

Zeyang Yu, Ph.D.

R&D Associate, Carbon & Composites Group
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Education

- **Doctor of Philosophy**, Chemical Engineering Aug. 2013-Aug. 2019
Michigan State University, East Lansing, Michigan, United States
Dissertation: Graphene Nanoplatelet Based Polymer Composites and Their Multiple Applications
GPA: 3.7/4.0
- **Bachelor of Science**, Chemical Engineering Sept. 2009-Jul. 2013
Beijing University of Chemical Technology, Beijing, China
Thesis: Hydrothermal Method to Prepare Silica-Graphene Aerogel and Its Application in Thermal Insulation
GPA: 3.7/4.0

Research Interests

Polymer and Polymer Composites, Carbon Materials, Biobased Materials, Polymer Recycling and Decarbonization, Surface Treatment, Interface Design, Electrochemistry, Energy Harvesting, Coating, Packaging, Adhesive, and Corrosion Resistance.

Professional Experience

R&D Associate, Oak Ridge National Laboratory Jul. 2024-Present

Advanced Polymer Composites Development

- Applied the experimental and computational technologies to investigate and design the surface and interface properties of polymer composites.
- Utilized green chemistry techniques to innovate reinforced polymer composites, enhancing their sustainability, recyclability, and durability.
- Developed bio-based coatings and adhesives for joining multi-materials and providing corrosion protection.

Postdoctoral Research Associate, Oak Ridge National Laboratory Jun. 2021-Jul. 2024

Biobased Adhesives for Joints Part between Revit and Metal Plate

- Incorporated lignin into acrylonitrile butadiene rubber (NBR) to fabricate a thermoplastic biobased adhesive.
- Different additives were investigated to customize the mechanical properties and surface energy of adhesive composites.

- A range of surface treatment techniques, including plasma treatment, base etching, anodizing, and primer layer coating, were systematically applied to enhance interfacial bonding strength.

Modified the Properties of Carbon Fiber and Designed Multi-functional Carbon Fiber Composites

- Applied chemical (acid, based, plasma), electrochemical, and physical (sizing) methods to functionalize the carbon fiber surface.
- Employed coatings of various polymers to the carbon fiber surface to augment its interfacial adhesion with different matrices.
- Formulated biobased coatings and adhesives utilizing functionalized carbon materials as reinforcement.
- Engineered porous carbon materials suitable for electrical, thermal, and adsorbing applications.

Smart Repair for Gas Transport Pipe

- Incorporation of clay particles and carbon fiber into the fast-curing epoxy system was undertaken to enhance both sag resistance and mechanical properties.
- The exploration of various promising reinforcements, including fillers such as basalt fiber, fiberglass, graphene nanoplatelets, among others, was conducted.
- A comprehensive investigation into the impact of filler loading, mixing conditions, degassing methods, curing temperature, and curing agents on the ultimate properties of epoxy-based coatings was carried out.
- The development of robot-assisted coating tools was engineered to facilitate the precise spray coating of the formulated epoxy composites onto the inner surfaces of gas transport pipes.

Postdoctoral Research Fellow, Georgia Institute of Technology

Sept. 2019-Jun. 2021

Polysaccharides Based Materials Used as the Coatings for Sustainable Packaging

- Extracted the chitin/cellulose nanocrystals from food waste or woods, carefully adjusting experimental conditions to control nanomaterial size.
- Utilized blade coating/spray coating techniques to craft biobased coated polymer films with outstanding oxygen permeability.
- Implemented various methods to control nanowire alignment, customizing barrier properties, mechanical properties, and conductivities to meet diverse requirements.
- Applied thermal treatment to eliminate bound water, resulting in additional enhancement in barrier properties.
- Demonstrated the recyclability of biobased coatings, offering an environmentally friendly end-of-life solution.

Graduate Research Assistant, Michigan State University

Aug. 2013-Aug. 2019

Improved the Mechanical Property of Epoxy Composite and Interfacial Design

- Investigated the mechanical properties of epoxy resin cured with different amines and curing dynamics.
- Analyzed synergistic effect of using a graphene oxide/graphene couple to reinforce the epoxy composites.
- Functionalized graphene oxide/graphene with various diamines and examining their influence on the curing process/mechanism and mechanical properties of epoxy composites.

