

**Daniel Liu, Ph.D.**  
**Associate**

**Professional Profile**

Dr. Daniel Liu is an Associate in Exponent's Mechanical Engineering and Materials/Metallurgy practice. His expertise includes polymer, composite and nanocomposite technologies, polymer failure mechanisms, structure-property relationships, polymer toughening and strengthening, and materials characterization. Dr. Liu has a strong background in polymer synthesis, formulation, compatibilization, compounding, and processing. He has hands-on experience in various applications of polymers, including structural materials, adhesives, coatings, food packaging, and electronic packaging. Dr. Liu also has proven proficiency in a variety of materials characterization/analysis techniques, including mechanical testing (both static and dynamic), fracture property evaluation, thermal analysis, microscopy, spectroscopy, rheology, and moisture/gas permeability measurements.

Dr. Liu has approximately 10 years research and development experience in materials/polymers related areas. Prior to joining Exponent, Dr. Liu performed research on the fracture behaviors and toughening mechanisms of polymers, composites, and nanocomposites. He provided consulting services to industrial clients related to development and performance of epoxy thermosets, polyolefins, blends, nanocomposites, laminate films, biodegradable plastics, and electronic packaging materials. He has held research appointments at Texas A&M University, Hong Kong University of Science and Technology, and Fudan University.

**Academic Credentials and Professional Honors**

Ph.D., Materials Science and Engineering, Texas A&M University, 2009  
M.Phil., Mechanical Engineering, Hong Kong University of Science and Technology, 2004  
B.S., Polymer Materials and Engineering, Fudan University, Shanghai, 2002

Elected Member, Sigma Xi, The Scientific Research Society, 2009  
Graduate Research and Presentation Grant, Texas A&M University, 2008  
First Prize Award, Poster Contest, International Polyolefins Conference, 2007  
TEES Research Assistantship, Texas A&M University, 2004–2009  
Postgraduate Studentship Award, Hong Kong Univ. of Science and Technology, 2002–2004  
Distinguished Graduate Award, Fudan University, 2002  
Outstanding Thesis Award, Fudan University, 2002  
Chun-Tsung Scholarship, Nobel Prize Laureate *Dr. Tsung-Dao Lee* Foundation, 2001  
First Prize Award, 3<sup>rd</sup> Contest of Science and Technology Innovation, 2000  
People Scholarship (awarded three times), Fudan University, 1999–2002

## Languages

English, Mandarin Chinese, Cantonese, Shanghainese

## Publications

Liu J, Sue H-J, Thompson ZJ, Bates FS, Dettloff M, Jacob G, Verghese N, Pham H. Effect of crosslink density on fracture behavior of model epoxies containing block copolymer nanoparticles. *Polymer* 2009, in press.

Liu J. Toughening of epoxies based on self-assembly of nano-sized amphiphilic block copolymer micelles. Texas A&M University Dissertation, 2009.

Liu J, Sue H-J, Thompson ZJ, Bates FS, Dettloff M, Jacob G, Verghese N, Pham H. Strain rate effect on toughening of nano-sized PEP-PEO block copolymer modified epoxy. *Acta Materialia* 2009; 57:2691–2701.

Sun L, Liu J, Kirumakki S, Schwerdtfeger ED, Howell RJ, Al-Bahily K, Miller SA, Clearfield A, Sue H-J. Polypropylene nanocomposites based on designed synthetic nanoplatelets. *Chem Mater* 2009; 21:1154–1161.

Thompson ZJ, Hillmyer MA, Liu J, Sue H-J, Dettloff M, Bates FS. Block copolymer toughened epoxy: Role of cross-link density. *Macromolecules* 2009; 42:2333–2335.

Sun L, Boo WJ, Liu J, Clearfield A, Sue H-J, Verghese NE, Pham HQ, Bicerano J. Effect of nanoplatelets on the rheological behavior of epoxy monomers. *Macromol Mater Eng* 2009; 294:103–113.

Gomes C, Castell-Perez ME, Chimbombi E, Barros F, Sun D, Liu J, Sue H-J, Sherman P, Dunne P, Wright AO. Effect of oxygen-absorbing packaging on the shelf life of a liquid-based component of military operational rations. *J Food Sci* 2009; 74:E167-E176.

Liu J, Sue H-J, Thompson ZJ, Bates FS, Dettloff M, Jacob G, Verghese N, Pham H. Nanocavitation in self-assembled amphiphilic block copolymer-modified epoxy. *Macromolecules* 2008; 41:7616–7624.

Sun L, Boo WJ, Liu J, Tien CW, Sue H-J, Mullins MJ, Pham H. Preparation of intercalating agent-free epoxy/clay nanocomposites. *Polym Eng Sci* 2007; 47:1708–1714.

