

# Plasmons and magnetic fields in electrochemistry

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In addition to engineering the morphology and electronic structure of electrocatalysts, local microenvironments at the electrode–electrolyte interface can markedly affect electrochemical reactions. In this talk, I will discuss two strategies that we are investigating to control concentration polarization and the chemical species at the electrode–electrolyte interface with the goal of improving activity and selectivity in electrocatalytic reactions. First, visible light excitation of noble metal plasmonic electrodes is known to generate localized charge carriers and heat. I will show that a rise in electrode surface temperature as small as 1 K from photothermal heating can induce convection in an electrolytic solution, and more than double electrochemical reaction rates. In a second strategy, we employ external magnetic fields to selectively interact with and control the movement of charged particles in an electrolytic solution. In the electrocatalytic reduction of CO<sub>2</sub> in a neutral, aqueous medium, I will demonstrate that the presence of a magnetic field enhances the selectivity of CO<sub>2</sub> reduction over solvent reduction, due to a change in the interfacial pH and pH gradient at the electrode–electrolyte interface. Collectively, the discussed results will highlight the importance of tuning chemical microenvironments by control over mass transport to optimize and control the outcomes of electrocatalytic reactions.