

Jianwei TU, Ph.D.

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Professional Summary

I am a polymer research scientist working in Dr. Palmese's Polymers and Composites Laboratory in the Department of Chemical Engineering at Drexel University. I have ten years of research experience in thermosetting polymers and composite processing, and my research areas include bio-based thermosetting polymers, viscoelasticity, solid-state transition dynamics, and deformation and recovery behaviors of polymers and composites.

Education Background

Doctor of Philosophy in Polymer Science and Engineering **2014**
The University of Southern Mississippi (USM)
Advisor: Dr. Jeffrey S. Wiggins
Dissertation: *Investigation of Glassy State Molecular Motions in Thermoset Polymers*

Bachelor of Science in Polymer Engineering **2008**
Nanjing University of Science and Technology (NUST), China

Experience

Research Scientist, Drexel University 09/2018 – Present.

➤ **Bio-based thermosetting polymers for composites**

- To exploit unique and enhanced functionality that can be obtained through bio-based polymer building blocks for composites, coatings, and adhesive applications
- These building blocks will be used individually and in combinations in a hybrid polymer design approach intended to maximize the performance advantages obtainable from bio-based sources.
- A fundamental understanding of the processing-structure-property relationships of novel bio-based systems will enable the design of thermosets with superior performance characteristics while also incorporate safe and sustainable design principles.

Research Laboratory Leader, University of Southern Mississippi 01/2015 – 08/2018

➤ **Daily Duties:**

- Assist with graduate research efforts, provide technical information, support, and direction;
- Manage contract work and other scientific activities, assist with research proposals, reports, and publications;
- Recommend and purchase new research equipment, maintain and operate instruments, train laboratory personnel.

➤ **Impact energy mitigation properties and modeling of polymeric foams and pneumatic cushions**

- The project funded by US Army created novel impact energy mitigation materials, for use as helmet cushions, military shoe soles, seat cushions, *etc.*, using combinations of the two very different materials.
- Polymeric foams are excellent impact mitigation materials but suffer from variation of properties due to temperature change. Pneumatic cushions have shown only mild temperature dependence.
- Empirical modeling effort to predict compression and impact behaviors at high strain rates.

➤ **Study of the effects of chain rigidity on material properties and strain recovery of thermosetting polymers**

- Four chemically similar epoxy networks were studied to minimize the differences in chemical affinity
- A broad range of properties were found to closely correlate to chain rigidity of the networks
- Strain recovery behaviors also followed a characteristic trend defined by network rigidity

➤ **Synthesis of a difunctional benzoxazine from biomass derived molecules**

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Graduate Research Assistant, University of Southern Mississippi

08/2008 - 12/2014

- **Study of glassy state transitions of isomeric epoxy networks using solid-state ^2H NMR spectroscopy**
 - Elucidated the molecular origin of an anti-plasticization phenomenon in isomeric epoxy networks utilizing the power of solid-state ^2H NMR spectroscopy and deuterium line shape analysis
 - Publication: *Macromolecules* **2015**, 48, 1748-1758; DOI: 10.1021/ma5022506.
- **Deformation Recovery Behaviors of Isomeric Epoxy Networks through Digital Image Correlation**
 - Quantified strain components of isomeric epoxy networks using Digital Image Correlation
 - Differences in elastic, viscoelastic, and plastic strains correlated to DMA and NMR observations
 - Publication: *Polymer* **2016**, 82, 87-92; DOI: 10.1016/j.polymer.2015.11.026.
- **Development of Abradable Composite Foam for GE Airplane Engines**
 - Developed abradable composite foam via twin-screw extrusion processing for next generation GE airplane engines
 - Led the fabrication and testing team to ensure delivery of high-quality materials
 - The successful outcome was transferred to a GE facility at Batesville, MS.

Publications

- ❖ **Tu, J.**; Tucker, S.J.; Christensen, S.; Sayed, A.R.; Jarrett, W.L.; Wiggins, J.S. Phenylene Ring Motions in Isomeric Glassy Epoxy Networks and Their Contributions to Thermal and Mechanical Properties. *Macromolecules* **2015**, 48 (6), 1748-1758; DOI: 10.1021/ma5022506.
- ❖ Heinz, S.R.; **Tu, J.**; Jackson, M.B.; Wiggins, J.S. "Analysis of Structural Isomerism on the Deformation Behaviors of Glassy Epoxy Networks." *Polymer* **2016**, 82, 87-92; DOI: 10.1016/j.polymer.2015.11.026.
- ❖ Knowles, K.R.; **Tu, J.**; Wiggins, J.S. Thermal and volumetric property analysis of polymer networks and composites using elevated temperature digital image correlation. *Polymer Testing* **2017**, 58, 48-53; DOI: 10.1016/j.polymertesting.2016.12.013.
- ❖ Sharma, A.K.; Hassan, M.K.; **Tu, J.**; Mauritz, K.A.; Wiggins, J.S. Kinetic studies of POSS–DGEBA precursors derived from monoamine functional POSS using dynamic dielectric sensing and nuclear magnetic resonance. *J. Appl. Polym. Sci.* **2017**, 135, 45994; DOI: 10.1002/app.45994.
- ❖ **Tu, J.**; Tucker, S.J.; Sayed, A.R.; Wiggins, J.S. Glassy State Ring Motions in Aerospace Epoxy Networks and Relation with Thermal and Mechanical Properties. Proceedings from SAMPE Spring Meeting: Baltimore, MD, May 23rd, **2012**.
- ❖ Hassan, M.; **Tu, J.**; Wiggins, J.S.; Mauritz, K.A. Real time dielectric spectroscopic monitor of curing epoxy-based composite resins produced by vacuum-assisted resin transfer molding. *Polymer Preprints* (American Chemical Society, Division of Polymer Chemistry) **2011**, 52 (2), 51-52.

Research Skillsets

Analytical Techniques: DMA, TMA, DSC, TGA, ARES rheometer, FTIR, solution and solid-state NMR spectroscopy, dielectric spectroscopy, dynamic and static light scattering

Composite Processing: Twin-screw extrusion, resin transfer molding, autoclave

Mechanical Testing: 3D digital image correlation (DIC), MTS MultiPurpose Testware programming

Computer Skills: MatLab, MestReNova, Origin, ChemDraw, MS Office, Excel Macros Programming (VBA)

Courseworks

Polymer Chemistry (Free radical, Living, Step growth, Cationic and anionic polymerizations)

Polymer Physics (Solution, Amorphous, and Crystalline phase, and Phase separated materials)

Polymer Composites and Processing; Rubber Compounding; Chemical Engineering

Nuclear Magnetic Resonance Spectroscopy; Light Scattering

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Professional Affiliations

American Chemical Society (ACS), Division of Polymer Chemistry
Society for the Advancement of Material and Process Engineering (SAMPE)

Peer Reviews

I have performed peer review duties for eight internationally renowned journals including: *Macromolecules* (5 times), *Polymer* (7 times), *Polymer Degradation and Stability* (8 times), and *Journal of Applied Polymer Science* (15 times).