



Yue Yuan

Alvin M. Weinberg Fellow

Where and when did you earn your PhD?

I earned my PhD in fiber and polymer science and a graduate minor in biochemistry in 2021 from North Carolina State University.

What was the subject of your dissertation?

My dissertation research focused on the challenges existing in global management of carbon dioxide emissions and recent research on applying biocatalysts, as an alternative to high-energy and high-cost traditional liquid solvents in carbon dioxide scrubbing processes. We have reduced the mass transfer barriers for immobilized diffusion-limited biocatalysts and improved their longevity, through surface modifications and introducing fibrous structures.

What was your dissertation's major contribution to your field?

My dissertation research introduced a new category of material that has hierarchical structure and biocatalytic function. These novel materials are nontoxic, renewable, and biodegradable and have potential for scaling up. The "drop-in" biocatalytic reactor design will benefit low-energy, low-cost post combustion carbon dioxide capture operations without redesigning the gas scrubbing unit in power plants. The study also uncovered the mechanism of enhanced catalyzed reactions at liquid-gas-solid interfaces.

To help understand the molecular interactions, I led a project to develop a novel deuteration approach of biopolymers with a team from across the ORNL campus, through my internship at the Center for Structural Molecular Biology.

Who is your ORNL mentor and which group and division are you working in?

I am working in the Macromolecular Nanomaterial Group at the Center for Nanophase Materials Sciences. Dr. Rigoberto Advincula, the group leader, is my mentor.

What will your fellowship research focus on?

My research will focus on renewable macromolecular nanomaterials, particularly how their charge and hydrophobicity impact their reassembly with additive manufacturing techniques, outside the biological system. Those macromolecules are building blocks of the biological system, and they assemble in certain ways in plants and organisms for critical functions, such as structural support or energy storage.

What are your research interests?

I enjoy working on advanced functional materials, particularly bioderived and bioinspired materials. My ultimate goal is to develop controlled processes for bioinspired material formation and add robustness and/or new functionality to the reassembled materials. My research interest is to bridge fundamental bioscience discoveries with advanced materials manufacturing through revealing the mechanisms behind the phenomena we observed in material formation.

What led you to science and your specific discipline?

I was trained as a textile engineer and moved into polymer and nanomaterial research after graduate school. While working at the Nanotechnology Innovation Center at Kansas State, I was amazed by the huge change of material properties when manipulating them at nanoscale. During my PhD time, I realized the benefit and potential of biomacromolecules, as well as the challenges of using them outside the biological system. Therefore, my research interests grew into figuring out how to better utilize these fragile and complicated nanomaterials.

What did you do before coming to ORNL?

After a short postdoc experience on biobased nanomaterial research, I worked as an Innovation Analyst at RTI International, a nonprofit research organization. I was in the chemical and manufacturing sector of Innovation Advisor, where I supported federal and industrial clients on R&D topics such as 3D printing, materials in water filtration, and clean energy.

Could you share an interesting fact or two about yourself? (Something you like to do in your free time, something unique you can do or a unique experience you've had, unique vacation)

The kitchen is my lab at home, and I enjoy reverse-engineering a dish from a restaurant as well as creating new recipes. When I travel, I attend short-term local culinary school, too.

What nonscience topic or activity is important to you and why?

Education and mental health. I think they are the foundation of long-term happiness and success. Spending my spare time on these topics through readings and volunteering helps me grow as a professional and a mom.

I was a Science Communication fellow in Manhattan, Kansas for K-12 students. I enjoy supporting our next generation to find their own passion and unique talent in STEM .