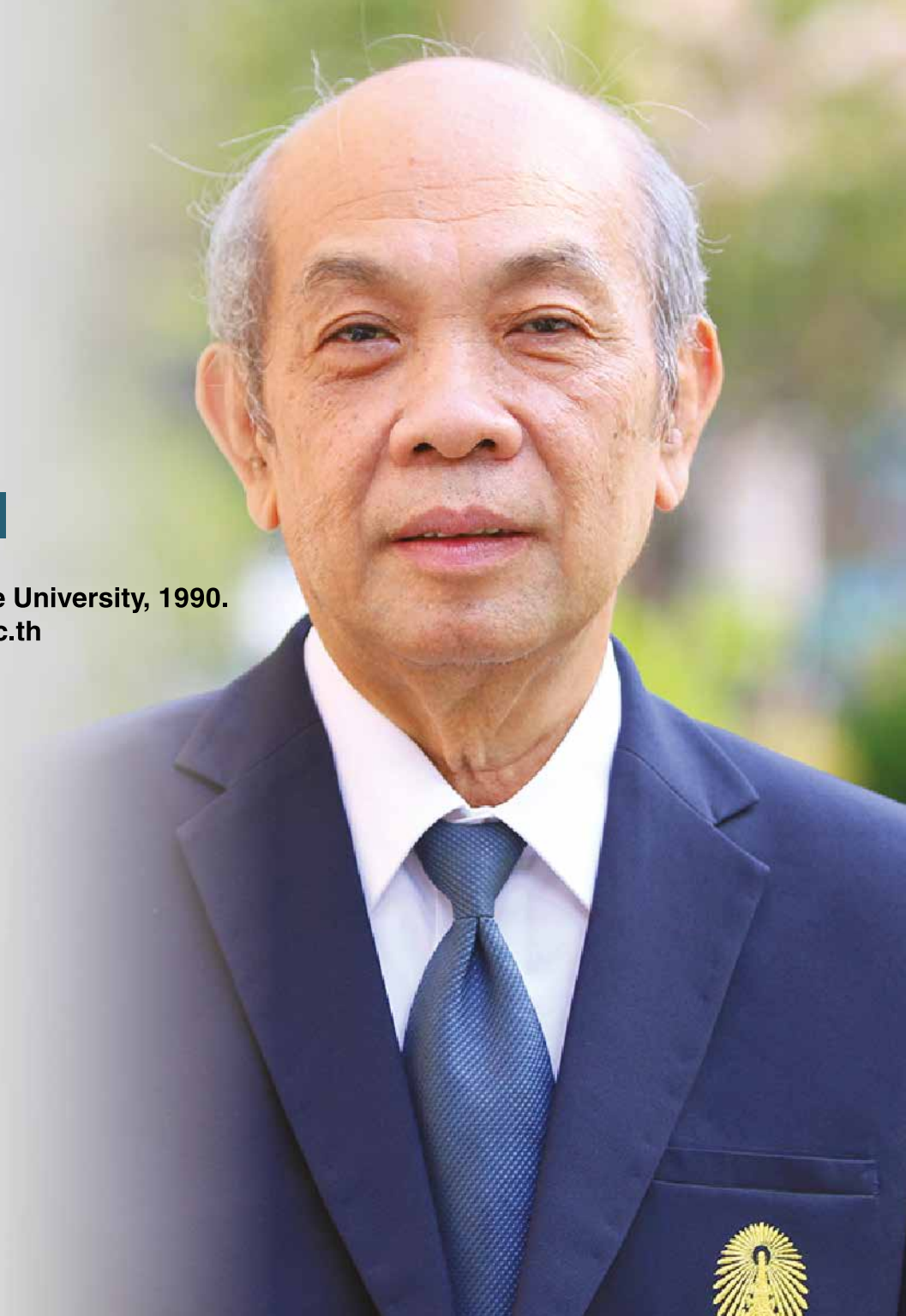
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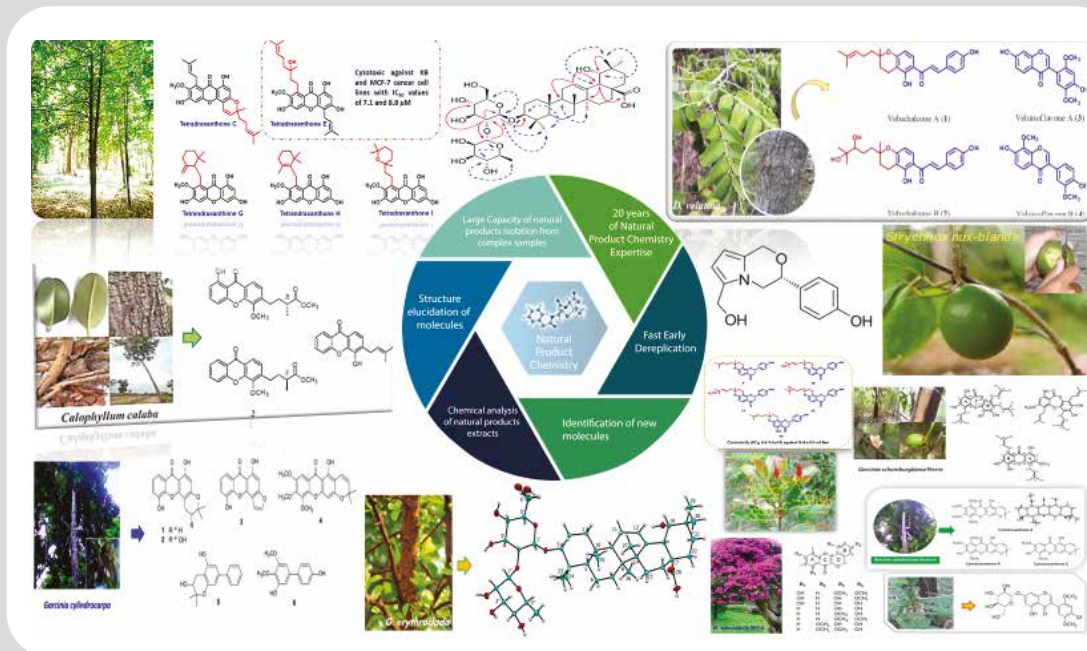
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Natural Products Chemistry

My research focuses on investigation of biological active substances from natural sources for therapeutic purposes. The specific biological tests and screens are used to detect biologically active substances potentially useful for the treatment of the diseases. Isolation of bioactive substances detected in extracts of medicinal plants, their identification and evaluation as potential drugs.



1. E.R.Sukandar, S.Kaennakam, K.Rassamee, P.Siripong, S.Fatmawati, T.Ersam, S. Tip-pyang, "Tetraxanthones A-I, Prenylated and Geranylated Xanthones from the Stem Bark of *Garcinia tetrandra*" J.Nat.Prod., 2019, 82, 1312-1318.
2. S.Kaennakam, K.Mudsing, K.Rassamee, P.Siripong, S. Tip-pyang, "Two new xanthones and cytotoxicity from the bark of *Garcinia shomburgkiana*" J. Nat. Med., 2019, 73, 257-261.
3. S.Kaennakam, E.R.Sukandar, P.Siripong, K.Rassamee, S. Tip-pyang, "Cytotoxic chalcones and isoflavones from the stems of *Dalbergia velutina*" Phytochemistry lett., 2019, 31, 187-191.
4. S.Kaennakam, E.R.Sukandar, P.Siripong, K.Rassamee, S. Tip-pyang, "Veluflavanones A-P, Cytotoxic Geranylated Geranylted Flavanones from *Dalbergia velutina* Stems" J.Nat.Prod., 2019, 82, 276-282.
5. F.Laopian, S.Kaennakam, K.Rassamee, P.Siripong, S.Tip-pyang "Calaxanthones A-C, three new xanthones from the roots of *Calophyllum calaba* and the cytotoxicity" Nat.Prod.Res., 2019, 33, 1584-1590.
6. J.Sichem, P.Siripong, S.Tip-pyang "Chemical constituents from the root bark of *Calophyllum inophyllum*" Nat.Prod.Comm., 2018, 13, 727-729.
7. S.Ponguschariyakul, J.Srijam, S.Khumkratok, K.Lugsanangarm, P.Siripong, S.Tip-pyang "Caloinophyllin A, a new chromanone derivative from the roots of *Calophyllum inophyllum*" Nat.Prod.Res., 2018, 32, 2535-2541.
8. E.R.Sukandar, S.Kaennakam, K.Rassamee, P.Siripong, S.Fatmawati, T.Ersam, S. Tip-pyang, "Xanthones and biphenyl from the stems of *Garcinia cylindrocarpa* and their cytotoxicity" Fitoterapia., 2018, 130, 112-117.
9. L. T. M. Do, T. Aree, P. Siripong, N.T.Vo, T. T. A. Nguyen, P. K. P. Nguyen, S. Tip-pyang, "Cytotoxic flavones from the Stem Bark of *Bougainvillea spectabilis* Willd" Planta. Med., 2018, 84, 129-134.
10. J.Sichem, T.Ruasilp, P.Sawasdee, S.Khumkratok, S.Tip-pyang "Chemical constituents of the Stems of *Spatholobus parviflorus* and Their Cholineesterase Inhibitory Activity" Chem.Nat.Comp., 2018, 54, 356-357.
11. S.Kaennakam, K.Rassamee, P.Siripong, S.Tip-pyang "Catomentosaponin, a new triterpene saponin from the roots of *Catunaregam tomentosa*" Nat.Prod.Res., 2018, 32, 1499-1505.
12. S.Kaennakam, T. Aree, J. Yahuaia, P. Siripong, S. Tip-pyang "Erythrosaponins A-J, triterpene saponins from the roots and stem bark of *Gardenia erythroclada*" Phytochemistry, 2018, 152, 36-44.
13. J.Sichaem, T. Aree, K. Lugsanangarm, S. Tip-pyang, "Identification of highly potent α -glucosidase inhibitory and antioxidant constituents from *Zizyphus rugosa* bark: enzyme kinetic and molecular docking studies with active metabolites" Pharm.Bio, 2017, 55, 1436-41.
14. J.Sichaem, K. Ingkanin, S. Tip-pyang, "A novel pyrrole alkaloid from the fruit pells of *Strychnos nux-blanda*" Nat. Prod. Res., 2017, 31, 149-154.
15. S.Kaennakam, P.Siripong, S. Tip-pyang, "Cytotoxicities of two new isoflavanes from the Roots of *Delbergia velutina* , "J.Nat.Med., 2017, 71, 310-314.



SAOWARUX FUANGSWASDI

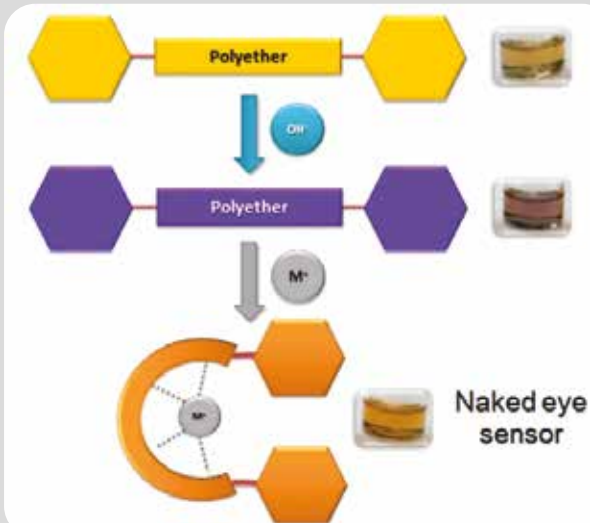
Associate Professor

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Supramolecular chemistry, Chemical equilibria in solution, Liquid extraction.

- 2018: CST Award for Distinguished Contribution to Chemical Education under the Patronage of Professor Dr. Her Royal Highness Princess Chulabhorn Mahidol
- 2018: Outstanding University Science Teacher from the Science Society of Thailand under the Patronage of His Majesty the King 2018
- 2017: Honorary Award in Academic Teaching in Health Science, Science and Technology from Chulalongkorn University
- 2013: Honorary Award in Student Affairs from Chulalongkorn University
- 2013: Honorary Award in Student Affairs from Faculty of Science, Chulalongkorn University



My research focuses on a) complexation study in solution using various techniques such as UV-visible and fluorescence spectrophotometry, potentiometry and calorimetry; and b) sensor development based on supramolecules such as crown ethers or calixarenes. Recently I have been also interesting to develop extraction processes for lanthanide separation.



RESEARCH
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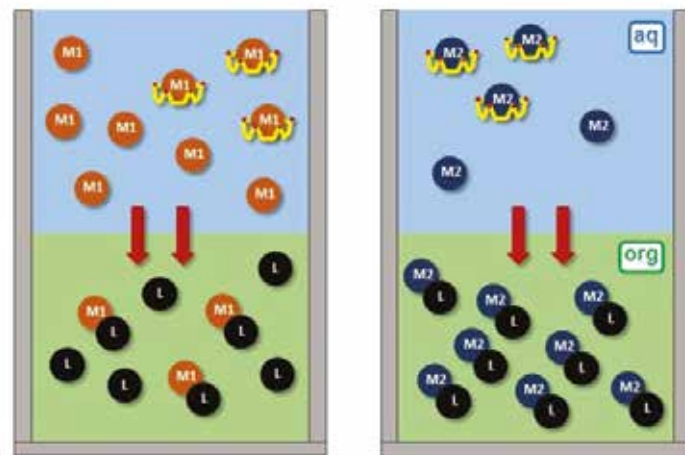


HONORS
+ AWARDS



RESEARCH

Enhancing rare earth extraction using ionic liquid and masking agent



1. Prasetia, R.; Fuangwasdi, S. and Unob F. "Silver nanoparticle-supported hydroxyapatite as material for visual detection of urinary cysteine" *Anal. Methods* **2019**, 11, 2888-2894.
2. Koonrugsu, N. and Fuangwasdi, S. "Metal ion chemosensors based on diaza-18-crown-6 coupling with azobenzene dye" *Spectrochim. Acta A* **2019**, 215, 15-23.
3. Sarntanayoot, P.; Fuangwasdi, S. and Imyim, A. "Iron nanoparticle-modified water treatment residues for adsorption of As(III) and As(V) and their cement-based solidification/stabilization" *Int. J. Environ. Sci. Technol* **2019**, 16(8), 4285-4292.



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Associate Professor

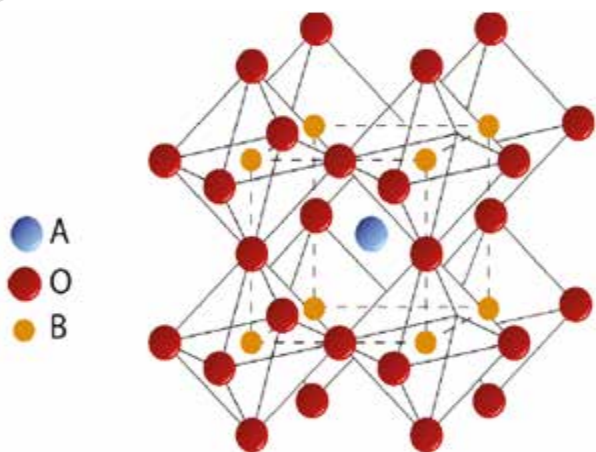
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M.Sc. Chulalongkorn University, 1993
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Electrode materials for intermediate temperature solid oxide fuel cell (IT-SOFC): synthesis and modification of perovskite-related structures and Ruddlesden-Popper (RP) oxide materials, electrochemical properties of materials, and single cell performance of materials for H_2 -fuel

My research group has working on synthesis and modification of perovskites and related structures to be applied for electrodes in solid oxide fuel cell (SOFC). The doping of metals on A- and B- site in the perovskite structure can alter thermal and electrochemical properties of materials. To understand the material behavior, phase structure, morphology, thermal expansion behavior, oxygen permeation flux, and impedance of materials are investigated. The potential materials will then be fabricated as electrodes for a single planar electrolyte-supported cell and tested for catalytic reaction under H_2 fuel at intermediate temperature (500-800 °C).



Recently, our group has explored the high potential of *p*-type semiconductor, a Ruddlesden-Popper oxide of $PrSr_3Fe_3O_{10-8}$ (PSFO10), as a novel cathode in low temperature SOFC. We successfully employ Ni in PSFO10 to enhance the surface exchange coefficient, *k*, and facilitate migration of oxide ions to the triple phase boundary. We are currently exploring co-addition of relevant metals providing high power density for single H_2 -fuel cell. We also have collaboration with other research groups for fabrication of electrolyte and electrodes applied in SOFC.



1. Wongsawatgul, N.; Yeyongchaiwat, J.; Pornprasertduk, R.; Kazunori, S.; Chaianansutcharit, S. "Ca and Pr substitution promoted the cell performance in $LnSr_3Fe_3O_{10-8}$ cathode for solid oxide fuel cells" *Ceram Inter.* **2019** (<https://doi.org/10.1016/j.ceramint.2019.10.009>).
2. Chauoon, S.; Meephoe, M.; Chuankrerkkul, N.; Chaianansutcharit, S.; Pornprasertsuk, R. "Fabrication of yttria stabilized zirconia thin films on powder-injected anode substrates by electrophoretic deposition technique for solid oxide fuel cell application" *Thin Solid Films*, **2018**, 741-748.



