

# Design Principles for Electrode-Electrolyte Interfaces in Energy Conversion and Biosensing

**Yirui (Arlene) Zhang, Ph.D.**

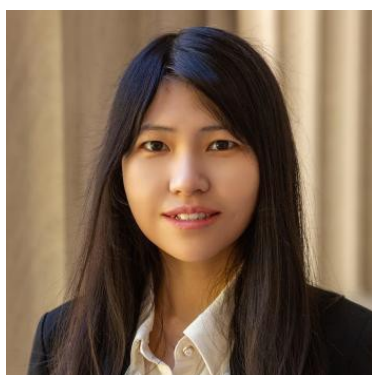
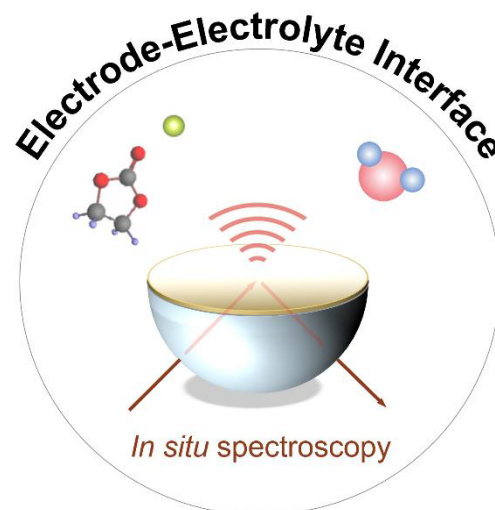
Schmidt Science Fellow, Postdoctoral Fellow, Stanford University

**Date: Monday, April 29, 2024**

**Time: 2:00pm – 3:00pm**

**In-person: RTH 306**

**Abstract:** Designing electrochemical and electrokinetic systems requires a deep understanding of materials behavior at the electrode-electrolyte interface, which determines their efficiency and lifetime. Challenges arise in characterizing the interface and understanding mechanisms under operando processes. In this talk, I will describe how we understand electrochemical reactions and electrokinetics at the electrode-electrolyte interface with *in situ* vibrational spectroscopy, which guides the design of efficient materials for Li-ion batteries, electrocatalysis, and biosensing. First, I will elucidate the formation of the electrode-electrolyte interface layer on Ni-rich positive electrodes in Li-ion batteries, revealed by *in situ* Fourier-transform infrared spectroscopy (FTIR), and demonstrate material design principles for stable battery cycling. Next, I will discuss strategies for electrolyte design in electrocatalysis and unravel the role of interfacial hydrogen bonding in enhanced oxygen reduction electrocatalysis using surface-enhanced infrared absorption spectroscopy. Lastly, I combine surface-enhanced Raman spectroscopy and electrokinetic systems to develop label-free and broad-spectrum platforms for bacterial biosensing. These studies offer insights for the rational design of materials for next-generation electrochemical devices with improved efficiency and lifetime.



**Biography:** Yirui Zhang is currently a Schmidt Science Fellow at Stanford University. She received her Ph.D. from Massachusetts Institute of Technology and B.S. from Tsinghua University, China. Her research focuses on understanding the materials interfaces in electrochemical energy storage and biosensing. She develops advanced characterization with *in situ* vibrational spectroscopy and electrochemical methods to elucidate and tailor the interfacial reactions, charge transfer across interfaces, and electrokinetic transport at the molecular scale. Her work has been recognized by the CAS Future Leaders in Chemistry, Electrochemical Society (ECS) Energy Technology Division Graduate Student Award, IE&EE H. H. Dow Memorial Student Achievement Award, and Materials Research Society Graduate Student Silver Award, etc.

Hosted by Prof. Jayakanth Ravichandran, Prof. Jianhua (Joshua) Yang, Prof. Han Wang, Prof. Chongwu Zhou, Prof. Stephen Cronin, and Prof. Wei Wu.

Sponsored by Ming Hsieh Institute.