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RESEARCH & COLLABORATION PROFILE

KEY WORDS: Electrocatalysis, Electrochemical Wastewater Treatment, Electrochemical/Environmental Engineering

Research Snapshot. Professor Lee designs electrocatalytic interfaces and the tools needed to see them work. His group combines oxide catalysts with *operando* scanning electrochemical microscopy to resolve reaction intermediates as they form, translating mechanistic insight into electrolyzers for water treatment, resource recovery, and sustainable chemical manufacturing. He is seeking partners who bring complementary catalyst platforms, separation processes such as membranes, or spectroscopic capabilities.

RESEARCH EXPERTISE

- Rational design of metal oxide electrocatalysts to steer selectivity among competing multi-electron pathways
- Operando scanning electrochemical microscopy with custom-functionalized tips for quantifying short-lived intermediates and products at solid/liquid interfaces
- Structure-activity correlation by coupling in situ spectroscopy and microscopy with kinetic and mechanistic analysis
- Translation of catalyst-level insight into electrolyzer design for water treatment, resource recovery, and energy conversion

RECENT RESEARCH HIGHLIGHTS

- Established operando SECM as a quantitative platform for tracking reaction intermediates, resolving selectivity descriptors that bulk electrolysis cannot access
- Demonstrated that atomically dispersed dopants in conductive oxide supports deliver precious-metal-lean catalysts with electrolyte-independent activity
- Showed that heterojunction anodes redirect anodic oxidation toward target products in complex, high-strength wastewater matrix

POTENTIAL COLLABORATION RESEARCH

Best-fit collaborator areas:

- **1. Electrochemical separation and resource recovery**
- **2. Electrochemical synthesis/molecular catalysis**
- **3. Photoelectrochemical water splitting**
- **4. Advanced in situ microscopy and spectroscopy**

SELECTED RECENT PUBLICATIONS

- **Environ. Sci. Technol. Lett., 2026, 13(3), 413-419** – In situ quantification of nitrate reduction intermediates using SECM
- **Small, 2024, 20(35), 2401248** – Developing atomically dispersed Ru doped Ti_4O_7 electrocatalysts for chlorine evolution reaction
- **Environ. Sci. Technol., 2023, 57(47), 18529-18537** – Quantitative evaluations on ozone evolution electrocatalysts using SECM
- **ACS Appl. Mater. Interfaces, 2021, 13(29), 34093-34101** – Disentangling the roles of Pt and PtO_x in the chlorine evolution reaction under polarity reversal

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https://sites.google.com/view/wleelab

REPRESENTATIVE RESEARCH FIGURES / SCHEMES

