Non-Equilibrium Conversion Using Plasmons

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Electroconversion is seeing a resurgence due to its utility for the manufacturing of chemicals and fuels powered by renewable energy. While catalyst design and engineering has been the key strategy for optimizing electroconversions, we have found that light excitation can instead be used to modulate the electrochemical activity in cases where the electrocatalyst is comprised of noble metal nanoparticles. The localized surface plasmon resonances of these nanoparticles allow strong absorption of light and the generation of non-equilibrium conditions at the electrode–electrolyte interface. As an outcome, the electrosynthetic activity is boosted beyond the equilibrium limit. I will describe several examples of such phenomena, including electrocatalytic ammonia oxidation, ammonia synthesis, methanol oxidation, and hydrogen evolution. I will also discuss the various non-equilibrium interfacial processes induced by plasmonic excitation and their mechanistic role in the electroconversion.