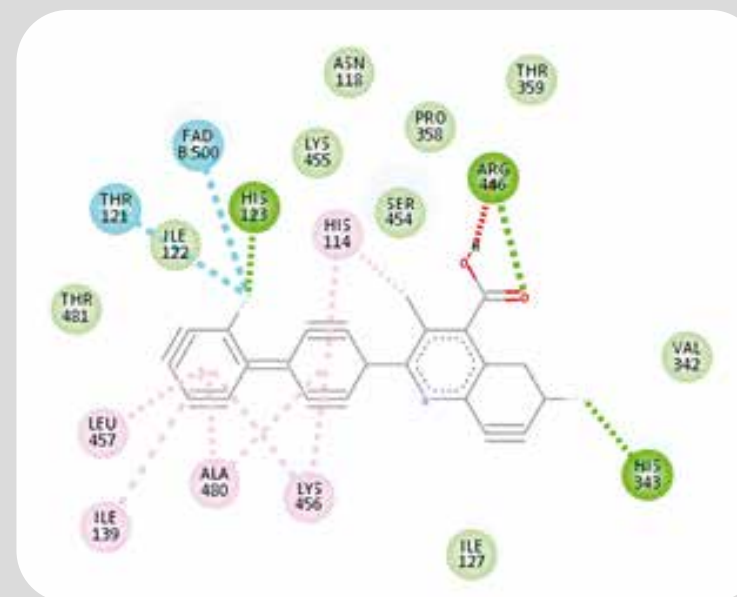
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Theoretical study on photo-induced electron transfer in biological system as well as molecular modeling of biological systems, mainly focus on computer-aided drug design, using several computational techniques, such as quantum chemical calculations, QSAR, molecular docking.

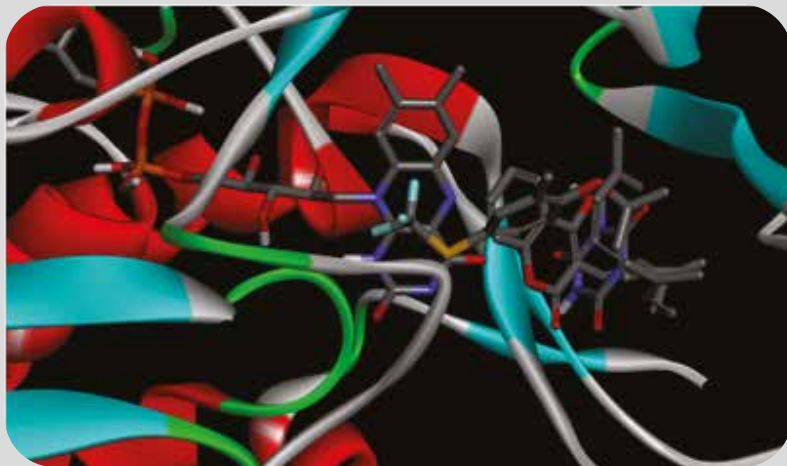
The new developed method that incorporates effect of enzyme's dynamics has been applied to several biological systems including FMN binding protein, D-amino acid oxidase (DAAO), and pyranose 2-oxidase (P2O) to investigate mechanism of photoinduced electron transfer (PET) process. For the molecular modeling part, molecular docking calculations on several enzyme-ligand systems have been carried out to elucidate their mechanism of actions. In addition, new algorithm to predict synthesis route of organic compounds is being studied using machine learning technique.



RESEARCH
EMPHASIS



RESEARCH



1. Nadtanet Nunthaboot, Kiattisak Lugsanangarm, Arthit Nueangaudom, Somsak Pianwanit, Sirirat Kokpol, Fumio Tanaka, Seiji Taniguchi, Haik Chosrowjan, Takeshi Nakanishi, Masaya Kitamura, "Photoinduced electron transfer from aromatic amino acids to the excited isoalloxazine in single mutated flavin mononucleotide binding proteins: Effect of the dimer formation on the rate and the electrostatic energy inside the proteins", *Computational and Theoretical Chemistry*, **2017**, 1108, 1-9.
2. Kiattisak Lugsanangarm, Arthit Nueangaudom, Somsak Pianwanit, Sirirat Kokpol, Nadtanet Nunthaboot, Fumio Tanaka, Seiji Taniguchi, Haik Chosrowjan, "Dynamics of the protein structure of T169S pyranose 2-oxidase in solution: Molecular dynamics simulation", *Proteins: Structure, Function and Bioinformatics*, **2017**, 85, 1913-1924.
3. Nadtanet Nunthaboot, Arthit Nueangaudom, Kiattisak Lugsanangarm, Somsak Pianwanit, Sirirat Kokpol, Fumio Tanaka, "Physical quantity of residue electrostatic energy in flavin mononucleotide binding protein dimer", *Computational Biology and Chemistry*, **2018**, 72, 96-104.
4. Arthit Nueangaudom, Kiattisak Lugsanangarm, Somsak Pianwanit, Sirirat Kokpol, Nadtanet Nunthaboot, Fumio Tanaka, Seiji Taniguchi, Haik Chosrowjan, "Comparative Study on the Mechanism of Photoinduced Electron Transfer from Tryptophan 168 to Excited Flavin in T169S and Wild-type Pyranose 2-Oxidase", *ACS Omega*, **2019**, 4, 593-605.



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Our research goal is to create method to prepare organic compounds in the way that are robust, convenient and environmentally friendly with less hazardous waste generation. Also, we use organic synthesis principles and tools to create novel molecules with new functions to enable the creation of innovative polymers for next generation point-of-care biological and chemical sensors.

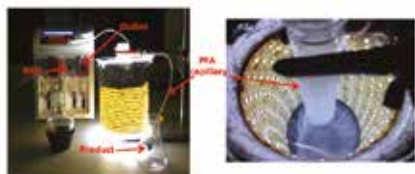
2014 TRF-CHE-Scopus Researcher Awards 2014
2012 Chulalongkorn University Young Lecturer Award
2012 Thailand Young Scientist Award

In the search for an alternative chemical feed stock for acetylene based chemicals which are the key raw material for production of specialty chemicals, we recently developed the utilization of calcium carbide as acetylene surrogate directly for the synthesis of diarylethynes, *poly*-phenylene ethynylenes and pyrroles. The work provides a greener, more efficient and sustainable chemical



transformation for the synthesis of acetylene based chemicals compared to existing process used by current chemical industry

We also developed methods to replace conventional oxidation reactions for organosulfur compounds with more sustainable methods such as photooxidation, electrochemical and microwave irradiation to perform the reaction “in or “on water” condition.



The process would be applied to the synthesis of guanidines, disulfide, sulfonamide and amandine which are important building blocks in chemical and pharmaceutical industry.

1. Srisa, J., Tankam, T., Sukwattanasinitt, M., Wacharasindhu, S.: Micelle-Enabled One-Pot Guanidine Synthesis in Water Directly from Isothiocyanate using Hypervalent Iodine(III) Reagents under Mild Conditions (2019) Chemistry - An Asian Journal, 14, pp. 3335-3343.
2. Thavornsin, T. Chamrasboon, Kiatmongkolkul K., Sakthanasait, R., Sukwattanasinitt M., Wacharasindhu S. :“Synthesis of Highly Pure Poly(aryleneethynylene)s Using Palladium Supported on Calcium Carbonate as an Eco-Friendly Heterogeneous Catalyst (2019) Journal of Polymer Science, Part A: Polymer Chemistry, 57, pp. 1556-1563.
3. Santra, S., Butta, P., Jithavech, P., Rojsitthisak, P., Palaga, T., Rashatasakhon, P., Sukwattanasinitt, M., Wacharasindhu, S. : “Turn on” orange fluorescent probe based on styryl-BODIPY for detection of hypochlorite and its application in live cell imaging (2019) Dyes and Pigments, 162, pp. 189-195.
4. Tankam, T., Srisa, J., Sukwattanasinitt, M., Wacharasindhu, S. Microwave-Enhanced On-Water Amination of 2-Mercaptobenzoxazoles to Prepare 2-Aminobenzoxazoles (2018) Journal of Organic Chemistry, 83 (19), pp. 11936-11943.
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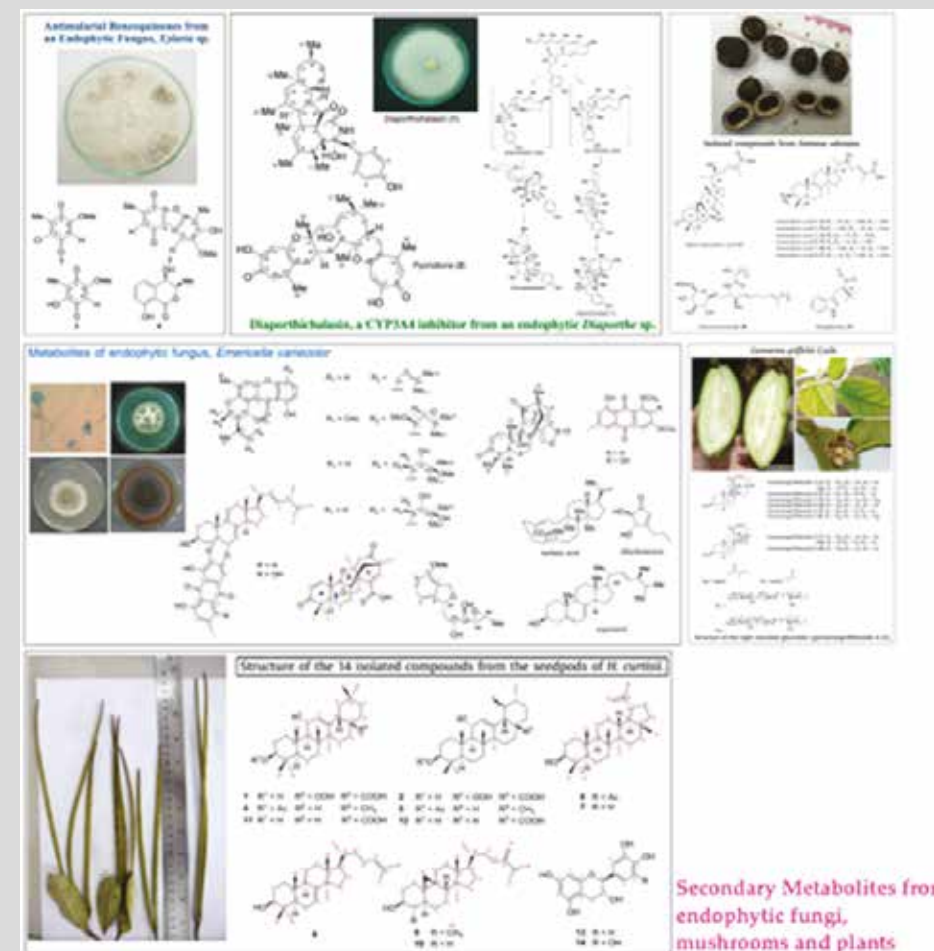


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Bioactive or medicinal compounds from edible plants, herbs, mushrooms and endophytic fungi; extraction process for essential oil, bioactive and medicinal compounds; use of micro-organisms or enzymes as synthetic reagents (bio-transformations); synthesis of biologically active or medicinal compounds using a variety of natural products as starting material; chemical constituent of *Croton* sp. and the use of diterpenoid compounds from the plants as biotransformation substrates and for synthesis of biologically active compounds; and biodiesel production using immobilized enzyme.



RESEARCH
EMPHASIS



RESEARCH



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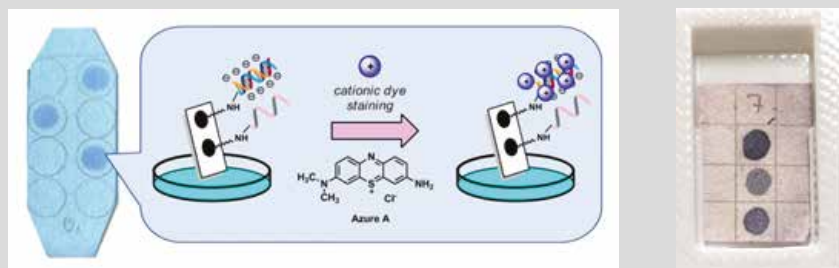
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Chemical methods for food, agricultural, and medical applications.

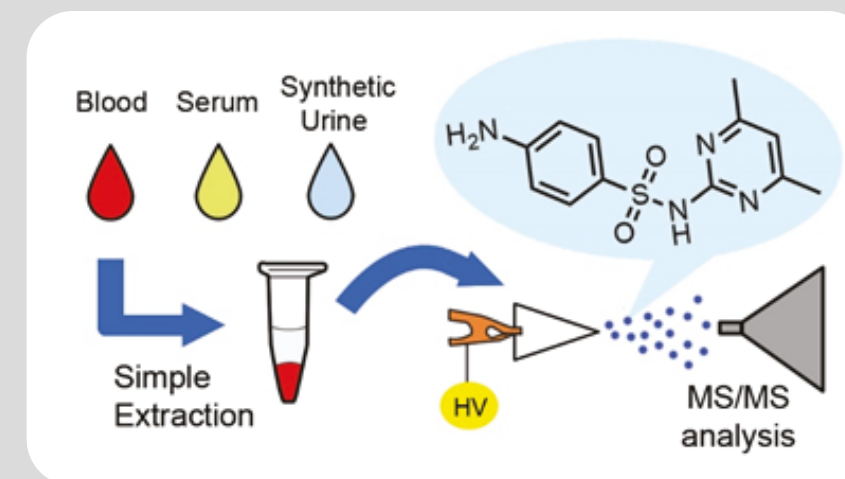
Young Researcher Award, Ratchadaphiseksomphot Fund,
Chulalongkorn University 2019

Our group focuses on the utilization of chemical approaches, mainly organic chemistry and synthesis, material chemistry, and analytical instrumentation to solve interesting and impactful research problems in food, agricultural, and medical sciences. With this unique and synergistic strategy, we have offered the relevant communities with new and fascinating research outcomes. Below are key research directions in our lab.

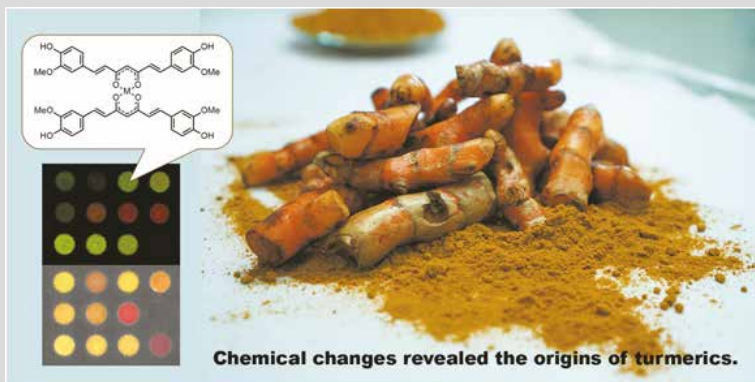


1) *The fabrication of paper-based sensor for DNA detection using pyrrolidinyl peptide nucleic acid (PNA).* As a collaboration with Prof. Tirayut Vilaivan, a pioneer in PNA, we aimed to combine the high performance of pyrrolidinyl PNA as a DNA probe, with the robustness of cellulose paper to create a set of economical DNA sensors. The results showed that the fabricated sensor delivered high accuracy, even in the challenging cases of single mismatches. Also, we have applied this principle to create a practical sensor to detect thalassemia genes, a group of important genetically inherited disorder in a majority of Thai population.

2) *The detection of food contaminants by paper spray-mass spectrometry (PS-MS).* As a collaboration with Dr. Simon Maher at the University of Liverpool, UK, we developed a method to detect a group of important antibiotics, namely sulfa drugs, in pig-derived samples, *e.g.*, pork tissue, serum, and whole blood. The technique reduces the requirement for lengthy pretreatment on the sample, while also allows more practical transport of a large amount of samples by carrying only small sheets of paper instead of liquid samples. The technique has also become a flagship technique for other applications such as the creation of GI (see below).



3) *The creation of geographic indications (GI) in food and agricultural products.* GI is an economically important tool to promote local foods and agricultural products. Nevertheless, there are some cases of ambiguous GI arisen from subjective identification methods. Our lab aims to utilize a variety of chemical tools including chromatography-based methods, and mass spectrometry to offer unbiased and clear-cut methods for the creation of GI for Thai products. In selected cases, this requires no complex instrumentation as illustrated in our study in GI for turmeric, which utilized only simple chemical reagents on paper.



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**VIWAT
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Areas of research include molecular dynamics simulation (MD) of aqueous solution based on ab initio quantum mechanical charge field (QMCF) MD framework, development of the program for analysis the simulation trajectories of composite solute, implementation of quantum chemistry program paralleling on graphics processing unit (GPU), and development of theory to extract the normal modes from the arbitrary geometry of molecules.

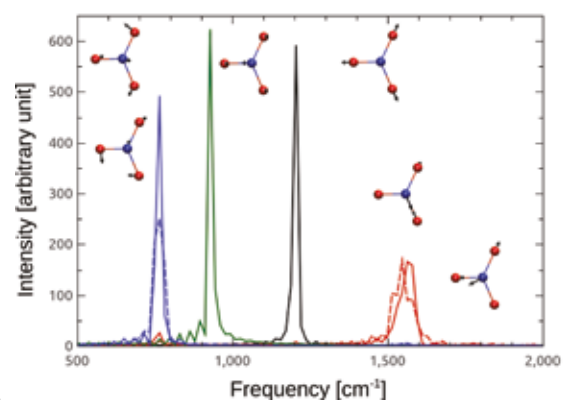


Chemical Society of Japan: The Distinguished Lectureship Award 2015

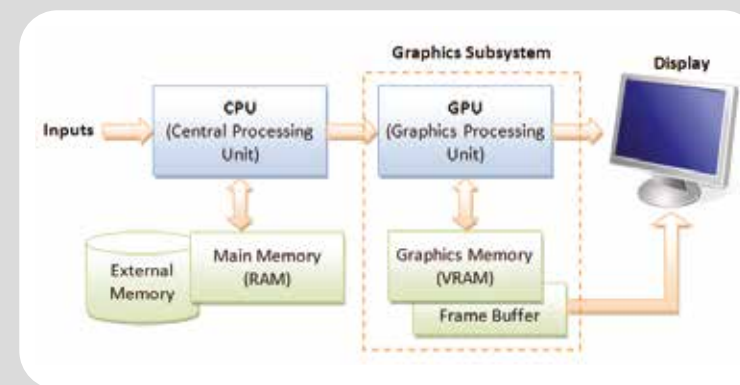


The previous works have studied the aqueous solution of composite solutes based on ab initio quantum mechanical charge field molecular dynamics (QMCF MD) framework. One interesting dynamical property evaluated from the simulation results that it can relate to the experimental data is the vibrational spectra. The spectrum for each vibrational mode is computed by projecting the velocities onto the corresponding normal mode to construct the autocorrelation function.

