Electrochemical CO2 reduction: controlling product selectivity through application of pulsed

potentials.

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Operating electrochemical cells in 'pulse-mode' (i.e., a transient electrochemical potential) has important and surprising implications on the selectivity of the reaction products. By controlling the pulsing potential profile applied to copper during the CO2 reduction reaction (CO2RR), we recently discovered that the competing hydrogen evolution reaction (HER) is suppressed and the composition of the reaction products can be tuned. This finding provides new insights into the timescales of competing pathways in CO2RR and enables an opportunity in which the CO2RR selectivity can be tuned by adjusting the temporal profile of the electrochemical potential. Intrigued by the prospect of probing and controlling the selectivity in the CO2RR, we see the pulse-profile engineering experiments as a compelling opportunity to gain much needed insights into the reaction mechanism. Our preliminary hypothesis is that the pulse conditions influence (1) the ionic species present near the electrode surface and (2) the surface coverage of the CO2RR intermediates. The student working on this project will gain a deeper understanding into the complex interplay of surface reactions and transport processes by investigating the impact of pulse condition and electrode structure. Students working on this project should grain proficiency in electrochemical analysis, and will also gain expertise in the following characterization techniques: gas chromatography, structure analysis (electron microscopy and X-ray scattering) and Fourier transform infrared spectroscopy (FTIR).