Boo WJ, Sun L, Liu J, Clearfield A, Sue H-J. Effective intercalation and exfoliation of nanoplatelets in epoxy via creation of porous pathways. *J Phys Chem C* 2007; 111:10377–10381.

Boo WJ, Sun L, Liu J, Clearfield A, Sue H-J, Mullins MJ, Pham H. Morphology and mechanical behavior of exfoliated epoxy/ $\alpha$ -zirconium phosphate nanocomposites. *Compos Sci Technol* 2007; 67:262–269.

Boo WJ, Sun L, Liu J, Moghbelli E, Clearfield A, Sue H-J. Effect of nanoplatelet dispersion on mechanical behavior of polymer nanocomposites. *J Polym Sci Part B: Polym Phys* 2007; 45:1459–1469.

Liu J, Boo WJ, Clearfield A, Sue H-J. Intercalation and exfoliation: A review on morphology of polymer nanocomposites reinforced by inorganic layer structures. *Mater Manuf Processes* 2006; 21:143–151.

Boo WJ, Liu J, Sue H-J. Fracture behaviour of nanoplatelet reinforced polymer nanocomposites. *Mater Sci Technol* 2006; 22:829–834.

Liu J. Polymer-layered silicate nanocomposites: synthesis, structure and properties. Hong Kong University of Science and Technology Thesis, 2004.

Chen B, Liu J, Chen H, Wu JS. Synthesis of disordered and highly exfoliated epoxy/clay nanocomposites using organoclay with catalytic function via acetone-clay slurry method. *Chem Mater* 2004; 16:4864–4866.

Ming M, Liu J, Huang L, Liu J, Li QG, Ding JD. Characteristics and potential application of bacteriorhodopsin/polymer functional composite film. *J Funct Polym* 2003; 16:405–411.

Huang L, Ming M, Liu J, Liu J, Li QG, Ding JD. Preparation of liposome containing bacteriorhodopsin with natural preferred orientation and detection of its transient photoresponse. *Acta Biochimica et Biophysica Sinica* 2003; 35:391–395.

Liu J. Preparation and investigation of optical materials based on bacteriorhodopsin. Fudan University Thesis, 2002.

Liu J, Ming M, Liu J, Huang L, Li QG, Ding JD. Preparation and study of bacteriorhodopsin/poly (vinyl alcohol) composite film. *Acta Chimica Sinica* 2002; 60:2209–2213.

Huang L, Liu J, Ming M, Liu J, Li QG, Ding JD. Self-assembly of bacteriorhodopsin in liposome. *Adv Liq Cryst Polym Supermolecules*, 2002; 157–161.

### **Conference Proceedings and Presentations**

Liu J, Sue H-J, Thompson ZJ, Bates FS. Structure-property relationship of nanostructured epoxies containing self-assembled block copolymer nanoparticles. 238<sup>th</sup> ACS National Meeting & Exposition, Washington, DC, 2009.

Liu J, Sue H-J, Thompson ZJ, Bates FS, Dettloff M, Jacob G, Verghese N, Pham H. Toughening of epoxy using PEP-PEO block copolymer nanoparticles. SPE ANTEC 2009, Chicago, IL, 2009.

Liu J, Sue H-J, Thompson ZJ, Bates FS, Dettloff M, Jacob G. Nano-toughening of epoxy using self-assembled block copolymer micelles. Nanotech Conference & Expo 2009, Houston, TX, 2009.

Verghese NE, Dettloff M, Jacob G, Pham H, Liu J, H.-J. Sue, Thompson ZJ, Bates FS. Toughening of epoxy thermosets using nano-scaled, self-assembled amphiphilic block copolymers: A look into the toughening mechanism. 14<sup>th</sup> International Conference on Deformation, Yield and Fracture of Polymers (DYFP 2009), Rolduc, Kerkrade, The Netherlands, 2009.

Liu J, Sue H-J, Thompson ZJ, Bates FS, Dettloff M, Jacob G, Verghese N, Pham H. Nanosized micellar structures of self-assembled amphiphilic block copolymers and their toughening effects in epoxy matrices. 236<sup>th</sup> ACS National Meeting & Exposition, Philadelphia, PA, 2008.

Liu J, Sue H-J, Thompson ZJ, Bates FS, Dettloff M, Jacob G, Verghese N, Pham H. Nano-cavitation in self-assembled amphiphilic block copolymer-modified epoxy. 2008 MRS Spring Meeting, San Francisco, CA, 2008.