However, the hardest part of the calculation process is the determination of normal modes due to the geometries of the molecule obtained from the simulation is located at any point in phase space. Thus, we have developed a new methodology, namely Expanded Moment of Inertia Tensor (EMIT), which rely on



the conservative expansion of angular momentum within the rigid body framework, leading to the symmetric object that has intuitive interpretation and gives meaningful solutions. This novel method provides normal modes that resemble those obtained from group theory and show their efficacy by accurately reproduce all characteristic frequencies in the vibrational spectra. Unfortunately, the results obtained from EMIT are laborious to understand; a visualization program is needed. We have also developed a program called EMIT Studio, written in C++ and OpenGL Library, to visualize atomic displacement vectors for the normal modes. EMIT Studio assists the users to interpret the results received from the EMIT calculation effectively.



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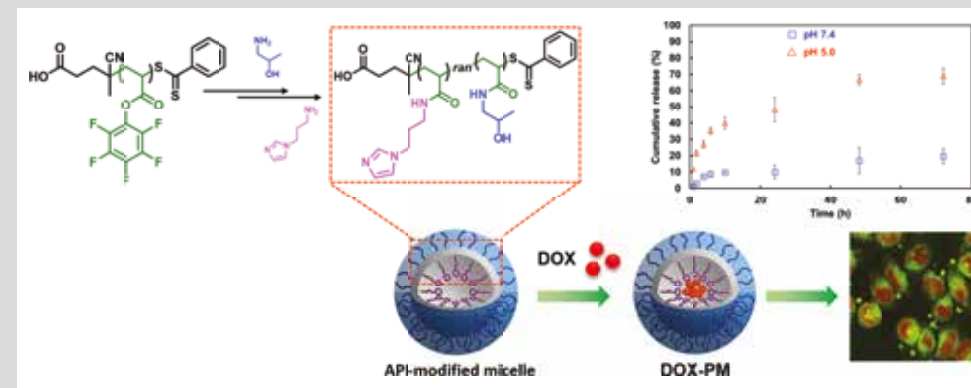
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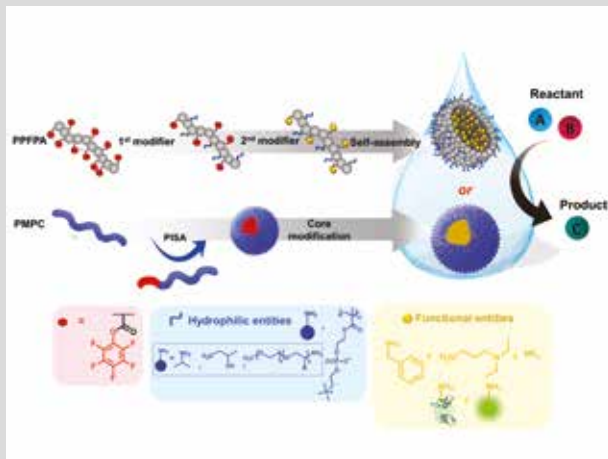


Chemical modification and characterization of polymer surface, functional organic thin film for biotechnology and nanotechnology, and polymer for biomedical applications

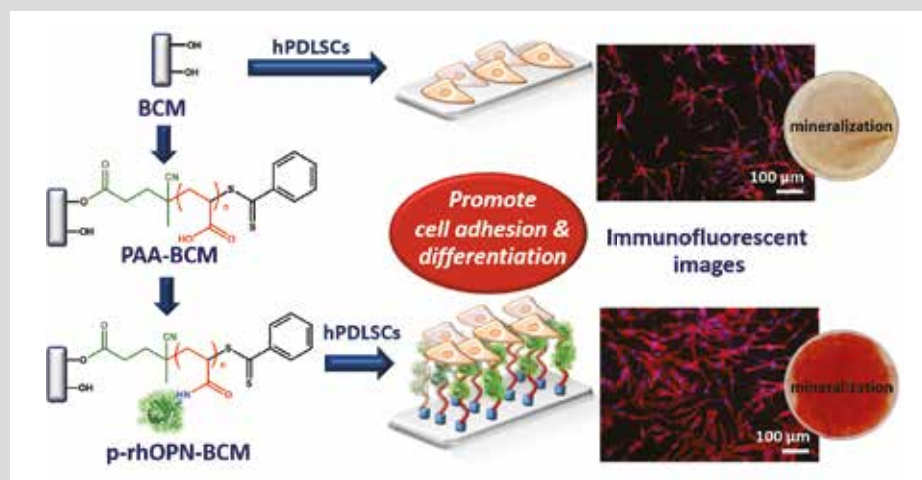
- Outstanding Research Award in “Chemical and Pharmaceutical Science” from National Research Council of Thailand, 2019
- Wiley-CST Outstanding Publication Award from John Wiley & Sons/ Chemical Society (Thailand), 2009
- L’Oreal Thailand “For Woman in Science” Fellowship for “Material Science” Research from L’Oreal Thailand and The Thai National Commission for United Nations Education, Scientific and Cultural Organization (UNESCO), 2008

Self-assembly of polymeric materials driven by non-covalent interactions such as hydrogen bonding, hydrophobic interaction epitomizes one of the effective ways that help creating potentially applicable nanotechnology. Our recent effort is dedicated to the development of polymeric nanoparticles by controlled synthetic methodologies (polymerization-induced self-assembly (PISA), post-modification of active ester-containing polymer) for a variety of biotechnology- and biomedical-related applications i.e. drug/gene carriers, nanoreactors for green organic synthesis, biocatalysis, bioimaging, cellular nanosensors.





Polymeric hydrogel has been recognized as a potential material for several bio-related applications. Our current interest has been focused on the development of natural- and synthetic-based hydrogels as substrate for artificial 3D skin fabrication, protein-immobilized membrane for bone tissue regeneration, biocompatible wearable sensing patch for theranostic applications, mucoadhesive and biocompatible patch for controlled release of therapeutic agent in dental applications, microorganism- and enzyme-laden hydrogels for energy- and environment-related applications.



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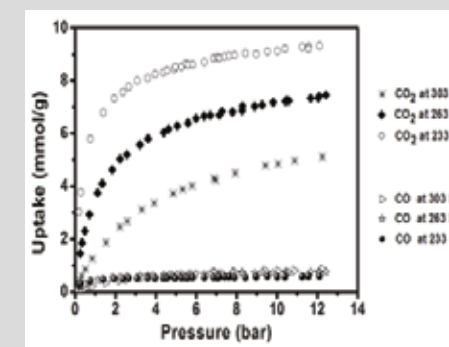
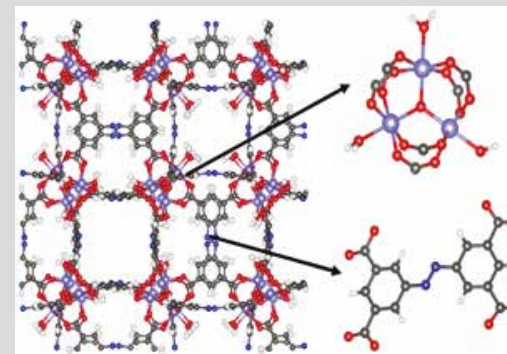
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Computer modeling of novel nanomaterials such as graphene-like structures and metal-organic frameworks (MOFs) for applications as nanoelectronics and storage devices; Design of novel catalysts for industrial and environmental applications

The highlight of our group research during 2017 - 2019 was theoretical studies of adsorption of CO/CO₂ mixtures by MIL-127. The knowledge which is obtained from the study can be used to purify CO from the mixtures. Thus, the material has a strong environmental impact. MIL-127, Material Institute Lavoisier-127, is a MOF which is composed of Fe(III) and azobenzenetetraacetate organic linker. With the pore-size of approximately 10 Å, MIL-127 is suitable for use as the gas storage. We have employed Gibbs Ensemble Monte Carlo (GEMC) for obtaining isotherm and Molecular Dynamics (MD) for radial distribution function (RDF).



RESEARCH
EMPHASIS



RESEARCH

The UFF force field and Lennard-Jones (LJ) potential were used for the simulations. First, the experimental isotherms for CO and CO₂ gases were compared with the isotherms obtained by GEMC to parameterize LJ potential. Those parameters were further used for the MD simulations. Our results revealed that CO₂ is better adsorbed in MIL-127 than CO where the metal cluster and N atoms on the linkers are preferential adsorption sites. The selectivity is also enhanced as the temperature is declined. The selectivity increases three folds at 233K as compared to 303K. Thus, MIL-127 could be well used to separate CO from CO/CO₂ mixtures. The separation is also achieved with high selectivity and low temperature.

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2. Chokbunpiam T., Fritzsche S., Parasuk V., Caro J., Assabumrungrat S. "Molecular simulations of a CO₂/CO mixture in MIL-127" *Chem. Phys. Lett.*, **2018**, 696, 86-91.
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4. Pongsajanukul P., Parasuk V., Fritzsche S., Assabumrungrat S., Wongsakulphasatch S., Bovornratanaraks T., Chokbunpiam T. "Theoretical study of carbon dioxide adsorption and diffusion in MIL-127(Fe) metal-organic framework" *Chem. Phys.*, **2017**, 491, 118-125.
5. Wongsakulphasatch S., Kiatkittipong W., Saupsor J., Chaiwisesphol J., Piroonlerkgul P., Parasuk V., Assabumrungrat S. "Effect of Fe open metal site in metal-organic frameworks on post-combustion CO₂ capture performance" *Greenhouse gases: Science and Tech.*, **2017**, 7, 383-394.
6. Kruawan S., Ratanasak M., Chanajaree R., Rungrotmongkol T., Saengsawang O., Parasuk V., Kungwan N., Hannongbua S. "Ethylene insertion in the presence of new alkoxysilane electron donors for Ziegler-Natta catalyzed polyethylene" *Comput. Theor. Chem.*, **2017**, 1112, 10-19.

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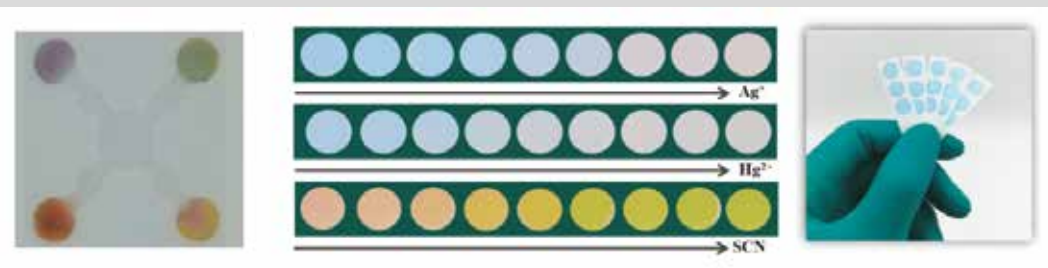




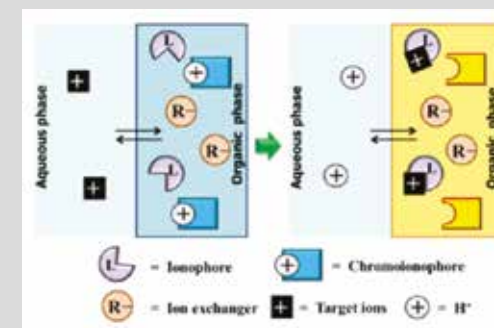
Chemical optical sensors as ion-selective optode and colorimetric sensors for cations/anions detection.

- CST Award for Distinguished Contribution in Chemical Education from the Chemical Society of Thailand under the Patronage of Her Royal Highness Princess Chulabhorn Mahidol 2014
- Outstanding University Science Teacher from the Science Society of Thailand under the Patronage of His Majesty the King 2013
- Honorary Award in Academic Teaching in Health Science, Science and Technology from Chulalongkorn University 2012
- Honorary Award in Academic Teaching from Faculty of Science, Chulalongkorn University 2012

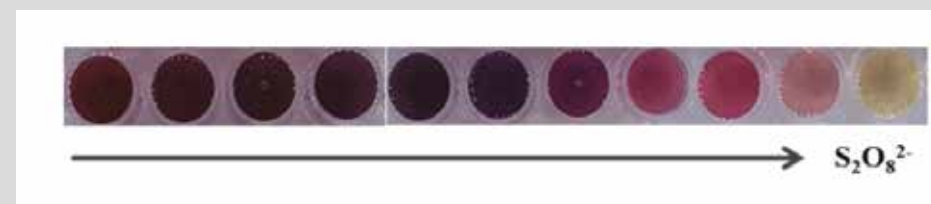
The colorimetric sensors were studied in various platforms for environmental analysis, clinical diagnostics and food application. These sensors were fabricated as portable devices for on-site analysis. The proposed sensors were mainly applied for some toxic cations and anions detection. We focused on the platforms and detection methods development of the colorimetric sensors.



- The paper-based analytical devices were developed for qualitative simultaneous naked eye detection of heavy metals. This work focused on colorimetric detection by using complexing agents and the selectivity of metal complexes was improved by using masking agents. The paper-based platform was also combined with ion-selective optical sensors (ISOs). Moreover, the potentiometric sensors were considered. The ion sensing probes are known as ion-selective electrode (ISEs) which response to the target ions. These sensors were applied for the determination of anions in aqueous sample.



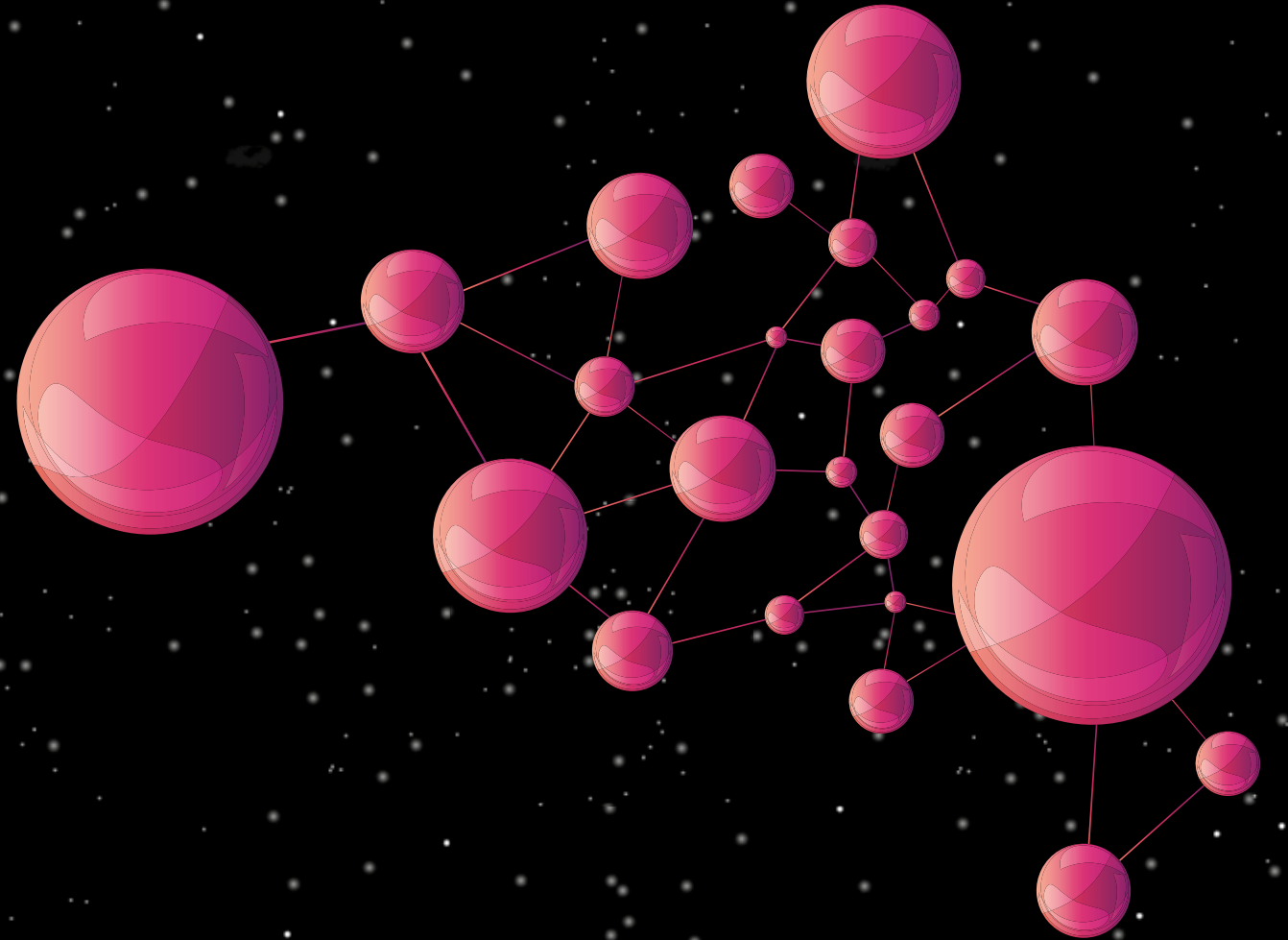
- The gold nanorods (GNRs) based sensors were established as a multicolor sensor for persulfate detection at trace level.



