3rd International Conference on Materials Research and Innovation (3rd ICMARI)

BOOK OF ABSTRACTS

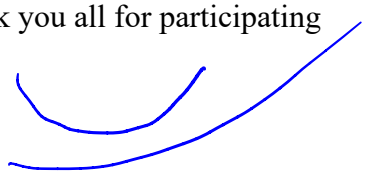
Organized by :

1. Specialized center of Rubber and Polymer Materials in agriculture and industry (RPM), Faculty of Science, Kasetsart University, Bangkok, Thailand.
2. National Research Council of Thailand (NRCT).
3. Kasetsart University Research and Development Institute (KURDI).
4. Faculty of Architecture, Kasetsart University.

PREFACE

The 3rd International Conference on Materials Research and Innovation (3rd ICMARI) was held on 15th – 17th December 2021 in Bangkok, Thailand. The conference was conducted in frontier research on materials research and Innovation including Rubber and Polymeric Materials, Bio- and Green-materials, and Special Advanced Materials. This 3rd ICMARI was announced to focused on the Bio-Circular-Green Economic Model or BCG. The BCG has been applied by the research community and promoted by the Thai government as a new economic model for inclusive and sustainable growth, this BCG model also conforms with the UN Sustainable Development Goals (SDGs). The 3rd ICMARI was a great opportunity for all participants to exchange knowledge and strengthen the research collaboration not only in ASEAN but also around the world. We hoped that the participants are fruitful by plenary and invited speakers from novel knowledge to new applications in the field of materials research and innovation.

Thank you all for participating



Asst. Prof. Wirasak Smitthipong
Chairman, ICMARI 2021

ACKNOWLEDGEMENT

On behalf of the organizing committee, we would like to sincerely thank all the sponsors, participants, and ICMARI 2021's teams for all the supports.

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Series seminar

PROGRAM

Program of International Conference on Materials Research and Innovation

15th – 16th December 2021 at Chatrium Hotel Riverside, Bangkok, Thailand

17th December 2021 via Zoom Video Conference

Wednesday 15th December 2021	
08.00-09.00	**Registration**
09.00-10.00	**Opening ceremony** The River Welcome speech: ***Assoc. Prof. Sutkhet Nakasathien*** *(Vice President for Research and Creation of Kasetsart University)* Opening speech: ***Ms. Nisakorn Jungjaroentham*** *(Former Director General of Department of Science Service and Advisor to the Minister of Ministry of Higher Education, Science, Research and Innovation)*
10.00-10.30	**Plenary lecture:** Strategy of innovation and business trend of material for sustainability The River *Dr. Wilaiporn Chetanchan** *Siam Cement Public Company Limited (SCG), Bangkok, Thailand*
10.30-11.00	**Coffee break**
11.00-11.30	**Plenary lecture:** Navigating a reliable translation of mussel adhesion The River *Prof. Herbert Waite** *University of California at Santa Barbara, USA*
11.30-12.00	**Plenary lecture:** Science and technology of functional materials design from various polymer materials including wastes The River *Prof. Sadhan C. Jana** *School of Polymer Science and Polymer Engineering, The University of Akron, USA*
12.00-14.00	**Lunch**
	Rubbers and Polymeric Materials 1 The River I **Session chairs:** Wirunya Keawwattana, and Nanthiya Hansupalak
14.00-14.30	**Invited lecture:** Deciphering the discoloration in the production process of natural rubber *Jitladda Sakdapipanich** *Department of Chemistry and Center of Excellence for Innovation in Chemistry, Faculty of Science, Mahidol University, Thailand*

14.30-14.50	**O-01:** Manufacturing processes and properties of PVC composites containing Bi_2O_3 and Para rubber wood particles as X-ray shielding materials *Worawat Poltabtim[1], Ekachai Wimolmala[2], Teerasak Markpin[2], Narongrit Sombatsompop[2], and Kiadtisak Saenboonruang[1,3,*]* *[1]Department of Applied Radiation and Isotopes, Faculty of Science, Kasetsart University; [2]Polymer PROcessing and Flow (P-PROF) Research Group, Division of Materials Technology, School of Energy, Environment and Materials, King Mongkut's University of Technology Thonburi; [3]Specialized Center of Rubber and Polymer Materials in Agriculture and Industry (RPM), Faculty of Science, Kasetsart University, Bangkok, Thailand*
14.50-15.10	**O-02:** Development of high-performance particleboard from sawdust of Para wood cover by vulcanized natural rubber and veneer wood sheet *Zakee Niseng[1,*], Anuwat Worlee[1], Nabil Hayeemasae[2], Arfan Haseemae[1], and Sareef Chekmae[1]* *[1]Faculty of Science and Technology, Fatoni University; [2]Department of Rubber Technology, Faculty of Science and Technology, Prince of Songkla University - Pattani Campus, Pattani, Thailand*
15.10-15.30	**O-03:** Influence of nanofiller types on morphology and mechanical properties of natural rubber nanocomposites *Bunsita Wongvasana[1], Abdulhakim Masa[2], Hiromu Saito[3], Tadamoto Sakai[4], and Natinee Lopattananon[1,*]* *[1]Department of Rubber Technology and Polymer Science, Faculty of Science and Technology, Prince of Songkla University; [2]Rubber Engineering & Technology Program, International College, Prince of Songkla University; [3]Department of Organic and Polymer Materials Chemistry, Tokyo University of Agriculture and Technology; [4]Tokyo Office, Shizuoka University, Japan*
15.30-16.00	**Coffee Break**
	Rubbers and Polymeric Materials 2 The River I **Session chairs:** Wirunya Keawwattana, and Nanthiya Hansupalak
16.00-16.30	**Invited lecture:** Ultrafine fully vulcanized natural rubber modified by graft-copolymerization with styrene and acrylonitrile monomers *Sarawut Rimdusit [1,*], Krittaphorn Longsiri[1], Phattarin Mora[1], Chanchira Jubsilp[2], and Kasinee Hemvichian[3]* *[1]Research Unit on Polymeric Materials for Medical Practice Devices, Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University; [2]Department of Chemical Engineering, Faculty of Engineering, Srinakharinwirot University; [3]Thailand Institute of Nuclear Technology, Thailand*
	Bio - and Circular - Materials 1 The River II **Session chairs:** Chomdao Sinthuvanich, Prakit Sukyai, and Pichamon Kiatwuthinon
14.00-14.30	**Invited lecture:** Structural and functional biomaterials in medical applications *Arkadiusz Chworos** *Centre of Molecular and Macromolecular Studies, Polish Academy of Sciences, Poland*
14.30-15.00	**Invited lecture:** Single-stranded DNA-packaged polyplex micelle as AAV-inspired compact gene vector to systemically target stroma-rich pancreatic cancer *Kensuke Osada** *Institute for Quantum Medical Science, National Institutes for Quantum Science and Technology (QST), Japan*

15.00-15.20	**O-04:** Plant growth promotion traits and antagonistic effect in white root disease of rhizobacteria in *Hevea* rubber of Thailand *Mathurot Chaiharn*[1,*], and *Saisamorn Lumyong*[2] *[1]Programmed in Biotechnology, Faculty of Science, Maejo University, Chiangmai; [2]Department of Biology, Faculty of Science, Chiangmai University, Chiangmai, Thailand*
15.20-15.40	**O-05:** Injection molding and characterization of polylactide stereocomplex blended with thermoplastic starch and chain extender *Yottha Srithep*[1,*], *Dutchanee Pholharn*[2], *and Onpreeya Veang-in*[1] *[1]Manufacturing and Materials Research Unit, Faculty of Engineering, Mahasarakham University; [2]Department of Chemistry, Faculty of Science and Technology, Rajabhat Mahasarakham University, Thailand*
15.40-16.10	**Coffee Break**
	Bio - and Circular - Materials 2 The River II **Session chairs:** Chomdao Sinthuvanich, Prakit Sukyai, and Pichamon Kiatwuthinon
16.10-16.30	**O-06:** Crosslinked polyvinyl alcohol/polyvinyl pyrrolidone hydrogel sheets by electron beam irradiation for wound dressings *Rattanakorn Chiangnoon*[1], *Pranita Meepean*[2], *Natawan Sritapanya*[2], *Sirirat Phakpaknam*[2], *Kanchana Chahorm*[3], *Thanapon Yooyen*[3], *Nuatawan Thamrongsiripak*[4], *and Pimpon Uttayarat*[1,*] *[1]Nuclear Technology Research and Development Center, Thailand Institute of Nuclear Technology (Public Organization); [2]Department of Biology, Faculty of Science and Technology, Suan Sunandha Rajabhat University; [3]Irradiation Center, Thailand Institute of Nuclear Technology (Public organization); [4]Development and Service Section, Thailand Institute of Nuclear Technology (Public Organization), Thailand*
	Special Advanced Materials 1 The River III **Session chairs:** Jukkrit Mahujchariyawong, and Chanapa Kongmark
14.00-14.30	**Invited lecture**: Development of a laboratory SAXS beamline with synchrotron level performance for high throughput characterization of bio-derived polymers *Youli Li*, Phillip Kohl, Miguel Zepeda-Rosales, Alvin Pan, and Ryan Willat* *Materials Research Laboratory and BioPacific MIP, University of California at Santa Barbara, USA*
14.30-14.50	**O-07:** Raman microscopy applied to polymer characterization *Chutchai Juntasaro** *Horiba Thailand LTD, Scientific Department, Thailand*
14.50-15.10	**O-08:** Valorization of rubberwood waste into porous carbon *Ronnachai Songthan*[1], *Voranuch Somsongkul*[1,*], *and Chanapa Kongmark*[2,**] *[1]Department of Industrial Chemistry, Faculty of Applied Science, King Mongkut's University of Technology North Bangkok; [2]Department of Materials Science, Faculty of Science, Kasetsart University, Thailand*
15.10-15.30	**O-09:** Properties of hydroxyapatite based geopolymer synthesized from calcined kaolin *Kanyapak Poolkwan*[1], *Suwimol Asavapisit*[1,*], *and Rungroj Piyapanuwat*[2] *[1]Environmental Technology Program, School of Energy, Environment and materials, King Mongkut's University of Technology Thonburi; [2]Innovative Environmental Management and Smart Construction Material Laboratory, King Mongkut's University of Technology Thonburi (Ratchaburi Learning Park), Thailand*

15.30-16.00	**Coffee Break**
	Special Advanced Materials 2 The River III **Session chairs:** Jukkrit Mahujchariyawong, and Chanapa Kongmark
16.00-16.30	**Invited lecture:** Toward the development of sensors and actuators by 4D printing *Karine Mougin[1,]*, Quentin Bauerlin[1], Xingyu Wu[1], Benjamin Leuschel[1], Feriel Ghellal[1], Damien Favier[2], Christian Gauthier[2], Thierry Roland[2], and Arnaud Spangenberg[1]* *[1]Institut de Science des Matériaux de Mulhouse; [2]Institut Charles Sadron, France*

Thursday 16th December 2021	
08.00-09.00	**Registration**
09.00-09.30	**Plenary lecture:** Structure and electronic properties of optical materials through the eyes of computational approach The River *Songwut Suramitr[1,2], and Prof. Supa Hannongbua[1,2,]** *[1]Department of Chemistry, Faculty of Science, Kasetsart University, Bangkok; [2]Center for Advanced Studies in Nanotechnology for Chemical, Food and Agricultural Industries, Kasetsart University, Bangkok, Thailand*
09.30-10.00	**Plenary lecture:** Statistical mechanics solvation theory for nano- and bio-materials The River *Assoc. Prof. Norio Yoshida** *Department of Chemistry, Graduate School of Science, Kyushu University, Japan*
10.00-10.30	**Coffee Break**
	Rubbers and Polymeric Materials 3 The River I **Session chairs:** Wirunya Keawwattana, and Nanthiya Hansupalak
10.30-11.00	**Invited lecture:** Thermoplastic natural rubber based on biodegradable polyesters and linear-low-density polyethylene *Rangrong Yoksan[1,2,]*, and Wanchana Wannawitayapa[1]* *[1]Department of Packaging and Materials Technology, Faculty of Agro-Industry, Kasetsart University; [2]Center for Advanced Studies for Agriculture and Food, Kasetsart University Institute for Advanced Studies, Kasetsart University, Thailand*
11.00-11.30	**Invited lecture:** Carbon fibre reinforced polymer composites: damage, repair, and future prospects *Kheng Lim Goh** *Newcastle University in Singapore, Singapore*
11.30-11.50	**O-10:** Preliminary study of laser-assisted technique for vulcanizing rubber latex in additive manufacturing *Kanchanabhorn Chansoda[1], Panithi Wiroonpochit[2], and Watcharapong Chookaew[1,]** *[1]Material and Manufacturing Innovation Research Group, Department of Mechanical Engineering, Mahidol University; [2]Innovative Rubber Manufacturing Research Group, National Metal and Materials Technology Center, National Science and Technology Development Agency (NSTDA), Thailand*
11.50-14.00	**Lunch**

	Rubbers and Polymeric Materials 4 The River I **Session chairs:** Kiadtisak Saenboonruang, and Nanthiya Hansupalak
14.00-14.30	**Invited lecture:** Finite element analysis of elastomer: case study – rolling resistance of pneumatic and solid tyres *Pairote Jittham[1,]*, Sedthawatt Sucharitpwatskul[1], Satit Siriruk[1], and Sira Meesaringkarn[2]* *[1]National Metal and Materials Technology Center (MTEC), National Science and Technology Development Agency (NSTDA); [2]Rubber Technology Research Centre (RTEC), Faculty of Science, Mahidol University, Thailand*
14.30-15.00	**Invited lecture:** Combining fractional order derivatives and spectral variable selection for crosslink density evaluation of Para rubber latex by Vis–NIR spectroscopy *Chin Hock Lim[1], Jetsada Posom[2,]*, and Panmanas Sirisomboon[3]* *[1]Thai Rubber Latex Group Public Company Limited; [2]Department of Agricultural Engineering, Faculty of Engineering, Khon Kaen University; [3]Department of Agricultural Engineering, School of Engineering, King Mongkut's Institute of Technology Ladkrabang, Thailand*
15.00-15.20	**O-11:** Electrospun polylactic acid (PLA) fibers loaded with Ag/$CaCO_3$ filler for antimicrobial applications *Moe Ei Ei Zin[1,2], and Wimonlak Sutapun[1,2,]** *[1]School of Polymer Engineering, Institute of Engineering, Suranaree University of Technology; [2]Research Center for Biocomposite Materials for Medical Industry and Agricultural and Food Industry, Suranaree University of Technology, Thailand*
15.20-16.00	**Coffee Break**
	Rubbers and Polymeric Materials 5 The River I **Session chairs:** Kiadtisak Saenboonruang, and Nanthiya Hansupalak
16.00-16.30	**Invited lecture:** Near infrared spectroscopy and machine learning classifier of crosslink density level of prevulcanized natural rubber latex *Panmanas Sirisomboon[1], Chin Hock Lim[2], and Jetsada Posom[3,]** *[1]Department of Agricultural Engineering, School of Engineering, King Mongkut's Institute of Technology Ladkrabang; [2]Thai Rubber Latex Group Public Company Limited; [3]Department of Agricultural Engineering, Faculty of Engineering, Khon Kaen University, Thailand*
16.30-16.50	**O-12:** Prediction of Crosslink density of Natural Rubber Latex by spectroscopic method based on fractional order derivative (FOD) *Chin Hock Lim[1], Jetsada Posom[2,]*, and Panmanas Sirisomboon[3]* *[1]Thai Rubber Latex Group Public Company Limited; [2]Department of Agricultural Engineering, Faculty of Engineering; [3]Department of Agricultural Engineering, School of Engineering, King Mongkut's Institute of Technology Ladkrabang, Thailand*
16.50-17.10	**O-13:** Effect of NR filled carbon black and ratio of NR/NBR on the thermal and oil aging properties *Wongsathorn Rattanaprechachai, Chakrit Suvanjumrat, and Watcharapong Chookaew** *Material and Manufacturing Innovation Research Group, Department of Mechanical Engineering, Mahidol University, Thailand*
10.00-10.30	**Coffee Break**

	Bio - and Circular - Materials 3 The River II **Session chairs:** Chomdao Sinthuvanich, and Pichamon Kiatwuthinon
10.30-11.00	**Invited lecture:** Optimising the friction welding of wood *Darshil Shah[1,]*, Thomas Reynolds[2], Scott Andrews[3], Bertrand Flipo[3], Kate Franklin[3], Steve Dodds[3], Michael Ramage[1], and Eleni Toumpanaki[4]* *[1]University of Cambridge, Department of Architecture, Centre for Natural Material Innovation, Cambridge; [2]University of Edinburgh, School of Engineering; [3]TWI, Granta Park, Great Abington, Cambridge; [4]University of Bristol, Department of Civil Engineering, Queen's Building, University Walk, UK*
11.00-11.20	**O-14:** Development of rubber tapping automatic robot and rubber tapping tool *Chanin Joochim** *College of Industrial Technology King Mongkut's University of Technology North Bangkok, Thailand*
11.20-11.40	**O-15:** Study on rapid measurement technic of dry rubber content in latex cup lump by electrical properties *Preedawan Chaisrichonlathan*, and Chusak Chavapradit* *Agricultural Engineering Research Institute, Department of Agriculture, Thailand*
11.40-14.00	**Lunch**
	Bio - and Circular - Materials 4 The River II **Session chairs:** Chomdao Sinthuvanich, and Pichamon Kiatwuthinon
14.00-14.30	**Invited lecture:** A bioinorganic approach to photoresponsive materials: V and Fe coordination in polysaccharides *Alexis D. Ostrowski*, Carina Haddad, and E. A. Kalani D. Edirisinghe* *Bowling Green State University, USA*
14.30-14.50	**O-16:** Evaluation on physicochemical properties and stability of Thanaka bark powder for natural face powder products *Nway Yu Hnin[1] and Mayuree Kanlayavattanakul[1,2,]** *[1]School of Cosmetic Science, Mae Fah Luang University, Chiang Rai; [2]Phytocosmetics and Cosmeceuticals Research Group, Mae Fah Luang University, Chiang Rai, Thailand.*
14.50-15.10	**O-17:** Utilization of lignin extracted from Thai ago-waste as UV-blocking agent for polylactic acid film *Pawarisa Wijaranakul[1,]*, Bongkot Hararak[2,]**, Charinee Winotapun[2], Chayanon Chotirotsukon[3], and Weerawan Laosiripojana[1]* *[1]Department of Tool and Materials Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi; [2]National Metal and Materials Technology Center (MTEC), National Science and Technology Development Agency; [3]National Center for Genetic Engineering and Biotechnology (BIOTEC), National Science and Technology Development Agency, Thailand*
15.10-15.30	**O-18:** The study of Para rubber farming system development changing from monoculture to integrated farming for smallholder rubber farms *Wandee Sutthinarakorn[1], Pattarawat Jeerapattanatorn[1], Somkiat Sutthinarakorn[2], Somkid Sangmanee[3], Aruunprapha Thanakijkosat[6], Arunothai Sarigakham[6], Roongnapa Korpraditsakul[1], Ramita Sutthinarakorn[6], Onuma Natseeta[4], and Nusara Larppuwanart[5]* *[1]Kasetsart University; [2]Arsomsilp Institute; [3]Trang Province Farmer Council; [4]Chitralada Technology Institute;[5]Suan Dusit University; [6]Independent Academic, Thailand*
15.30-16.00	**Coffee Break**

	Bio - and Circular - Materials 5 The River II **Session chairs:** Chomdao Sinthuvanich and Pichamon Kiatwuthinon
16.00-16.30	**Invited lecture:** Diffusion coefficient of one macromolecule in an aqueous solution: the system size dependence of the viscosity in the estimation method using MD simulations *Tomoya Iwashita[1], Masaaki Nagao[1], Akira Yoshimori[2], Masahide Terazima[3], and Ryo Akiyama[1,*]* *[1]Department of Chemistry, Kyushu University; [2]Department of Physics, Niigata University; [3]Department of Chemistry, Kyoto University, Japan*
16.30-16.50	**O-19:** Development of high performance particle board based Para wood reinforced with thermoplastic and bonding with citric acid and moltosdaxtrin *Arfan Haseemae[1,*], Anuwat Worlee[1], Nabil Hayeemasae[2], Zakee Niseng[1], and Sareef Chekmae[1]* *[1]Faculty of Science and Technology, Fatoni University; [2] Department of Rubber Technology, Faculty of Science and Technology, Prince of Songkla University - Pattani Campus, Thailand*
16.50-17.10	**O-20:** Comparison of prediction of moisture content of oven-dried Para rubber timber between small portable NIR spectrometer and commercial digital moisture meter *Sirinad Noypitak[1,*], Anupun Terdwongworaku[1], Naridol Paunrat[2], Amornrit Puttipipatkajorn[3] and Amorndej Puttipipatkajorn[4]* *[1]Department of Agricultural Engineering, Faculty of Engineering at Kamphaengsaen, Kasetsart University; [2]Agriculture Innovation and management program, Faculty of Science and Technology, Nakhon Pathom Rajabhat University; [3]Department of Computer Engineering, Faculty of Engineering at Kamphaengsaen, Kasetsart University; [4]Department of Food Engineering, Faculty of Engineering at Kamphaengsaen, Kasetart University, Thailand*
10.00-10.30	**Coffee Break**
	Special Advanced Materials 3 The River III **Session chairs:** Nattasamon Petchsang, and Sutee Boonchui
10.30-11.00	**Invited lecture**: Structural characterization of polymer and polymer composite with synchrotron x-ray *Supagorn Rugmai*, Siriwat Soontaranon, Nuntaporn Kamonsutthipaijit, and Sirinart Srichan* *Synchrotron Light Research Institute (Public Organization), Thailand*
11.00-11.20	**O-21:** High-harmonic generation (HHG) in silicene *Thanakrit Fudulwatjananon, Chavanon Summueang, and Sutee Boonchui** *Department of Physics, Faculty of Science, Kasetsart University, Bangkok, Thailand*
11.20-11.40	**O-22:** Development of trinary blended rubber foam for using as ceiling board *Kim Bunsreyneang[1], Kanokon Hancharoen[2], Phattarawadee Nun-anan[3], Kanoktip Boonkerd[1,3,]* *[1]Department of Materials Science, Chulalongkorn University; [2]Center of Building Innovation Technology, Department of Building Innovation, Faculty of Architecture, Kasetsart University; [3]Center of Excellence on Petrochemical and Materials Technology, Faculty of Science, Chulalongkorn University, Thailand*
11.40-14.00	**Lunch**

