

Simple Design and Synthesis of Environmentally Friendly Functional Materials Based on Ester/Amide Building Blocks

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Biodegradability of polymer is known to rely on the short C-C repeat unit of building blocks containing hydrolyzable bonds, i.e., ester and amide. This is because those building blocks allow the microbial adhesion along with hydrolysis to convert them into carbon dioxide, water, and biomass under appropriate temperature and moisture conditions. Polylactic acid (PLA), polybutylene succinate (PBS), and polycaprolactone (PCL) are good examples to learn how biodegradability proceeds. From this viewpoint, we pay our attention on designing functional polymers consisting of those building blocks to obtain environmentally friendly materials. The presentation will demonstrate (i) arabitol containing star PLA building block as PLA toughening agent, aniline-PLA building block as conductive agent, poly (ester amide) building block for bio-elastomer, and branching PLA-co-PBS building block for shape memory.

Speaker: Prof. Suwabun Chirachanchai

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Education (Degree/Place/Year of Graduation)

Ph.D. (Applied Fine Chem., Functional Polymer)/Osaka University, Japan/1995

M. Eng. (Applied Fine Chem., Functional Polymer)/Osaka University, Japan/1995

B. Eng. (Applied Fine Chem.)/Osaka University, Japan/1989

Professional Experience

- Sep 2016 – Aug 2020 Dean of The Petroleum and Petrochemical College, Chulalongkorn University
- July 2012 – June 2016 President of Polymer Society of Thailand
- Nov 2012 – Aug 2016 National Science and Technology Development Agency (NSTDA), National Nanotechnology Center (NANOTEC), Nanofunctional Textile Laboratory Consultant
- Oct. 2009 - Present Full Professor in Polymer Science and Engineering, The Petroleum and Petrochemical College, Chulalongkorn University
- Oct. 2007- Sep. 2008 Associate Dean of Research Affairs, The Petroleum and Petrochemical College, Chulalongkorn University
- Oct. 2004 - Oct. 2007 Deputy Director of Research Affairs, The Petroleum and Petrochemical College, Chulalongkorn University
- Apr. 2003 - Oct. 2009 Associate Professor of The Petroleum and Petrochemical College, Chulalongkorn University
- Jun. 2002 - Present Vice Center-Head, Center for Chitin-Chitosan Biomaterials, Chulalongkorn University
- Oct. 2000 – Nov. 2004 External Expertise, the Processing Technology Program, The School of Environment, Resources and Development, Asian Institute of Technology
- Oct. 2004 – Apr. 2005 Visiting Professor, Venture Business Laboratory, Hiroshima University, Japan
- Nov. 2002–May 2003 Visiting Scientist, Department of Macromolecular Science and Engineering, Case Western Reserve University, USA.
- Oct. 1999 - Apr. 2003 Assistant Professor of The Petroleum and Petrochemical College, Chulalongkorn University
- Oct. 2000 - Oct. 2002 Assistant Director for Research Affairs in The Petroleum and Petrochemical College, Chulalongkorn University
- Oct. 1999-Mar. 2000 Visiting Scientist for Japan Society of Scientific Promotion (JSPS), Department of Macromolecules, Osaka University, Osaka, Japan

- Oct. 1997 - Mar. 1998 Visiting Lecturer at Department of Chemical Engineering, Thammasart University
- Jun. 1997- Sep.1997 Visiting Lecturer at Department of Chemical Engineering, Khon Kaen University, Khon Kaen
- Oct. 1996 - Mar. 1997 Visiting Lecturer at Department of Chemical Engineering, Thammasart University
- Apr. 1991 -Sep. 1999 Lecturer of The Petroleum and Petrochemical College, Chulalongkorn University
- (April 1992-Mar. 1995 Leave for Ph.D. Degree in Japan)