1. Phichi, M.; Imyim, A.; Tuntulani, T.; Aeungmaitrepirom, W. "Paper-based cation-selective optode sensor containing benzothiazole calix[4]arene for dual colorimetric Ag⁺ and Hg²⁺ detection" *Anal. Chim. Acta.*, **2020**, *1104*, 147-155.



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Methodological study for heterocyclic compounds & their applications as the fluorescent sensor

- Thai Government Scholarship to study in Japan. Awarded July 1987.
- Overseas Research Scholarship (ORS) from UK. Awarded July 1999.
- Research Award from Department of Chemistry, Chulalongkorn University. Awarded 2011.

Our research group has been developing novel synthetic method for many heterocycles. The use of such heterocyclic compounds as fluorescent chemosensor and biosensor has been also extensively pursued. Recently, the methodological development of synthetic pathway for a series of benzodihydroquinoline (BDHQ) and dipicolyl amine (DPA) derivatives and their applications on chemosensing properties as fluorescent sensor were successfully achieved. For instance, Novel oxazolidinonyl dipicolylamine based quinoline derivatives (QOD) were synthesized via halo-induced cyclization of t-butyl allyl(quinolinyl) carbamate followed by substitution of dipicolylamine (DPA). One of the quinoline derivatives, 6QOD, shows a remarkable fluorescent enhancement in both Hg^{2+} in aqueous media and Fe^{3+} in CH_3CN over other metal ions with excellent detection limits.



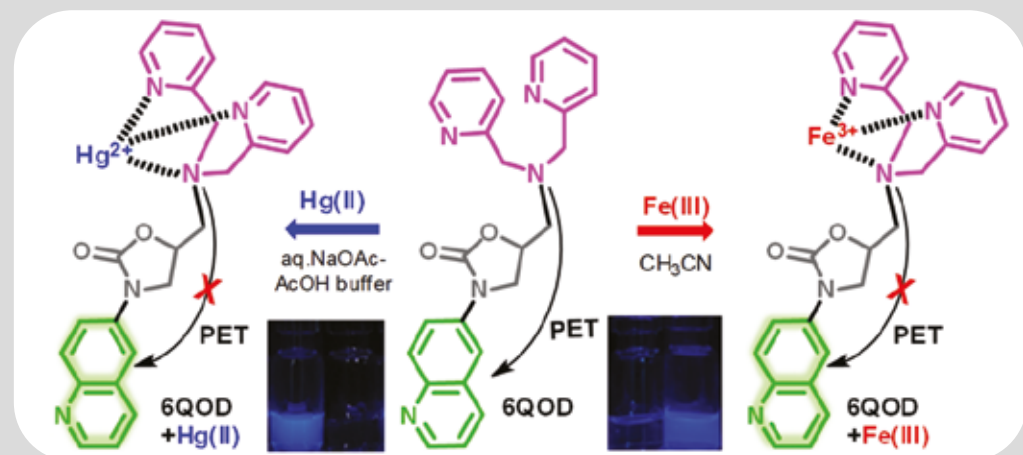
RESEARCH
EMPHASIS



HONORS
+ AWARDS



RESEARCH



1. Paisuwan, W.; Rashatasakhon, P.; Sukwattanasinitt, M.; Ajavakom, A. "Oxazolidinonyl dipicolylamine containing quinoline derivatives for dual fluorescent detection of Hg²⁺ and Fe³⁺." *Sensing and Biosensing Research*, **2019**, 24, 100283.
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4. Paisuwan, W.; Chanttra, T.; Rashatasakhon, P.; Sukwattanasinitt, M.; Ajavakom, A. "Direct synthesis of oxazolidin-2-ones from tert-butyl allylcarbamate via halo-induced cyclisation", *Tetrahedron*, **2017**, 73, 3363-3367.

AROONSIRI SHITANGKON

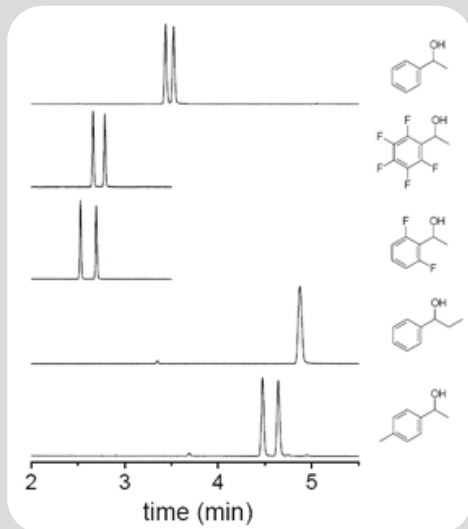
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Chiral separation by gas chromatography



Separation of selected chiral alcohols using derivatized beta-cyclodextrin stationary phase

Our research focuses on systematic studies to better understanding the effect of chiral analyte structures towards the enantiomeric separation using gas chromatography through various types of cyclodextrin-based stationary phases. Chiral analytes of interest include derivatives of important building blocks and intermediates in pharmaceutical products and agricultural industries, such as alcohols, epoxides, and amines. Prediction of enantiomeric separation was also explored by molecular docking.

1. Issaraseriruk, N.; Sritana-anant, Y.; Shitangkoon, A. "Substituent effects on chiral resolutions of 1-phenylalkylamines by 2,3-di-*O*-methyl-6-*O*-*tert*-butyldimethylsilyl- β -cyclodextrin GC stationary phase" *Chirality* 2018, 30, 900–906.
2. Issaraseriruk, N.; Shitangkoon, A.; Aree, T. Molecular docking study for the prediction of enantiodifferentiation of chiral styrene oxides by octakis(2,3-di-*O*-acetyl-6-*O*-*tert*-butyldimethylsilyl)- γ -cyclodextrin. *Journal of Molecular Graphics and Modelling* 2010, 28, 506–512.

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Chemical sensors based on molecular sensor and nanomaterials and encapsulation for detection of anion, cation and bioorganic compounds using fluorescence spectroscopy.



Middle Scientist Awards from Faculty of Science, Chulalongkorn University



My research interest is host-guest chemistry including synthesis of a new sensory molecule and application of fluorescence, UV-visible and electrochemical sensors for detection of anions, cations and neutral molecules such as neurotransmitters, amino acids, saccharides, biomarker compound of cancer.

Moreover, I currently focus on the field of chemical sensor based on either macromolecules or nanoparticles for chemical and biological targets. The chemical sensor based on carbon dots (CDs) or graphene quantum dots (GQDs) for detection of amino acids and organophosphate pesticide by using fluorescent spectroscopy. For example, our group has demonstrated the hybrid graphene quantum dots/enzyme hydrogel for highly efficient photoluminescence sensing of organophosphate pesticides. The encapsulation of GQDs an enzyme by low molecular weight gelator to form supramolecular hydrogel offers a highly promising sensitivity to improve the limit of detection down to nanomolar level for detection of organophosphate via enzymatic reaction.

Furthermore, the development of the optical nanosensor is based on AuNPs and GQDs (GQDs/AuNPs) which perform the efficiency dual optical sensor. Apart from its photophysical sensing ability, this hybrid material demonstrated the dual sensing of cysteine and lysine regarding to colorimetric and fluorometric techniques, respectively, in PBS solution pH 7.4.

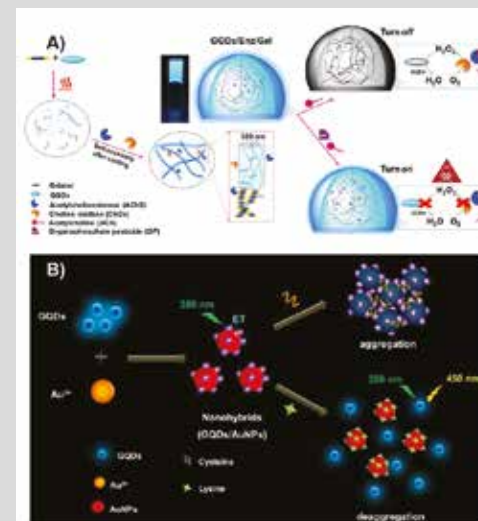


Figure 1. the conceptual design of A) GQDs/Enz hydrogel for detection of organophosphate and B) GQDs/AuNPs hybrid materials for dual detection of Cysteine and Lysine

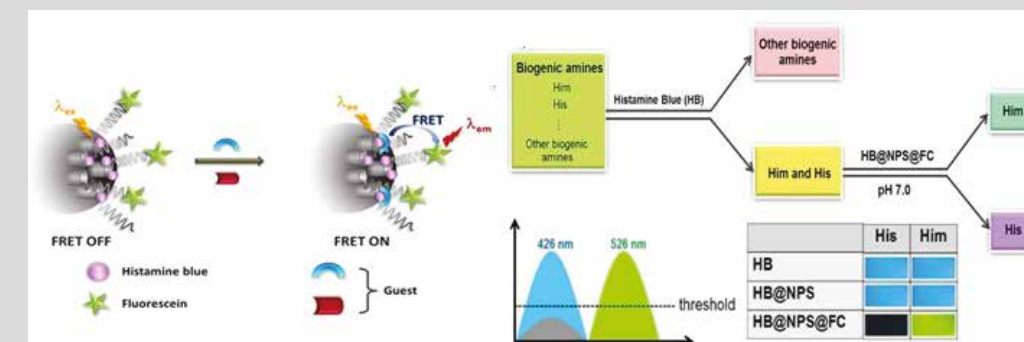


Figure 2. concept of nanosensor based on modified silica nanoporous and the conceptual illustration of fluorescence sensor for specific Him or His detection.

The successful development of a new fluorescence sensors based on the superior Histamine blue (HB) doped in nanoporous silica (NPS) and surface modification with FC to provide FRET On-Off process and highly discriminate detection of histamine among other biogenic amines through the charge repulsion of FC and histidine and the specific reaction of mesoionic acid fluoride based Histamine blue (HB) with the amine group of Him via self-catalytic reaction of imidazole group in Him.





1. Tummachote, J.; Punyaina, W.; Thanomsak, S.; Sirikulkajorn, A.*; Tomapatanaget, B. "Colorimetric N-butyl-3,6-diamidecarbazole-based chemosensors for detection of fluoride and cyanide anions" *Spectrochim. Acta A Mol. Biomol. Spectrosc.* **2019**, *214*, 384–392.
2. Chaicham, C.; Tuntulania, T.; Promarak, V.; Tomapatanageta, B.* "Effective GQD/AuNPs nanosensors for selectively bifunctional detection of lysine and cysteine under different photophysical properties" *Sens. Actuator B; Chem.* **2019**, *282*, 936–944.
3. Chaicham, A.; Kongwutthivech, J., Tuntulani, T., Tomapatanaget, B.* "Couple of Histamine blue fluorescence chemosensor and surface charge selector of FC-modified silica nanoporous for highly specific histamine detection via FRET-process" *Sens. Actuator B; Chem.* **2018**, *258*, 621-627.
4. Sahub, C.; Tuntulani, T.; Nhujak, T.; Tomapatanaget, B.* "Effective biosensor based on graphene quantum dots via enzymatic reaction for directly photoluminescence detection of organophosphate pesticide" *Sens. Actuator B; Chem.* **2018**, *258*, 88–97.
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6. Sahub, C.; Tumcharern, G.; Chirawatkul, P.; Ruangpornvisuti, V.; Ekgasit, S.; Wanichweacharungruang, S.; Tuntulani, T.; Palaga, T.; Tomapatanaget, B.* "Self-assembly of Gd³⁺/SDS/HEPES complex and curcumin entrapment for enhanced stability, fluorescence image in cellular system" *Colloids Surf. B: Biointerfaces* **2017**, *156*, 254-261.

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Environmental electrochemistry



I am interested in extending the application of voltammetric techniques to environmental work such as the determination or elimination of electroactive species in or out of wastewater, natural water, food or beverages. The work requires modifications of the equipment along with an understanding of the advantages and limits of each voltammetric technique. The analytical procedures in the laboratory are necessary for the validation of the method, prior to launch the technique for field studies. In-situ data obtained from field work must be reliable with small error limits. Besides, the field measurements help reduce the cost for sample collection, storage space and transportation.

**MONPICHAR
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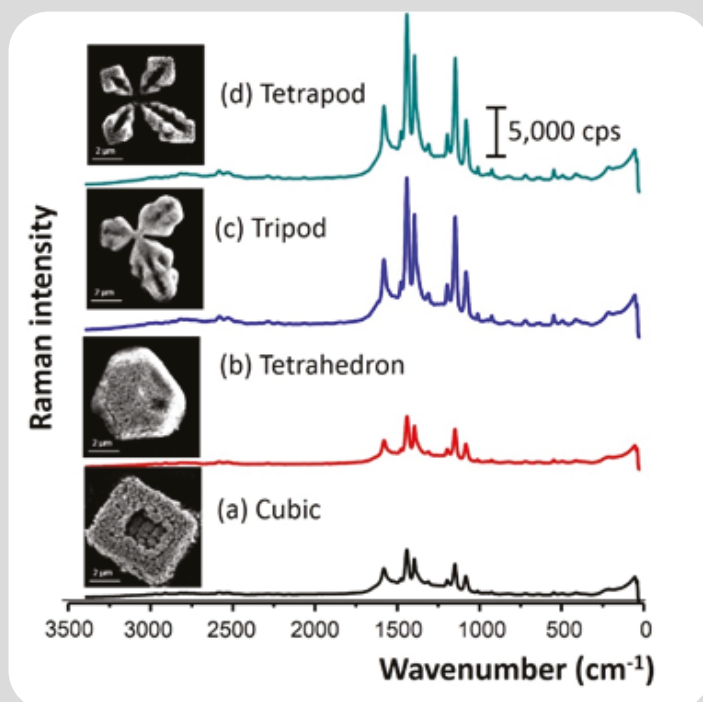
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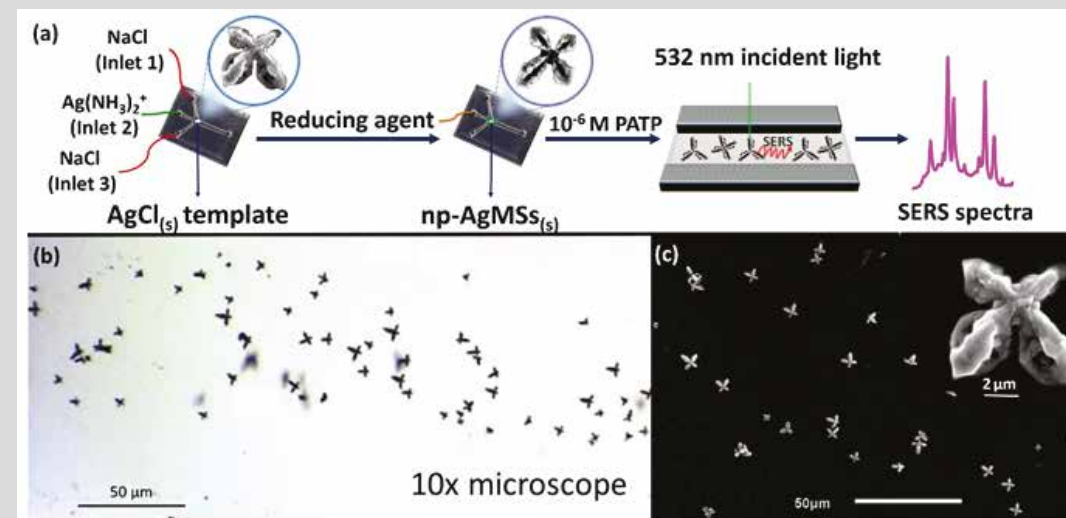




Microfluidic systems and paper-based analytical devices (PADs) for biomedical applications.



Our group has successfully in-situ synthesized nanoporous silver microstructures (np-AgMSs) using a microfluidic system. Chloride induced precipitation with NH_4OH was used to prepare AgCl as a sacrificial template. Exploiting the microfluidic platform, effects of reactant concentrations on the morphology of AgCl templates were studied by simply adjusting the input flow rates. The AgCl templates were subsequently reduced into Ag^0 or np-AgMSs using chemical reduction. The synthesized np-AgMSs were tested as on-chip SERS substrates using *p*-aminothiophenol (PATP) as an analyte. It was found that the np-AgMSs with multipod structures (tripod and tetrapod) provided the highest SERS signal compared to other structures.