	Special Advanced Materials 4 The River III **Session chairs:** Sutee Boonchui, and Saree Phongphanphanee
14.00-14.30	**Invited lecture:** Application of near infrared spectroscopy for quality evaluation in Para rubber industry *Anupun Terdwongworakul[1,*], Amorndej Puttipipatkajorn[2], Amornrit Puttipipatkajorn[3], Sirinad Noypitak[1], and Dharell Siano[1]* *[1]Department of Agricultural Engineering, Faculty of Engineering at Kamphaeng Saen, Kasetsart University; [2] Department of Food Engineering, Faculty of Engineering at Kamphaeng Saen, Kasetsart University; [3] Department of Computer Engineering, Faculty of Engineering at Kamphaeng Saen, Kasetsart University, Thailand*
14.30-14.50	**O-23:** Properties of hydroxyapatite based geopolymer synthesized from bituminous fly ash *Sirirat Yoolamnan[1], Suwimol Asavapisit[1,*],Rungroj Piyapanuwat[2]* *[1]Environment Technology Program, School of Energy, Environment and materials, King Mongkut's University of Technology Thonburi*; *[2]Innovative Environmental Management and Smart Construction Material Laboratory, King Mongkut's University of Technology Thonburi (Ratchaburi Learning Park), Thailand.*
14.50-15.10	**O-24:** A comparative study of the drying methods on drying efficiency of natural rubber gloves using microwave and hot air sources *Pornthip Keangin*, Aphisara Charoenlerdchanya and Teerawat Jamsai* *Department of Mechanical Engineering, Faculty of Engineering, Mahidol University, Thailand*
15.10-15.30	**O-25:** Development of contact pressure model for motorcycle tires by experiment *Ravivat Rugsaj[1,2], Juthanee Phromjan[1,2], and Chakrit Suvanjumrat[1,2,*]* *[1]Department of Mechanical Engineering, Faculty of Engineering, Mahidol University; [2]Laboratory of Computer Mechanics for Design (LCMD), Department of Mechanical Engineering, Faculty of Engineering, Mahidol University, Thailand*
15.30-16.00	**Coffee Break**
	Special Advanced Materials 5 The River III **Session chairs:** Sutee Boonchui, and Saree Phongphanphanee
16.00-16.20	**O-26:** Monte Carlo simulations of nanotube filler in composite material: optimize programing code *Nathanon Kerdkaen[1,2,3], Thana Sutthibutpong[2,3,4,**], Saree Phongphanphanee[2,5,6], Sutee Boonchuay[1,6], and Jirasak Wong-ekkabut[1,2,3,6,*]* *[1]Department of Physics, Faculty of Science, Kasetsart University; [2]Computational Biomodelling Laboratory for Agricultural Science and Technology (CBLAST), Faculty of Science, Kasetsart University; [3]Thailand Center of Excellence in Physics (ThEP Center), Ministry of Higher Education, Science, Research and Innovation; [4]Department of Physics, Faculty of Science, King Mongkut's University of Technology Thonburi (KMUTT); [5]Department of Material Science, Faculty of Science, Kasetsart University; [6]Specialized Center of Rubber and Polymer Materials for Agriculture and Industry (RPM), Faculty of Science, Kasetsart University, Thailand*
16.20-16.40	**O-27:** Solid-state reaction synthesis and characterization of Mn-doped $LiFePO_4$ cathode material *Aye Myint Myat Kyaw[1,2], Gasidit Panomsuwan[1,2], and Ratiporn Munprom[1,2,*]* *[1]Department of Materials Engineering, Faculty of Engineering, Kasetsart University; [2]International Collaborative Education Program for Materials Technology, Education, and Research (ICE-Matter), ASEAN University Network/Southeast Asia Engineering Education Development Network (AUN/SEED-Net), Thailand*

16.40-17.00	**O-28:** Self-energy generation from graphene vibrations *Thanaset Mongkolsawat[1], Ongart Suntijitrungruang [1], Jakkapong Charoenpakdee[1], and Sutee Boonchui[1,2,]** *[1]Department of Physics, Faculty of Science, Kasetsart University; [2]Center of Rubber and Polymer Materials in Agriculture and Industry (RPM), Faculty of Science Kasetsart University, Thailand*

POSTER SESSION

Wednesday 15th December 2021	
18.00-21.00	**Poster Sessions and Cocktail party (announcement of the Best Poster Award)** The Curve
	P-01: Study of non-negligible chemical reduction of ZnO in the rubber industry *Watcharapong Wilaiwong[1], and Wirasak Smitthipong[1,2,]** *[1]Kasetsart University; [2]National Research Council of Thailand (NRCT), Thailand*
	P-02: Study of nylon textile-reinforced natural rubber composite *Nantinee Choosang[1], and Wirasak Smitthipong[1,2,]** *[1]Kasetsart University; [2]National Research Council of Thailand (NRCT), Thailand*
	P-03: Effect of potassium oleate on chemical structure-compression relationship of natural rubber foam *Peerayut Kunklang[1], and Wirasak Smitthipong[1,2,]** *[1]Kasetsart University; [2]National Research Council of Thailand (NRCT), Thailand*
	P-04: Study of chemical structure and mechanical properties of anionic surfactant on natural rubber foam *Noppawan Tundiew[1], and Wirasak Smitthipong[1,2,]** *[1]Kasetsart University; [2]National Research Council of Thailand (NRCT), Thailand*
	P-05: Study of yield percentage of epoxidized natural rubber preparation *Kesinee Panmanee[1], and Wirasak Smitthipong[1,2,]** *[1]Kasetsart University; [2]National Research Council of Thailand (NRCT), Thailand*
	P-06: Study of particle size of natural latex/polysaccharide composite *Kanyapat Wongphul[1], and Wirasak Smitthipong[1,2,]** *[1]Kasetsart University; [2]National Research Council of Thailand (NRCT), Thailand*
	P-07: Theophylline extended-release monolithic matrix comprising natural rubber latex as binder *Pornsit Chaiya[1], and Thawatchai Phaechamud[2,]** *[1]School of Pharmacy, Walailak University, Tha sala, Nakhon Si Thammarat; [2]Department of Pharmaceutical Technology, Faculty of Pharmacy, Silpakorn University, Thailand*
	P-08: Screening for antimicrobial activity from some Thai medicinal plants *Worrakanya Narakornwit[1,]*, Juree Charoenteeraboon[2], and Thawatchai Phaechamud[3]* *[1]Department of Pharmacognosy; [2]Department of Biopharmacy; [3]Department of Pharmaceutical Technology, Faculty of Pharmacy, Thailand*

P-09: Effect of arecoline, aqueous and methanolic areca nut crude extracts on rumen fluke

*Napaphol Puyathorn[1], Chanokporn Sukonpan[2], Prapansak Toungsuwan[3], Worrakanya Narakornwit[4], and Thawatchai Phaechamud[5,]**
[1]Program of Pharmaceutical Engineering; [2]Department of Pharmaceutical Chemistry; [3]Department of Lifelong Education; [4]Department of Pharmacognosy; [5]Department of Pharmaceutical Technology, Faculty of Pharmacy, Silpakorn University, Thailand

P-10: A grafting reaction of acrylamide onto saponified natural rubber using UV irradiation

*Nichapat Juntree[1], Porntip Rojruthai[2], and Jitladda Sakdapipanich[1,2,]**
[1]Department of Chemistry and Center of Excellence for Innovation in Chemistry, Faculty of Science, Mahidol University; [2]Division of Chemistry Industrial Process and Environment, Faculty of Science, Energy and Environment, King Mongkut's University of Technology North Bangkok, Thailand

P-11: A photochemical modification of deproteinized natural rubber latex (DPNRL) to be a hydroxyl-terminated DPNRL using TiO_2 film as a catalyst

*Phattharawadi Saekhow, Apisara Sillapasuwan, and Jitladda Sakdapipanich**
Department of Chemistry and Center of Excellence for Innovation in Chemistry,Faculty of Science, Mahidol University, Thailand

P-12: A model study on the impact of metal Ions on prevulcanization of concentrated natural rubber latex and dipped-products

*Narueporn Payungwong[1], Porntip Rojruthai[2] and Jitladda Sakdapipanich[1,]**
[1]Department of Chemistry and Centre of Excellence for Innovation in Chemistry, Faculty of Science, Mahidol University; [2]Division of Chemical Industrial Process and Environment, Faculty of Science, Energy and Environment, King Mongkut's University of Technology North Bangkok, Thailand

P-13: Role of non-rubber components on the properties of silica-filled rubber compounds in the presence of TESPD as a silane coupling agent

*Apisara Sillapasuwan, Sirawan Kaewsikoun, and Jitladda Sakdapipanich**
Department of Chemistry and Center of Excellence for Innovation in Chemistry,Faculty of Science, Mahidol University, Thailand

P-14: Elemental analysis of natural rubber latex from RRIM 251 and RRIM 600 clones

*Voranuch Somsongkul[1], Yanatanich Chintapunyakul[2], and Jitladda Sakdapipanich[2,]**
[1]Department of Industrial Chemistry, Faculty of Applied Science, King Mongkut's University of Technology North Bangkok;[2]Department of Chemistry and Center of Excellence for Innovation in Chemistry, Faculty of Science, Mahidol University, Thailand

P-15: The validation HPLC method for determination of gambogic acid in gamboge resin

*Ei Mon Khaing[1], Kritamorn Jitrangsri[2], Jongjan Mahadlek[3], Chanokporn Sukonpan[4], and Thawatchai Phaechamud[1,5,]**
[1]Program of Pharmaceutical Engineering, Faculty of Pharmacy, Silpakorn University; [2]Program of Pharmaceutical Sciences, Faculty of Pharmacy, Silpakorn University; [3]Pharmaceutical Intellectual Unit "Prachote Plengwittaya", Faculty of Pharmacy, Silpakorn University; [4]Department of Pharmaceutical Chemistry, Faculty of Pharmacy, Silpakorn University; [5]Natural Bioactive and Material for Health Promotion and Drug Delivery System Group (NBM), Faculty of Pharmacy, Silpakorn University, Thailand

P-16: A new procedure of powder-free latex glove manufacturing using a mixture of carboxylated nitrile butadiene rubber and polychloroprene for surface coating of NR film

*Pakkaphorn Lertkijboworn[1], Phawasoot Rodgerd[1], Porntip Rojruthai[2], and Jitladda Sakdapipanich[1,2,]**
[1]Department of Chemistry and Center of Excellence for Innovation in Chemistry, Faculty of Science, Mahidol University; [2]Division of Chemical Industrial Process and Environment, Faculty of Science, Energy and Environment, King Mongkut's University of Technology North Bangkok, Thailand

P-17: Electrochemical performance of binder-free and flexible spinel $NiCo_2O_4$ electrode

Voranuch Somsongkul[1,], Pawat Chaojeen[1], Anayaporn Thong-em[1], and Chanapa Kongmark[2,]***
[1]Department of Industrial Chemistry, Faculty of Applied Science, King Mongkut's University of Technology North Bangkok; [2]Department of Materials Science, Faculty of Science, Kasetsart University, Thailand

P-18: Study of porous rubber pipes reinforced with waste tire fibers and pineapple leaf fibers for smart irrigation system

*Monticha Junpunya[1], Boonharn Ou-udomying[2], Taweechai Amornsakchai[3], and Ittipol Jangchud[1,]**
[1]Department of Chemistry, School of Science, King Mongkut's Institute of Technology Ladkrabang (KMITL); [2]Saeng Thai Rubber Co., Ltd., Samrong-Tai, Prapadaeng, Samutprakan; [3]Department of Chemistry and Center of Excellence for Innovation in Chemistry, Faculty of Science, Mahidol University, Thailand

P-19: Study of bladder release agent formulas and comparative study to evaluate release agent efficiency by using reciprocating tribometer

*Nopphawan Tanboriphan[1], Boonyawat Teeraprawatekul[2], Sithipong Mahathanabodee[3], and Ittipol Jangchud[1,]**
[1]Department of Chemistry, School of Science, King Mongkut's Institute of Technology Ladkrabang (KMITL); [2]Acme International (Thailand) Limited.; [3]Department of Production Engineering, Faculty of Engineering, King Mongkut's University of Technology North Bangkok (KMUTNB), Thailand

P-20: Wood Plastic Composites (WPCs) from multilayer packaging waste and rHDPE as pallets for green industry

*Thitikul Boonsri[1], Suparat Rukchonlatee[1,2], and Ittipol Jangchud[1,]**
[1]Department of Chemistry, School of Science, King Mongkut's Institute of Technology Ladkrabang (KMITL); [2]Polymer Synthesis and Functional Materials Research Unit, School of Science, KMITL, Thailand

P-21: Bio-based cellulose nanocrystals filled epoxidized natural rubber/chitosan composites: self-healing and enhanced mechanical properties

*Oranooch Somseemee, and Chomsri Siriwong**
Applied Chemistry Division and Center of Excellence for Innovation in Chemistry (PERCH-CIC), Department of Chemistry and Materials Chemistry Research Center (MCRC-KKU), Faculty of Science, Khon Kaen University, Thailand

P-22: Cure characteristics and tensile properties of styrene-butadiene rubber composites: influence of ZnOs types as an effective curing activator

*Supparoek Boopasiri, and Chomsri Siriwong**
Materials Chemistry Research Center (MCRC) and Center of Excellence for Innovation in Chemistry (PERCH-CIC), Department of Chemistry, Faculty of Science, Khon Kaen University, Thailand

P-23: Investigation of heated silver nanowires under surface modification

Thaweewat Khamla[1], *and Nattasamon Petchsang*[1,2,*]
[1]*Department of Materials Science, Faculty of Science, Kasetsart University;* [2]*Specialized Center of Rubber and Polymer Materials for Agriculture and Industry (RPM), Faculty of Science, Kasetsart University, Thailand*

P-24: Investigation of freshly prepared AgCl for high yield silver nanowires under polyol method

Saowanee Yala[1], *and Nattasamon Petchsang*[1,2,*]
[1]*Department of Materials Science, Faculty of Science, Kasetsart University;* [2]*Specialized Center of Rubber and Polymer Materials for Agriculture and Industry (RPM), Faculty of Science, Kasetsart University, Thailand*

P-25: The effect of shot peening on corrosion performance of anodized laser powder bed fusion manufactured $AlSi_{10}Mg$

Timo Rautio, Atef Hamada, Jani Kumpula, and Antti Järvenpää*
Kerttu Saalasti Institute, University of Oulu, Finland

P-26: Mechanical properties of laser welded and adhesively bonded ultra-high-strength steel lap joints

Mikko Hietala, Markku Keskitalo, and Antti Järvenpää*
Kerttu Saalasti Institute, University of Oulu, Finland

P-27: Physico-chemical properties of artificial tear ducts from fractionated Thai silk fibroin solution

Pitsinee Limteamcharoen[1,2], *and Sorada Kanokpanont*[1,2,*]
[1]*Biomaterial Engineering for Medical and Health Research Unit;* [2]*Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Thailand*

Series seminar on UN Sustainable Development Goals (SDGs) in the field of Materials Research and innovation: 17th December 2021 (All participants are invited without additional fees) via Zoom Video Conference

Friday 17th December 2021	
09.00-12.00	**Speaker 1:** Sustainable development goals *Nattasamon Petchsang** *Department of Materials Science, Faculty of Science, Kasetsart University, Thailand*
	Speaker 2: Knowledge transfer from university to community for sustainable community development: A case study of Khung Bang Kachao communities, Phra Pradaeng district, Samut Prakan province *Wirasak Fungfuang*[1,*], *Uthaiwan Kovitvadhi*[1], *Pramote Chumnanpuen*[1], *Wanwipa Vongsangnak*[1], *Apinya Hirunwong*[2], *Chantha Wongoutong*[2], *Attawit Kovitvadhi*[3], *Akkarasiri Sangsawang*[4], *Jeerawan Ketsing*[5], *Chatree Faikhamta*[5], *and Chakkapan Sapkaew*[1] [1]*Department of Zoology, Faculty of Science, Kasetsart University;* [2]*Department of Statistics, Faculty of Science, Kasetsart University;* [3]*Department of Physiology, Faculty of Veterinary Medicine, Kasetsart University;* [4]*Department of Aquaculture, Faculty of Fisheries, Kasetsart University;* [5]*Department of Education, Faculty of Education, Kasetsart University, Thailand*

Speaker 3: Solar energy materials for photovoltaic and photoelectrochemical applications and devices

*Franca Drexler, Sebastian Lebioda, and Bernhard Neumann**
Department of Physical Chemistry, Faculty of Natural Science and Engineering, University of Applied Science Merseburg, Germany

Speaker 4: Flow and fine: a new ventilation system integrating wireless technology to improve residences indoor conditions under new normal

*Joseph Khedari**
Sunsyr Company Limited, Thailand

Speaker 5: NMR characterization of conformational interconversions of Lys48-linked ubiquitin chains in solution

*Methanee Hiranyakorn[1,2,3], Saeko Yanaka[1,2,3,4], Tadashi Satoh[4], Thunchanok Wilasri[2,3], Benchawan Jityuti[2,3], Maho Yagi-Utsumi[1,2,3,4], and Koichi Kato[1,2,3,4,]**
[1]Department of Functional Molecular Science, School of Physical Science, The Graduate University for Advanced Studies (SOKENDAI), Japan; [2]Institute for Molecular Science (IMS), National Institutes of Natural Sciences, Japan; [3]Exploratory Research Center on Life and Living Systems (ExCELLS), National Institutes of Natural Sciences, Japan; [4]Graduate School of Pharmaceutical Sciences, Nagoya City University, Japan

Speaker 6: Molecular dynamics simulation of disease-related biomolecules

*Hisashi Okumura[1,2,3,]**
[1]Exploratory Research Center on Life and Living Systems, Japan; [2]Institute for Molecular Science, Japan; [3]SOKENDAI (The Graduate University for Advanced Studies), Japan

PLENARY LECTURE

Strategy of innovation and business trend of material for sustainability

Wilaiporn Chetanchan*

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Recently, the BCG economy (bio-, circular- and green economy) has been applied by Thai government to elucidate environmental and energy consumption problems. This BCG model is an important parameter which should help us to escape from the middle-income trap. So, the sustainable materials are interested to manufacture a lot of important everyday items, especially sustainable materials for COVID-19 pandemic. Thus, we would like to employ science, technology and innovation to create the added value in sustainable materials. Situation and business trend of sustainable materials are discussed. This presentation summarizes the innovation strategy and market of sustainable materials from global to the Thai visions.

Navigating a reliable translation of mussel adhesion

J. Herbert Waite*

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Biomaterials from the natural world include many examples of high performance, multi-functionality, adaptability, and even programmed degradability in obsolescence. Biomimetics initiatives were introduced to capture these qualities for synthetic systems but effective capture requires more than just a superficial appreciation of the natural paradigm [1]. Mussel byssus is a prime example of this. Byssal threads are tough, shock absorbing and self-healing. Many of these properties are transferrable to synthetic polymeric materials by simple functionalization with catechols and Fe^{3+} addition - both of which are essential ingredients of byssus. Hydrogels and epoxies [2,3,4] functionalized with catechols and complexed with Fe^{3+} show up to 100-fold improvements in toughness and are self-healing, but are severely limited by ageing due to their susceptibility to oxidative damage. Oxidation of the catecholic residues by $-2H^+$ and $-2e^-$ turns them into quinones, which can no longer complex with Fe^{3+}. Paradoxically, nature's catechols *in situ* are much less prone to damage than the synthetics, and this can only mean that nature's invention has been imperfectly translated. Returning to the biochemistry of mussel byssus, we found that the catecholic coatings and adhesives of byssus include high levels of thiols which readily repair the initial oxidation sustained by catechols hence prolong their functional lifetime [5]. Does inclusion of thiols in biomimetic formulations solve this problem? We show that long-term oxidation is not prevented because the redox potentials of thiols (cysteine $E_o' = -0.25V$) are even lower than those of catechols (Dopa $E_o' = +0.25V$), hence more susceptible to oxidation. The secret of how mussels commandeer redox against thermodynamic predictions lies in their exploitation of protein phase behavior. Mussel byssus is produced with a built-in reducing poise that lasts for the lifetime of the material [6]. This is achieved by combining two immiscible phases – a discontinuous coacervate phase with catechols and thiols as well as a continuous solid phase stabilized with Fe^{3+} and Dopa. Whenever oxidation damage occurs in the solid phase, it is promptly repaired by reducing equivalents from the coacervate phase. What insulates thiols and catechols within the coacervate phase and actuates release of damage-repairing electrons and protons is the really valuable insight worth capturing.