Honors and Awards

- 1) เมธีวิจัยอาวุโส วช. ประจำปี 2564
- 2) PTT NSTDA Chair Professor/ NSTDA and PTT Public Company Limited, 2015.
- 3) รางวัลอาจารย์ดีเด่นแห่งชาติ (ปอคมท.), 2013
- 4) PTIT Innovation Award, 2011.
- 5) Best National Researcher: Chemical and Pharmaceutical Science, National Research Council of Thailand, 2009.
- 6) Innovation Ambassador: Bio-based Materials/ National Innovation Agency, 2009.
- 7) Thailand Innovation Awards/ PTT Chem. and Ministry of Science and Technology, 2007.
- 8) Innovation Ambassador/ National Innovation Agency, 2006.
- 9) Micrograph Award (3rd prize), Microscopy Society of Thailand, 2006.
- 10) Visiting Professor, Venture Business Laboratory, Hiroshima University, 2004.
- 11) Best Ph.D. Thesis Advisor/ National Council Research, 2004.
- 12) Science and Technology Research Grant Award, Toray Science Foundation, 2003.
- 13) Overseas Research Grant Award, The Asahi Glass Foundation, 2003.
- 14) Micrograph Award (1st prize), Microscopy Society of Thailand, 2002.
- 15) Editorial Board, Journal of Scientific Research, Chulalongkorn University, 2002 -2003.
- 16) Visiting Scientist Scholar from Japan Society of Scientific Promotion (JSPS), 1999.
- 17) Hitachi Fellowship Scholar from Hitachi Scholarship Foundation, 1995-Present.

Membership

- 1) Polymer Society of Thailand
- 2) Thai Academy of Science and Technology Foundation
- 3) Chitin Chitosan Center of Excellence (Thailand)
- 4) Japan Chemical Society
- 5) Japan Polymer Society
- 6) American Chemical Society
- 7) Chitin-Chitosan Society of Japan
- 8) Material Research Society Japan
- 9) Material Research Society USA

Research Interests

- 1) Polymer Modifications, Functional Polymers
- 2) Controlled Molecular Recognition and Inclusion Compounds
- 3) Biopolymers, Chitin-Chitosan
- 4) Nanomaterials, Polymer Composites
- 5) Polymer Electrolyte Membrane Fuel Cells
- 6) Biodegradable Plastics American Chemical Society

Research Activities: (5 years)

Books

- 1) Agricultural Transforming Terrain through Biorefinery: Trends and Opportunities (2018), National Innovation Agency, Thailand.
- 2) Rungswang, W.; Chirachanchai, S. “Chapter 30 – Precision Thermoset-Spherical Nano- and Microparticles Formation in Nanoconfinement: A Model Case From Benzoxazine Polymerization in the Blend System With Aromatic Containing Thermoplastic Resin” In Advanced and Emerging Polybenzoxazine Science and Technology; Ishida, H.; Froimowicz, P.; Elsevier, Amsterdam, Netherlands, 2017; pp. 601–610

Publications: (*: Corresponding Author) (24 publications in 5 years (2018-2023)) (total 128 publications)

- 1) Pokprasert, A.; Chirachanchai, S.* “Tailoring proton transfer species on the membrane surface: An approach to enhance proton conductivity for polymer electrolyte membrane fuel cell” *Polymer*, 256, 125583, 2023. (Impact Factor 2020: 4.430)
- 2) Pokprasert, A.; Chirachanchai, S.* “Proton conductivity and dimensional stability of proton exchange membrane: A dilemma solved by chitosan aerogel framework” *Electrochimica Acta*, 441, 141764, 2023 (Impact Factor 2022: 6.901)
- 3) Phunpee, S., Ruktanonchai, U.R., Chirachanchai, S.* “Tailoring a UCST-LCST-pH Multiresponsive Window through a Single Polymer Complex of Chitosan-Hyaluronic Acid” *Biomacromolecules*, 2022, 23, 5361-5372. (Impact Factor: 3.882)
- 4) Phunpee, S.; Ruktanonchai, U.R.; Chirachanchai, S.* “Brush-Structured Chitosan/PolyHEMA with Thymine and Its Synergistic Effect on the Specific Interaction with ssDNA and Cellular Uptake” *Langmuir*, 38, 18, 5915–5923, 2022. (Impact Factor 2020: 3.882)
- 5) Wiwatsamphan, P.; Chirachanchai, S.* “Persistently reversible pH-/thermo-responsive chitosan/poly (N-isopropyl acrylamide) hydrogel through clickable crosslinked interpenetrating network” *Polymer Degradation and Stability*, 198, 109874, 2022. (Impact Factor 2020: 5.030)
- 6) Pokprasert, A.; Theato, P.; Chirachanchai, S.* “Proton donor/acceptor copolymer brushes on sulfonated poly(ether ether ketone) membrane: An approach to construct efficient proton transfer pathway in polymer electrolyte membrane fuel cell” *Polymer*, 240, 124523, 2022. (Impact Factor 2020: 4.430)