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3. Suea-Ngam, A.; Srisa-Art, M.; Furutani, Y. "PDMS-Based Microfluidic Device for Infrared-Transmission Spectro-Electrochemistry" *Bull. Chem. Soc. Jpn.* **2018**, 91, 728-734.
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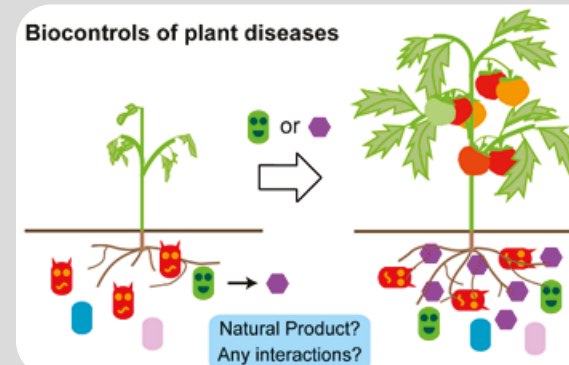
NAWAPORN VINAYAVEKHIN

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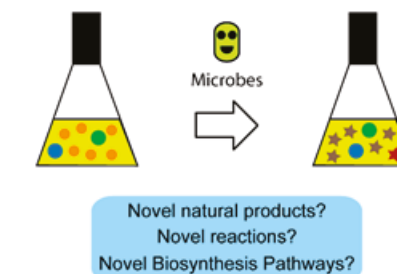
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Biocontrols of plant diseases and the related natural products; Effects of microbe-microbes interactions on biocontrols; Microbial biotransformation of chemical wastes and the related biosynthesis for green chemistry applications; Lipids detection and identification through untargeted metabolomics platforms; Chemical biology

Biocontrols of plant diseases



Microbial biotransformation of wastes



Our research group are currently focusing on discovering bioactive natural products, novel reactions and biosynthesis pathways for agricultural or green chemistry applications. Particularly, the two areas we are actively exploring are:

- I. The searches for rhizospheric microbes, their interactions, and the resulting natural products that can be used for biocontrols or for direct combat of plant diseases caused by plant pathogens (*e.g.*, tomato wilt diseases), and
- II. Microbial biotransformation of agricultural and industrial chemical wastes (*e.g.*, ginger bagasse) to products with potential added values or altered biological functions.

For both research areas, apart from investigating on the structures and various biological activities of the natural products themselves, we are also interested in the regulation and biosynthesis of these natural products, which can potentially lead to discovery of novel reactions and pathways for future green chemistry applications.



RESEARCH
EMPHASIS



RESEARCH



1. Vinayavekhin, N.*; Kongchai, W.; Piapukiew, J.; Chavasiri, W. *Aspergillus niger* upregulated glycerolipid metabolism and ethanol utilization pathway under ethanol stress. *MicrobiologyOpen* **2019**, 00: e948. DOI: 10.1002/mbo3.948
2. Vinayavekhin, N.*; Vangnai, A.S. The effects of disruption in membrane lipid biosynthetic genes on 1-butanol tolerance of *Bacillus subtilis*. *Appl. Microbiol. Biotechnol.* **2018**, 102: 9279–9289.
3. Vinayavekhin, N.; Sueajai, J.; Chaihad, N.; Panrak, R.; Chokchaisiri, R.; Sangvanich, P.; Suksamrarn, A.; Piyachaturawat, P.* Serum lipidomics analysis of ovariectomized rats under *Curcuma comosa* treatment. *J. Ethnopharmacol.* **2016**, 192: 273–282.
4. Vinayavekhin, N.*; Mahipant, G.; Vangnai, A.S.; Sangvanich, P. Untargeted metabolomics analysis revealed changes in the composition of glycerolipids and phospholipids in *Bacillus subtilis* under 1-butanol stress. *Appl. Microbiol. Biotechnol.* **2015**, 99: 5971–5983.

NIPAKA SUKPIROM

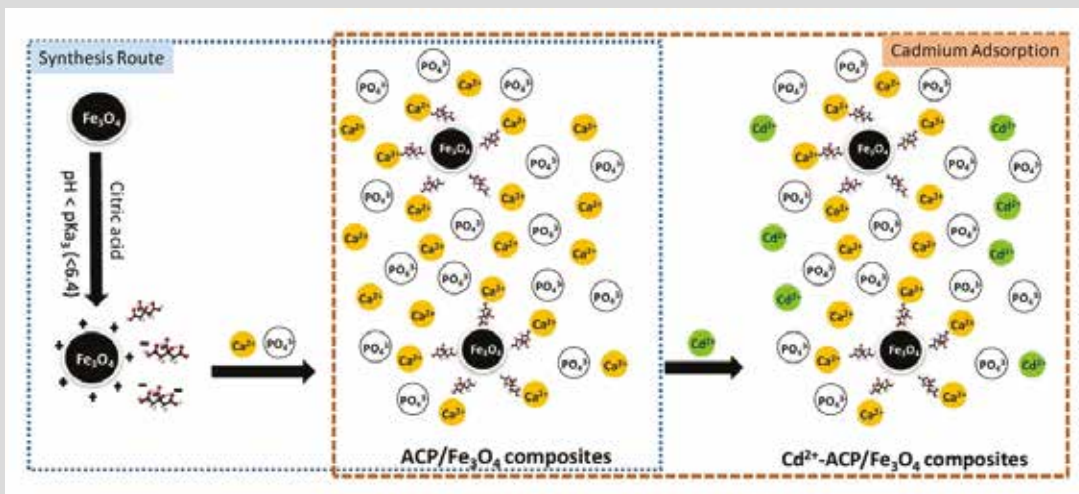
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Synthesis and investigation on composites and modified layered materials and functionalized porous materials for specific applications.



A new preparation of amorphous calcium phosphate (ACP) through a one-pot synthesis was reported. The utility of citric acid, together with, preformed Fe_3O_4 renders the formation of ACP/ Fe_3O_4 magnetic composites, hampering the aggregation of calcium phosphates and hence hindering the transformation of ACP into undesired Hap. The superior cadmium adsorption capacity of the composite is top ranked among previously reported adsorbents. The thorough investigation underpins the adsorption mechanism, whereby the specific replacement of Ca^{2+} ions in ACP network by Cd^{2+} is highly selective over other M(II) ions such as Co^{2+} and Ni^{2+} . Furthermore, the superparamagnetic nature of the composites allows a convenient separation of the materials after use.



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Design and preparation of inorganic nanomaterials for applications in biological and environmental applications.



Scholarship from Anandamahidol Foundation, 2004-2010

Our group is interested in the relationship between inorganic materials and biological and environmental problems. For biological applications, we are developing biocompatible inorganic nanocomposites and magnetically-guided drug delivery systems based on superparamagnetic iron oxide nanoparticles. Various nanocomposites have been prepared and evaluated their potential as drug carriers. For example, hydroxyapatite nanoneedles for bone regeneration (Figure 1A), magnetic nanocubes coated with biocompatible polymer for trandental delivery (Figure 1B) and PLGA-magnetic nanocomposites (Figure 1C) for activation of dendritic cells. Moreover, we are also working on the fluorescent sensing systems for the detection of specific biomolecules in order to early detection of illness. For the fluorescent sensors, we mainly focus on the surface modification of semiconductor nanoparticles or quantum dots such as CdSe, CdTe, and ZnSe nanoparticles.

For environmental applications, we are working on preparations of different types of nanocomposites based on superparamagnetic iron oxide nanoparticles for environmental remediation. For examples, nanocomposites of silica-iron oxides and titania-silica-iron oxides (Figure 2) were used as photocatalysts in the photodegradation of organic dyes and inhibition the growth of bacteria. We are also investigating the superparamagnetic porous silica materials for the treatment of contaminated water with ability to remove the materials back with magnetic forces.

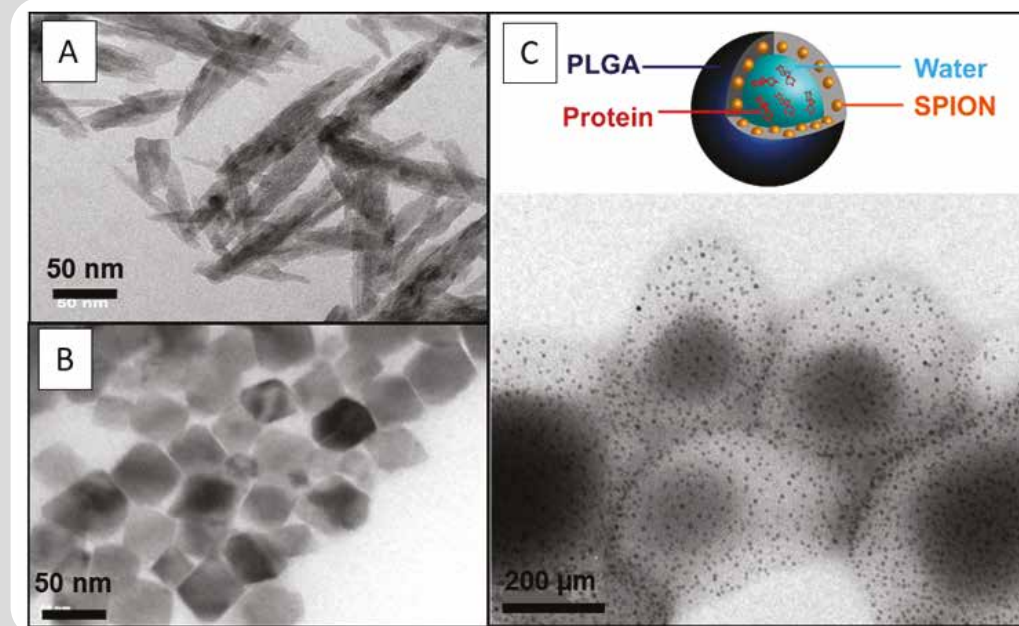


Figure 1 Inorganic materials-based nanostructures for biological applications; (A) hydroxyapatite nanoneedles, (B) superparamagnetic nanocubes⁶ and (C) Nanocomposites of PLGA-iron oxide nanoparticles⁴.

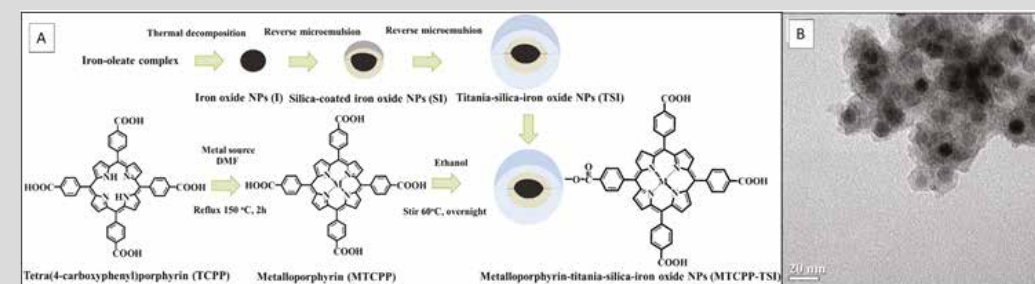


Figure 2 (A) Schematic diagram for the synthesis and (B) TEM images of nano-composites of iron oxide-silica-titania coated with metalloporphyrin¹



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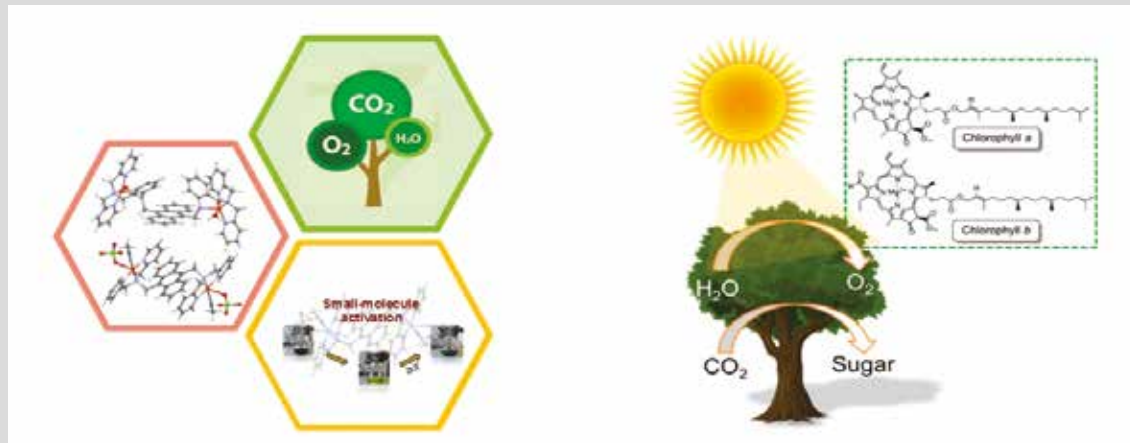


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3. Injumba, W.; Khotavivattana, T.; Insin, N. "Synthesis of peroxy-functionalized magnetic mesoporous silica for epoxidation of vinyl acetate" *J. Magn. Magn. Mater.* **2019**, *475*, 579-585.
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5. Injumba, W.; Ritprajak, P.; Insin, N. "Size-dependent Cytotoxicity and Inflammatory Responses of PEGylated Silica-Iron Oxide Nanocomposite Size Series." *J. Magn. Magn. Mater.* **2017**, *427*, 60-66.
6. Ajkidkarn, P.; Injumba, W.; Ritprajak, P.; Insin, N. "Synthesis, Characterization, Drug Release and Transdental Delivery Studies of Magnetic Nanocubes coated with Biodegradable Poly(2-(dimethyl amino)ethyl methacrylate)." *J. Magn. Magn. Mater.* **2017**, *427*, 54-59.
7. Chanhom, P.; Charoenlap, N.; Tomapatanaget, B.; Insin, N. "Colloidal titania-silica-iron oxide nanocomposites and the effect from silica thickness on the photocatalytic and bactericidal activities." *J. Magn. Magn. Mater.* **2017**, *427*, 235-240.
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Bioinorganic and coordination chemistry focusing on development of bio-inspired metal complexes and materials for biomedical, catalytic and energy-related applications

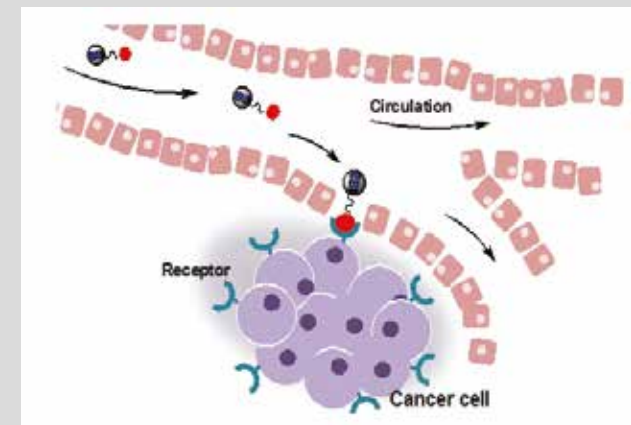


Small-molecule activation is one of the key steps in metal-based catalysis to convert basic chemicals into value-added products in both industrial and biological processes. However, many synthetic catalysts for this process rely on precious metals, which are not sustainable for future applications. Thus, our research interest is to develop first-row transition metal complexes and inexpensive materials for organic transformation as well as energy-related application such as O_2 reduction, CO_2 reduction and H_2 evolution.

Inspired by enzyme active sites that use cheap and abundant metals, our group has synthesized a series of copper complexes for biomimetic reactions and O_2 reduction reaction. We are also inspired by photosynthesis in Nature that use sun light to activate and carry out a number of reactions. Our group has prepared photocatalysts based on composite of carbon-based materials and transition metal complexes which can mediate photocatalytic reactions efficiently.



For biomedical application, we aim to develop novel drug delivery systems for targeted therapy. Our strategy is to incorporate the targeting molecules into anticancer drugs and carriers by simple coordinate covalent bonds. This coordination can also help to prevent drug release before reaching the targeted cells, so that the drug will be protected from undesirable reactions during circulation. As a result, this nanoparticle modification can enhance specificity and efficiency of the drug system.



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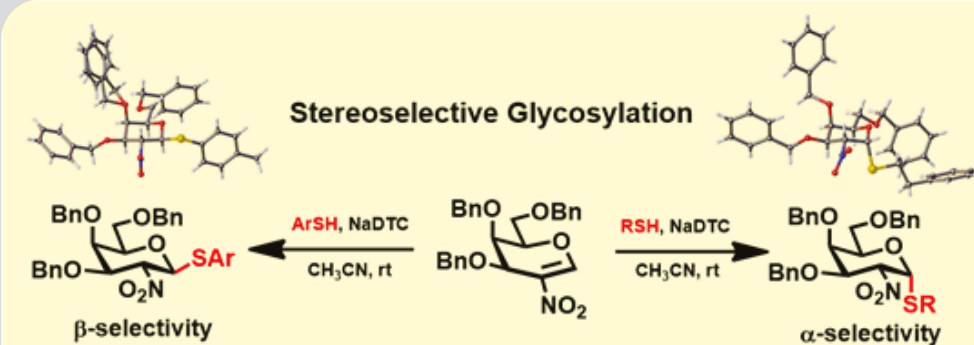
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Chemical synthesis of carbohydrates and glycoconjugate molecules
 Green organic synthesis enabled by micellar catalysis

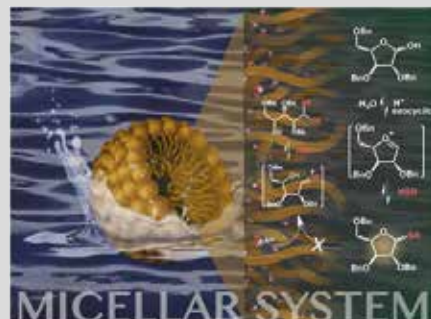
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2-Nitroglycals are important precursors for the synthesis of amino deoxy sugars which are ubiquitous in biologically active molecules. Michael additions of 2-nitroglycals were demonstrated with *S*-, *N*-, and *O*-nucleophiles using sodium diethyldithiocarbamate (NaDTC; Na⁺-SC(S)NEt₂) as catalyst. Glycosylation between 2-nitroglycals and *S*-nucleophiles activated by NaDTC proceeded smoothly under mild and non-anhydrous conditions resulted in thioglycosides in high yield and selectivities. The stereochemistry of the thioglycosides were determined by NMR spectroscopy and confirmed by X-ray crystallography.

Green and aqueous-based dehydrative glycosylation of thiofuranosides in micellar media was developed. The dehydrative glycosylation of 1-hydroxy furanosides and pyranosides with aliphatic, aromatic, and heterocyclic thiols catalyzed by dodecylbenzenesulfonic acid (DBSA) was accomplished.