References

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Science and technology of functional materials design from various polymer materials including wastes

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The demands for cleaner air and drinkable water will grow rapidly in the next decades as we face the growth in world population, climate change, and the shortage of fossil fuels. The next generation scientists and engineers will face several tough challenges ahead of them. They must find technology solutions backed by intelligent curricula and the abundant use of data science tools and come up with pathways for conversion of post-consumer wastes, such as plastics, food materials, and second-hand clothing into useful, upcycled products for air cleaning and water purification. This talk will present a survey on what are possible in the landscape of current research on sustainability. In addition, the talk will share advances made in our laboratory on fabrication of functional materials from consumer wastes via additive manufacturing in conjunction with the processes of sol-gel transition and electrospinning for gel and nanofiber formation respectively. Specifically, data on air filtration to remove airborne nanoparticles using high specific surface area aerogels, cleaning of water to remove organic dies using 3D-printed constructs (Fig. 1), and the performance of 3D-printed thermally insulating Lego block materials will be discussed. The data trends will be discussed as function of the structure-properties relationships of the functional materials.

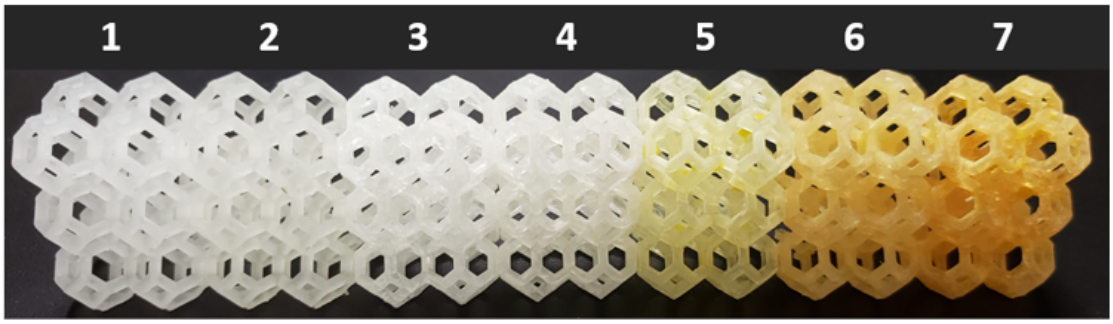

Fig. 1 3D-printed templates for growth of aerogel constructs. The numbers 1-7 are different functional materials.

Structure and electronic properties of optical materials through the eyes of computational approach

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Computational calculations on molecular and electronic properties of organic compounds have been widely investigated due to a challenge to achieve optical materials. In this contribution, an example of Ir(III) complexes which the effect of substituent moiety on the electron transfer and energy levels of Ir(III) phosphors was investigated by low temperature photoluminescence (PL) and density functional theory (DFT) calculations. The computational results revealed the HOMOs of these phosphors in the ground state are assigned to the d-orbital of Ir(III) center and the π-orbitals of the cyclometalating ligands. In sight into the characteristics in the frontier molecular orbital compositions of the Ir(III) complexes in ground state, the d(Ir)→π*(L) charge transfer play dominant role in the HOMO→LUMO transition. To further investigate the nature of the emissive excited state, the lowest triplet excited state of the Ir(III) complexes was calculated based on their optimized geometry by using the time-dependent DFT (TD-DFT). The calculated phosphorescent wavelengths of the six Ir(III) complexes are in good agreement with the experimental results. Some related optical materials are also demonstrated to highlight the performance of a computational approach as a key role on molecular and electronic properties relationships for the development of novel optical materials.

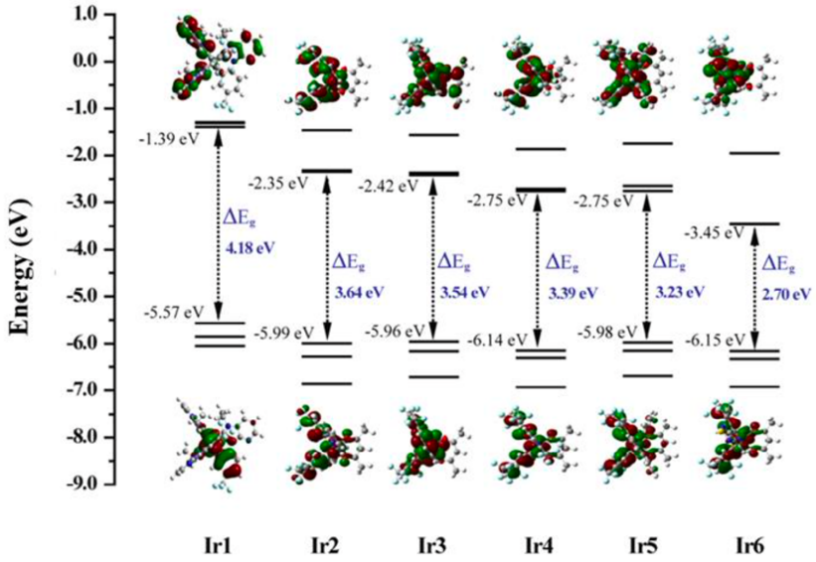

Fig. 1 The calculated contour plots of the HOMO and LUMO energy levels of Ir(III) complexes [1].

References

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Statistical mechanics solvation theory for nano- and bio-materials

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Life phenomena are a series and a network of chemical reactions, which are regulated by genetic information inherited from generation to generation. The genetic information itself is generated and transmitted by a series of chemical processes. In each of those reactions, some characteristic process takes place, which distinguishes biochemical reactions from ordinary chemical reactions in solutions. Such a process is referred to as molecular recognition (MR). MR is an extremely selective and specific process in the atomic level, and that selectivity as well as specificity plays a key role for living systems to maintain their life. MR is a molecular process determined by specific interactions between atoms in host and guest molecules. On the other hand, the process is a thermodynamic process as well, with which the chemical potential or the Gibbs energy of guest molecules in the recognition site and in the bulk solution are concerned.

A theoretical approach to MR has been launched based on a three-dimensional reference interaction site model (3D-RISM) method [1,2]. By solving 3D-RISM equations, we can obtain the solvation structure around a solute. The theory has been successfully applied to such MR problems as probing ligand molecules caged in protein, ion binding by protein, and the ion conduction through the channels.

The electronic structural changes of ligand and receptor molecules are another serious concern in MR processes. Recently, we proposed an efficient implementation of 3D-RISM to the electronic-structure theory of macromolecules such as fragment molecular orbital (FMO) and quantum mechanics/molecular mechanics (QM/MM) methods [3,4]. These methods are referred to as FMO/3D-RISM and QM/MM/RISM, respectively. They allow us to treat an electronic structure of macromolecules, such as protein, as well as a solvent distribution around the solute macromolecules.

In the presentation, we review our recent studies on the molecular recognition by protein based on 3D-RISM and its extensions. The applicability of these methods to nano- and bio-material design will also be discussed.

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INVITED LECTURE

Deciphering the discoloration in the production process of natural rubber

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Natural rubber (NR) latex comprises many naturally generating color components, especially non-rubber components, which restricts some NR applications, especially for light-colored NR products, which are growing in demand. One way to diminish the yellow color of NR is to eliminate non-rubber components, *i.e.*, lipids and proteins, from NR. This investigation focused on the factor influencing the yellow index (YI) in NR, including discoloration techniques for NR latex. It was clear that proteins are a major factor directly influencing the YI of NR. Thus, the techniques to remove proteins to reduce the YI of NR were carried out by increasing the number of washing by centrifugation, speed, and time. Percentage of total solid content (% TSC) of field NR latex, the blend ratio between cream rubber and skim latex, or bottom fraction from fresh-field NR latex collected from centrifugation process, were also important factors. The addition of sodium metabisulphites as a polyphenol oxidase (PPO)-reducing agent was also a powerful method to lessen the YI. Air-drying conditions of NR were also affirmed to serve the increase in YI value due to the oxidative degradation of the endogenous non-rubber components at high temperatures.

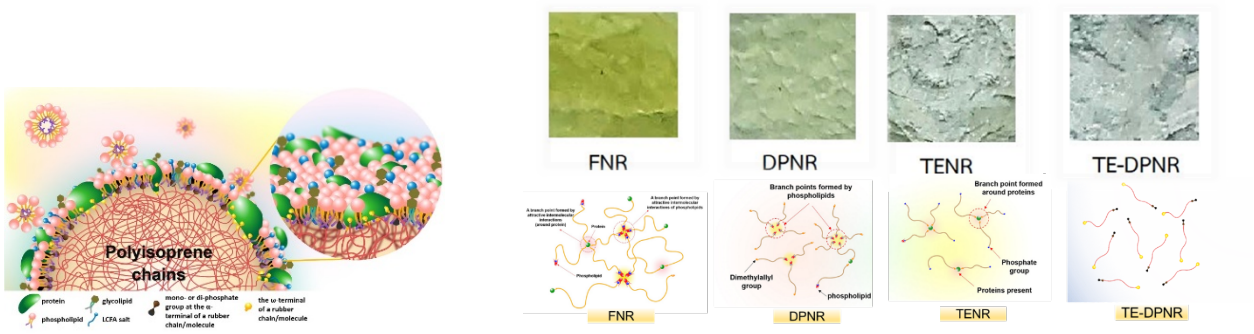

Fig. 1 Non-rubber components on the surface of NR particle and appearance of various types of NR after removal of non-rubber components.

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Ultrafine fully vulcanized natural rubber modified by graft-copolymerization with styrene and acrylonitrile monomers

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Natural rubber (NR) is known as one of the most important renewable agricultural resources in Thailand. To enhance the NR's value, development, and utilization of NR in form of commercial product are necessary. Commercial product based on ultrafine fully vulcanized powdered rubber (UFPR) was widely used in numerous potential applications such as toughening filler or friction modifier in brake pads. However, to meet the required thermal stability of friction modifier in brake pads for replacing the synthetic rubber powder, the modification of NR by graft-copolymerization with styrene (ST) and acrylonitrile (AN) monomer and production into the powder form are promised related to a sustainable economic system. From the beginning, the grafting process of NR latex was prepared by emulsion graft-copolymerization with ST and AN monomers onto deproteinized natural rubber (DPNR). The results revealed that the grafting with ST/AN monomer content of 80/20 weight ratio possessed the monomer conversion and grafting efficiency as high as 71% and 63%, respectively. After that, the obtained DPNR-g-(PS-co-PAN) was radiated by an electron beam, followed by a spray drying process to produce ultrafine fully vulcanized powdered natural rubber (UFPNR-g-(PS-co-PAN)). The SEM micrographs showed that UFPNR particles are relatively spherical with a particle size of approximately 3.56 μm. Furthermore, thermal stability i.e., degradation temperature at 5% weight loss (Td_5) of the modified UFPNR was substantially improved from 334 to 350 °C. The benefits of these advanced technologies give an obvious conclusion proved that the modified UFPNR is a good candidate for replacing a commercial synthetic powdered rubber and suitable for using as toughening filler in high performance polymer composite applications.

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Structural and functional biomaterials in medical applications

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Biomaterials can be regarded as a substance which was created or inspired with the use or based on the biological materials. The field is now very broad and covers many aspects of biopolymers, bioconjugates and species which exist in surrounding environment such as polysaccharides, polyesters, proteins and structurally more complex such as nucleic acids.

The genetic information for all living organisms is stored in the form of nucleic acids. Many scientists believe that discovery of the DNA structure was one of the most important for modern biology and biotechnology. The structure that was carefully engineered by nature, in the evolution process is now at hands of scientists. With that, nucleic acids remain chemical molecules for which the sequence can be programmed and molecules synthetized by chemical and enzymatic methods. Viewing such polynucleotide fragments as potential material became possible with discovery of modern analysis and visualization techniques such as SEM, TEM, CryoEM and AFM and X-ray methods (SAXS, WAXS).

Here we will view the methodology leading to the structural RNA fragments self-assembly, RNA nanoparticles formation and analysis methods. Additionally, we will elucidate how we can apply this knowledge for the design of functional RNA nanoparticle with regulatory activity and use it for gene expression regulation.

On the other hand, the diversity of other natural and artificially engineered peptides, proteins and polyesters have also been successfully applied for functional biomaterials. More recently 3D printing has been applied as the new way of formation of soft materials for biomedical applications. Polymers used for such application may be artificial, but as these will operate in bio-environment must be biocompatible and we must understand and control its influence. For that modern structural analytic methods with biocompatibility and stability by enzymatic degradation, cytotoxicity analysis have to be applied.

Single-stranded DNA-packaged polyplex micelle as AAV-inspired compact gene vector to systemically target stroma-rich pancreatic cancer

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Despite the rising demands for smaller non-viral gene carriers to elicit smooth tissue penetration of therapeutic genetic codes into size-restricting target sites, the construction of gene carriers inclines towards packaging rigid double-helix DNA (dsDNA) because it is ubiquitous and widely accepted as necessary for transcription. However, the appeal of employing single-stranded DNA (ssDNA) as an alternative template to entrust genetic codes continues to loom on because its flexibility promises an easier track to compaction. Hinging on the adeno-associated virus (AAV) as prime example of a transcriptionally active ssDNA system, we seek to design a non-viral gene carrier that can not only capture unpaired ssDNA as its core, but also retain transcriptional activity and achieve augmented compaction in the process.

Herein, we would like to report the successful encapsulation of ssDNA from heat-melting plasmid DNA by poly(ethylene glycol)-poly(L-lysine) block copolymers that lead to the formation of a compact polyplex micelle (PM) [1] (Fig. 1). Thus-prepared PM based on ssDNA offered a smaller spherical version of PM (ssDNA PM), improving compaction relative to the PM encapsulating dsDNA (dsDNA PM) that presented rod-shape [2]. Ultimately, unlike dsDNA PM, ssDNA PM penetrated the fibrous stroma of pancreatic tumor, accessed the tumor cell nest, exhibited transgene expression, and demonstrated tumor growth suppression by means of a strategy of suicide gene therapy when systemically dispatched to pancreatic tumor xenograft.

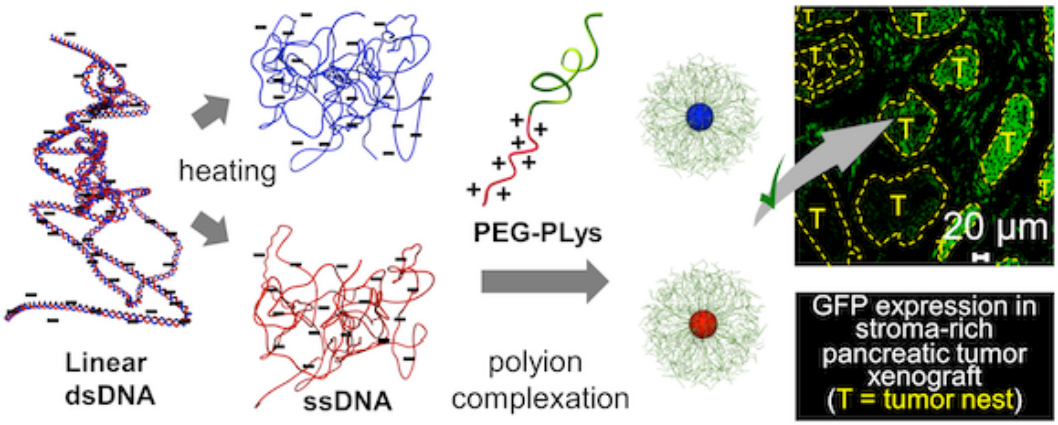

Fig. 1 Single-stranded DNA-packaged polyplex micelle as compact gene vector to systemically target stroma-rich pancreatic cancer.

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Development of a laboratory SAXS beamline with synchrotron level performance for high throughput characterization of bio-derived polymers

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We present the development of an advanced laboratory based SAXS-WAXS (small and wide angle x-ray scattering) beamline with unparalleled beam brightness for high throughput characterization of biopolymers and nanostructures. The instrument, incorporating the most advanced x-ray source and detector technologies, is developed in the BioPacific Materials Innovation Platform (www.biopacificmip.org) for rapid discovery and speedy development of new high-performance materials. A 70keV liquid metal jet x-ray source (Exicillum D2+ Metaljet) provides the world's highest beam brightness in a laboratory, with performance level comparable to a 2nd generation synchrotron beamline. Diffraction data will be collected using a large, 4-megapixel hybrid photon counting x-ray detector (Eiger2 R 4M from Dectris), which is housed inside a large vacuum tube with motorized translation for optimal positioning in SAXS or WAXS modes. Development of the beamline design and the sample environment, which includes a number stages of in-situ studies, is focused on optimizing the high throughput capabilities by incorporating a high degree of automation, an intuitive user interface and smart analysis software for rapid measurement turn around as well as versatility to suit a wide range of applications. Preliminary results on rapid characterization of bio-derived polymers and automated cellular structures will be presented.

Toward the development of sensors and actuators by 4D printing

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The "polymer" 3D printing was invented in the 1980s, we see that today, there is a very limited choice of resins or polymers compatible with this process, greatly limiting the range of final properties or functionality of the 3D objects obtained. Hence, this project deals with the implementation of 3D printing processes to manufacture complex three-dimensional objects that are able to react or adapt to their environment, process so called 4D printing. To achieve this goal, new resins for additive manufacture by photopolymerization are developped. In order to obtain a 4D effect, colloidal metallic nanoparticles with different shapes (spherical, rod, etc.) have been synthesized and then introduced into the photosensitive resins [1-3]. Different objects of controlled geometry have then been realized by photopolymerization according to the desired effects. Several stimuli (light, temperature, stress mechanical, etc.) have been explored. For example, on a macroscopic scale, one can imagine producing a colour change induced by light (photochromic) or mechanical stress (mechanochromic) [4]. At the microscopic scale, the aim will be to propose miniaturized actuators controllable by light or temperature. These programmable materials will be able to find application in several fields such as sensors, robotics or the microfluidics.

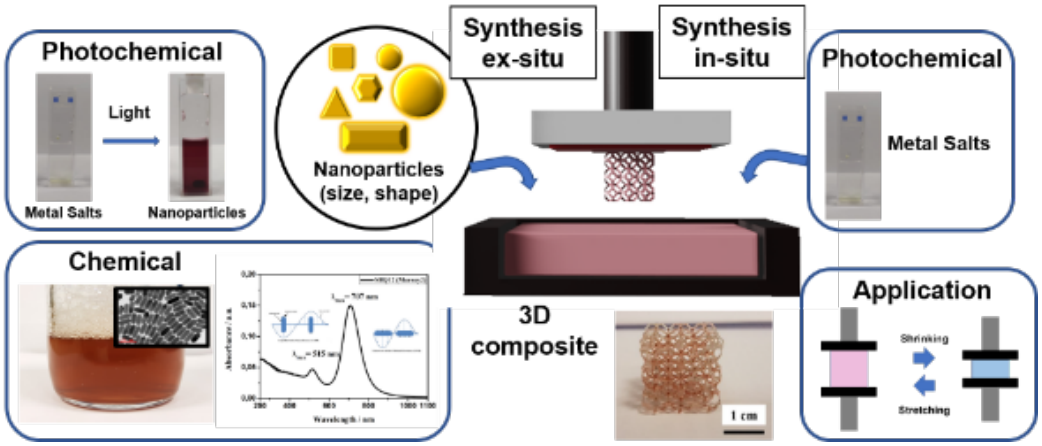

Fig. 1 Global outline of the subject.

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Thermoplastic natural rubber based on biodegradable polyesters and linear-low-density polyethylene

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Thermoplastic natural rubber (TPNR) is one of the alternative natural rubber (NR) products obtained by blending NR with any compatible thermoplastics, e.g., high-density polyethylene (HDPE) [1], low-density polyethylene (LDPE) [2], linear-low-density polyethylene (LLDPE) [3], polystyrene (PS) [4], polylactic acid (PLA) [5] at the temperature above the melting point of plastics, which is always above the softening point of NR. Unlike vulcanized NR, TPNR is recyclable and convertible to the final articles using the existing plastic technologies, including extrusion and injection molding. Two TPNR systems are raised as examples in the current presentation. NR/poly(butylene adipate-*co*-terephthalate) (PBAT) blend is prepared and used as a toughening agent for PLA. Elongation at break and impact strength of PLA increase by melt mixing with NR/PBAT blend. The obtained PLA/NR/PBAT 62/19/19 ternary blend does not break during tensile testing (Fig. 1A). For NR/LLDPE blends filled with two types of inorganic fillers, i.e., titanium dioxide and silica, silica provides better reinforcing effect to NR/LLDPE blends, whereas the blends filled with titanium dioxide exhibit excellent UVA and weather resistance. The resulting NR/LLDPE blends filled with inorganic fillers can be injection molded to form the products with desired shapes; example is shown in Fig. 1B.

Fig. 1 (A) Appearances of dumbbell-shaped specimens after tensile testing of PLA (left) and PLA/NR/PBAT 62/19/19 ternary blend (right) and (B) injection molded prototype of NR/LLDPE blends filled with titanium dioxide and silica.

