Conversion of CO_2 using electrochemical flow processes

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The conversion of CO_2 *via* electrochemical processes is a relevant technology to close the carbon cycle; especially when combined with renewable energy sources. Because of their high market value and their high energy density, research has aimed at developing catalysts for the electrochemical conversion of CO_2 into multicarbon molecules. Copper (Cu) is one of the few transition metals that can efficiently catalyze the electrolysis of CO_2 to multicarbon products such as ethylene, ethanol, acetate, propanol. The design of Cu-based catalysts by adapting some of the concept of molecular catalysts in order to finely tailor the behavior of the active sites of metallic surfaces is currently regarded as the long-standing interest for the controlled design of novel electrocatalytic materials. Increasing the oxidation state of copper has been suggested to improve the CO_2RR performance and notably the formation of C_{2+} species.

In this context, we have proposed a new strategy to improve the conversion of CO_2 to hydrocarbon molecules with two or more carbon atoms (C_{2+}) via molecular doping of a metal catalyst. Specifically, we have identified electrophilic functional groups that can direct the electrochemical reactions towards the production of C_{2+} species such as ethanol and ethylene and improve the reaction rates at the catalyst surface. Our research has also focused on the integration of our electrocatalyst into a flow electrolysis process. Flow electrolysers have recently been proposed to facilitate electrochemical CO_2RR due to their unique ability to achieve electroreduction at high reaction rates via the creation of a three-phase interface. Although some examples of flow electrolyzers for CO_2 conversion have been recently reported, the influence of CO_2 and electrolyte flows on the overall catalytic mechanism has remained ambiguous. We explored the correlation between the applied potential and the feeds in both electrolyte and CO_2, on the one hand, and the performance metrics, on the other hand.

I will review our recent findings on our recent progress in electrocatalytic CO_2 reduction using a continuous flow process.