

From nanostructured planar electrocatalysts to preferentially shaped nanocrystals

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Mass transport effects, including the delivery of reactants to the catalyst and the off-transport of reaction products/intermediates away from the catalyst surface, are known to contribute to the (electro)catalytic reaction activity and selectivity. To specifically address mesoscopic mass transport effects two-dimensional model nanostructured catalysts were fabricated via colloidal lithography techniques, which consist of ordered arrays of electrocatalytically active Pt nanostructures on a planar glassy carbon substrate. The nanostructured Pt catalyst at different Pt island size and density were characterized and tested in electrocatalytic reactions under well-defined electrolyte flow rate. The results will be discussed on a molecular scale in terms of the 'desorption - re-adsorption - reaction' model for complex reaction networks which are including formation of reactive intermediate(s).

The knowledge gained on extended single crystal electrode surfaces at a low defect density (or defect-free) is often not that straightforward to transfer for realistic nanoparticle catalysts with a high density of defects and undercoordinated sites, which are envisaged to play a key role in heterogeneous catalysis. To bridge a material gap between extended single crystal electrode surfaces and realistic nanoparticulated electrocatalysts, regularly shaped metal nanoparticles (e.g., truncated octahedrons, cubes, or tetrahedrons) were fabricated, which are sized (ca. 10 nm) close to those used for practical applications, although having highly selective (111) or (100) two-dimensional ordered domains. The synthesis routes, physical and electrochemical characterization of the shape-selective Pt nanoparticles, their shape-structure relation will be discussed.