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Carbon fibre reinforced polymer composites: damage, repair, and future prospects

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Carbon fibre reinforced polymer composite laminates (CFRP) are light-weight, strong and stiff materials that are used for making structural supports, for large-scale to small-scale engineering, in aerospace, automotive, marine, construction, sports, and medical industries, to name a few. As the adoption of CFRP in these areas is growing rapidly annually, this makes it an important material for discussion in this invited lecture. The main argument for using CFRP in is transport industry is fuel efficiency arising from reduction in weight in the main structural components of the vehicle, e.g. aircraft fuselage and car chassis. The key drivers of the uptake in the adoption of CFRP are the advancement in automated, rapid and precision manufacturing technology for fibre layout, computer simulation for composite structural design application, and commitment to sustainability, i.e. efficient fuel consumption to achieve net zero carbon emission by 2050. However, CFRP are prone to out-of-plane impact damage, e.g. from bird strikes to a simple tool drop (Fig. 1). Damage as such can be repaired but the process is generally very elaborate, time consuming and requires skilled engineers. (In fact, on that note, Mr. Elon Musk's SpaceX launch vehicle was not made of CFRP but metal as the key concern was about repairing damage in space, especially when they can send humans to the Moon.). However, damage to CFRP may not always be repairable. This raises a concern about end-of-life issue for the damaged CFRP components, particularly with regard to reuse, recycle and repurpose, and how to ensure that use of CFRP support a circular economy. Already, the number of damaged wind turbine blades made of CFRP are mounting at many storage areas. The recycling approach is complicated by the difficulty in carrying out large-scale separation of the matrix from the fibre efficiently, without damaging the fibre structure. Other applications, such as car chassis of electric vehicles (EVs), could face similar problems at end-of-life, with increasing number of EVs on the road. In addition, with a reduced demand in fossil fuel, stranded assets relating to the oil industry, would be affected. With regard to the downstream products of oil, how this would impact on the polymer industry and the supply chain for manufacturing CFRP? This talk begins with a brief discussion on the fundamentals of CFRPs, and thereafter, on current applications, our understanding of damage in CFRP and repair mechanism and approaches. Finally, the talk will briefly highlight the future prospect of CFRP.

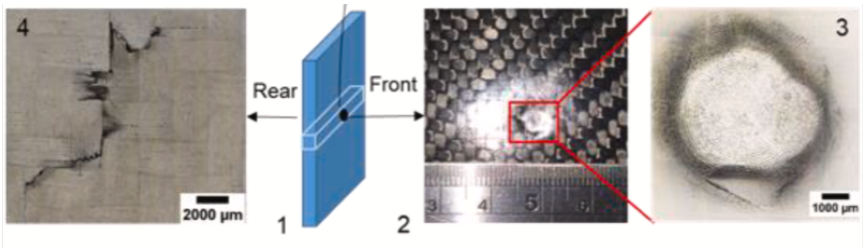

Fig. 1 A damaged CFRP [1].

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Finite element analysis of elastomer: case study – rolling resistance of pneumatic and solid tyres

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EU tyre labelling rules have been applied since November 1st, 2012, to inform about the performance of tyres on fuel efficiency (rolling resistance), safety (braking on wet surfaces) and noise (external noise). The tyre labels help customers to make their purchase decisions by trade off on tyre performances and prices. Consequently, manufacturers have to engineer their products so that their tyres are classified on top of the label categories. Tyre rolling resistance involves in many kinds of tyre knowledge such as rubber formulations, tyre structures and tyre tread patterns. Generally, 70% of tyre rolling resistance depends on the hysteresis properties of rubber compounds and 30% depends on other properties such as road conditions, tyre pressures, load carrying, vehicle speeds, and tyre tread designs. From this point of view, even if rubber compounds are formulated to have good hysteresis properties, they can help reduce tyre rolling resistance up to 70%. If tyre rolling resistance needs to be further reduced, tread designs have to be considered. Therefore, this case study will show how to reduce tyre rolling resistance by using Finite Element Analysis (FEA). Radial tyres for light trucks were used to study their tread patterns and tread depths affecting their rolling resistance, while solid tyres were used to study on their tread patterns, tread depths and tyre structures affecting their rolling resistance. The FEA results showed that tread patterns had high effects on rolling resistance of radial light truck tyres while they had little effects on solid tyres. Contact areas and tread depths affected rolling resistance of both tyres. Increase in contact areas reduced tyre rolling resistance while increase in tread depths resulted in higher tyre rolling resistance.

Combining fractional order derivatives and spectral variable selection for crosslink density evaluation of Para rubber latex by Vis–NIR Spectroscopy

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The aim of this investigation was to develop NIR models for estimation of crosslink densities of PV and PV_{50} latices. In order to achieve high accuracy, the spectral pre-treatment of fractional order derivatives (FOD), spectral variable selection (i.e. successive project algorithm (SPA) and genetic algorithm (GA)) combined with partial least squares regression (PLSR) were utilized. The result shows that the overall accuracy of PV latex had higher accuracy than PV_{50} latex. The FOD of 0.75th and 1st were optimal to pre-treat the PV_{50} and PV latex spectra. The prediction model showed the standard error of cross validation (SECV) of 3.53% and 3.21% for estimation of crosslink density (toluene swell, TS) of PV_{50} and PV latex, respectively. The model accuracy of PV latex could improve with wavelength selection method of GA, with SECV reduce from 3.21% to 3.17% and number of wavelengths reduced from 1059 to 937. Meanwhile, model accuracy of PV_{50} could not improve by using the wavelength selection method, however, the GA could reduce the number of wavelengths from 1059 to 216.

Near infrared spectroscopy and machine learning classifier of crosslink density level of prevulcanized natural rubber latex

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By toluene swell index for cross link density level of prevulcanized natural rubber latex knowledge is needed in industry, it is used to confirm quality before trading and production management. Therefore, aim of this research is to use the Fourier transform near infrared (FT- NIR) spectroscopy with machine learning to classify different cross link density levels by toluene swell index including, Unvulcanized (U) (> 160%swell), Lightly vulcanized (L) (100-160%swell), Moderately vulcanized (M) (80-100%swell), Fully vulcanized (F) (< 80%swell) of prevulcanized (PV) natural rubber latex of raw PV latex and 50% solids content PV latex (PV50). The result shows that toluene swell index of rubber prevulcanized latex could be 91.8% correct classified into L group and M group using PV50 MSC pretreated spectra with PLS-DA classifier. Unfortunately, sample obtained for this experiment were loss of U and F groups. In future, to develop the robust model, the sample of all crosslink density levels should be collected.

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Optimising the friction welding of wood

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The optimum welding time for welded beech specimens is assessed with the compression shear test method and the softening of the wood polymers during friction welding is evaluated with dynamic mechanical analysis. A welding time of 2-3 sec yields the highest mechanical performance (13.6-14.7 MPa) that is equivalent to the shear strength of glue laminated beech. A shear strength reduction of up to 56% is observed when specimens are loaded perpendicular to the grain. Welding times of 5 and 7 secs resulted in a sudden drop in shear strength capacity and smooth failure interfaces within the weld-line. This is attributed to expelled cellulose fibres and thermal degradation of cellulose with increasing temperature at longer friction welding times. The softening of beech wood to form the weld-line is postulated to occur at temperatures greater than 65 ºC due to intermolecular debonding and depolymerisation of low molecular weight lignin. Drops in storage modulus were also observed at 125 and 175 ºC attributed to softening of lignin and hemicellulose.

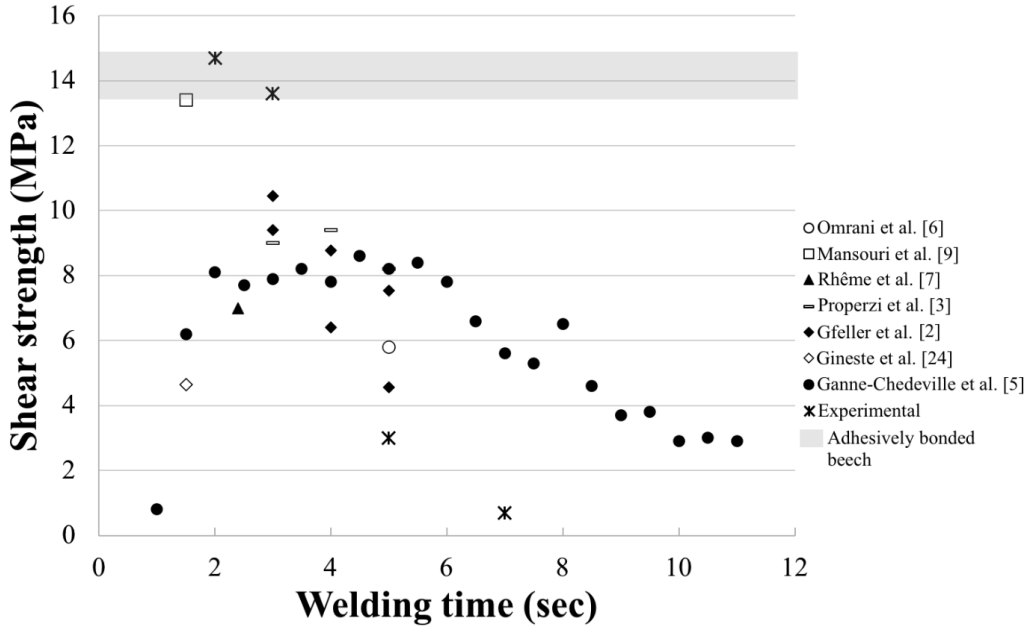

Fig. 1 Shear strength of weld-line in beech specimens as a function of welding time – comparison with literature.

A bioinorganic approach to photoresponsive materials: V and Fe coordination in polysaccharides

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Many organisms rely on metal ion coordination of biopolymers to produce materials with specific mechanical properties. Some natural materials also have architectures where soft, biopolymers interfacing with hard, stiff inorganic materials, which allow for unique mechanical properties. Our approach is use inorganic oxide clusters of Fe and V to cross-link with polysaccharides through metal coordination bonds. These materials also have added functionality, where the metal-coordination bond can be controlled with light due to changes in the bonding interactions in the excited state. We have created Fe(III)-polysaccharide materials that show changes in stiffness (modulus) upon light irradiation [1]. We have also created robust, plastic-like materials that use V(V) coordination to polysaccharides. These materials show remarkable water stability and stiffness compared to similar polysaccharide materials without metal coordination [2].

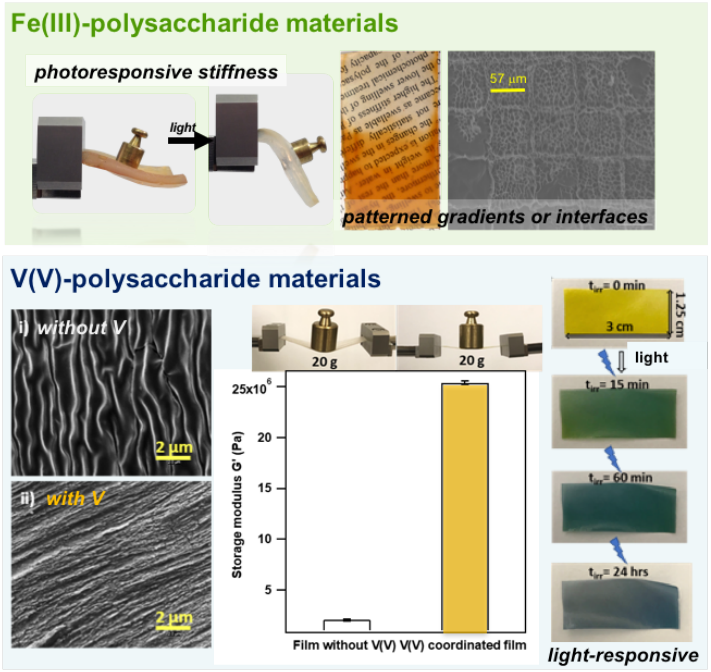

Fig. 1 Top: Photoresponsive polysaccharide materials can be created with Fe(III) coordination. These materials can be patterned with light. Bottom: Stiff, robust polysaccharide materials can be designed using V(V) coordination. These materailas also show color changes with light irradiation.

References

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Diffusion coefficient of one macromolecule in an aqueous solution: the system size dependence of the viscosity in the estimation method using MD simulations

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Einstein proposed the Stokes-Einstein law by combining the fluctuation-dissipation theorem with fluid dynamics. The relation is,

$$D = \frac{k_B T}{6\pi\eta a}$$

where D, k_B, T, η, and a are the diffusion coefficient, Boltzmann constant, temperature, viscosity, and hydrodynamic radius for the Brownian particle, respectively. This law gave us a method to estimate the size of a macromolecule using the diffusion coefficient D obtained by experiments, such as the dynamical light scattering. It has been an important method to determine molecular size. On the other hand, Terazima et al. showed that the diffusion coefficients changed significantly upon conformation changes associated with reactions, even when the shape and volume changes of the proteins were minor. The volume estimated using D increases more than two times. The authors proposed that the hydrodynamic radius change is caused by the hydration change. If it is an important factor to determine the diffusion behaviors, D should become a useful tool for diagnosing the state of proteins.

We carried out molecular dynamics studies to study the effect on the coefficient D of a protein, such as β-lactoglobulin(BLG, Fig. 1), in an aqueous solution. However, the hydrodynamic effect of the dependence on the basic cell size was much stronger than that of the hydration effect. To remove the hydrodynamic effect from MD results we adopted the simplified Yeh-Hummer method in the estimation. However, additional size dependence remained. The analysis showed that the viscosity between the protein in the basic cell and the proteins in the replica cells depends on the cell size (See Fig. 2, left closed diamonds for water). The unsimplified Yeh-Hummer theory can explain this dependence. We propose a new estimation method for the estimation of D based on the unsimplified Yeh-Hummer theory.

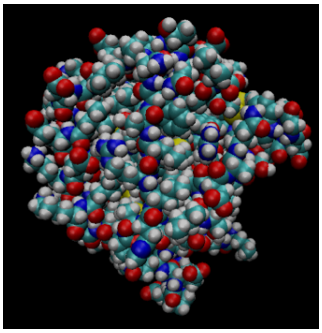

Fig. 1 β-lactoglobulin.

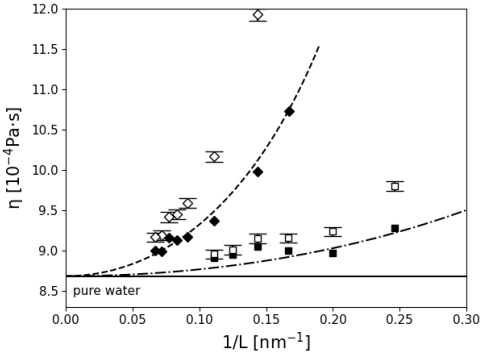

Fig. 2 System size dependences of water viscosity for the BLG aqueous solution.

Structural characterization of polymer and polymer composite with synchrotron x-ray

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Small and Wide Angle X-ray Scattering (SAXS/WAXS) are powerful tools extensively used for structural investigation of polymer and polymer composite. High intensity x-ray from a synchrotron light source, combining with flexibility for installation of sample holder apparatus in synchrotron end-station enable fast accumulation of high quality scattering data that contains wide range of information. With efficient software capable of data analyses and structural modeling, the scattering data can be a valuable source for various kinds of structural information. In this report, detailed description of the SAXS/WAXS station, shown in Fig. 1, at the Synchrotron Light Research Institute (SLRI) is presented. The system has capability for structural characterization of polymer and polymer composite, ranging from Angstrom to nanometer scale. The station is also equipped with in-situ apparatus for studies of dynamic structural changes, such as tensile and heating stages. Description of Python-base and Matlab-base software developed in-house for data deduction and structural modeling of polymer and polymer composite using x-ray scattering data are given.

Fig. 1 SAXS/WAXS station at BL1.3W.

Application of Near Infrared Spectroscopy for quality evaluation in Para rubber industry

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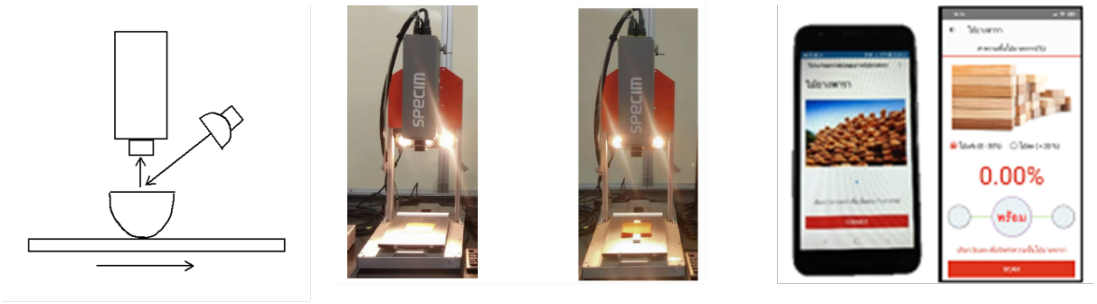
Quality of products manufactured from Para rubber was an important aspect for merchandizing. Near infrared spectroscopy in a wavelength range of 900 to 1700 nm, which was a rapid and non-destructive technique, was applied to create quality predicting models for various Para rubber products. Near infrared hyperspectral imaging (NIR-HIS) technique was implemented to predict dry rubber content (DRC) of cup lump (Fig.1a) [1]. Classification of adulterated Para rubber sheet was investigated using NIR-HSI (Fig. 1b) [2]. And NIR portable system was also developed for moisture content determination of Para rubber timber (Fig. 1c). The results showed that the DRC of the cup lump could be predicted with high accuracy with the coefficient of determination (R^2) of 0.99 and root mean square of error of prediction (RMSEP) of 0.64%. Regarding the Para rubber sheet, the sulphuric acid coagulated sheets was classified from the formic acid coagulated sheet very good accuracy of 98.3%. Finally, The NIR portable system could be used to determine the moisture content of the timber with R^2 and RMSEP of 0.96 and 5.37%, respectively. The application of NIRS was successful and provided feasibility for development into a future commercial use.



(a) (b) (c)

Fig. 1 (a) Cup lump NIR measurement, (b) Rubber sheet NIR-HIS experiment and (c) NIR portable system for moisture content of rubber timber.

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ORAL PRESENTATION

Manufacturing processes and properties of PVC composites containing Bi_2O_3 and Para rubber wood particles as X-ray shielding materials

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The potential utilization of Para rubber wood/polyvinyl chloride (WPVC) composites containing an X-ray protective filler, namely bismuth oxide (Bi_2O_3) particles, was investigated as novel, safe, and environmentally friendly X-ray shielding materials. The Para rubber wood and Bi_2O_3 contents used in this work varied from 20 to 40 parts per hundred parts of PVC by weight (pph) and from 0 to 25, 50, 75, and 100 pph, respectively. The study considered X-ray shielding, mechanical, density, water absorption, and morphological properties. The results showed that the overall X-ray shielding parameters, namely the linear attenuation coefficient (μ), mass attenuation coefficient (μ_m), and lead equivalent thickness (Pb_{eq}), of the WPVC composites increased with increasing Bi_2O_3 contents but slightly decreased at higher Para rubber wood contents (40 pph). Furthermore, comparative Pb_{eq} values between the Para rubber wood/PVC composites and similar commercial X-ray shielding boards indicated that the recommended Bi_2O_3 contents for the 20 pph (40 pph) rubber wood/PVC composites were 35, 85, and 40 pph (40, 100, and 45 pph) for the attenuation of 60, 100, and 150-kV X-rays, respectively. In addition, the increased Bi_2O_3 contents in the WPVC composites enhanced the Izod impact strength, hardness (Shore D), and density, but reduced water absorption. On the other hand, the increased wood contents increased the impact strength, hardness (Shore D), and water absorption but lowered the density of the composites. The overall results suggested that the developed WPVC composites had great potential to be used as effective X-ray shielding materials with Bi_2O_3 acting as a suitable X-ray protective filler [1].

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Development of high-performance particleboard from sawdust of Para wood cover by vulcanized natural rubber and veneer wood sheet

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The objective of this research was to determine the optimum conditions for processing high performance particleboard from sawdust of Para wood cover by vulcanized natural rubber and veneer wood sheet by uses citric acid and maltose dextrin as a binder according to industrial standards. This research had studied the optimum ratio between maltose dextrin and citric acid for rubber wood particleboard processing, the temperature and time of compression molding, appropriate amount and concentration of binder for preparation of veneer-coated particleboard. And this research also had studied the formula of vulcanized rubber for surface coating, the thickness and viscosity factor of rubber and the ratio of paraffinic oil and calcium carbonate mixture that affects the adhesion, strength, shock absorption and friction of the rubber. The results of the study found that, the optimum conditions for the preparation of veneer-coated high-quality particleboard are the ratio of maltose dextrin to citric acid 25:75 at a concentration of 60% by weight of dry sawdust, using an amount of 20% by weight of dry sawdust, compression molding at 220 °C for 7 minutes, as veneer-coated particleboard had pass the TIS876-2547 criteria and it had good qualities. The preparation of vulcanized rubber-coated particleboard can be prepared by compression molding according to the same condition as the preparation of veneer coated particleboard and then compressed together with the vulcanized rubber that is set to the temperature at the top of compression plate which attached to the rubber and the temperature at the bottom of compression plate attached to the rubber sawdust particleboard were 164 and 185 degrees Celsius respectively, with a time of 8 minutes. The results of the study of the best coating thickness level were 3 mm., the ratio of calcium carbonate and paraffinic oil in the compound rubber formulation at 10/5 phr. The rubber coated particleboard can be used as floor coverings for futsal courts and playgrounds as well as anti-slip floor mats for toddlers and the elderly with qualifying criteria TIS. 2658-2558 criteria.

