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Colloidal chemistry to design well-defined and tunable nanomaterials for catalysis and energy applications

Raffaella Buonsanti
Laboratory of Nanochemistry for Energy Research, Institute of Chemical Sciences and Engineering, Ecole Politechnique Fédérale de Lausanne, Sion CH-1950, Switzerland.

Affordable clean energy and climate action are two of the sustainable development goals set by the United Nations to be achieved by 2030. The vast majority of energy technologies relies on nanomaterials and their progress is strongly connected to the ability of materials chemists to tune their property and function-dictating features (i.e. size, composition, composition, morphology).

In this talk, I will present our recent group efforts towards the synthesis via colloidal chemistry of atomically defined nanocrystals (NCs) with properties of interest for energy conversion applications.

The first part will focus on our studies on the synthesis development and formation mechanism of Cu NCs. I will illustrate how these NCs with precisely tunable shapes, sizes and interfaces serve as ideal platforms to make more selective catalysts in the electrochemical CO2 reduction reaction. Finally, I will share our results evidencing that these NCs can sustain their catalytic activity and selectivity at technologically relevant conditions, therefore might also offer practical solutions.

The second part will be dedicated to our colloidal atomic layer deposition (c-ALD) method to grow tunable oxide shells around different inorganic NC cores. I will discuss the formation mechanism of the shell by sharing our recent insights into the surface chemistry. I will also demonstrate some of the enabled applications, such as the improved stability of the colloidal ink, which is particularly important in the context of quantum dot-based LEDs and solar cells, and the enhanced resistance against harsh environment, which is relevant for catalytic applications.