Gomes C, Chimbombi E, Barros F, Castell-Perez E, Sun D, Liu J, Sue H-J, Meyer C, Dunne P. Oxygen-absorbing packaging material to prolong shelf-life of oxygen-sensitive meal-ready-to-eat rations. ITF, New Orleans, LA, 2008.

Liu J, Weon J-I, Sue H-J. Impact fracture behavior of PP/EPR blends. SPE ANTEC 2007, Cincinnati, OH, 2007.

Liu J, Boo WJ, Clearfield A, Sue H-J. synthetic nanoplatelet reinforced polymer nanocomposites. Nano Summit 2007, College Station, TX, 2007.

Liu J, Weon J-I, Sue H-J. Fracture behavior of polypropylene/EPR blends. International Polyolefins Conference 2007, Houston, TX, 2007.

Warren G, Sun L, Liu J, Chu CC, Sue H-J. Processing and characterization of b-staged epoxy/SWNT nanocomposite thin films. 44<sup>th</sup> Annual Technical Meeting, Society of Engineering Science (SES 2007 Conference), College Station, TX, 2007.

Liu J, Boo WJ, Sue H-J. Double-notch four-point bending technique for toughening mechanism studies on polyolefins. International Polyolefins Conference 2006, Houston, TX, 2006.

Boo WJ, Sun L, Liu J, Clearfield A, Sue H-J. Influence of nanofiller structure on gas permeability and mechanical properties of epoxy/ $\alpha$ -zirconium phosphate nanocomposites. SPE ANTEC 2006, Charlotte, NC, 2006.

Weon J, Wei G, Liu J, Sue H-J. fundamental understanding of impact fracture behavior of TPOs. SPE Automotive Global TPO Conference, Sterling Heights, MI, 2006.

Liu J, Wu JS. A comprehensive study on intercalation and exfoliation of epoxy/clay nanocomposites. Asian-Australian Conference on Composite materials (ACCM-4), Sydney, Australia, 2004.

Wu JS, Wang K, Liu J, Chen L, He CB. Producing polymer nanocomposites with exfoliated pristine clay. SPE ANTEC 2004, Chicago, IL, 2004.

Liu J, Wu JS. A comprehensive study on intercalation and exfoliation of epoxy/clay nanocomposites: the influence of processing condition, curing temperature, clay modification and curing agent. 2<sup>nd</sup> International Conference on Materials for Advanced Technologies (ICMAC) & IUMRS-International Conference in Asia, Singapore, 2003.

Liu J, Ming M, Huang L, Liu J, Chen YT, Ding JD. Fundamental study of bacteriorhodopsin and relevant functional materials. 9<sup>th</sup> National Biophysics Conference, Dalian, China, 2002.

Liu J, Huang L, Ming M, Liu J, Ding JD. Potential optical material containing bacteriorhodopsin self-assembly of this membrane protein. Sino-German Young Scientist Forum on Macromolecular Science, Beijing, China, 2002.

Ming M, Liu J, Huang L, Chen YT, Liu J, Ding JD. Preparation of a protein (bacteriorhodopsin)/polymer film and associated fundamental research. IUPAC World Polymer Congress 2002 (MACRO 2002), Beijing, China, 2002.

### **Prior Experience**

Research Assistant, Polymer Technology Center (PTC) and Texas Engineering Experiment Station (TEES), Texas A&M University, 2004–2009

Research Assistant, Materials Research Group and Electronic Packaging Laboratory (EPACK), Hong Kong University of Science and Technology, 2002–2004

Research Assistant, Key Laboratory of Molecular Engineering of Polymers, Fudan University, Shanghai, 2000–2002

## **Project Experience**

Prior to joining Exponent, Dr. Liu had long-term experience in working on consulting projects related to product development and/or failure analysis of epoxy thermosets, polyolefins, blends, nanocomposites, laminate films, biodegradable plastics, and electronic packaging materials, with a number of companies in chemical, plastics and microelectronics industries, including Dow Chemical, BASF, Huntsman, Sunoco, Metabolix, Specialty Minerals, Cadillac Products, ASAT, etc.

## **Peer Reviewer**

- Annual Technical Conference (ANTEC), Society of Plastics Engineers (SPE)
- Composites Science and Technology
- European Polymer Journal
- Journal of Materials Science
- Journal of Polymer Science Part B: Polymer Physics
- Macromolecular Chemistry and Physics
- Macromolecular Rapid Communications
- Macromolecules
- Polymer

## **Professional Affiliations**

- American Chemical Society—ACS
- American Society of Mechanical Engineers—ASME
- International Microelectronics and Packaging Society—IMAPS
- Materials Research Society—MRS
- Sigma Xi, The Scientific Research Society
- Society of Plastics Engineers—SPE  
— President, Society of Plastics Engineers Texas A&M Chapter, 2005–2006