Influence of nanofiller types on morphology and mechanical properties of natural rubber nanocomposites

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Natural rubber (NR) nanocomposite containing different types of filler, i.e., nanoclay (clay) and cellulose nanofiber (CNF) were prepared in this study. The masterbatches of NR with 5 parts per hundred parts of rubber of nanofiller were firstly prepared by using the latex mixing method, followed by compounding on two roll mill and compression molding to obtain NR nanocomposite specimens. The unfilled NR sample was also prepared for comparison. Morphological properties of NR nanocomposites were investigated by using transmission electron microscopy, while the mechanical and dynamic properties were studied by using a universal tensile testing machine and dynamic mechanical analyzer (DMA). It was found that the clay with platelet morphology was uniformly dispersed, while the long and flexible CNFs were aggregated and poorly dispersed. The greater improvement of modulus at various strains was achieved from CNF filled NR nanocomposites, while the highest tensile strength was obtained from the clay filled nanocomposite. As compared to the clay containing nanocomposite, the addition of CNF markedly decreased the tensile strength and elongation at break of the NR due to poor dispersion of CNF. However, a significant improvement in mechanical properties at low strain was obtained when the CNF was used as filler due to higher degree of fiber entanglement in CNFNR nanocomposite, as suggested by DMA observation.

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Plant growth promotion traits and antagonistic effect in white root disease of rhizobacteria in *Hevea* rubber of Thailand

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White root disease causing by *Rigidoporus* sp. is a severe problem that decreases latex productivity and can even cause mortality of rubber trees. With the aim to control biologically this disease, antifungal rhizobacteria were isolated from rhizospheric soils of *Hevea brasiliensis* plants cultivated in Thailand. Among all isolated actinobacteria, an isolate Lac-17, Lac-19 and LRB-14 exhibited distinctive antagonistic activity against the fungus. Lac-17, Lac-19 and LRB-14 were produced ammonia, β-1,3-glucanase, cellulase, chitinase, protease, indole-3-acetic acid, phosphate solubilization, and siderophores. They were inhibited the mycelial growth of *Rigidoporus* sp. *in vitro* and the best antagonistic strain were *Streptomyces* Lac-17. According to cell wall composition analysis and 16S rRNA homology, Lac-17 strains were identified as *Streptomyces malaysiensis* Lac-17. The plant growth promoting and antifungal activity of *Streptomyces malaysiensis* Lac-17 in this study highlight its potential suitability as a bioinoculant.

Injection molding and characterization of polylactide stereocomplex blended with thermoplastic starch and chain extender

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Polylactide (PLA) is an interesting biodegradable polymer but has limited application because of its brittleness and low thermal stability [1]. We found that both drawback of PLA were solved by stereocomplexes (ST) augmented with thermoplastic starch (TPS). In this work, 15% and 30% TPS and 2% chain extender (CE) were blended with poly(L-lactide) (PLLA)/poly(D- lactide) (PDLA) (50/50) in an internal mixer. The blended materials were then injection molded into tensile specimens. Differential scanning calorimetry (DSC) as shown in Fig. 1 demonstrated that despite the added TPS, the stereocomplex structures were still generated and stereocomplex crystallinity decreased with increasing TPS content. Compared to neat PLLA, the melting temperature of the stereocomplex polylactide and its TPS blends was approximately 55 °C higher [2]. Furthermore, the addition of TPS enhanced the elongation at break of the stereocomplex samples.

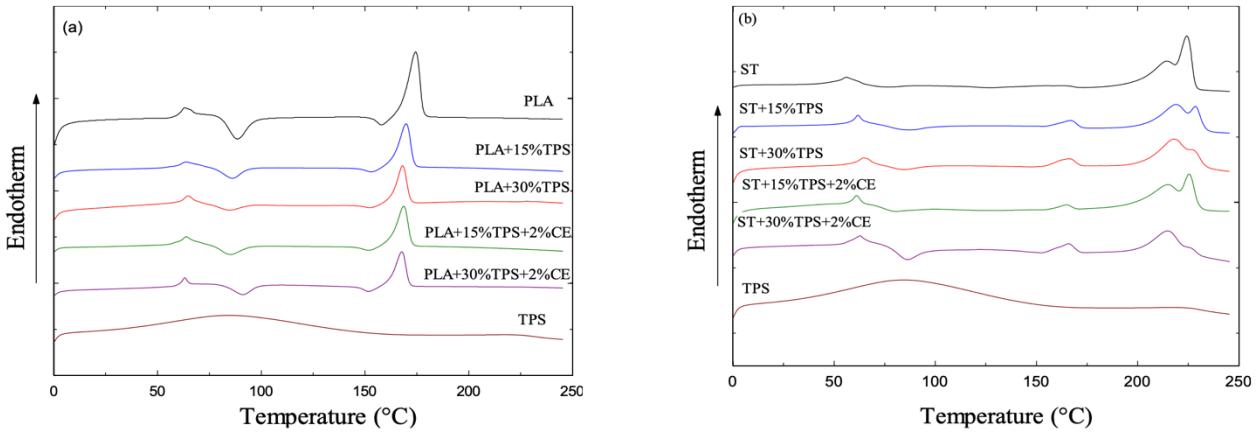

Fig. 1 DSC thermograms of (a) PLA blends and (b) polylactide streocomplex (ST) blends.

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Crosslinked polyvinyl alcohol/polyvinyl pyrrolidone hydrogel sheets by electron beam irradiation for wound dressings

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Hydrogel dressings provides a temporary, nonadherent barrier for the wounds while maintaining the appropriate moist environment for wound healing. In this study, a series of soft and pliable hydrogel sheet dressings were developed by electron beam irradiation from polyvinyl alcohol (PVA) and polyvinyl pyrrolidone (PVP), and evaluated for water absorption, mechanical, and bacterial barrier properties. As the PVP composition in the PVA/PVP hydrogels was varied as 30, 50, 70 and 100% (w/w), the resulting swelling ratios at equilibrium were shown to increase significantly from 1.7 to 2.3 folds for the 30PVA/70PVP and 100PVP formulations. However, the ability of hydrogel sheets to withstand loading decreased significantly from the maximum load of 150 to 50 g when the hydrogels contained only PVP. The gel fraction remained relatively the same above 90% across all PVA/PVP formulations. Using contact plate setup to determine the passage of microbes through porous materials, the selected 30PVA/70PVP hydrogel sheets could serve as a barrier against both Staphylococcus aureus and Escherichia coli up to 10^5 CFU for at least 4 h. Based on these results, the crosslinked 30PVA/70PVP hydrogel sheets by electron beam irradiation could potentially be applied as wound dressings.

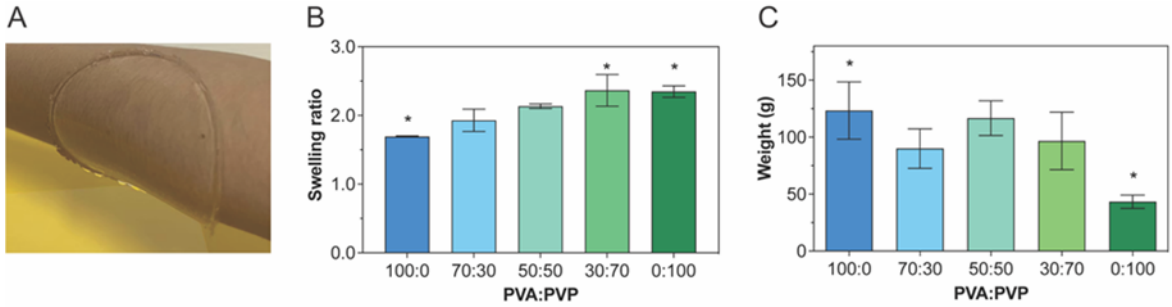

Fig. 1 (A) Representative of PVA/PVP hydrogel sheet. (B) Swelling at equilibrium and (C) ability to withstand loads at varied PVA/PVP compositions.

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Raman microscopy applied to polymer characterization

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Raman microscopy is an excellent tool to address the polymer research. Raman microscopy can be used to characterize raw materials, to inline or outline monitor polymerization process, to investigate orientation and crystallization changes, and also to control the quality and traceability of genuine products, by understanding defects and compounds distribution. In this article we present how HORIBA Raman microscopy solutions can support the polymer chemical and structural understanding.

Valorization of rubberwood waste into porous carbon

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Rubberwood is one of the main Thailand goods exports. In each year, about 45,000 hectares of rubber tree are cut down, only about 30% of them is appropriated for furniture production while most of the rest is used as woodfuel. This research work focuses on the valorization of rubberwood waste into porous carbon and the optimization of carbonization process for the production of hierarchical porous carbon. Rubberwood wastes obtained from a rubberwood processing industry (in Thailand's southern region) were treated with H_3PO_4 and subjected to two different carbonization methods. In the first method, the rubberwood was carbonized at 500 °C for 1 hour (PC-1 step). The second method consisted of two steps of heat treatment, the rubberwood was pre-carbonized at 200 °C for 15 minutes and subsequently carbonized at 500 °C for 45 minutes (PC-2 step). The physical properties of the porous carbon were investigated using thermogravimetric analysis, Fourier transform infrared spectroscopy, scanning electron microscopy, and N_2 adsorption-desorption isotherm techniques. The porous carbons obtained from both carbonization methods have hierarchical porous structures comprising the naturally existing tubular macropores (diameter 4-20 μm) and the micropores (diameter 0.3-1 nm) generated during carbonization process. The PC-2 step provided a specific surface area of 336.2 m^2g^{-1} and a pore volume of 0.093 cm^3g^{-1}, which are almost twice those of the PC-1 step. It is possible that the pre-carbonization at 200 °C would allow a slow and gradual evaporation of moisture within the wood, thus preserving pore walls in the materials. The obtained hierarchical porous carbons can be used in many applications such as energy storage, waste water treatment, air purification and metal recovery.

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Properties of hydroxyapatite based geopolymer synthesized from calcined kaolin

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This research synthesized the geopolymer from calcined kaolin which was prepared in an electric muffle furnace at 600 °C for 2 hours. The effect of NaOH and KOH on strength development of kaolin-based geopolymer was studied. Results showed that the highest 28-days compressive strength was obtained from samples with 0.4 moles of Na_2O/SiO_2 and K_2O/SiO_2, and gave strength of 12.97 and 11.96 MPa, respectively. When calcium phosphate was added to the geopolymer mixes having the highest strength at 2.5, 5.0, 7.5 and 10 wt.%, strength reduction of all samples was observed. The geopolymer samples containing 0.4 moles of Na_2O/SiO_2 and K_2O/SiO_2 with the addition of 5 wt.% calcium phosphate and gave strength of 9.95 and 8.88 MPa, at 28 days were selected for heat treatment at 500, 600 and 700 °C. The highest 28-days compressive strength of geopolymer heated at 600 °C was obtained with the presence of various crystalline phases including hydroxyapatite, muscovite, alunite and quartz.

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Preliminary study of laser-assisted technique for vulcanizing rubber latex in additive manufacturing

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In engineering applications, rubber or elastomer product is usually presented the good mechanical properties and their flexibility in nature. However, rubber shaping and forming have been limited by only molding technique, which is a high costing in mold and machine. No-mold shaping by 3D printing is an alternative approach to reduce the product cost. It was also attributed the flexible design and/or customized requirement in the product development process. This work introduced the new approach to additive manufacturing with natural-rubber latex. The machine concept from FDM and SLS was designed and fabricated. Filling mechanism was used to draw the rubber track in each layer. While, laser source was directly pointed to the rubber path for partially crosslinking of rubber. The result was found that the liquid temperature was increased by additional concentration of latex color [1]. The distance of laser head from printed base and given power were mainly affected to the inducing temperature. The printed sample was left in hot air oven at 60 ^{o}C for 24 hr [2] and then tested the mechanical properties. It was indicated that the tensile testing was shown thermal degradation under the influence of increasing temperature. Future work will be expected to improve stability of extrudate latex and to control the initial viscosity of natural rubber latex.

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Electrospun polylactic acid (PLA) fibers loaded with $Ag/CaCO_3$ filler for antimicrobial applications

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Silver nanoparticles (AgNPs) are widely used as antimicrobial agent in commercial products like textiles, cosmetics and drugs. AgNPs deposited on the surface of calcium carbonate ($CaCO_3$) particles, serve as sustained release of antimicrobial activity. Silver nanoparticles embedded calcium carbonate particles ($Ag/CaCO_3$) were prepared by a precipitation method. In this study, precipitated ($Ag/CaCO_3$) filler will be used for preparation of $Ag/CaCO_3$-poly(L-lactic acid) ($Ag/CaCO_3$-PLA) nanofibers by electrospinning. Polymer concentration and functional filler amount in binary solvent system will be studied. The condition for fabricating electrospun PLA and $Ag/CaCO_3$-PLA was a 15 cm of collection distance and 15 kV of working voltage. Morphology of Ag/CaCO3 loaded PLA electrospun fibers will be investigated by the field emission scanning electron microscope (FE-SEM). The electrospun fibers will be further applied as the antimicrobial material.

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Prediction of crosslink density of natural rubber latex by spectroscopic method based on fractional order derivative (FOD)

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Quality of natural rubber latex is defined by cross density before trading. Rapid method for measuring crosslink density is required in factory. The objective of this study was to create the NIR models for predicting of crosslink densities of PV and PV50 latices. The prediction models were developed based on partial least squares regression (PLSR) with spectral pre-treatment of fractional order derivatives (FOD) [1], and wavelength selection method of successive project algorithm (SPA) and genetic algorithm (GA). Fig. 1 shows schematic for data analysis of quick toluene swell (QST) estimation. The result demonstrates that PV latex model had higher accuracy than that of PV50 latex model. Effective model in prediction crosslink density of PV50 and PV could be preprocessed with 0.75th and 1st FOD, respectively, the prediction model had the standard error of cross validation (SECV) of 3.53% and 3.21%, respectively.

The model performance of PV latex could improve with wavelength selection method of GA, reduce the SECV from 3.21% to 3.17% and number of wavelengths reduced from 1059 to 937. The model performance of PV50 could not reduce by using the wavelength selection method, however, the GA could reduce the number of wavelengths from 1059 to 216.

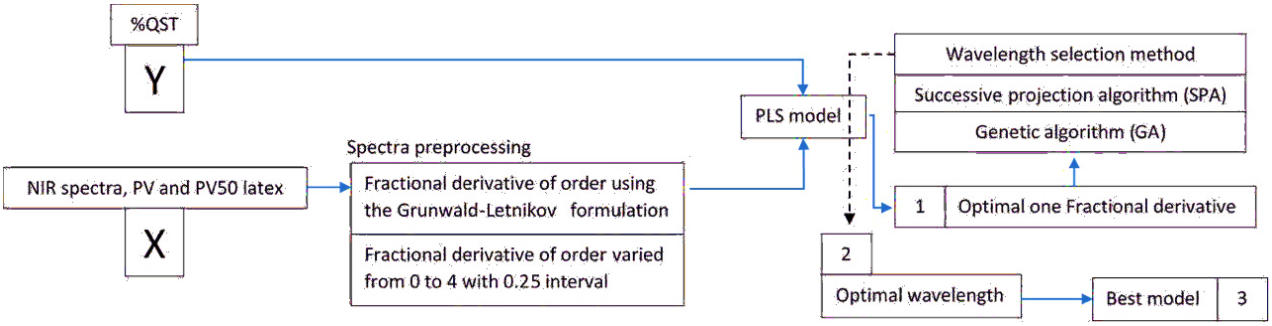

Fig. 1 Schematic for data analysis for quick toluene swell estimation.

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Effect of NR filled carbon black and ratio of NR/NBR on the thermal and oil aging properties

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Normally, natural rubber (NR) presents an excellent in the mechanical properties and a good energy dissipation. In contrast, it always shows the disadvantage characteristic under ambient temperature. This is due to the high reactivity of double bond in the long chains of polymer molecules. Moreover, the non-polar group of natural rubber reduces the oil resistance. The polarity of acrylonitrile butadiene rubber (NBR) indicates the retardation from oil attacking. An addition of carbon black in rubber recipe is an effective method for providing the good mechanical strength. Rubber blends are simply and cost-effective in improvement of the property requirement. For instance, the under-sleeper pad (USP) in railway track will be installed at field site. It has a chance to contact with residue oil and thermal surrounding. This work was applied the NR to support the polymeric substrates in railway systems. NR formulas and NR/NBR ratios were developed. The mechanical properties of NR filled carbon black were investigated. The NR/NBR formulations were mixed as ratio of 20/80, 30/70 and 40/60. The tensile test of aged samples was a comparative investigation. The obtained results showed that an adding of carbon black in NR recipe attributed the heat conveyed into rubber parts. The observation represented in terms of property reduction. From the comparison of NR and blended rubber, the low sensibility of double bond in NBR gave the better thermal aging. Furthermore, the polar group in NBR was also promoted the hot oil resistance.

Development of rubber tapping automatic robot and rubber tapping tool

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At present, equipment products that help in tapping rubber in the market both domestically and internationally. The innovative blade support technique is available to cut the face of the rubber bark. Confirmed academically about the efficiency of use in various environments of Thailand. In rubber garden. One of the costs incurred is the cost of collecting latex. Collecting latex in a rubber garden with a lot of space. Rubber farmers will hire a rubber tapping machine. The cost is approximately 50 percent of the amount of latex collected or as agreed. However, Thailand faces the problem of low rubber prices due to the problem of the global economic downturn or increasing the amount of rubber production in China. As a result, rubber farmers bear the burden of such costs while rubber prices fall. In order to collect latex yields, good and accurate tapping requires the skill and expertise of the rubber tapping operators to obtain good latex yields. Reduce the problem of rubber tree disease and extending the life of the rubber tree. This is to eliminate such problems and reduce the time of tapping the rubber. The invention of tools or equipment that helps to cut rubber effectively is a very important topic. In this research, the research team aims to create a automatic rubber tapping robot in the market by analyzing the cost-effectiveness to be used in practice. The rubber tapping robot is therefore a device that can help farmers save time in working and maintain constant control of rubber tapping. Including rubber tapping aids to use electric power to help save labor cost. Rubber farmers used to cut rubber instead of human labor and create a rubber tapping aid to facilitate the tapping of rubber. To reduce the cost of rubber production for farmers in the long run. It can help rubber farmers to control the time of rubber production and export to the market.

Study on rapid measurement technic of dry rubber content in latex cup lump by electrical properties

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Dry rubber content meter is substantial tool for Impartial trade on rubber cup lump. Department of Agriculture researchers proposed rapid measurement technic of dry rubber content in latex cup lumps by their electrical properties. Two probe types needle and roller were designed, in the first phase, constructed, installed and tested. Needle type probe of 25 millimeters in length and 5 millimeters apart was selected in measuring the electrical properties of cup lump samples as its penetration depth is half of the thickness. Two cylindrical rollers probe of 220 millimeters in length and 101.6 millimeter (4 inches) in diameter powered by 2 HP gear motor were designed, constructed, installed and tested. Rubber cup lump samples were each statistical divided into 9 regularly measuring parts in needle type probe. Rubber cup lump samples in rollers type probe were typically enforced to pass through 1-inch gap between two rollers. Irregular size sample of more than 3 inches thickness of rubber cup were sliced into 2 equal thickness pieces before measuring. Electrical properties of samples are measured with standard electrical measuring instruments and percentage of dry rubber content were determined by standard oven method for all sample segments. Rubber content percentage of cup lump was correlated with electrical capacitance than resistance. Electrical capacity value of the latex cup lump from needle-type and two roller-type probes were inversely correlated with the percentage of dry rubber content within the range of 0 – 75 nano-farads and 0 – 380 nano-farads and coefficient of determinations were 0.90 and 0.97, respectively. These initiate features will be utilized in designing of percentage of dry rubber content prototype meter by electrical property values in the future. Percentage of dry rubber content from DRC method of lump from fresh latex and conventional cup lump by oven method was significantly correlate. Electrical properties of latex cup lump produced in the laboratory and farmers are also significantly consistent.

(A) (B)

Fig. 1 Electrical properties measurement; (A) Needle type probe and (B) Two rollers probe.

Evaluation on physicochemical properties and stability of Thanaka bark powder for natural face powder products

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Thanaka (*Hesperethusa crenulata* Roem.) has been traditionally applied as cosmetics in Myanmar and the northern of Thailand [1] and exhibited anti-oxidant, anti-inflammatory, anti-microbial, skin lightening, and sun protection properties [1-4]. Thanaka's specification for cosmetic development are sparsely to be presented, although its flowability was reported [1]. Of which, bark was more suitable than stem for solid dosage form development [1]. Thus, this study was aimed to assess physicochemical properties and stability of Thanaka bark powder. The yellowish light brown powder (L^* = 75.63 ± 0.01, a^* = 5.58 ± 0.02 and b^* = 23.45 ± 0.02) (Fig. 1A) with bulk and tapped densities of 0.25 ± 0.00 and 0.29 ± 0.00 g/ml, was able to absorb water and oil (17.31 ± 0.77 and 13.39 ± 0.29%). The powder was ICP-MS proved to be uncontaminated with heavy metals prohibited for cosmetics. The powder morphology was plate-like crystals with fractured as SEM observed (Fig. 1B). Thermal properties examined by DSC resulted in glass transition, crystallization and melting temperatures of 66.43, 70.25 and 73.39 °C, with 51.32 ± 4.13% of crystallinity by XRD. The color slightly shifted with $\Delta E \leq 1.43 \pm 0.04$, as per morphology and thermal properties following 3-month storage under ambient temperature and 45 ºC.

