



Andrew Ullman

Eugene P. Wigner Fellow

Where and when did you earn your PhD?

I started my PhD at Massachusetts Institute of Technology in 2009, with Prof. Daniel G. Nocera. Dr. Nocera was recruited by Harvard University halfway through my program, and I moved with him. I finished my PhD at Harvard University in 2015.

What was the subject of your dissertation?

My dissertation focused on polynuclear cobalt complexes as models of a cobalt water oxidation catalyst.

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

Using molecules to study structural and electronic analogs of an amorphous cobalt-oxide catalyst, I was able to provide atomic-level insight into the mechanism of water oxidation at neutral pH, specifically pertaining to the contribution of the anionic electrolyte species beyond their role as proton acceptors. This work provided the understanding needed to further optimize the activity of metal-oxide-based water oxidation catalysts in neutral pHs.

Who is your ORNL mentor and where are you working on campus?

My mentor is Jagjit Nanda, Energy Storage group leader in the Chemical Sciences Division. I am working in the Chemical Sciences Division, Physical Sciences Directorate.



What will your fellowship research focus on?

My fellowship research focuses on solid-state battery research. More specifically, I am designing, synthesizing, and characterizing a new type of solid electrolyte for enabling high-energy solid-state batteries.

What is your project's expected contribution to your field?

My project will introduce a new type of solid-state electrolyte to the battery research field that has high single-ion conductivity, forms a stable interface with lithium metal anodes, enables uniform stripping and plating of lithium, and ultimately, is incorporated into a high-energy, inherently safe, solid-state battery. Such batteries have the potential to revolutionize the future of electromobility.

What are your research interests?

I am interested in applying synthetic chemistry to problems related to the movement of electrons (quantum particles) and ions (classical particles). These problems span the fields of energy storage, batteries, catalysis, and quantum information systems.

What led you to science and your specific discipline?

I knew I wanted to study math, physics, or chemistry in college. I took courses in all three subjects and was immediately drawn to chemistry because of the logical progression of the material—specifically, how understanding the advanced material built naturally upon understanding the basic material. As a result, I find that problems in chemistry are easily understood from first-principles thinking.

What did you do before coming to ORNL?

After my PhD was finished, I was a postdoc at Sandia National Labs, working on projects related to metal-organic frameworks for electronics and sensing applications. I then joined a battery start-up called Sepion Technologies, where I developed battery separator coating materials for lithium ion and lithium metal batteries.

Could you share an interesting fact or two about yourself?

I was born in Australia—my American parents were living there at the time—so I am a dual USA and Australian citizen. Though I grew up in the USA, I have traveled to Australia for extended periods on three different occasions: once as a high school senior for 1 year (I technically graduated from a US high school and again at a high school in Adelaide, AUS); for 6 months as a university student (I studied at the University of Adelaide); and then again for 5 months (right before starting graduate school) with a close friend, traveling and working on organic farms up and down the east coast of the country. Someday I'd like to go back and explore the west coast, which is only part of the country in which I haven't spent much time. Maybe I could visit a western Australia mine where they produce much of the lithium and nickel used in today's batteries!

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

Any activity that makes me a better Dad to two small girls is important to me. Somedays you'll find me practicing braiding hair or applying nail polish, other days I am encouraging them to explore the outdoors, and most days I am doing my best to teach them to be kind, thankful, and generous human beings.

