Combinatorial Screening of Catalyst Materials for Electrochemical CO2 Reduction

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The strategy for the efficient conversion of CO₂ into useful products (methanol, methane...) can have multilateral significance, but still represents a serious scientific and technical challenge. While conceptual considerations on the conversion of CO₂ into fuels are already quite advanced in heterogeneous catalysis, electrocatalysis is still in its infancy on this aspect despite an over 30 years history on CO₂ reduction research. Nevertheless the topic has gained considerable interest recently, as the conversion of CO₂ at the electrochemical interface has some distinct advantages: 1) operation at ambient conditions 2) flexible control of reaction rate by the electrode potential 3) rather straightforward separation of the products. However, the central challenge for deployment of electrochemical energy conversion is the still relatively low efficiency and thus the significantly higher operational voltages as predicted by thermodynamics.

The priority task is to design catalytic materials (electrocatalysts) which will allow high rate of electrode reaction with acceptable selectivity and sufficient stability. In order to 1) build a fundamental understanding of the reaction and its dependence on various operation conditions, as well as 2) identifying superior catalytic materials utilizing material libraries, we have developed a special electrochemical high-throughput screening approach.[1] Moreover, we have coupled this scanning flow cell (SFC) to an inductively-coupled-plasma mass spectrometer (ICP-MS) for the online-investigation of the stability, and to a differential electrochemical mass spectrometer (DEMS) for studying selectivity. First exciting results utilizing this approach will be presented, concerning the electrochemical CO₂ reduction at ambient temperature and pressure. [2] [3]