(A) (B)

Fig. 1 Thanaka bark and bark powder (A) Morphology of bark powder using SEM (B).

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Utilization of lignin extracted from Thai ago-waste as UV-blocking agent for polylactic acid film

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Polylactic acid (PLA) is one of the most promising biopolymer materials derived from renewable resources. Due to its mechanical properties, biodegradability, and renewability, PLA is an interesting materials choice for packaging applications. However, PLA has a poor UV absorption that might not be suitable for UV-sensitive products. For improving this property, bio-additives were desired. Lignin is a biodegradable material which is isolated and extracted from plants. Lignin comprises mainly of aromatic monolignol that can provide a good UV absorption and anti-oxidation property. In this current work, organosolv lignin extracted from sugarcane bagasse (BG-lignin) was used as-multifunctional bio-additive for improving the properties of PLA. BG-lignin were determined using several techniques including SEM, DLS, FTIR, quantitative ^{31}P NMR, GPC and DSC. BG-lignin/PLA composite films were prepared via melt-extrusion with different addition of BG-lignin contents from 0.1 to 1.0 wt%. Properties of the obtained BG-lignin/PLA composite films including mechanical properties, UV-shielding ability and anti-oxidation property were reported and compared with neat PLA film. An increasing of BG-lignin content resulted in an improvement in UV-shielding ability. The composite film with 0.5 wt% BG-lignin exhibited almost 70% blocking of UVB. At 0.5 wt% loading content of BG-lignin, oxidation-onset temperature of the composite films increased by 33% as compared to neat PLA film.

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The study of Para rubber farming system development changing from monoculture to integrated farming for smallholder rubber farms

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This research aimed to 1) explore success stories of farmers who transformed their farming systems from monoculture into integrated farming, 2) explore success stories towards the connections between production and appropriate marketing of integrated farms, 3) compare the different success stories between monoculture and integrated farming, and 4) propose guidelines towards policies and practices on the promotion of integrated para rubber farming system. This qualitative research employed interviews as research instruments. Target population were 36 farmers who employed integrated para rubber farms in Northern, Eastern, Northeastern, and Southern of Thailand. Content analysis was used for data analysis. The primary results were presented among selected members of National Farmers Council for important reflections.

Results revealed that the monoculture averagely made profit 10,000 baht per rai; when comparing with integrated para rubber farming system, all four farmers in Chachoengsao province (Eastern) made lower than 10,000 baht profit, nine out of ten farmers in Trang province (South) made higher than 10,000 baht profit, two out of six farmers in Phitsanulok province (North) made higher than 10,000 baht profit, and six out of eleven farmers in Bueng Kan province (Northeastern) made higher than 10,000 baht profit. In summary, 17 out of 31 farmers were successful in integrated para rubber farming while the remaining 14 farmers gained lower performances due to managerial factors. The proposed policies suggested the government on the promotion of integrated para rubber farming system which brought about more sustainable regarding career persistence and more diversified agricultural productions. This could help reduce para rubber farm area indirectly. The government should promote bamboo planting integrated in para rubber farms and make use of bamboo to create bamboo-related innovations and products for economic value creation that could positively affecting community, local and societal level. Development of local researchers within communities will allow community people to analyze, plan and identify their own future. Furthermore, related government organizations should support farmers' needs when they already identified their own future by using community process.

Development of high performance particle board based Para wood reinforced with thermoplastic and bonding with citric acid and moltosdaxtrin

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The objective of this research is to process of high performance particle board based Para wood reinforced with thermoplastic and bonding with citric acid and moltosdaxtrin that meets the Thai Industrial Standard (TIS. 876-2547) using citric acid as a binder and processed by thermal compression method physical properties tests (density, moisture, water absorption, and thickness swelling) and mechanical properties test results (Tensile strength perpendicular to the surface, the tensile strength, and the modulus of elasticity) of the particle board. The results showed that the optimum citric acid test for sawdust powder in particle board production is the ratio of 20% by dry weight of sawdust powder. The test of the concentration of citric acid to sawdust powder that suitable for the production of particle board is given the ratio of 60% by dry weight of sawdust powder. The study of the temperature and time for compression molding found that the optimum compression temperature and time are 200 degrees celsius the optimum time is 10 minutes. And the study of the amount of thermoplastic and the type of thermoplastic suitable for reinforcing plywood sheet is SAN type plastic at 20% by dry weight, because it has the most suitable physical and mechanical properties. And the optimal ratio of citric acid and maltose daxtrin to be used as a binder was studied at 75:25 due to the optimal physical and mechanical properties. from the above research we will get particle board with higher efficiency than middle and low grade particle board, which is very resistant to water. There is a high strength. Binder used carcinogenic, non-toxic to the atmosphere producers and consumers they are also cheap. Therefore resulting in low production costs and can create value for sawdust from rubber wood in the future.

Comparison of prediction of moisture content of oven-dried Para rubber timber between small portable NIR spectrometer and commercial digital moisture meter

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In the year 2019, Thailand has the export value of processed rubber wood up to THB 39,166 million [1]. Before exporting to foreign countries, the quality of wood and moisture content must be inspected [2]. The sawmill uses commercial digital moisture meter to checked moisture content but the specific gravity of the wood must be known to calculate the moisture content. Currently, near-infrared (NIR) spectroscopy technique has applied to evaluate the quality of various types of wood in the wood processing industry with non-destructive method [3]. The objective of this research was to build a prediction model of moisture content using NIR spectroscopy technique and compare prediction of moisture content value between small portable NIR spectrometer and commercial digital moisture meter. The 397 of oven-dried Para rubber samples were collected from 3 locations in Thailand. All sample were scanned using the small portable spectrometer in a range of 900-1700 nm in diffuse reflectance mode and commercial digital moisture meter. Then they were determined for moisture content following ASTM D143 [4]. The moisture content of oven-dried Para rubber timber was in range 0.51-13.22% dry basis (%db). The predictive models of NIR spectra data were built by the partial least squares regression (PLSR). The moisture percentage obtained from the standard normal variate spectra using the portable NIR spectrometer had values of correlation coefficient (R) = 0.84 and the lowest root mean square error of estimation (RMSEE) = 1.07%db. Although the digital moisture meter had a higher correlation R = 0.90 there was a higher error with RMSEE = 1.20%db in predicting the moisture percentage of oven-dried timber. Therefore, using near-infrared spectroscopy technique to predict the moisture content of Para rubber timber offered a rapid and non-destructive measurement as an alternative to destructive checking moisture content of oven-dried Para rubber timber. But also, it could be used to predict the moisture content of fresh wood for future analysis. In addition, NIR spectroscopy technique could be developed to predict other chemical components of Para rubber timber in future research.

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High-harmonic generation (HHG) in silicene

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Silicene, a freshly isolated silicon allotrope with a two-dimensional (2D) honeycomb lattice structure, is expected to have electrical properties comparable to graphene [1-3]. In the application of an external electric field, we explore high-harmonic generation (HHG) in silicene. The existence of an external electric field has a substantial influence on the optical emission peaks of the low-frequency optical emission, according to our estimates [4-6].

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Development of trinary blended rubber foam for using as ceiling board

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Nowadays, global warming leads the atmosphere temperature to increase in every year. Therefore, in construction, both architecture and engineers must design the structure of a building or house to reduce heat transfer from the outside. Another way is the use of materials having low thermal conductivity. The one with that excellent performance is a rubber foam. According to the world top in 2019, Thailand was the top country exporting natural rubber (NR). To promote the usage of NR, this research is aimed to develop the NR based foam for using as a thermal ceiling board. However, NR has low weathering resistance. To overcome this disadvantage, NR must be blended with EPDM and EVA to meet the specific requirement. The effects of NR/EPDM/EVA ratio, type and loading of blowing agent and flame retardant, and also molding condition on physical properties, thermal conductivity, and flammability of the obtained rubber foam were determined. The result showed that the NR/EPDM/EVA rubber foam at 50/20/30 with chemical blowing agent of Supercell DP (dinitrosopentamethylenetramine) at 5 phr showed the lowest thermal conductivity (0.0458±0.0024 W/m.K). Moreover, its thermal conductivity was also lower than that of commercial ceiling broad. This representative rubber foam could be a potential candidate in order to use as a ceiling broad in the future.

Properties of hydroxyapatite based geopolymer synthesized from bituminous fly ash

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The engineering properties of hydroxyapatite formation on the geopolymer synthesized from coal fly ash have been studied. The ratios of Na_2O/SiO_2 and K_2O/SiO_2 at 0.15 0.20 0.25 0.30 moles were used to prepared geopolymer. The fly ash-based geopolymer containing 0.20 and 0.15 moles of Na_2O/SiO_2 and K_2O/SiO_2 gave the highest 28-days compressive strength of 21.99 and 19.14 MPa, respectively. When calcium phosphate was added to the above geopolymer samples at 2.5 5.0 7.5, 10 wt.%, the optimum calcium phosphate of 2.5 wt.% with strength of 19.03 and 13.27 MPa for geopolymers containing NaOH and KOH was selected for further heat treatment at 500 °C, 600 °C and 700 °C for 1 hours. Results showed that the heat treatment at 500 °C gave the highest strength of 9.09 MPa and 20.87 MPa for NaOH and KOH containing geopolymers. In addition, XRD diffractograms reveals the presence of crystalline phases of hydroxyapatite, mullite, quartz and sodium aluminum silicate after heat treatment of both NaOH and KOH containing geopolymers.

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A comparative study of the drying methods on drying efficiency of natural rubber gloves using microwave and hot air sources

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The aim of this research is to compare the drying methods on drying efficiency of natural rubber gloves using microwave and hot air sources. An experiment to study the influences of the difference of two heating sources uses a rubber glove heating oven that has been developed. The study the effects of the types of energy include the numbers of energy source on the pattern of temperature distribution within the rubber gloves, maturing of rubber gloves and mechanical properties of rubber gloves are studied. The results of the research found that the rubber gloves with a microwave heating process by opening both magnetons provides the highest temperature distribution and the has a highest tensile test results but has a higher energy cost than the rubber gloves with hot-air heating. The results can be providing guidance for the study of heat transfer during the production of rubber gloves with the microwave energy in the industry.

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Development of contact pressure model for motorcycle tires by experiment

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The footprint of tires is a parameter for tire grip performance. This research aimed to develop mathematical modeling of contact area and contact pressure for motorcycle tires. A smooth tread motorcycle tire employed in the study could eliminate the dependency on tread patterns. The inflation pressure and vertical load were varied to investigate effects on footprint and contact pressure. The vertical stiffness test was performed on a selected motorcycle using a tire testing machine. The vertical force of 4.4, 4.6, and 4.9 kN was assigned to accommodate the vehicle, driver, and passenger weight. The inflation pressure was 190, 220, 250, 280, and 310 kPa to cover all operating pressure ranges. The tires rotated to test at five positions along their circumference, and the results averaged to eliminate the randomness of tire position. In addition, the footprints at each pair of load and inflation pressure were collected by a pressure measurement film. The results were collected and interpreted using a conversion algorithm. The mathematical model proposes for the changing tire-ground contact area. The developed model was a good tool for predicting the tire-ground contact area to be used in the further development of another tire's characteristic models.

Monte Carlo simulations of nanotube filler in composite material: optimize programing code

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The electrically conductive polymer composites (CPCs) have attracted intensive attentions for several decades due to their flexibility and unique electrical properties. CPCs are potentially used in many applications such as flexible electrodes, batteries and strain sensors. The percolated conductive pathways are formed by conductive filler in polymer matrix which is a major effect on the electrical behavior of CPCs. Computational simulations have been used to study the percolation phenomena of CPCs. The simulation algorithms need to be developed and optimized for reducing the simulation time-consuming. In this study, the in-house Monte Carlo simulation that used to estimate percolation threshold is optimized. To simulate in the large-scale system, cutoff distance will be defined to avoid the unnecessary complex calculations. Calculation sequence within the code has been rearranged to omit the unnecessary calculation processes. Results show that the optimized version takes less processing time than the previous version around 5 times. Therefore, we can perform the large system to investigate the percolation phenomenon with less lattice confinement effect.

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Solid-state reaction synthesis and characterization of Mn-doped $LiFePO_4$ cathode material

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Olivine type $LiFePO_4$ has great advantages for Li-ion batteries due to its non-toxicity, high safety and good cycle life performance. However, its low-rate capability and low energy density make some challenges for this $LiFePO_4$. Several methods like doping with transition metals are used and Mn ion is used for this work to improve the overall electrochemical properties. $LiMn_xFe_{1-x}PO_4$ is promising cathode material owing to high voltage, structural and chemical stability. However, the electrochemical performance of these materials depends on phases and structures obtained from synthesis. In this work, the effect of solid-state reaction condition, namely calcination temperature and duration, on morphology, structure, and electrochemical properties of $LiMn_xFe_{1-x}PO_4$ cathode materials with the composition of x=0.5 was investigated. The morphology, crystallography and local structure of the synthesized materials were examined by field emission scanning electron microscope (FE-SEM), X-ray diffractometer (XRD) and Fourier-transform infrared spectrometer (FTIR), respectively. The surface area was also measured by the Brunauer-Emmett-Teller (BET) model. The effect of calcination temperature and reaction time upon the morphology, structures of the synthesized cathode materials were studied and discussed. The results could be essential for further development and for employment of $LiMn_xFe_{1-x}PO_4$ in Li-ion batteries.

Self-energy generation from graphene vibrations

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The application of electrical conductivity, extremely flexible graphene membranes, to capture energy from ambient vibrations has promising potential. We study the physics of self-energy from the vibrations and how current is created in graphene for theoretical research [2,4-6,]. We demonstrate the effects of lattice distortions on the electrical current [1,3], such as isotropic tensile strain ϵ_{is}, shear strain ϵ_{ss}, uniaxial armchair strain ϵ_{as}, and zigzag strain ϵ_{zs}. We show how this movement might cause an electrical current to flow in a neighboring circuit.

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POSTER PRESENTATION

Study of non-negligible chemical reduction of ZnO in the rubber industry

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Although the presence of small portion of zinc in the tire industry has been employed as activator, it should be concerned as the non-negligible chemical toxics and risks. The aim of this work was to study the effect of zinc oxide (ZnO) on physical and mechanical properties of tire rubber compound. The control characteristics of the composites were determined by the composites of practical compounds and vulcanizates by filling of sulfur and curing of a hot press machine. The properties of the composites, i.e. Mooney viscosity, curing time, tension, etc, were characterized. Basically, ZnO could work coupled with stearic acid (SA), the experimental was prepared by reducing ZnO at 20% and reducing stearic acid at approximately ratio to prevent excessive amount. The comparative data revealed the trend of the changes in the physical and mechanical properties just not lower at the same percentage. This recognized study supports the high possibilities in enhancing low ZnO and stearic acid content typical.

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Study of nylon textile-reinforced natural rubber composite

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This study focuses on the production of nylon-reinforced natural rubber composites. In general, technical textiles serve as reinforcement and strength materials for a wide range of applications in rubber/textile composites. The adhesion between rubber and nylon is the most important factor affecting the assembly process and the strength of the finished product. The results showed that natural rubber reinforced with nylon textiles can be efficiently prepared by splicing a single layer of nylon fabric between two layers of rubber. The nylon textile-reinforced natural rubber composite was characterized by tensile testing machines and rubber curing characteristics, etc. The main result showed that the mechanical properties of rubber/nylon composites were higher than those of pure rubber. From the experimental results, it was found that nylon fabric can strengthen the natural rubber composite material for use with car tires.

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Effect of potassium oleate on chemical structure-compression relationship of natural rubber foam

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Rubber foam-based products, such as mattresses, pillows, and cushions, are becoming increasingly popular. Rubber foam's formulation is still being developed to improve the properties, because of its wide range of applications. Potassium oleate is a surfactant for producing the rubber foam, although it can be used in different concentrations to prepare the different properties of rubber foam. The Dunlop method was used in this work, due to its simplicity and easy-to-use in the foam preparation. The effect of potassium oleate, which was used as a foaming agent, was investigated in this study by reducing the amount of potassium oleate. The density, compression, and Fourier transform infrared (FTIR) spectroscopy results showed that both density and compression of foam samples with half amounts of potassium oleate are higher than those of control sample with normal amounts of potassium oleate. Moreover, the FTIR result revealed a significant change in spectra with the reductions of potassium oleate contents. Therefore, rubber foam formulations are still developed to provide the optimum properties for suitable applications.

Study of chemical structure and mechanical properties of anionic surfactant on natural rubber foam

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Surfactants have an essential importance in the industry. An anionic surfactant is one of the most commonly used surfactants in soaps and detergents because it produces a lot of foam when mixing and is also responsible for foam formation. As a result, surfactants also function as blowing agents, which are significant in changing chemical structural, physical, and mechanical properties. The purpose of this research was to investigate the relationship between the mechanical and physical properties of natural rubber foam with varying loading contents of potassium laurate and potassium oleate as anionic surfactants via the Dunlop method. The chemical structure, physical and mechanical properties were further characterized by attenuated total reflectance-Fourier transform infrared (ATR-FTIR) and mechanical properties test. According to the results of the analysis, the rubber foam, with mixing of potassium laurate and potassium oleate, had better mechanical properties and higher density. The FTIR results showed the presence of carboxylate groups, a functional group found in the structure of potassium laurate and potassium oleate at a wavelength of 1470 cm^{-1}. An appropriate proportion of potassium laurate and potassium oleate as a surfactant, according to research, contributes to the development of improved mechanical properties. However, additional investigations and studies are required in an attempt to implement the knowledge acquired to be used in reinforcing natural rubber foam.

Study of yield percentage of epoxidized natural rubber preparation

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Natural rubber (NR) mostly composes of *cis*-1,4-polyisoprene as rubber part and a few amounts of nonrubber part, mainly proteins and lipids. For the modification of NR, hydrogen peroxide and formic acid can be applied to produce epoxidized natural rubber (ENR) in the latex stage. The oxygen atom is added to the double bond of NR during epoxidation, resulting in oxirane (epoxide). The ENR reaction was allowed to operate at 60 °C for 4 h. Characteristic infrared peaks at 870 and 835 cm^{-1} from Fourier Transform Infrared (FTIR) spectroscopy were used to calculate the mole percent of epoxidation. When the reaction time was increased, the proton-nuclear magnetic resonance (^{1}H-NMR) spectra of ENR showed an increase in mole percent of epoxidation. So, FTIR and NMR could be used to characterize the yield percentage of ENR preparation.

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Study of particle size of natural latex/polysaccharide composite

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The natural additive especially polysaccharide is interested in polymer composite field because it can be biocompatibility, biodegradability, non-toxic, low cost and easy to find. In addition, it should be used to reinforce the polymer matrix and to reduce the cost of material. This work focused on the comparison of particle size of natural latex with and without polysaccharide. Besides, the particle size of natural latex composite with polysaccharide was also investigated in various concentrations of polysaccharide. The natural latex with 5 wt.% of alginate represented the biggest particle size due to the agglomeration of rubber molecule with polysaccharide. The particle size of polymer latex is an important parameter to better understand the interaction between polymer and filler in the polymer composite.

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Theophylline extended-release monolithic matrix comprising natural rubber latex as binder

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A major component of polymer in natural rubber latex (NRL) obtained from *Hevea brasiliensis* consists of poly-*cis*-1,4-isoprene. Poly-*cis*-1,4-isoprene exhibited interesting physical properties suitable for possible use as a binder in pharmaceutical solid dosage forms such as monolithic matrix tablet. The aim of this study was to study the feasibility of using NRL as the binder in theophylline anhydrous (THE)-incorporated monolithic matrix tablet in comparison with polyvinyl pyrrolidone K-30 (PVP-30). Physical properties of granules and tablets fabricated with wet granulation and tableting process, *in vitro* drug release test and release kinetic model were investigated and compared with those prepared using PVP-K30 as a binder. THE-incorporated monolithic matrix tablet was successfully fabricated with wet granulation and tableting process using NRL or PVP-K30 as binder. Granules and tablets of monolithic matrix tablet using NRL as a binder exhibited similar physical properties to those of tablet prepared using PVP-K30 as a binder. In addition, the controlled THE release with diffusion mechanism were presented in both formulations. Surprisingly, the addition of sodium bicarbonate in THE monolithic matrix tablets employing NRL as a binder could also prolong the drug release.

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Screening for antimicrobial activity from some Thai medicinal plants

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Sixteen medicinal plant extracts prepared with percolation with 95% ethnol were screening for antimicrobial activity against *Staphylococcus aureus*, *Escherichia coli* and *Candida albicans* by disc diffusion method. Almost of the plant extracts such as *Finlaysonia pierrei*, *Typha angustifolia*, *Citrus reticulata*, *Chromolaena odoratum*, *Lemna minor*, *Allium tuberosum*, *Ruellia tuberosa*, *Gomphrena globosa*, *Cleome gyanadra*, *Azima tetracantha* and *Colocasia gigantea* exhibited antimicrobial activity against both *S. aureus* and *C. albicans*. *Neptunia oleracea* and *Acacia pennata* subsp. *Insuavis* extracts had activity against only *S. aureus*. *Barleria lupulina* and *Clinacanthus nutans* extracts inhibited only *C. albicans*. *Talinum fruticosum* extract did not exhibit an activity against all test microbes. None of the plant extracts had antibacterial activity against *E. coli*. In conclusion, *F. pierrei* and *T. angustifolia* showed high antimicrobial activity against *S. aureus* and *E. coli*.