Microwave irradiation led to improved yields and shorter reaction times. Noteworthy, the open-chain dithioacetal which is a common by-product from the dehydrative glycosylation was not detected. Moreover, the methodology was simple and convenient to set up without the requirement for anhydrous conditions.



1. Kitiyanant, V.; Lotrakul, P.; Kanchanabanca, C.; Padungros, P.; Punnapayak, H.; Prasongsuk, S.; Chanvorachote, P. "Fusigen Reduces Intracellular Reactive Oxygen Species and Nitric Oxide Levels" *In Vivo* **2019**, 33, 425–432.
2. Prasongsuk, S.; Patipong, T.; Lotrakul, P.; Padungros, P.; Punnapayak, H.; Bankeeree, W. "Enzymatic hydrolysis of tropical weed xylans using xylanase from *Aureobasidium melanogenum* PBUAP46 for xylooligosaccharide production" *3 Biotech* **2019**, 9, 56.
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4. Wangpaiboon, K.; Padungros, P.; Nakapong, S.; Charoenwongpaiboon, T.; Rejzek, M.; Field, R.A.; Pichyangkura, R. "An α -1,6-and α -1,3-linked glucan produced by *Leuconostoc citreum* ABK-1 alternansucrase with nanoparticle and film-forming properties" *Scientific Reports* **2018**, 8, 8340.
5. Seankongsuk, P.; Vchirawongkwin, V.; Bates, R. W.; Padungros, P.; Vilaivan, T. "Enantioselective Synthesis of (2S,3S)-epi-Oxetin and Its Incorporation into Conformationally Constrained Pyrrolidiny PNA with an Oxetane Backbone" *Asian J. Org. Chem.* **2017**, 6, 551–560.

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- Molecular vibrational spectroscopy (IR and Raman spectroscopy)
- Design and fabrication of spectroscopic accessories
- Synthesis and characterizations of advanced functional precious metal (Ag, Au, Pt, and Pd) nanoparticles
- Surface- and tip-enhanced Raman spectroscopy (SERS and TERS)



- 2017 Young Researcher Award from Chulalongkorn University, THAILAND
 2017 Asahi Glass Foundation Overseas Research Grant, JAPAN
 2016 Hitachi Research Fellowship, JAPAN

My current research focuses on fabricating and using metal nanoparticles/structures to enhance Raman signals via surface- and tip-enhanced Raman scattering (SERS and TERS) for investigating properties of materials in a nanoscale level.

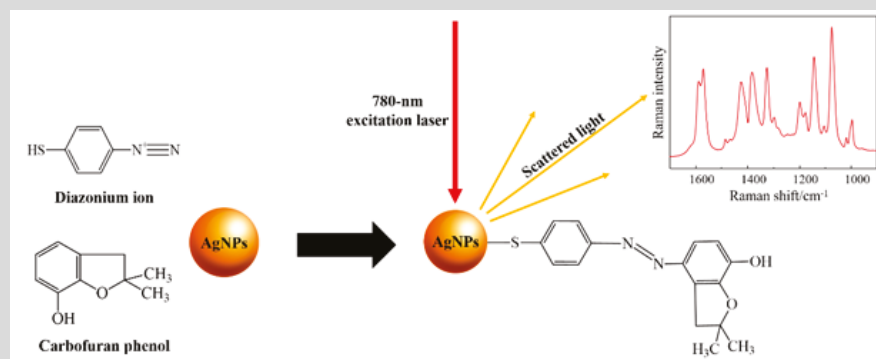


Figure 1. Schematic diagram for a detection method of carbofuran carbamate pesticide in rice and soybean using coupling reaction-based SERS.

For example, we propose a sensitive and selective method for detecting one of the most toxic insecticides, "carbofuran", in rice and soybean. This method is based on a coupling reaction of diazonium ion combined with a SERS technique. Diazonium ion produced from *p*-aminothiophenol reacts specifically with carbofuran phenol from a hydrolysis of carbofuran. The generated azo compounds attach to the surface of AgNPs via Ag-S bond. Therefore, a strong Raman intensity can be obtained. The concentration of carbofuran can be determined by following the intensity of the peak at 1201 cm^{-1} , attributed to the C-N stretching vibration of the azo compound. The result shows a good linear correlation ($R^2 = 0.9786$) against carbofuran concentrations (0.1–5 ppm) with a detection limit of 0.452 ppm. Our proposed protocol is insignificantly influenced by various common interferences. Additionally, this method has been successfully validated to determine carbofuran concentrations in rice and soybean with detection limits of 0.446 and 0.520 ppm, respectively.

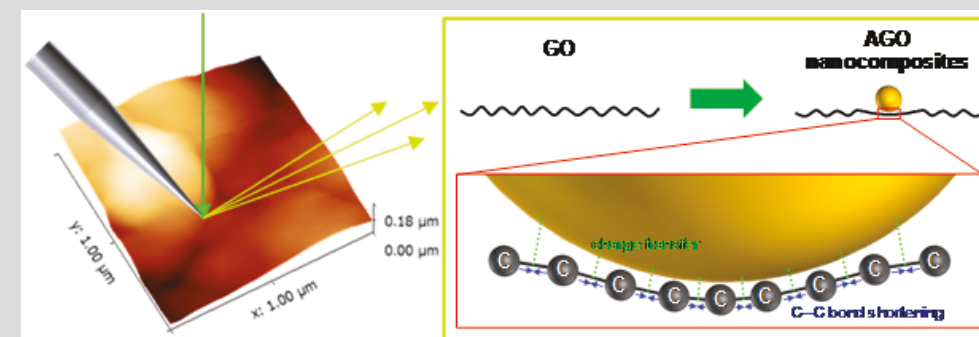


Figure 2. By using TERS, local structural changes of graphene oxide (GO) in silver/graphene oxide (AGO) nanocomposites are successfully proposed.

Our up-to-date research is a use of TERS to investigate structural changes of graphene oxide (GO) in silver/graphene oxide (AGO) nanocomposites. Because of markedly high spatial resolution of TERS technique, the measurements of molecular information at specific nano-scaled positions can be achieved by constructing line-profile TERS spectra straight from the center of AgNPs on a GO layer. The results show evidences that AgNPs cause shortening of C–C bonds beneath AgNPs, flattening of GO layers, and critical bending on GO layers. Additionally, a connection of carbon atoms via C–C network subsequently expands structural changes with the distance of 200–250 nm from the center of AgNPs, even though this distance is larger than the size of AgNPs. From this model, it is supposed to be that the better conductivity of AGO nanocomposites than that of GO arises not only from an excellent conductivity of AgNPs but also from the flattening of GO layers. It also unveils new understanding about changes in properties from GO to AGO nanocomposites, which will contribute to a development of advanced nanostructures/nanocomposites in the near future.

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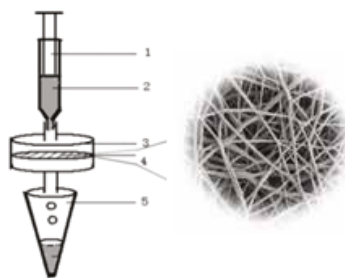




Sample preparation and method development for food and environmental analysis; Electrospun polymer and silica fibers as sorbents for solid-phase extraction.

My research group has been working on the sample preparation techniques prior to chromatographic analysis. The development of sorbent for solid-phase extraction (SPE) and solid-phase microextraction (SPME) was ongoing study with the use of polymeric nanofibers fabricated by electrospinning method.

The electrospun nanofibers exhibit a good efficiency and low consumption of solvent and sample which is a good alternative sorbent in extraction aspect. Additionally, the method development of solid phase microextraction for trace analysis of toxic compounds in complex matrix such as food and environmental samples are research.



Electrospun nanofibers for solid-phase extraction (SPE)

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3. Tungkijanansina, N.; Alahmad, W.; Nhujak, T.; Varanusupakul, P. "Determination of benzoic acid, sorbic acid, and propionic acid in fermented food by headspace solid-phase microextraction followed by GC-FID" *Food Chemistry*, submitted.



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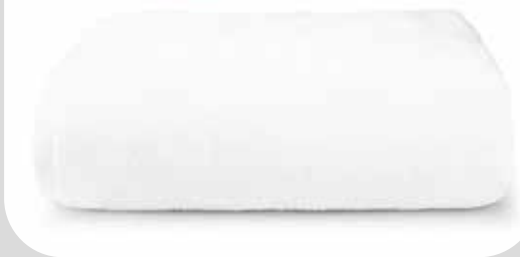
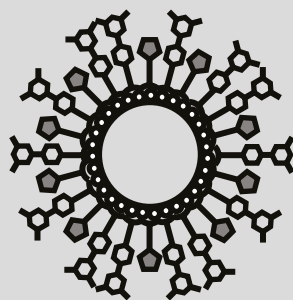
Supramolecular chemistry on ionic nanoparticles and their biomedical applications



Tab Neelanithi Foundation Scholarship 1999
Scholarship from Ministry of University Affairs 2002

My research interests focus on the design, synthesis and modification of ionic nanoparticles by supramolecular techniques for biomedical applications. Calcium based nanoparticles including calcium carbonate and calcium phosphate can be encapsulated with drug molecules for their controlled releasing properties. Moreover, the nanoparticle surface can be modified with fluorescent tag or targeting units for cell selectivity. Controlling of shape and size of the nanoparticles is also capable.

The chemistry developed in my research group has also been transformed to commercialised product under the name **DeoFresh**, deodorising towel. The towel exhibits high affinity to unpleasant odours and traps them all into molecular capsules covalently bounded onto the cotton yarns.



In the near future, there will be more commercial products from my research on the market. Please stay tuned.

1. Sustaining Antibiotic Release from a Poly(methyl methacrylate) Bone-Spacer, Oungeun, Pongpat; Rojanathanes, Rojrit; Pinsornsak, Piya; Wanichwecharungruang, Supason, *ACV OMEGA*, **2019**, 4 (12), 14860-14867.
2. Molecular and Morphological Evidence of Hepatotoxicity after Silver Nanoparticle Exposure: A Systematic Review, In Silico, and Ultrastructure Investigation, Sooklert, Kanidta; Wongjarupong, Asarn; Cherdchom, Sarocha; Wongjarupong, Nicha; Jindatip, Depicha; Phungnoi, Yupa; Rojanathanes, Rojrit; Sereemasapun, Amornpun; *TOXICOLOGICAL RESEARCH*, **2019**, 35 (3), 257-270.
3. N-acetylcysteine reverses the decrease of DNA methylation status caused by engineered gold, silicon, and chitosan nanoparticles: Sooklert, Kanidta; Nilyai, Siwaporn; Rojanathanes, Rojrit; Jindatip, Depicha; Sae-liang, Nuchanart; Kitkumthorn, Nakarin; Mutirangura, Apiwat; Sereemasapun, Amornpun; *INTERNATIONAL JOURNAL OF NANOMEDICINE*, **2019**, 14, 4573-4587.
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Synthesis of carbon nanomaterials and their applications in chemical sensing, catalysis and energy storage

Royal Thai Government Scholarship by the Development and Promotion of Science and Technology Talents Project (DPST) 2000-2004
Anandamahidol Foundation Scholarship 2004-2010

Our group has been focusing on synthesizing various forms of carbon nanomaterials including graphene, graphene oxide (GO), reduced graphene oxide (rGO), graphene foam (GF) and carbon nanotubes (CNTs). These nanomaterials have been used in chemical sensing, catalysis and energy storage. Recently, we have prepared Pd nanoparticles supported on rGO. Here, we aimed at using this nanocomposite to catalyze cross coupling reactions, for example, Sonogashira-Hagihara coupling and Suzuki-Miyaura coupling. This work has been conducted in collaboration with Materials Advancement and Proficient Synthesis (MAPS) group at Chulalongkorn University.



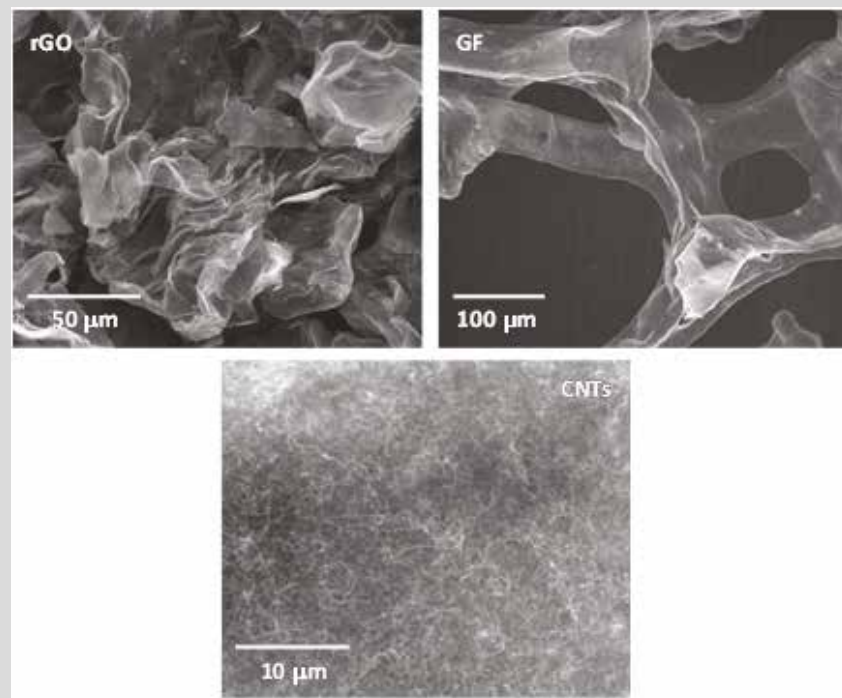
RESEARCH
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1. Srisantitham, S.; Sukwattanasinitt, M.; Unarunotai, S. "Effect of pH on fluorescence quenching of organic dyes by graphene oxide" *Colloids Surf. A* **2018**, 550, 123-131.

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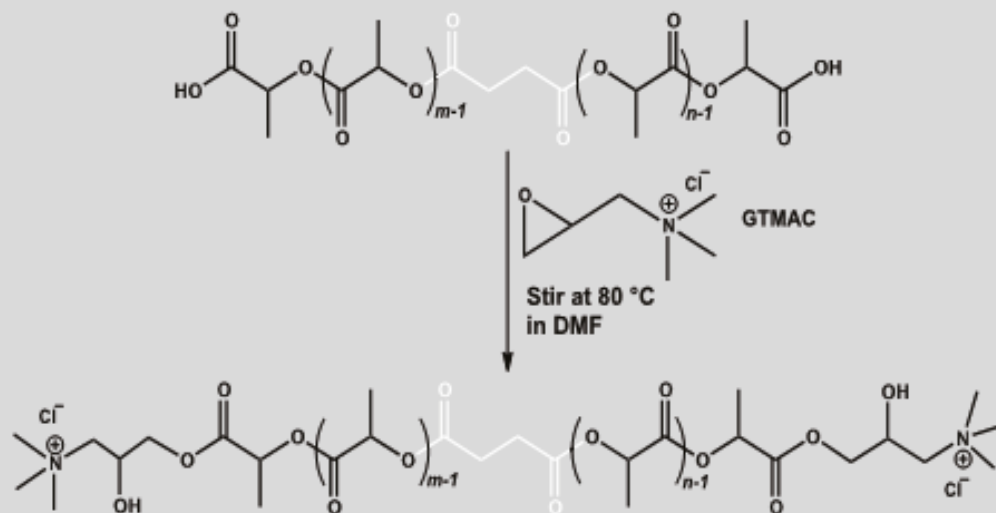




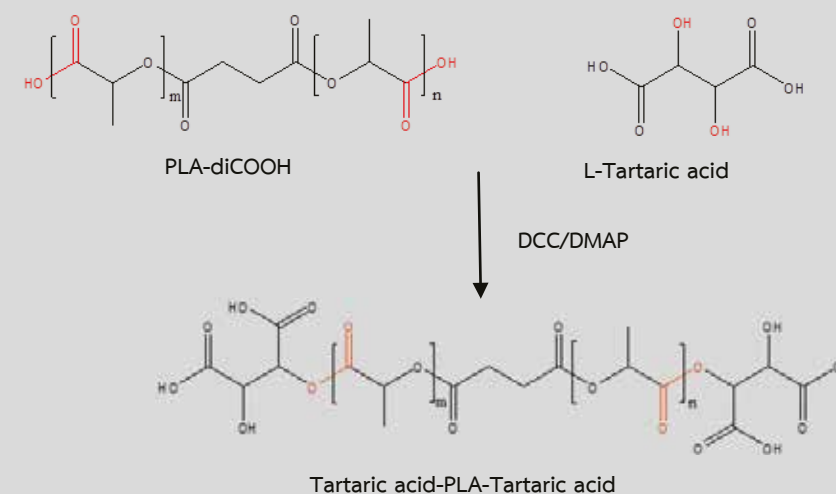
Polymer chemistry, structure-property modification of bio-based polymers, biodegradable and telechelic polyesters, rubber reinforcement by nano-silica

1. Chemical modification of poly(lactic acid) (PLA)- A number of polar moieties were attached to the PLA chain ends, with the aim to increase the polarity (or hydrophilicity) of PLA. The increase in polarity should also increase the degradation rate of the polymer.

a. Positively charged ammonium ions- The charged polymers tend to be more hydrophilic and degrade faster than the original PLA. Furthermore, the presence of positive charges on the polymer can facilitate charge-charge interaction with biological substances.



b. Tartaric acid- The carboxylic acid chain ends of PLA was subjected to react with the hydroxyl groups of tartaric acid (TA). Attaching the tartaric acid led to an increase of hydrophilicity of the modified PLA-TA films



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2. Wattanakul, S. and Tangpasuthadol, V. "Enhancing hydrophilicity of poly(lactic acid) film by attaching tartaric acid onto polymer chains" Abstract in The 9th Polymer Conference of Thailand, June 13-14, 2019, Amari Watergate Hotel, Bangkok.