Extruded Graphene Nanoplatelets (GnP)-Thermoplastic Polyurethane (TPU) Composite Film as the Electronic Packaging Material

- Engineered thermally conductive GnP-TPU composite packaging films via extrusion.
- Investigated the impact of extrusion speed and temperature on the alignment of graphene nanoplatelets, as well as the crystallinity of the polyurethane-based composite.

- Explored the synergistic effects of graphene-carbon nanotube combinations on enhancing the thermal conductivity, electrical conductivity, and mechanical properties of polyurethane composite films.
- Introduced features onto the composite films to enhance thermal convection in an air-cooling system using the hot compression method.
- Conducted simulations to assess the effects of aspect ratio, materials, arrangement, and density of features on thermal convection.

Graphene Nanoplatelets-Epoxy Composite Flexible ‘Paper’ as an Electrostatic Actuator

- Developed a rapid and straightforward method for constructing millimeter-scale graphene paper-based flexible electrostatic actuators.
- Created an epoxy coating layer using various diamines to fine-tune the stiffness of the electrode.
- Utilized electrostatic mechanisms to increase the actuating stroke, avoiding the pull-in effect existed in traditional electrostatic actuators.
- Improved the actuating performance by increasing the surface area of electrodes and the dielectric constant of the insulating layer.
- Investigated the structure designing of actuators for better performance.

Technical Skills

- **Polymer Composites Processing:** Extrusion, Injection, Compression, Resin Transfer Molding, Casting/Curing.
- **Sustainable Polymer Composites:** Bio-derived polymers, Biofibers, Polymer Recycling.
- **Coating Techniques:** Spray Coating, Blade Coating, Layer-by-Layer Method, Electrochemical Deposition
- **Surface Functionalization and Interfacial Design:** Plasma Treatment, Wetting, Sizing, Electrochemical Functionalization, Grafting and Deposition.
- **Characterization Techniques:** SEM, EDS, AFM, Optical Microscopy, TGA, DSC, FTIR, Raman Spectroscopy, XRD, DMA, Mechanical Property Test (Tensile, Flexural), BET, Thermal Diffusivity Analysis, Gas Barrier Analysis, Single Filament Pull-out Test, Interfacial Shear Strength Measurement, Electrochemical Analysis.
- **Proposal Application:** Drafting the proposals for the VTO, EERE, ARPA, HFTO fundings.
- **Software:** MATLAB, Origin, AutoCAD, COMSOL, Microsoft Office.

Publications

- **Zeyang Yu**, Nihal Kanbargi, Sumit Gupta, Yongsoon Shin, Yao Qiao, Christopher C. Bowland, Daniel R. Merkel, Kevin L. Simmons, Amit K. Naskar. Toughened Lignin-based Thermoplastic Rubber Adhesive for Metal-to-Metal Joining. *Polymer Composites*. 2024 March (in press).
- **Zeyang Yu**, Xinzhang Zhou, Christopher C. Bowland, Logan T. Kearney, Holly E. Hinton, Sargun Singh Rohewal, Amit K. Naskar. A Sustainable Route to Control Interfacial Properties of Carbon Fiber Composites. Submitted to *Matter*.
- **Zeyang Yu**, Yawei Gao, Nihal Kanbargi, Christopher C. Bowland, Amit K. Naskar. Adhesive Gel Intermediates with Partial Networks Forms Stronger Interface with Aluminum. Under reviewed by *ACS Applied Materials & Interfaces*.
- **Zeyang Yu**, Yue Ji, J. Carson Meredith. “Multilayer Chitin–Chitosan–Cellulose Barrier Coatings on Poly (ethylene terephthalate)” *ACS Applied Polymer Materials*. 2022 Sep 7; 4(10):7182-90.
- **Zeyang Yu**, Yue Ji, Violette Bourg, Julien Bras, Mustafa Bilgen, J. Carson Meredith. “Chitin- and Cellulose-Based Sustainable Barrier Materials: A Review” *Emergent Materials*. 2020 Dec; 3:919-36.