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Effect of arecoline, aqueous and methanolic areca nut crude extracts on rumen fluke

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Paramphistomosis is a parasitic disease that causes a reduction of livestock production and economic losses worldwide. To avoid side effect and chemical residue from usage of chemical drugs, medicinal plant is a good source of natural medicine for treatment of fluke infection. Areaca nut, a seed of *Areca catechu* tree which is a domestic plant in Southeast Asia, had antihelmintic activity. In this study, arecoline, aqueous and methanolic extracts of areca nut prepared in solutions were tested for antihelmintic activity against rumen flukes. The parasites were incubated in a culture media (RPMI-1640, pH 8) at 39 ºC in a carbon dioxide-incubator containing 0.01, 0.1 and 1 mg/ml of the tested compounds for 15, 30 min, 1 hour and 24 hours. The results showed that the methanolic and aqueous crude extracts from seeds of *Areaca catechu* and arecoline HBr at concentration of 1 mg/ml solutions could destroy the tegument (surface membrane) of the flukes and killed them all at initial time. Thus, these areca nut extracts exhibited the potential alternative medicine for paramphistomosis treatment in cattle.

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A grafting reaction of acrylamide onto saponified natural rubber using UV irradiation

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The preparation of functionalized saponified natural rubber (FSP) latex using UV irradiation as a continuous process was studied under various conditions and then subjected to compounding with silica to improve the compatibility of silica-filled NR products. Natural rubber (NR) from *Hevea brasiliensis* grafted acrylamide (AM) monomer by treatment with a high-pressure mercury UV lamp to enhance the polarity and mechanical properties of NR after functionalization, which can confirm the structure by FT-IR and ^{1}H-NMR spectroscopies. Moreover, it was found that the suitable condition for the functionalized reaction as a continuous process was 10% DRC of latex concentration, 10 phr of AM content, 4 phr of Irgacure 2959 content, 10 ml/min of flow rate, and 6 cm of distance between sample and UV lamp, which was confirmed by nitrogen content and grafting efficiency. The improvement of silica-rubber interaction was confirmed by an increasing the bound rubber and less silica aggregation from SEM images. Therefore, it can be concluded that FSP by using UV irradiation as a continuous process is a good material to improve the silica-rubber interaction and mechanical properties of NR.

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A photochemical modification of deproteinized natural rubber latex (DPNRL) to be a hydroxyl-terminated DPNRL using TiO_2 film as a catalyst

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Recently, there have been many attempts to modify natural rubber latex (NRL) to give it specific properties in a greater range of applications. Hydroxyl-terminated NR (HTNR) is engaged in making NR easy and versatile to use in numerous applications. Our work, a so-called a telechelic low molecular-weight NRL (TLNRL), was prepared from deproteinized NRL (DPNRL) *via* photochemical decomposition using TiO_2 film coated on a glass substrate as a catalyst associated with H_2O_2. As a result of the UV cutoff of a glass substrate, light energy is lost in the photodegradation process; quartz as another substrate was also used for coating TiO_2 film. The TiO_2 film was analyzed by X-ray diffraction (XRD) and atomic force microscopy (AFM). Moreover, the mechanism of photochemical degradation on the rubber particles was concurrently studied by various factors, *i.e*., rubber concentration, rubber particle size, and the surfactant concentration used to stabilize latex. The obtained products were subjected to characterization by GPC for molecular weight, FT-IR, and NMR for microstructure. It was found that TiO_2 film coated on the quartz substrate exhibited unique diffraction peak for the anatase @101°. The film was photochemically active and showed higher photocatalytic efficiency than glass substrate. It was found that the HTNR could be produced efficiently, in the case using DPNR latex at 10% DRC (pH 5) with 20% w/w H_2O_2 and TiO_2 film coated on a quartz substrate.

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A model study on the impact of metal ions on prevulcanization of concentrated natural rubber latex and dipped-products

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Natural rubber latex exists as a colloid of rubber particles formed by long polyisoprene (PI) chains coiled up in a globular structure stabilized by a mixed layer of protein and phospholipids [1]. However, the metal ions present on the surface of NR hinder the adsorption and reaction of the vulcanizing agent with the particles of rubber [2]. In addition, these metal ions also reduce the stability of the latex by creating the interaction with the carboxylate ion at the surface of the rubber particles [3]. In the present work, the influence of some heavy metal ions on the stability and vulcanization efficiency of uncompounded and compounded high-ammonia natural rubber (HANR) latex was carried out by an exogenous addition. The compounded HANR was coagulated after adding $Mn^{2+}$and Mg^{2+}; meanwhile, it was unaltered by Zn^{2+}, Fe^{2+}, and Cu^{2+} ions. Therefore, these metal ions were chosen further to study the pre-vulcanization of compounded HANR latex. The presence of Zn^{2+}, Fe^{2+}, and Cu^{2+} in the latex is responsible for delaying the vulcanization process and changing the appearance of compounded latex. Before compounding, the addition of such metal ions led to the reduction in tensile strength of the obtained gloves. In contrast, an insignificant difference in tensile strength was observed in the case of the addition of metal ions after compounding. The addition of metal ions hindered the diffusion of compounding ingredients into the rubber particles.

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Role of non-rubber components on the properties of silica-filled rubber compounds in the presence of TESPD as a silane coupling agent

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Natural rubber (NR) is a biopolymer with outstanding properties leading to producing the products, especially tires. Silica is a popular reinforcing filler for the rubber compound. It has a high polarity, resulting in silica agglomeration in NR. Therefore, a silane coupling agent is applied in a silica-filled NR compound for enhancing the compatibility between silica and rubber. In addition, the proteins on rubber particles affected the silanization via hydrogen interaction with silica, resulting in the better compatibility between the silane coupling agent and silica [1,2]. In this work, the interaction between the silane coupling agent and silica-filled NR materials was investigated to show the components influencing the filler-filler and filler-rubber interaction along with mechanical properties. The different rubber types, including fresh NR, deproteinized NR (DPNR), and polyisoprene (IR), were used to prepare a silica-filled rubber compound. They were mixed with *bis*-triethoxysilylpropyl disulfide (TESPD) and silica by an internal mixer at 150 °C. Silica dispersion was studied from the Payne effect of the unvulcanized rubber samples. In contrast, vulcanizing rubber samples were characterized by a swelling test to determine crosslink density in the rubber sample. The results showed that non-rubber components play an important role in enriching the crosslink density. The tensile strengths of NR and DPNR compounds with TESPD were higher than the one without TESPD, except for the IR compound.

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Elemental analysis of natural rubber latex from RRIM251 and RRIM600 clones

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Natural rubber latex (NRL) obtained from the rubber tree *Hevea brasiliensis* consists of 94% of *cis*-1,4 polyisoprenes and 6% of non-rubber components such as proteins, lipids, sugars, and various elements. Little is known about the trace element composition of NRL. It can be affected by several factors, such as rubber clone, cultivated area and collection period. In this work, the elemental analysis of NRL were performed by using X-ray fluorescence (XRF). The NRL was collected 4 times a year from two rubber clones (RRIT251 and RRIM600) and from two cultivated areas, eastern and southern regions of Thailand. The major trace elements in NRL were zinc, sulfur, potassium and silicon, which were possibly caused by the addition of silicon acid during cultivation to improve plant resistance to insect damage and fungal diseases and the addition of ZnO, tetramethylthiuram disulfide (TMTD), alkali stabilizer (KOH, potassium laurate or potassium oleate) during the preservation of natural rubber latex against coagulation. The RRIM600 clone tended to provide higher trace elemental contents than the RRIT251 clone. Regarding to the cultivated area, both clones from eastern region provide higher element contents than those from southern region. Moreover, the elemental contents of the NRL collected during rainy season, from June to October, were significantly less than those collected during dry season, from December to February.

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The validation HPLC method for determination of gambogic acid in gamboge resin

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Gambogic acid obtained from plant resin of *Garcinia* species has anticancer properties. This study focuses on the development and validation of the high-performance liquid chromatography (HPLC) method for the quantification of gambogic acid (GA) content in the gamboge raw sample. The chromatographic system was performed on C18 column (150 × 4.6 mm, 5 µm). The system consisted of acetonitrile and 0.1% orthophosphoric acid (85:15 v/v) as mobile phase with a flow rate of 1.5 mL/min. The detection was carried out at a wavelength of 360 nm and the retention time of GA was evident at 9 min. The method was validated according to ICH guidelines. The obtained calibration plot exhibited good linearity in the range of 5 to120 µg/mL ($r2 > 0.999$). The percentage recovery GA spiked in the gamboge sample ranged from 98.87% to 102.92%. The LOD and LOQ were shown to be 2.069 and 6.271 µg/mL, respectively. The validation study demonstrated that this method was simple, specific, and applicable for quantitative analysis of GA in gamboge resin.

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A new procedure of powder-free latex glove manufacturing using a mixture of carboxylated nitrile butadiene rubber and polychloroprene for surface coating of NR film

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Natural rubber (NR) latex is an excellent material widely used for manufacturing various kinds of dipping latex products, especially surgical gloves. However, the absorption of contaminating like proteins in NR latex present in the powder, as a lubricant, is acknowledge to originate the allergy to the customer. The way to solve this problem is the production of the powder-free surgical glove. This present work attempts to apply the surface coating technique using carboxylated nitrile butadiene rubber (XNBR) on the NR film surface. Due to quite different polarities between XNBR and NR, the adhesion of XNBR and NR become poor. Thus, to improve the adhesion between XNBR and NR, the XNBR would be blended with polychloroprene (CR) before coating on the NR film. The effect of CR content on adhesion was studied. The obtained gloves were subjected to characterization according to the ISO 10282, including physical properties, peel strength, surface morphology, and contact angle. It was found that the adhesion between XNBR and NR films was improved by blending CR/XNBR at ratio 20/80. Tensile strength, modulus 300%, peel strength and contact angle of the obtained gloves tend to increase with increasing CR contents. In addition, SEM micrographs shows the surface of NR film coated with XNBR/20phrCR blends without fracture after 500% elongation. Furthermore, it can be deduced that the adhesion between XNBR and NR films can be improved by blending XNBR compound with CR latex.

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Electrochemical performance of binder-free and flexible spinel $NiCo_2O_4$ electrode

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This research aims to study the one-step hydrothermal synthesis of a binder-free and flexible spinel nickel cobaltite ($NiCo_2O_4$) electrode for supercapacitor application. The hydrothermal synthesis method is well known to generate highly crystalline products, with high purity, narrow size distribution, and low aggregation of particles. The spinel $NiCo_2O_4$ nanoparticles were grown on a flexible carbon cloth substrate under hydrothermal conditions at 130 °C for various reaction times (1, 3 and 6 h). The morphology of the $NiCo_2O_4$ samples synthesized from 1 h to 3 h are nanosheets-nanowires, the formation of nanosheets completely transformed into nanowires with increasing reaction times from 3 h to 6 h. The electrochemical properties of $NiCo_2O_4$ electrodes were investigated. The $NiCo_2O_4$ electrode prepared for 6 h exhibit the highest specific capacitance and the lowest charge transfer resistance compared with the other electrodes.

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Study of porous rubber pipes reinforced with waste tire fibers and pineapple leaf fibers for smart irrigation system

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Global trend in waste management involves sustainable development for waste, resource efficient according to the concept of circular economy. Wastes from worn-out tires have been known as a world problem and not yet to be resolved successfully. In this work, wastes from worn-out tires, i.e., ground tire rubber (GTR), reclaimed rubber (RR) and waste tire fibers (WTF) were used to produce reinforced porous rubber pipes as irrigation system for smart farming. In addition, comparative study of porous rubber pipes reinforced with natural fibers (pineapple leaf fibers, PALF) was also carried out. The experiment was divided into 2 parts, i.e., porous sheets (model study) and extruded porous pipes. Compound samples were prepared from mixing GTR, RR, and natural rubber (NR) at a ratio of 60:20:20 (by weight) with other additives by using an internal mixer, then shaped into samples by using a compression molding machine (sheets) and a single-screw extruder (pipes). Samples were vulcanized by hot air oven. Factors affecting sample properties were studied, such as fiber types (WTF and PALF) and fiber loadings (0-15 phr). Then, properties of the samples were characterized, such as, cure characteristics, mechanical properties, morphology, water permeability rate, %diameter swell and burst pressure. When WTF or PALF loading was increased, it was found that tensile strength and tear strength were increased up to an optimum point at 12 phr. Mooney viscosity, M100 and hardness were increased with increasing fiber loading. However, %elongation at break had a trend to decrease. Morphologies of the composites for both fibers were insignificantly different with good fiber distribution. By adding the fibers, %diameter swell and burst pressure were clearly improved. Pipe samples were also tested in precision smart agriculture system. It can be proven that WTF and PALF can be used to reinforce the porous pipes and used as a watering device for precision irrigation systems.

Study of bladder release agent formulas and comparative study to evaluate release agent efficiency by using reciprocating tribometer

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It has been known that "bladder" is one of the most important components in tire manufacturing process. Tire industry has been yearning for bladders with permanent coatings for non-stick surface with long service-life. Bladder coated with good release agents can help reducing nonconforming products and increasing production efficiency. In this work, semi-permanent and permanent release agent formulas were studied. A new method to evaluate release agent efficiency by using a reciprocating tribometer were also carried out. First, silicone-based release agent formulas were developed with and without methyl hydride promoter. Effects of fluorocarbon additives in the formulas were also studied. Comparative studies of bladder release agents were tested for their mold release efficiency and durability. In the second part, a new method of mold release performance test was developed by using a tribometer with reciprocating mode according to ASTM G133-05. It can be used to determine coefficient of friction of the coated surface and wear resistance of the coatings. Factors affecting the test method were studied including force, speed, and distance. Coating durability test was also confirmed by compression molding technique to determine the number of release cycles. It was found that friction coefficient of the coatings could be related to the mold release ability and durability of the release agents. The new technique can be used to estimate the service-life of the coated bladders. It can be used as a guideline for development of mold release agents in tire manufacturing industry.

Wood Plastic Composites (WPCs) from multilayer packaging waste and rHDPE as pallets for green industry

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People are becoming more aware of plastic pollution. Consumers, researchers, and manufacturers are seeking ways to reduce their contribution to the problem. Management of plastic wastes has still been severely environmental problems, especially those with multilayer or multicomponent structures due to the difficulty in recycling process. According to the concept of circular economy, this research aimed to overcome these problems by recycling the multilayer plastic film wastes after use from consumers (classified as post-consumer recycled (PCR) plastics) and transforming those into high-value products. In this work, Wood Plastic Composites (WPCs) made from mixtures of multilayer packaging waste (PCRs), recycled high density polyethylene (rHDPE) and wood powder were studied in order to be used as pallets in green industry. Studied factors affecting WPCs properties included PCR types (multilayered oriented polyamide (OPA)/PE and polyethylene terephthalate (PET)/PE films) and rHDPE:PCR weight ratios (40:5, 35:10, 30:15 and 25:20). WPC samples were compounded by melt-mixing by a two-roll mill and then shaped into samples by a compression molding machine. Morphology, density, mechanical and thermal properties of WPCs were examined. From SEM morphological study, it was revealed that wood powders and fibers (55 wt%) were well distributed and randomly oriented in WPCs. Both PCRs (OPA/PE and PET/PE) were partially melted because the processing temperatures were below the crystalline melting temperatures of OPA and PET. PCR orientation in WPCs was aligned with the compression direction. Mechanical properties of WPCs with OPA/PE were similar to those of WPCs with PET/PE. WPCs with rHDPE:PCR weight ratio of 40:5 and 35:10 had good mechanical properties which passed the industrial target values. Optimum formulas were then used to form WPC samples by extrusion technique and fabricated into WPC pallets. It was found that the WPC pallets from wastes showed promising properties with high potential to replace conventional pallets in warehouses and industrial transport for green industry.

Bio-based cellulose nanocrystals filled epoxidized natural rubber/chitosan composites: self-healing and enhanced mechanical properties

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Cellulose nanocrystals denote a promising and environmentally friendly reinforcing nanofiller for polymers, especially for rubbers and elastomers. Here, a simple method of latex mixing is used to manufacture high strength bio-based healable rubber based on epoxidized natural rubber (ENR)/chitosan. Cellulose nanocrystals (CNCs) with a high aspect ratio are modified with aminosilane and used as a filler to improve the mechanical properties and self-healing behaviour of the material. By introducing dynamic hydrogen bond supramolecular networks between oxygenous groups of ENR/chitosan and hydroxyl groups on the CNC surface, along with chain inter diffusion in permanently but slightly cross-linked rubber, self-healing and mechanical properties are expedited significantly in the resulting materials. CNC content, healing time and healing temperature have significant effects on healing behaviour. The synergistic effect between molecular inter-diffusion and dynamic hydrogen bond supramolecular networks plays an important role of the improved self-healing behaviour.

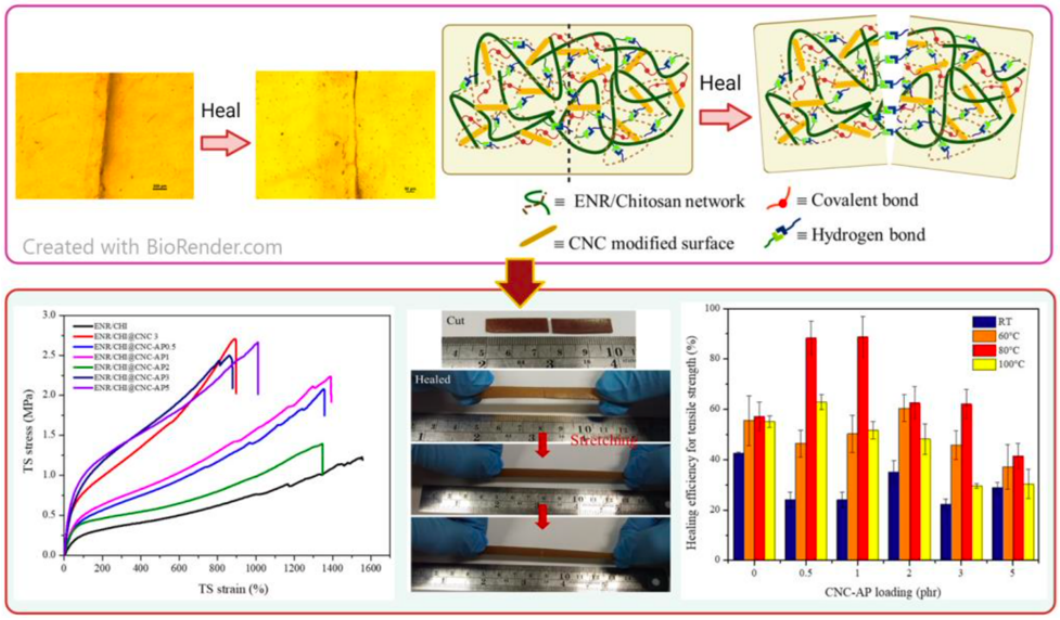

Fig. 1 ENR/Chitosan/CNC composite for self-healing and mechanical properties.

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Cure characteristics and tensile properties of styrene-butadiene rubber composites: influence of ZnOs types as an effective curing activator

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This work aims to characterize and compare the efficiency of using three different commercial ZnO (including White seal, NC236, and Az12N) as an activator for styrene butadiene rubber (SBR) composites. X-ray diffraction (XRD), dynamic light scattering (DLS), specific surface area, were investigated. Az12N had the largest surface area and smallest size, which has a positive effects to proficiently cured the SBR. The variation of ZnO loading was studied from 0, 1, 3, and 5 parts per hundred of rubber (phr). The results show that all ZnO exhibits the highest torque difference, crosslink density and tensile properties with an optimal loading of 3 parts. Especially Az12N filled SBR, the largest surface area can effectively improve the overall performance. However, the SBR filled with NC236 can reflect the same potential as the two types of ZnO, despite the relatively low composition of ZnO. This effect would strongly answer the environmental friendliness.

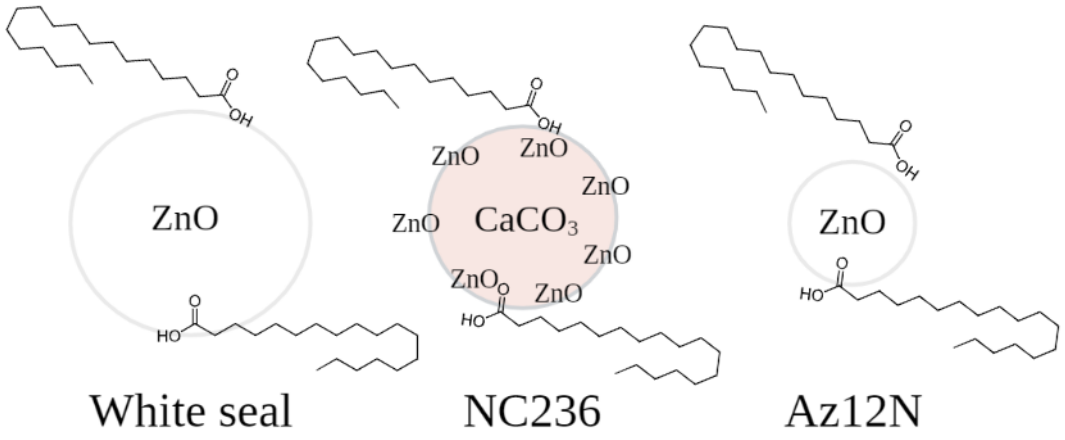

Fig. 1 ZnO (White seal, NC236, and Az12N) interacted with stearic acid.