- 7) Kertsomboon, T.; Agarwal, S.; Chirachanchai, S.* “UCST-Type Copolymer through the Combination of Water-Soluble Polyacrylamide and Polycaprolactone-Like Polyester” *Macromolecular Rapid Communications*, 2000243, 2020. (Impact Factor 2019: 4.886)
- 8) Kertsomboon, T.; Chirachanchai, S.* “Amphiphilic biodegradable co-networks of Poly(butylene succinate)-Poly(ethylene glycol) chains for nano-gelation via Click chemistry and its potential dispersant for multi-walled carbon nanotubes” *Polymer Degradation and Stability*, 179, 109266, 2020. (Impact Factor 2019: 4.032)
- 9) Pokprasert, A.; Chirachanchai, S.* “Polymer electrolyte membrane with magnetic nanoparticles containing benzimidazole terminals: An approach to induce proton transfer species on membrane surface” *International Journal of Hydrogen Energy*, 45, 16, 9989-9999, 2020. (Impact Factor 2018: 4.084)
- 10) Yenpech, N.; Intasanta, V.; Tashiro, K.; Chirachanchai, S.* “Color and shape reversible, recoverable and repeatable mechanochromic shape memory polycaprolactone: a single material with dual functions” *Polymer Chemistry*, 11, 91-101, 2020. (Impact Factor 2018: 4.760)
- 11) Yenpech, N.; Intasanta, V.; Chirachanchai, S.* “Laser-triggered shape memory based on thermoplastic and thermoset matrices with silver nanoparticles” *Polymer*, 182, 121792, 2019. (Impact Factor 2018: 3.771)
- 12) Suwattanachai, P.; Pimkhaokham, A.; Chirachanchai, S.* “Multi-functional carboxylic acids for chitosan scaffold” *International Journal of Biological Macromolecules*, 134, 156-164, 2019. (Impact Factor 2018: 4.784)
- 13) Kanokpreechawut, P.; Pitakchatwong, C.; Matsumoto, M.; Sereemasapun, A.; Honsawek, S.; Chirachanchai, S.* “Incorporation of chitosan whisker and hydroxyapatite: A synergistic approach to reinforce chitosan/ Poly(ethylene glycol) gel” *Polymer Degradation and Stability*, 164, 198-205, 2019. (Impact Factor 2018: 3.193)
- 14) Niyomsin, S.; Hirai, T.; Takahara, A.; Chirachanchai, S.* “Incorporation of Benzoxazine Pendants in Polymer Chains: A Simple Approach to Add-Up Multi-Responsive Functions” *Macromolecular Chemistry and Physics*, 5, 220, 1800526, 2019. (Impact Factor 2018: 2.492)
- 15) Jariyasakoolroj, P., Tashiro, K., Chinsirikul, W., Kerddonfag, N., Chirachanchai, S.* “Microstructural Analyses of Biaxially Oriented Polylactide/Modified Thermoplastic Starch Film with Drastic Improvement in Toughness” *Macromolecular Materials and Engineering*, 304, 9, 1900340, 2019 (Impact Factor 2018 : 3.038)
- 16) Pitakchatwong, C.; Chirachanchai, S.* “pH Variation as a Simple and Selective Pathway for Obtaining Nanoparticle or Nanocapsule Polysaccharides” *Langmuir*, 34, 51, 15820-15826, 2018. (Impact Factor 2017: 3.789)
- 17) Engkagul, V.; Sereemasapun, A.; Chirachanchai, S.* “One Pot Preparation of Chitosan/ Hyaluronic Acidbased Triple Network Hydrogel via In Situ Click Reaction, Metal Coordination and Polyion Complexation in Water” *Carbohydrate Polymers*, 200, 616-623, 2018. (Impact Factor 2017: 5.158)
- 18) Niyomsin, S.; Chirachanchai, S.* “Poly (acrylic acid) with benzoxazine-based supramolecular crosslinker for responsive and reversible functional hydrogel” *European Polymer Journal*, 105, 451-458, 2018. (Impact Factor 2017: 3.741)