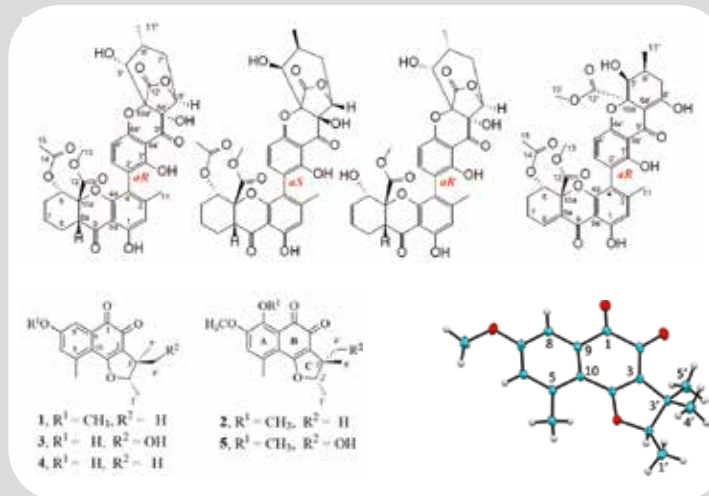


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Chemistry of natural products, chemical ecology, agricultural chemistry, methodology in organic synthesis and catalysis applied to fine chemicals.



The main research is focused on bioactive compounds from medicinal plants, mangrove plants, tropical weeds, mushrooms and lichens. The structure-activity relationship of bioactive compounds is scrutinized to deeply understand the role of functional groups towards biological activity. Both pharmaceutical (anticancer, melanogenesis, antioxidant and anti-infectious diseases) and agricultural (antiphytopathogenic microbial, insect controlled agents and allelochemicals) proposes are of interest.

In addition, homogeneous catalysis using transition metal complexes applied to fine chemicals is also investigated. Various organic transformations including selective oxidation, alkylation, rearrangement, condensation reactions are being studied intensively. The investigation of halogenating agents has led to the discovery of the new and efficient methodology for organic transformation such as the preparation of carboxylic acid derivatives, alkyl halides, halosilanes, haloaromatics, etc. These methods can also feasibly apply for the synthesis of heterocycles and other bioactive compounds.



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RESEARCH



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2. Ruga, R.; Chavasiri, W. Enhancing Antibacterial Activity by Combination of Chloramphenicol with Constituents from *Dracaena cochinchinensis* (Lour.) S.C.Chen *Anti-Infective Agents*, **2019**, *17*, 74-80.
3. Duong, T.H.; Beniddir, M.A.; Genta-Jouved, G.; Nguyen, H.H.; Nguyen, D.P.; Nguyen, T.A.T.; Mach, D.H. Boustie, J.; Nguyen, K.P.P.; Chavasiri, W.; Le Pogam, P. Further Terpenoids from *Euphorbia tirucalli* *Fitoterapia*, **2019**, *24*, 44-51.
4. Sangpheak, K.; Tabtimmai, L.; Seetaha, S.; Runnim, C.; Chavasiri, W.; Wolschann, P.; Choowongkamon, K.; Rungrotmongkol, T. Biological Evaluation and Molecular Dynamics Simulation of Chalcone Derivatives as Epidermal Growth Factor-Tyrosine Kinase Inhibitors *Molecules*, **2019**, *24*, 1092.
5. Duong, T.H.; Benididir, M.A.; Boustie, J.; Nguyen, K.P.P.; Chavasiri, W.; Bernadat, G.; Le Pogam, P. DP4-Assisted Structure Elucidation of Isodemethylchodatin, a New Norlichexanthone Derivative Meager in H-Atoms, from the Lichen *Parmotrema tsavoense* *Molecules*, **2019**, *24*, 1527.
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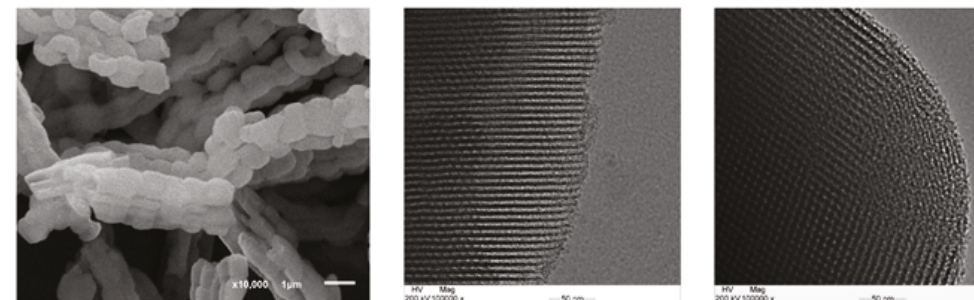
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Synthesis, functionalization, and modification of mesoporous materials and their applications as:

- 1) heterogeneous catalysts for biomass conversion and for CO₂ conversion
- 2) adsorbents for wastewater treatment and for removal of refractory sulfur compounds in fuels

Our research group focuses on the synthesis and application of mesoporous materials—those with pore sizes of 2-50 nm such as mesoporous silicas (SBA-15, MCM-41, and MCM-48)— which combine the advantages of large surface area, large pore volume, and high thermal stability. Pure mesoporous silicas, however, are lack of or possess a limited amount of catalytic or adsorption sites, preventing them from serving as efficient heterogeneous catalysts or adsorbents. Our research group, therefore, emphasizes on functionalization and modification of mesoporous silicas in order to enhance their catalytic and adsorption efficiency. Examples of methods that we use for the functionalization and modification of mesoporous silicas include the co-condensation or post-synthetic grafting method for the attachment of organic functional groups on the surface of mesoporous silicas as well as the wetness impregnation method for the immobilization of metals/metal oxides/metal phosphides on the surface of mesoporous silicas.



SEM and TEM images of modified mesoporous silicas



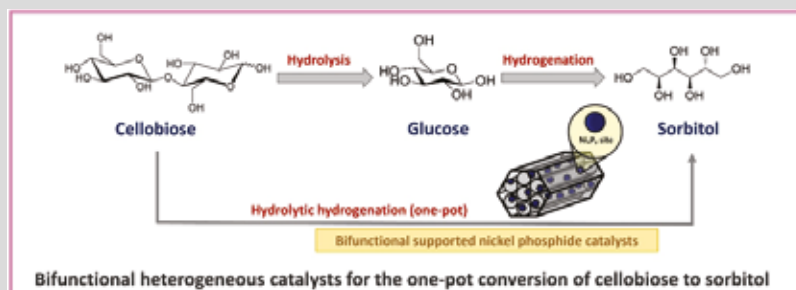
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RESEARCH



One of our current interests is to develop bifunctional heterogeneous catalysts for multi-step reactions. The development goals include mesoporous silica-supported nickel phosphide-based catalysts whose acidic and metallic sites can facilitate the one-pot conversion of cellobiose to sorbitol *via* hydrolytic hydrogenation. Using these modified mesoporous materials leads to the increase in product yield, simpler isolation and purification procedures, reduction of waste products, and lower energy consumption. Therefore, our research efforts are oriented towards the key principles of green chemistry.



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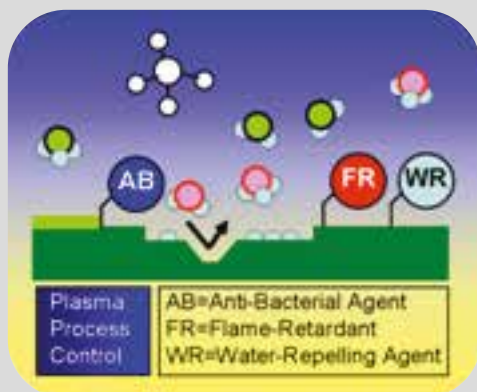
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Research areas of interest lies upon methodology development for synthesis of biologically active compounds. This include synthetic and utilization of chiral catalysts and organocatalysts. Synthesis of organic materials with excellent properties for sensing and optical applications for small volatile organic components and phototherapeutic is also within the scope. Current areas of interest have expanded to cover areas encompassing organic chemistry and plasma technology where utilization of plasma process comes in as a method to incorporate functional properties such as flame retarding, water repelling, anti-bacterial, chemical adhesive onto the surface of choice.

- Chemical Society of Thailand – Citations Award (co author) 2009
- ASEM-DUO Fellowship 2008
- Thailand Toray Science Foundation – Science and Technology Research Grant 2004
- PacifiChem 2000 Young Scholar Grant 2000
- 7th Asian Chemical Congress Grant 1997
- University of Utah Research Presentation Awards 1995 and 1994
- Henry Eyring Research Fellowship 1990



A series of highly conjugated at the meso- as well as an extended π -conjugated porphyrin derivatives possessing UV absorptions and fluorescence emissions at relatively long wavelengths have been synthesized. Preliminary optical and binding properties have been shown to be potentially useful in optical and sensing applications.

Flame retarding cotton and silk fabrics which are self-extinguishable shortly upon ignition in ambient atmosphere have been prepared without significant changes in mechanical and physical properties as well as the color shades. Superhydrophobic nanofabric preparation has also



been achieved through plasma modification of desired surfaces. Moreover, conductive poly(thiophene) and poly(pyrrole) with higher electrical conductivity have been successfully fabricated through plasma polymerization on surfaces of choice.

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YONGSAK SRITANA-ANANT

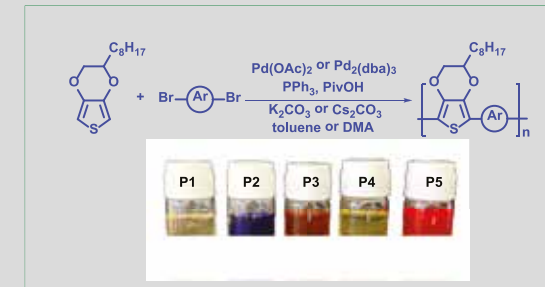
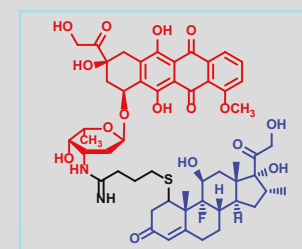
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- Synthesis of conjugated polymers
- Organic photovoltaic cells
- Synthesis of biologically active compounds
- Supramolecular chemistry

Direct C-H arylation polymerization is an emerging “green” cross-coupling method to synthesize conjugated polymers, bypassing the organometallic intermediates. Several donor-acceptor conjugated copolymers of 2'-octyl-3,4-ethylenedioxythiophene as the donor units were introduced through this strategy. Large bathochromic visible absorptions of these copolymers were measured with the λ_{max} value up to 630 nm. The results demonstrate their promising prospect of development into part of efficient organic photovoltaic cells.



The preparation of targeting-drug conjugates is one of the highly successful strategies towards the selective delivery of potent drugs to the tumor cells. This approach was exemplified in our synthesis of dexamethasone-doxorubicin conjugate, which retained its potent cytotoxicity to the MCF-7 cancer cells in the manner that is different to that of doxorubicin alone. The conjugate can also escape the efflux of drug that is found on multidrug resistance cancer cells, suggesting its potential development towards their treatments.

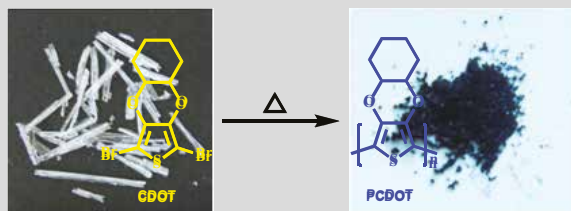


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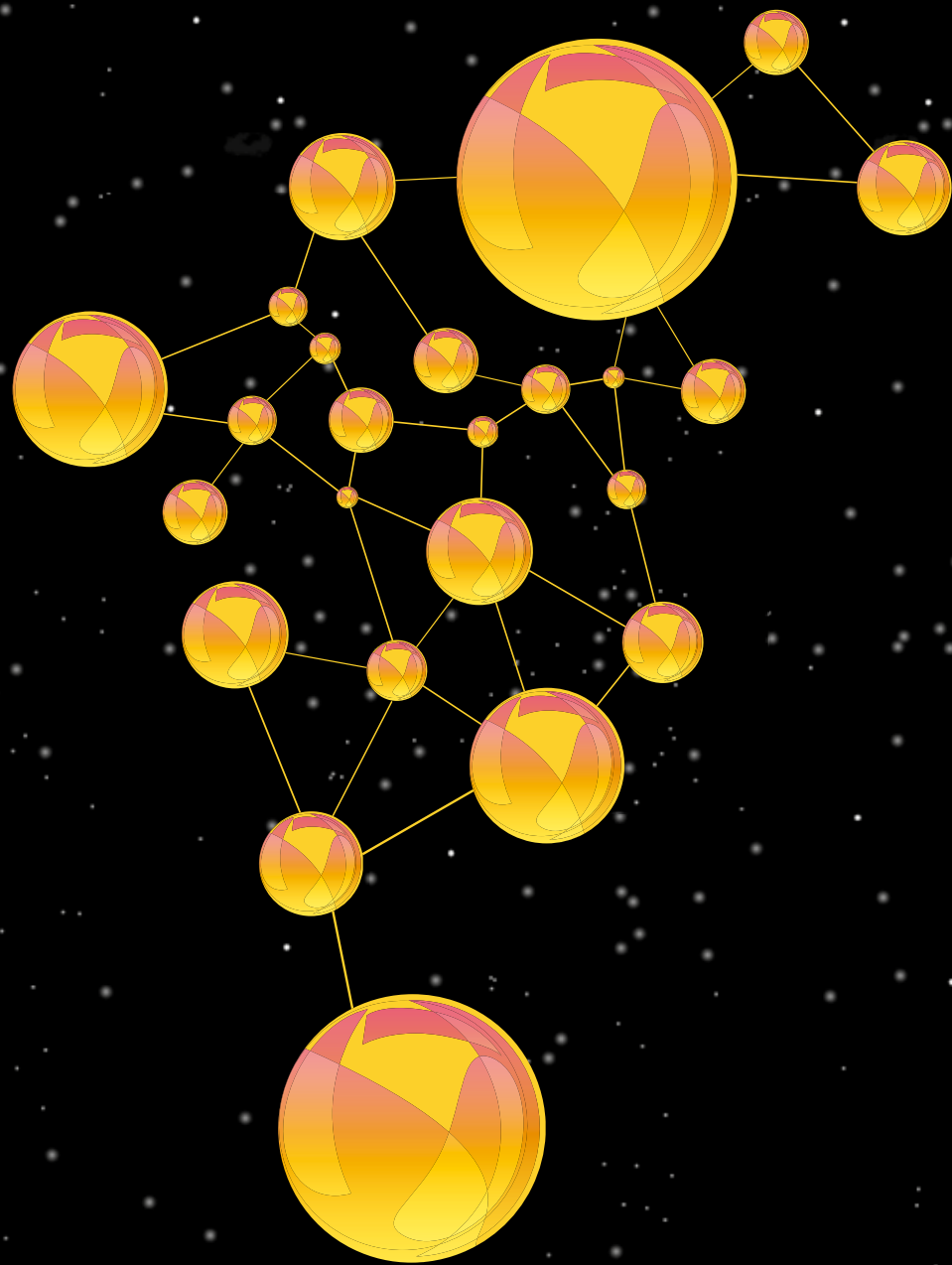
RESEARCH

Building on our success on solid state polymerizations (SSP) of 2,5-dibromo-3,4-dialkoxythiophenes, conjugated polymer composite films containing poly(3,4-ethylenedioxythiophene) (PEDOT) was prepared in the matrices of various polymers. Their solution mixtures were electrospun into thin fiber mats, followed by heating to induce the SSP of the embedded monomers to yield the dark blue PEDOT composite film. Their relatively high conductive properties were comparable to pure PEDOT from SSP without the polymer matrix.



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LECTURER

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Experimental design in chromatography, multidimensional chromatography, MS and MSⁿ, manufacture of new devices in chromatography, novel concepts in capillary electrophoresis, online reaction in chromatography, automated sample preparation techniques, separation in micro pipette tips, chiral separation, new column synthesis approaches, zeta potential measurement, surface characterisation techniques, density functional theory, qualitative structure retention relationship and statistical thermodynamic simulation in chromatography and MS, and novel materials in chromatography (ionic liquids, metal organic frameworks, imprinted polymers).



Our group develops novel approach in sample preparation, multidimensional chromatography and mass spectrometry (MS) for improved analysis of complex samples (>200 compounds). This increases the number of volatile compounds (>10 times compared with the conventional methods) and provides greater confidence in compound identification and preparative-scale separation for new compound discovery. The development includes new instrument manufacture, new theory for effective experimental design, improved data analysis approaches, and construction of database of a wide range of samples including food, petrochemical, environmental, herbs and plants with multidimensional chromatography and MS.