Investigation of heated silver nanowires under surface modification

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Silver nanowires (Ag NWs) have received much attention and applied in many fields due to their excellent conductivity. Hence, Ag NWs were usually integrated with low conductive materials to enhance the conductivity of the overall system. In some conditions, the surface of Ag NWs need to be modified before combining with other materials. There are many ways to modify and prepare the surface of Ag NWs, for example, ligand exchange which is a simple process. TOPO (trioctylphosphine oxide) is a strong coordinating ligand and is classified as an essential component for low-dimensional nanomaterials. In comparison, ODE (1-octadecene) is a noncoordinating ligand that is often used in quantum nanomaterials preparation. In this experiment, we investigated the heat effect for ligand exchange of TOPO and ODE on the surface of Ag NWs under variations of temperatures and reaction times. The scanning electron microscope showed the rough surface when TOPO was added, and there was no noticeable change of surface when ODE was added. These results are promising for the preparation of heterostructure in the future.

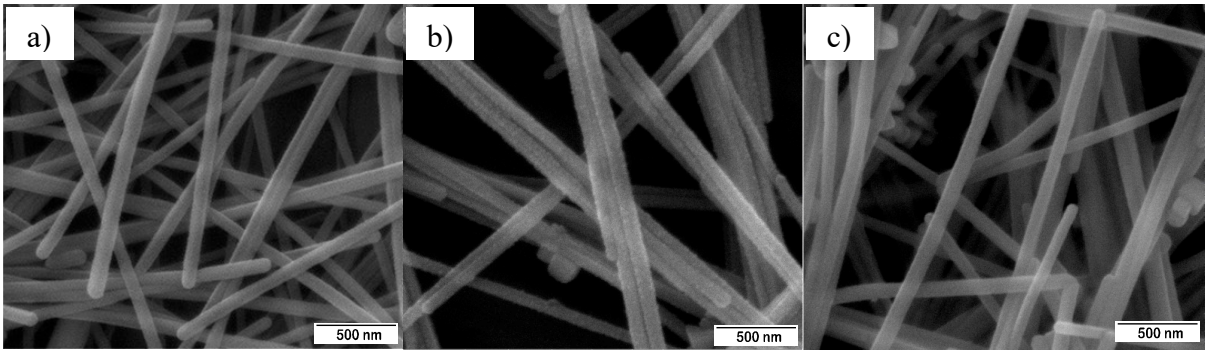

Fig. 1 SEM images of a) bare silver nanowires, b) silver nanowires with TOPO and c) silver nanowires with ODE.

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Investigation of freshly prepared AgCl for high yield silver nanowires under polyol method

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Silver nanowires (Ag NWs) have attracted much interest in academics and industries because of their potential applications in electronic devices such as flexible displays, pressure sensors, temperature sensors, and conductive layers. Generally, silver nanowire synthesized by the polyol method is the most common and promising chemical reaction. However, its by-products, a mixture of Ag NWs and silver nanoparticles, reduced Ag NWs' performance. In this work, we reported Ag NWs synthesis by using freshly prepared silver chloride as seeding material. It is crucial in supporting the creation of Ag NWs. The results showed that the by-product minimized compared to using commercial silver chloride. We investigated the different amounts of freshly prepared silver chloride. In addition, we also found that avoiding boiling bubbles in flask by injecting ethylene glycol resulted in decreasing nanowires degradation. Furthermore, instantaneously lower temperature after finishing at design cooking time helps reduce creating its by-product.

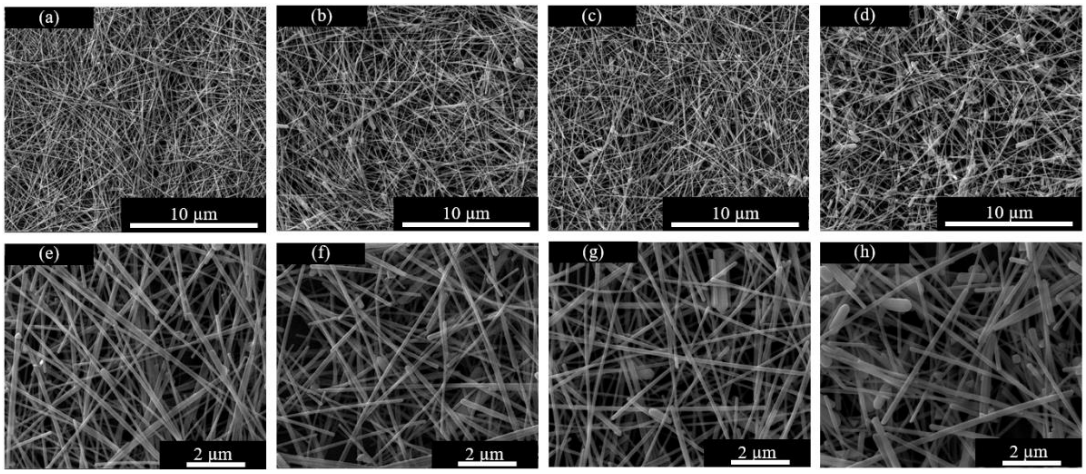

Fig. 1 SEM images of Ag nanowires grown with the polyol process by various amounts of freshly prepared AgCl which are 1.7 mg (a,e), 10 mg (b,f) 15 mg (c,g) and 20 mg (d,h).

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The effect of shot peening on corrosion performance of anodized laser powder bed fusion manufactured $AlSi_{10}Mg$

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Anodizing is commonly used on aluminium to improve the surface properties of the product for better corrosion resistance and wear resistance. In this research, the anodizing of laser powder bed fusion (LPBF) manufactured AlSi10Mg parts which were subjected to prior shot peening (SP) were investigated. Anodized specimens were analyzed using SEM imaging and the corrosion properties were examined considering the effect of residual stress relief heat treatment and the SP process. The results showed that the SP deteriorates the corrosion performance of the material as such, but together with the subsequent anodizing it resulted to the lowest corrosion current of all investigated structures. As the SP can be used to lower the surface roughness of the LPBF parts and to increase fatigue life as well, the results of this work further encourage the use of SP with anodizing.

Mechanical properties of laser welded and adhesively bonded ultra-high-strength steel lap joints

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The need to manufacture lightweight structures from ultra-high-strength steels is forcing industry to look for new joining technologies. Hybrid joints are one of the new ways to join materials. This paper investigates joining ultra-high strength steel plates using laser welding and adhesive bonding. Steel used in this paper was abrasion resistant steel (AR600) with tensile strength (Rm) ≥ 2 GPa. Three different adhesives were used in the experiments. The weld profiles were investigated using optical microscopy. The mechanical properties of the lap joints were evaluated by hardness measurements and tensile tests. Examining the profiles of the welds, it became clear that the adhesive causes an air gap between the plates, which affects the profile of the joint. Based on tensile tests, the use of adhesive in addition to the laser weld significantly improved the shear strength of the lap joint as seen from Fig.1.

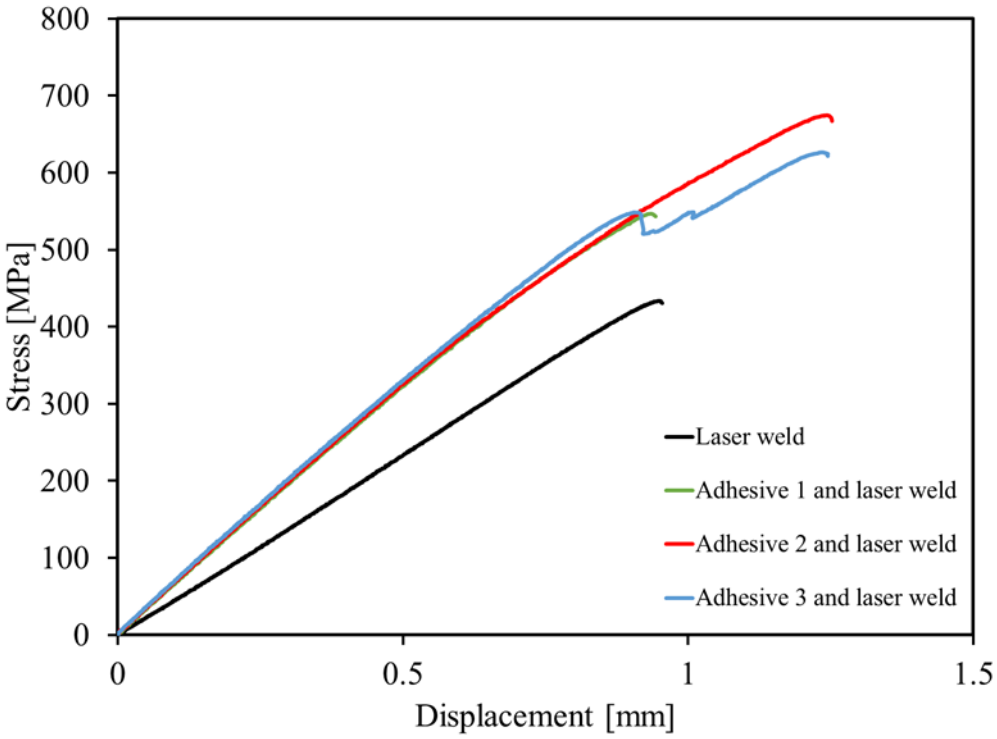

Fig. 1 Shear stresses of the lap joints.

Physico-chemical properties of artificial tear ducts from fractionated Thai silk fibroin solution

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Artificial tear ducts (ATD) or Jones tube, have been used in patients with tear ducts obstruction for draining tears into the nose. Commercial ATDs are generally made of glass but they have slippery surface causing the ducts pushing out and easily broken [1]. Polymer-based ATD, such as silicone and polyethylene are more flexible and adhesive to tissues [2]. However, the users could encounter material-related problems due to allergic reactions, low tissue adhesion and complications. Generally, ATDs are reported to have 1.5-3.5 mm. inner diameter, 18-40 mm. length, [1-2]. We designed artificial tear ducts from Thai silk fibroin solution (SF). The SF was fractionated using freeze-thaw cycles (-4 °C and 25 °C for 5 cycles) into SF-P (precipitants, 63.53±4.58% yields) and SF-S (soluble, 34.05±5.76% yields (w/v)). The concentrated solutions (20%W/W) of SF, SF-P and SF-S were dip-coated into tubes. The leaking test was performed using simulated natural tear flow rate of 0.0022 ml/min [3] for 6 hr. SF-S duct lost its shape and leaked. Absorption of the balanced salt solution (BSS) of the SF and SF-P were at 5.67±0.76% and 8.05±1.28 %Wt respectively, giving their wet inner and outer diameters at 2 and 2.5 mm. and the thickness 500 microns. Crystallinities of SF and SF- P analyzed using ATR-FTIR, were at 53.21 and 55.89% respectively. Thermal decomposition temperature of SF and SF-P analyzed using TGA, were at 273.5 and 274.5 °C. Degradability in BSS containing lysozyme 1.69×10^5 U/mg to mimic tears [4] at 37 °C *in vitro* showing that both ATDs are stabilized for at least 4 weeks. Both samples are in the process of mechanical strength, surface wetting, and capillary evaluation. From these early test results, SF-P had the highest potential for further developed into natural polymer based ATDs.

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SERIES SEMINAR

Sustainable development goals

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The Sustainable Development Goals were established by the United Nations in 2015 and aim to be achieved by 2030. It is divided into 17 interlinked global goals which include as follows: No Poverty, Zero Hunger, Good Health and Well-being, Quality Education, Gender Equality, Clean Water and Sanitation, Affordable and Clean Energy, Decent Work and Economic Growth, Industry, Innovation and Infrastructure, Reduced Inequality, Sustainable Cities and Communities, Responsible Consumption and Production, Climate Action, Life Below Water, Life on Land, Peace, Justice and Strong Institutions, Partnerships to achieve the Goals. All these goals are connected and support each other to improve human societies. These goals are built up as a blueprint to be applied to all countries. The interlinked goals will make communities better and more sustainable.

Fig. 1 The 17 targets of sustainable gevelopment goals.

Knowledge transfer from university to community for sustainable community development: a case study of Khung Bang Kachao communities, Phra Pradaeng district, Samut Prakan province

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The philosophy, vision, mission, goals, and strategies of Kasetsart University are focused on collaboration between departments and faculties in order to create learning models that improve the quality of life for Thai communities and all sectors of society. Kasetsart University has been funding this program since 2014 and is currently presenting it. Our teams' knowledge and technology were delivered to the communities in Khung Bang Kachao on the following issues: The first workshop, which served as a learning resource and a source of extra income for community stakeholders (sub-district Songkanong) and students (Wat Pa Ked school) in the Kung Bang Kachao area, Phra Pradaeng district, Samut Prakan province. The workshop's outcomes demonstrated that participants could breed earthworms on their own and earn extra money in a sustainable manner. Following our session, the participants continued to share their skills and provide help to communities. The school director and instructors of Wat Pa Ked School were awarded the first prize from the Office of the Basic Education Commission, as well as several other accolades, for the automatic machines for vermicompost worm sorting and young sunflower seedling harvesting that they invented by themselves. Furthermore, following the workshop, ecological tourism was established in the communities. Finally, as a result of the workshop, schools and communities were shown to be a sustainable source of learning and additional income. The second workshop, "The Usage of Black Soldier Fly Larvae to Reduce Organic Waste in Schools and Communities in Kung Bang Ka Chao Area, Phra Pradaeng District, Samut Prakan Province," was conducted. The training's outcomes assisted teachers, students, and communities in the Kung Bang Kachao area accomplish their goals of knowledge transfer. The trained individuals applied their knowledge to managing household organic waste and generating other benefits in order to increase their revenues. Further workshops could be used to expand the production scale. The application of knowledge on the rearing and use of the black soldier fly was integrated into the core knowledge and evolved into a local curriculum for the Khung Bang Kachao School Group for the most recent workshop. The training's outcomes were written into a local curriculum prototype as well as a guidebook on how to raise and use the black soldier fly, which will be turned into a local curriculum by Khung Bang Kachao School Group and other interested schools. Finally, all workshops fulfilled their objectives, and the community demonstrated its ability to produce and disseminate knowledge in a sustainable manner.

Fig.1 Knowledge transfer from Kasetsart University to community at Khung Bang Kachao communities, Phra Pradaeng district, Samut Prakan province for sustainable community development.

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Solar energy materials for photovoltaic and photoelectrochemical applications and devices

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An interdisciplinary covered exchange of material related information between the two major fields of research in photovoltaics (PV) and photoelectrochemistry/photocatalysis (PEC) can provide the basis to overcome recent limitations by mutual learning and synergizing already achieved knowledge and experiences. In actuality, it is a fact that the academic and applied research on photovoltaic applications and devices combined with industrial production processes grown rapidly over the last twenty years. Several markets were explored and a competitive, self-promoting mass-production of PV-active solar modules and PV-based power plants were established by reputable, worldwide active companies. Instead of that, research and application of photoelectrochemically active devices stay clearly behind this progress.

Focusing on current challenges about climate change, artificial carbon dioxide capture plus activation together with an ongoing replacement of fossil energy fuels against storable chemical energy fuels produced by using primarily renewable energy sources, like wind or solar energy, electrochemical processes entirely and (photo)electrochemical active devices will gain in importance. One major goal in field of research is still an technical solar driven fuel- and fine chemicals synthesis unit implemented by decentral organized (photo)electrochemical active systems. In this contribution, several solar energy materials for photovoltaic and photoelectrochemically active applications were analyzed looking to their advantages and disadvantages for direct application, utilization as hybrid-device and their PV-based combination with electrolyzer-units in focus for an artificial fuel synthesis of hydrogen gas and short chain hydrocarbons.

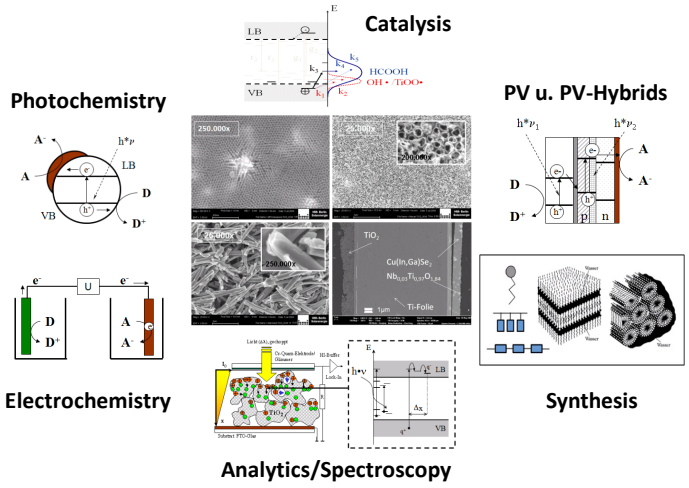

Fig. 1 Fields of research touched with the topic of solar energy conversion materials.

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Flow and fine: a new ventilation system integrating wireless technology to improve residences indoor conditions under new normal

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Under COVID19, nations worldwide imposed strong measures and issued various recommendations to face reduce contamination. The ones that affected human life include stay home help nation, work from home, travel restrictions and curfew. As a consequence, owners of houses, architects and professionals adopted various options and developed innovative approaches to adapt to this new normal living. New houses design is now introduced into the market. This paper reports on the design, development and performance of a new ventilation system named "flow and fine". It includes, mainly, a small solar panel, door vents, air intake, sets of fans and a Smart Universal Ventilation Controller (SUVC). The design concept is to fully ventilate the residence at appropriate rates by admitting fresh ambient air at one side, circulating inside the living space then moving to the bedrooms to be exhausted to the outside at appropriate positions located on different sides. SUVC optimizes the use of electricity produced by the solar panel or from the grid. SUVC can be controlled from anywhere through WIFI or using remote control while at home. Flow and fine can improve indoor conditions, reduce temperature and remove humidity and odors and assist residents for self-isolation to reduce risk of home contamination. It is easily installed and maintained in existing and new houses. Two modes of operation are provided for residence owner to select based on indoor temperature or programmed schedules.

NMR characterization of conformational interconversions of Lys48-linked ubiquitin chains in solution

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Polymeric ubiquitin (Ub) chains, in which several Ub proteins are connected through specific isopeptide bonds, are known to paly regulatory roles in various cellular processes. The Ub chains conjugated by different linkages carry distinct biological information as "Ub code", which is read out by specific Ub-interacting proteins, which generally recognize the hydrophobic surfaces displayed on the Ub chains. The Lys48-linked Ub chains, which serve as tags for proteasomal degradation, undergo conformational interconversions between open and closed states, in which the hydrophobic surfaces are exposed and shielded, respectively.

Here we provide quantitative view of such dynamic processes of Lys48-linked Ub chains in solution. The native and cyclic forms of diUb, triUb, and tetraUb chains were prepared with isotope labeling by *in vitro* enzymatic reactions and subjected to comparative NMR analysis. Our NMR results showed that the native Ub chains exhibited temperature-dependent conformational equilibria between closed and open states primarily through transient hydrophobic interactions at the inter-subunit interface [1]. We successfully determined populations of the open and closed states for each Ub unit of the native Ub chains. Furthermore, our data show that the most distal Ub unit in the Lys48-linked Ub chains is most apt to expose its hydrophobic surface to solvent, suggesting its preferential involvement in interactions with the Ub-recognizing proteins. We also demonstrate that a mutational modification of the distal end of the Ub chain can remotely affect the solvent exposure of the other Ub units. These data suggest that the Lys48-linked Ub chains may offer unique design frameworks for creating allosterically controllable multidomain proteins.

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Molecular dynamics simulation of disease-related biomolecules

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Protein aggregates such as spherical substances called oligomers and acicular substances called amyloid fibrils (Fig. 1) cause more than 30 kinds of diseases. For example, Alzheimer's disease is thought to be caused by aggregated amyloid-β (Aβ) peptides. To overcome these diseases, it is essential to understand the aggregation and disruption mechanisms of Aβ peptides. We have performed such MD simulations of oligomers and amyloid fibrils [1-7].

Another target of our research is the RNA-dependent RNA polymerase (RdRp) of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which causes coronavirus disease 2019 (COVID-19). We performed all-atom molecular dynamics simulations to clarify the recognition mechanism of RdRp for drug candidates, such as remdesivir and favipiravir, and ATP. We found that the multiple lysine residues of RdRp carried the ligands to the binding site like a bucket brigade, as shown in Fig. 2 [8].

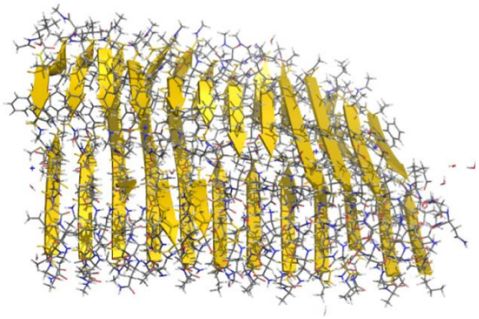

Fig. 1 Snapshot of Aβ amyloid fibril.

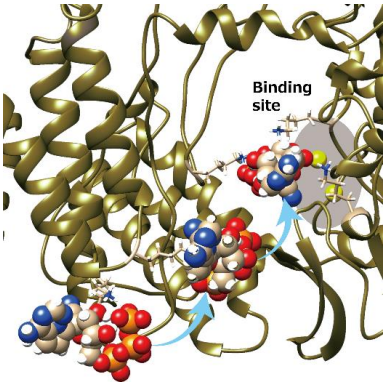

Fig. 2 Remdesivir is transferred to the binding site of the RNA polymerase while being passed from one lysine residue to another.

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