Catalysts for the efficient electrochemical conversion of CO_2 to CO

Sichao Ma
University of Illinois at Urbana-Champaign

Over the past few decades the CO_2 levels in the atmosphere have been rising steadily, which has led to negative impact on the climate. Multiple strategies, such as carbon capture and sequestration, switching to cleaner fuels, expanding utilization of renewable energy sources, and increasing the energy efficiency of buildings, need to be employed simultaneously to curb this rise. An additional approach that can be used is the electrochemical reduction of CO_2 into value added chemicals or their intermediates. This process can be driven by the vast amounts of excess renewable power, thereby providing a means to store excess intermittent renewable energy while simultaneously recycling CO_2 as an energy carrier. Furthermore, by utilizing CO_2 as the starting material for chemical production, society's dependency on fossil fuels is reduced.

For this conversion to become economically viable, efficient catalysts that can be used at low metal loading, and are able to achieve high reaction rates at low overpotential need to be developed. To this end, Ag nanoparticles supported on titanium dioxide (TiO_2) catalyst was developed to decrease the mass fraction of silver in the catalyst layer. Using this supported catalyst, similar performance as the commercially available unsupported Ag catalyst was achieved in terms of selectivity for the desired product and in the rate of conversion, but at much lower Ag loading. In addition, the use of an anode catalyst different from Pt significantly increased the current density as well as cell energy efficiency. Through these improvements, we are able to improve overall performance in the electrolysis of CO_2, bringing this process closer to becoming economically viable.