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RESEARCH



1. Kulsing, C.; Nolvachai, Y.; Trapp, O.; Marriott, P.J. "Multidimensional gas chromatography investigation of concentration and temperature effects of oxime interconversion on ionic liquid and poly(ethylene glycol) stationary phases" *Analytica Chimica Acta* **2019**, 1081, 200-208.
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5. Kulsing, C.; Nolvachai, Y.; Wong, Y.F.; Glouzman, M. I.; Marriott, P.J. "Observation and explanation of two-dimensional interconversion of oximes with multiple heart-cutting using comprehensive multidimensional gas chromatography" *Journal of Chromatography A* **2018**, 1546, 97-105.
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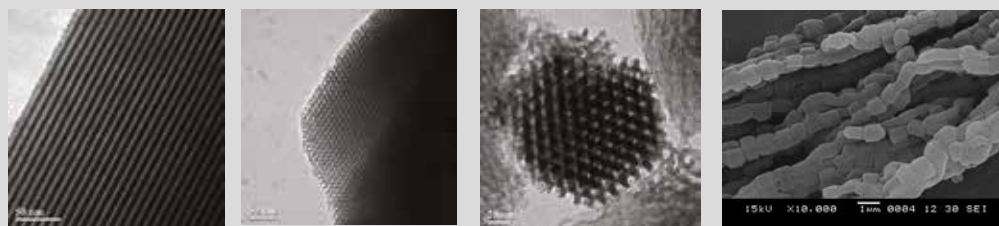




Synthesis, Modification and Catalytic Applications of Zeolites; Clays and Mesoporous Materials Design of Catalytic Reactions toward Green Chemical Synthesis Methods; Biomass Transformation; Up-cycling product and Process design; Lubrication Science and Tribological Chemistry

- Western Digital Innovative Award
- Vice President of the Asian Network of Green Chemistry

Zeolite and mesoporous acidic, basic and redox catalysts are expected to make a key contribution to the solution of the problems in resources, environment and energy. These materials exhibit the good performance catalysts in high conversion and product selectivity in many petrochemical reactions and biomass transformation.



Modified clay materials also get high attention in other industrial applications due to their low cost in preparation with a good ion-exchange and catalytic performance. My research focus is on the modification and optimization of catalytic material. This includes synthesis, material characterizations and reaction processes in order to achieve novel and high quality catalytic materials that can be applied in industry and future innovation. More going on research projects, I am also working on surface lubrication science and tribological chemistry especially for micro-electronic industry. This research is in collaboration with Western Digital (Thailand) Co., Ltd.

Another project is about the thin film chemistry i.e. hydrogen separation membrane (in collaboration with PTT) and corrosive protection for anti-ferromagnetic layer in HDD head (in collaboration WD (Thailand)).

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2. Duangkamon Jiraroj, Sukkanaste Tungasmita and Duangamol Nuntasri Tungasmita "Zeolite A-polypropylene and silver-zeolite A-polypropylene composite films for antibacterial and breathable applications" *Journal of Applied Polymer Science*, **2017**, 134, 45450.
3. Chakrapong Saengarun, Amorn Petsomand Duangamol Nuntasri Tungasmita, "Etherification of Glycerol with Propylene or 1-Butene for Fuel Additives" *The Scientific World Journal*, **2017**, 4089036.
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6. Sari Rautiainen, Davide Di Francesco, Sarmad Katea, Gunnar Westin, Duangamol Tungasmita and Joseph Samec "Lignin valorization by cobalt-catalyzed fractionation of lignocellulose to yield monophenolic compounds, *ChemSusChem* **2019**, 12 (2), 404.
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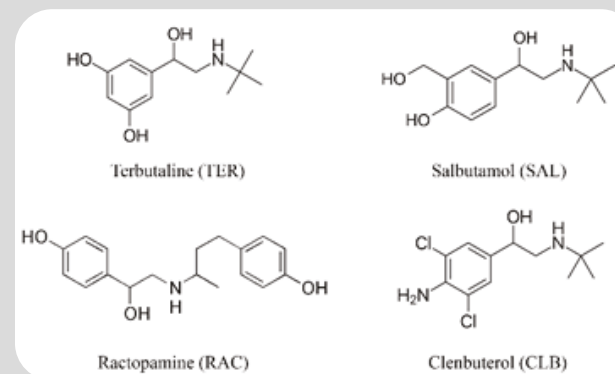
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Analytical chemistry with emphasis on electrochemistry and electroanalysis. The modification of electrode surfaces with a range of electrocatalytic species and metal nanoparticles for electrochemical determination of various analytes of interest with enhanced sensitivity and selectivity.

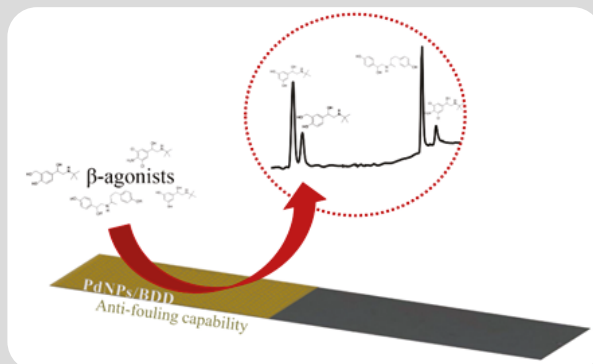


Electrochemical techniques typically have many potential advantages in terms of simplicity, high sensitivity, fast analysis time, cost effectiveness, and capability of miniaturization. The electrochemical detection of electroactive species can be directly performed at the electrode surface. Therefore, the deliberate modification of electrode surfaces in order to introduce electrochemical surface functionalities, to increase the active surface area, and to enhance the electrochemical sensitivity is currently in our interest. The modified electrodes can then be further developed as electrochemical sensors for use in various medical and environmental applications.

For example, the palladium nanoparticles (PdNPs) modified boron-doped diamond (BDD) was in-house fabricated and first used as the electrode for the simultaneous determination of four β -agonists, including terbutaline (TER), salbutamol (SAL), ractopamine (RAC), and clenbuterol (CLB) by UHPLC separation coupled with amperometrically electrochemical detection (ECD). Typically, these β -agonist compounds have been misused either as doping drugs in the athletes, or as growth promoters in livestock feed. These abuses have generally caused the poisonous effects to human health *via* the consumption.



In our work, we found that, unlike other carbon-based materials, the PdNPs-modified BDD electrode exhibited the excellent fouling resistance against β -agonists due to the H-terminated groups on the BDD surface, leading to the high stability and reusability with high sensitivity in the detection, owing to the electrocatalytic properties of the PdNPs.



The UHPLC separation combined with the PdNPs/BDD-based electrochemical sensor then offered considerable promise for simultaneous electrochemical determination of four β -agonists without electrode passivation, as well as providing good detecting performance in real sample applications.

1. Lomae, A.; Nantaphol, S.; Kondo, T.; Chailapakul, O.; Siangproh, W.; Panchompoo, J. "Simultaneous determination of β -agonists by UHPLC coupled with electrochemical detection based on palladium nanoparticles modified BDD electrode" *J. Electroanal. Chem.* **2019**, 840, 439-448.
2. Gatemala, H.; Tongsakul, D.; Naranaruemol, S.; Panchompoo, J.; Ekgasit, S.; Wongravee, K. "Synthesis of silver microfibers with ultrahigh aspect ratio by galvanic replacement reaction" *Mater. Chem. Phys.* **2019**, 237, 121872.

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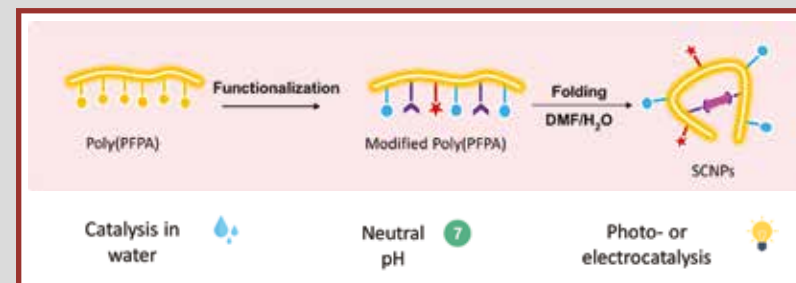


Polymeric functional materials for catalysis.

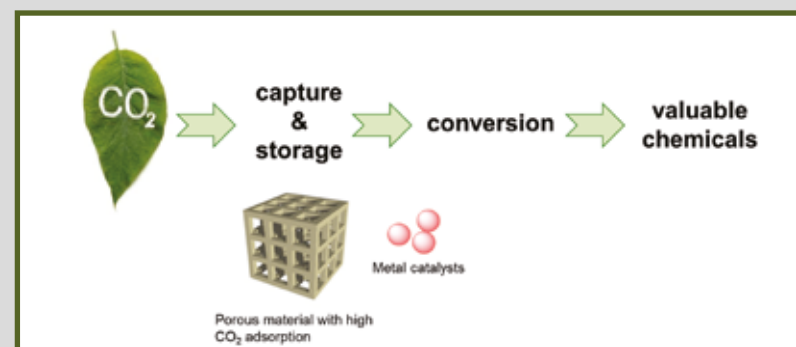
- Exchange Scholar, Shanghai International Science & Technology Cooperation 2019
- Domus Scholarship, Pembroke College, University of Oxford 2010
- The Royal Thai Government Scholarship 2004-2014

I was initially trained as an organometallic chemist with my expertise lying in the field of design and synthesis of organometallic catalysts for small molecule activation and polymerization process including its mechanism. Later my experience was broadened towards the field of material chemistry, especially biodegradable polymer-based materials. All the research experiences are pursued in my current research career.

Recently my research interest has focused on designing and utilizing polymer-based functional materials to serve in catalysis reactions. Of which, the functional materials are manifested to adopt the combined advantages of homo- and heterogeneous catalysts. The two main types of materials recently under our investigation are single-chain nanoparticles and covalent organic frameworks. Both types of material with suitable features are expected to catalyze hydrogen production or carbon dioxide conversion. These two reactions have received tremendous attention, by which their scientific advancement could be significant in the avenue of renewable energy. Furthermore, the on-going works are carried out under collaborations with our departmental research groups as well as international collaborators in Japan and China.



Our single-chain nanoparticle (SCNP) catalyst is designed to mimic hydrogenase enzyme with metal active site. The SCNP is expected to perform in neutral pH aqueous media in photo- or electrochemical catalysis.



Designable crystalline porous polymeric material such as "covalent organic framework - COF" has been introduced just over the past decade. Our current interest is to design and synthesize COF for catalyzing CO₂ transformation to more valuable chemicals and fuel.

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3. T. Stoesser, C. Li, J. Unruangsri, P. K. Saini, Rafaël J. Sablong, Michael A. R. Meier, Charlotte K. Williams and Cor Koning, "Bio-derived polymers for coating applications: Comparing Poly(limonene) carbonate and Poly(cyclohexadiene) carbonate". *Polym. Chem.*, **2017**, *8*, 6099-6105.



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Preconcentration unit equipped with colorimetric sensors to use as in field pre-screening analysis method for agriculture applications.

Overuse of herbicides and pesticides in the agriculture in Thailand has been reported. Their contaminations in water resources have been a concern in the past years. Our group has been working on the development of preconcentration unit combining with colorimetric sensors for in field semi-quantitative analysis of herbicides and pesticides in surface water especially in the agriculture filed. Our developed pre-concentration unit is based on the novel absorbents with high liquid permeability or selective polymer thin films supported on either particles or filter for herbicides. The environmental friendly colorimetric sensors are also our approach to evaluate the quality of the water in the agriculture area.



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RESEARCH

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Discovery of novel electrocatalysts for energy, synthesis, and analytical applications; Development of electrodes and electrochemical systems; and Practical aspects of synthetic electrochemistry.

- Young researcher at 59th Lindau Nobel Laureate Meeting, Germany, 2009
- Recipient of the Anandamahidol Foundation Scholarship (under the Royal Patronage of His Majesty the King of Thailand), 1999-2005

Electrocatalyst plays an important role in selecting and accelerating electron transfer reaction. Research in our laboratory has focused on the discovery and development of metal-based electrocatalysts for electrochemical reactions occurring in detecting and synthesizing systems as well as fuel cells and other energy-related devices. Since electrochemical detection of organic compounds is frequently limited by either slow electron transfer reactions or irreversible passivation of the electrode surfaces, proper catalysts are required. In one of our projects, *poly*-nickel salen-based films were prepared and optimized for the electro-oxidation of aldehydes. Cyclic voltammetric results reveal that this *poly*-nickel salen film modified electrode can respond well to aldehydes, especially acetaldehyde, by giving anodic peak currents for their oxidation.

In addition to metal complexes and their electropolymerized films, carbon nanomaterial-supported and film-based metal nanoparticles have been designed and prepared for other electrochemical reactions including alcohol oxidation, the main reaction of direct alcohol fuel cell anode. Furthermore, our group has also been involved in collaborations on projects which require electrochemical investigations and understanding.



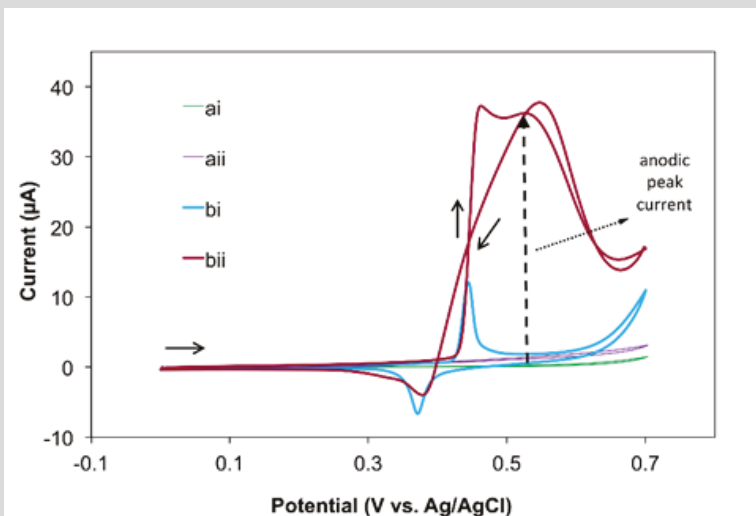
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HONORS
+ AWARDS



RESEARCH



Cyclic voltammograms of (a) glassy carbon electrode recorded in 0.1 M NaOH containing (i) 0 mM and (ii) 10.00 mM acetaldehyde; and (b) poly-nickel salen based film modified glassy carbon electrode recorded in 0.1 M NaOH containing (i) 0 mM and (ii) 10.00 mM acetaldehyde.

1. Suktanarak, P.; Watchasit, S.; Chitchak, K.; Plainpan, N.; Chainok, K.; Vanalabhpatana, P.; Pienpinijtham, P.; Suksai, C.; Tuntulani, T.; Ruangpornvisuti, V.; Leeladee, P. "Tuning the reactivity of copper complexes supported by tridentate ligands leading to two-electron reduction of dioxygen" *Dalton Trans.* **2018**, 47, 16337–16349.
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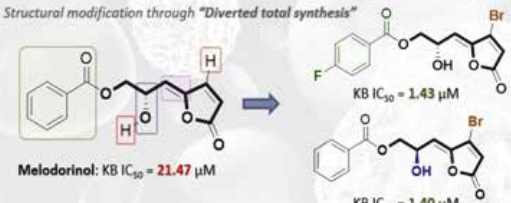


Medicinal chemistry and drug discovery

- Elsevier Best Poster Prize, 20th Tetrahedron Symposium, Bangkok, Thailand 2019
- SCI Messel Scholarship, Society of Chemical Industry, UK 2014

Anticancer and Antiageing drug discovery

Structural modification through "Diverted total synthesis"

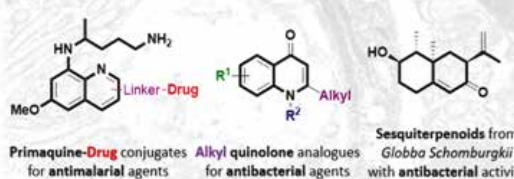
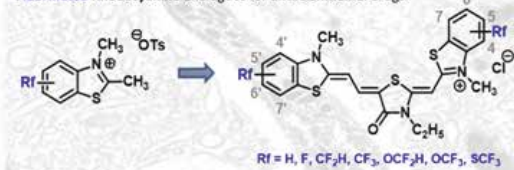


Structural modification through "Semi-synthesis"



Antiparasitic and Antibacterial drug discovery

Fluorinated Rhodacyanine analogues for antileishmanial drugs



Our research focuses on a synthesis of natural product and small-molecule drug analogues through semi- and diverted total synthesis for structure-activity relationship study. One of our key research areas focuses on the discovery of new anti-cancer and anti-ageing drugs such as the diverted total synthesis of melodorinol and the semi-synthesis of colchicine, metformin, and furocoumarin derivatives to improve their cytotoxicities against various cancer cell lines.

Moreover, we are also interested in drugs for tropical diseases such as antiparasitic, antibacterial, antifungal and antidengue drugs; for example, synthesis of novel fluorinated rhodacyanine analogues for potent anti-leishmanial agents, primaquine drug conjugates for anti-malarial agents, and novel alkyl quinolone derivatives for anti-bacterial agents. In addition, we also investigated chemical composition and performed bioassay-guided isolation of Thai plants, for example, the sesquiterpenoids in the extracts of *Globba schomburgkii* HOOK. F., which can ultimately be used as new scaffold for drug discovery and further applications in pharmaceuticals and cosmeceuticals.

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3. Doungchawee, J.; Kulsing, C.; Suekaew, N.; Pombejra, S. N.; Chavasiri, W.; Plabutong, N.; Thammahong, A.; Khotavivattana, T. "Volatile Chemical Composition, Antibacterial and Antifungal Activities of Extracts from Different Parts of *Globba schomburgkii* Hook.f." *Chem. Biodivers.* **2019**, 16, e1900057.
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5. Khotavivattana, T.; Khamkhenshornphanuch, T.; Rassamee, K.; Siripong, P.; Vilaivan, T. "Diverted Total Synthesis of Melodorinol Analogues and Evaluation of Their Cytotoxicity" *Tetrahedron Lett.* **2018**, 59, 2711-2715.



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