Abstract: C3 for the price of CO2: in-situ characterization of the CO2 reduction reaction on colloidal electrocatalyst nanoparticles

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The increase of the carbon dioxide (CO2) footprint of our society is a major environmental issue that needs to be tackled by governmental legislation and technology. One compelling strategy to reduce our CO2 footprint is to use CO2 as a feedstock for the production of value-added fuels that can eventually replace fossil fuels. In order to achieve this, novel technologies have to be developed that efficiently convert CO2 into chemicals, which would allow us to store energy in chemical bonds on a large scale and create a sustainable carbon-neutral cycle. Electrocatalytic conversion of CO2 into hydrocarbons is an example of such a novel technology. Unfortunately, the current electrocatalysts that produce hydrocarbons are not selective enough, and only methane and ethylene are produced with reasonable efficiencies (up to 70-80%). In order to reach the goals of the energy transition and reduce the CO2 footprint with 80-95% by 2050, larger amounts of energy would have to be stored in chemical bonds by the electrocatalytic conversion of CO2. One way to achieve this would be to efficiently produce longer (e.g. three carbon atoms, C3) hydrocarbon chains from CO2, which has remained largely elusive up to this point.

In this talk, I will discuss the opportunities and challenges of electrocatalysis in general, and of colloidal metal nanoparticles as efficient electrocatalyst materials in particular. I will discuss how I envision that the size-, shape- and composition-tunability of colloidal nanomaterials can be used to direct and induce C-C coupling, in order to efficiently produce longer hydrocarbon chains from CO2.