CO_2 Electroreduction

CO_2 electroreduction is a promising technology that uses intermittent renewable electricity and CO_2 emissions to produce fuels (e.g., methanol) and other economically relevant products (e.g., syngas). One of the great promises of this technology is to recycle the CO_2 produced by factories, reducing CO_2 emissions and its impact to climate change.

In order for CO_2 electroreduction to play a major role in the energy transition, the main components of a CO_2 electroreduction device, the electrocatalysts, need to be optimised to produce fuels or chemicals efficiently and selectively.

Challenges

Selectivity is one of the main challenges scientists face in CO_2 electroreduction research, since current catalysts produce undesirable bi-products, or a desirable product mixture with a wrong ratio. For instance, if syngas ($CO + H_2$) is desired as a product, the catalyst needs to be able to produce it in the right CO/H_2 ratio. The most efficient catalysts for CO_2 reduction are metallic nanostructured materials. A nanostructured catalyst not only allows to tune the selectivity by changing the catalyst composition, but also by changing the nanoparticle size. Being able to tune these properties accurately to test or study their effect on the selectivity and efficiency of the CO_2 reduction is the key for the rapid development of this field.

TECHNICAL INPUT

Particle Source	VSP-G1 & VSP-S1
Deposition Method	Diffusion & Impaction
Deposition System	VSP-A3 or S1
Deposition Parameters	N/A
Sample	Conducting substrates
Material	Transition metals
Application	CO_2 electroreduction
Analysis technique	TEM

Solution

The particle generator VSP-G1 allows to control both size and composition in a strikingly accurate and efficient way to study/understand the nanoparticle properties that lead to a desirable product or a product ratio (see syngas example in the illustration below). VSPARTICLE recommends two setups ideal for device optimization in a gas-diffusion layer system (setup 1) and ideal for fundamental catalyst research in a H-cell (setup 2).

Example experiment setup

1) Nanostructured catalysts with control over the primary particle size, composition and mesoscopic properties (e.g., porosity):

2) Well-separated particles with control over the size and composition:

Catalyst optimisation for syngas production

- VSPARTICLE tools are ideal to study/optimize the product selectivity of highly active alloy catalyst by fine tuning the catalyst composition.