



## Electrochemistry-Driven Small Molecule Upgrading for Sustainable Chemical Manufacturing

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Global efforts to decarbonize industrial sectors are accelerating in pursuit of a sustainable future. Among them, the chemical manufacturing industry is one of the largest contributors to global CO<sub>2</sub> emissions, underscoring the urgent need for green technologies to replace fossil fuel-based, energy-intensive chemical production processes. Electrochemical upgrading of CO<sub>2</sub> into high-value chemicals, powered by renewable electricity, offers a promising, carbon-neutral pathway. However, to replace well-established thermochemical processes, it is essential to develop energy-efficient and highly selective electrocatalysts that enable cost-competitive chemical and fuel production from CO<sub>2</sub>. A major challenge in this field lies in the limited fundamental understanding of how catalysts structurally evolve under operating conditions and how catalytic microenvironments are formed in situ. In this seminar, I will discuss the dynamic nature of catalytic active site and their surrounding microenvironment under electrochemical conditions, highlighting key challenges and strategies to tune them for improved CO<sub>2</sub> upgrading. I will conclude by presenting future research directions, which focus on the development of well-defined yet tunable electroactive materials for electrochemical carbon capture and small molecule upgrading.