- **Zeyang Yu**, Lawrence Drzal. “Functionalized graphene oxide as coupling agent for graphene nanoplatelet/epoxy composites” Polymer Composites. 2020 Mar; 41(3):920-9.
- **Zeyang Yu**, Lawrence Drzal. “Graphene nanoplatelet composite ‘paper’ as an electrostatic actuator” Nanotechnology. 2018 Jun 1;29(31):31LT02.
- **Zeyang Yu**, Lawrence Drzal, Andre Lee. “GnP-TPU Composite Films for Packaging Applications” to be submitted to Journal of Materials Science.
- Kanbargi, Nihal, David Hoskins, Sumit Gupta, **Zeyang Yu**, Yongsoon Shin, Yao Qiao, Daniel R. Merkel, Christopher C Bowland, Nicole Labbé, Kevin L. Simmons, Amit K. Naskar. “A renewable lignin-based thermoplastic adhesive for steel joining” European Polymer Journal. 2023 May 8; 189:111981.
- Yongsoon Shin, Yao Qiao, Nathan Canfield, **Zeyang Yu**, Harry M Meyer III, Daniel R Merkel, Ethan K Nickerson, Nihal S Kanbargi, Angel Ortiz, Amit K Naskar, Kevin L Simmons. “Significant Slowdown of Plasma-Optimized Surface Energy Deactivation by Vacuum Sealing for Efficient Adhesive Bonding” Composites Part B: Engineering. 2022 Jul 1; 240:110001.

Patents

- Carbon Fiber Reinforced Composites and Method for Making Same. US Non-Provisional Patent Application No. 18/373,628.
- Pipe Renewal via Full-circumferential Polymer Lining Deposition. US Provisional Patent Application No. 63/462,694
- Sustainable Adhesives for Metal Bonding. US Provisional Patent Application No. 63/409,857.

Presentations

- **Zeyang Yu**, Lawrence Drzal, Andre Lee. “GnP-TPU Composite Films for Packaging Applications” SPE ANTEC Conference 2019.
- **Zeyang Yu**, Lawrence Drzal. “Functionalized graphene oxide as coupling agent for graphene nanoplatelet/epoxy composites”. CHEMS Symposium, Michigan State University 2018.
- **Zeyang Yu**, Lawrence Drzal. “Graphene composite paper used as the electrode materials for the electrostatic actuators” IACMI Composite Conference 2017.
- **Zeyang Yu**, Lawrence Drzal. “Graphene composite paper used as the electrode materials for the electrostatic actuators” SPE ACCE Conference 2017.
- Yong Chae Lim, Nihal Kanbargi, **Zeyang Yu**, Bradley Lokitz, Jiheon Jun, Yi Feng Su, Amit Naskar, Zhili Feng. “Adhesive Bonding of Lightweight Multi-materials with Surface Modifications.” TMS 2023.
- Gupta, Sumit, Arijit Mahapatra, Polyxeni Angelopoulou, Logan Kearney, **Zeyang Yu**, Amit K. Naskar, Christopher Bowland. “A versatile fiber coating process for efficient fabrication of multifunctional composites”. In Nondestructive Characterization and Monitoring of Advanced Materials, Aerospace, Civil Infrastructure, and Transportation XVII SPIE 2023.

Teaching Experience

- Teaching Assistant, Michigan State University
CHE 473 Chemical Engineering Processing Control Sept. 2013-Dec. 2013
Responsibilities: Organized computer lab, simulation section, and process control lab section

- Teaching Assistant, Michigan State University
CHE 804 Foundations in Chemical Engineering Jan. 2018-May. 2018
Responsibilities: Organized students study group, grading, and office hours
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Awards

- Dissertation Completion Fellowship 2019
 - Outstanding Student of College of Chemical Engineering 2011
 - NHU Enterprise Scholarship 2010, 2011
 - Second-class People's Scholarship 2010
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Professional Services

- **Ad-hoc Reviewer for Refereed Journals**
ACS Applied Nano Materials, ACS Omega, Powder Technology, Journal of Applied Polymer Science, ACS Applied Nano Materials
- **Professional Memberships:** Society of Plastics Engineers (SPE)