

Master Project:

## Colloidal Synthesis of Cu and Cu-base Alloy Nanocrystals for CO<sub>2</sub> Reduction

The ever-increasing worldwide consumption of fossil fuels has not only accelerated the depletion of these finite natural resources, but led to overproduction of greenhouse gas CO<sub>2</sub>. One sustainable solution to these problems is to electrochemically reduce CO<sub>2</sub> into value-added hydrocarbon fuels by making use of a renewable energy. However, a main challenge remains to be the the lack of a high-performance electro-catalyst that can convert CO<sub>2</sub> with high efficiency and selectivity.

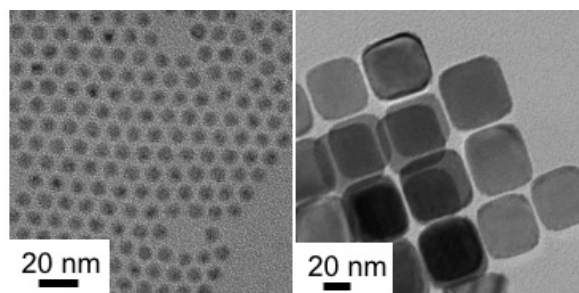


Figure 1. (a) TEM images of NC electrocatalysts. (b) Photo of the electrochemical flow cell utilized to test their activity.

The Laboratory of Nanochemistry for Energy (<http://lnce.epfl.ch>) exploits precisely engineered colloidal nanocrystals (NCs) as model systems to define design principles for new catalysts in electrochemical CO<sub>2</sub> reduction by aiming at revealing unambiguous structure/properties relations (Figure 1). One intriguing project

concerns the development of Cu and Cu based alloy nanocrystals, as Cu is currently the only catalyst with propensity to form hydrocarbons and C-C coupled products in the CO<sub>2</sub> reduction reaction.

This project will mainly focus on the control on the size, composition, shape and crystalline structure of the nanocrystals by employing colloidal chemistry, which is one of the most powerful solution-based bottom-up approaches to nanomaterials. Different synthetic strategies to precisely engineer the nanocrystal will be pursued in either organic or aqueous media: a direct approach involving a homogeneous nucleation followed by a subsequent crystal growth, and seed-mediated growth involving preferential deposition on preformed seeds. Many factors, such as the addition of ligands, the modulation of precursor ratio, the choice of seeds in terms of their size and shape, *etc.* will be played with. The student will carry the project at the new campus EPFL Valais.

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