Selectivity Control in CO_2 Electroreduction through Rational Catalyst and Electrolyte Design

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The utilization of fossil fuels as the main energy source gives rise to serious environmental issues, including global warming caused by the continuously increasing level of atmospheric CO_2. Recently, the electrochemical conversion of CO_2 (CO_2RR) to chemicals and fuels driven by electricity derived from renewable energy has been recognized as a promising strategy towards sustainable energy.

In my talk I will provide examples of recent advances in the development of highly active plasma-modified single crystals, nanostructured thin films and nanoparticle (NP) electrocatalysts (Cu, Ag, Zn, and Cu-M with M = Zn, Sn) and how their structure (crystal orientation, atomic arrangement, size, shape, defects), oxidation state and composition influence their selectivity in CO_2RR. I will also discuss how important morphological motives and chemical sites can be created and regenerated in pulsed electrochemistry experiments. Additionally, the determining role of the electrolyte in the surface restructuring, reaction activity and selectivity will be illustrated.

The importance of *in situ* and *operando* characterization methods (e.g. EC-AFM, Liquid-TEM, XAS, XPS) to gain in depth understanding on the structural and chemical transformations of CO_2RR catalysts under working conditions will be demonstrated. Our results are expected to open up new routes for the reutilization of CO_2 through its direct selective conversion into higher value products such as ethylene and ethanol.