Catalysis:
A Part of the Solution for Future Energy Conversion

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For many decades to come we shall still rely on fossil resources and as new sustainable energy sources emerge there will be a need for averaging out the temporal variation. Both schemes will require extensive use of heterogeneous catalysts and the need for new electro- and photo-catalysts will increase. In order to improve catalytic reactions by a rational approach it is mandatory to understand which step in the process that is the rate-limiting one, and what is the nature of the site where it takes place [1]. In other words, what is the relation between reactivity and structure/size of nanoparticles? In this presentation we will demonstrate a number of surface chemistry reactions, in which a combination of theoretical insight and interplay between experimental surface science on well-defined single crystal surfaces, model systems of mass selected nanoparticles deposited on planar surfaces, and measurements on supported catalysts have made such an identification possible [2,3]. Gaining fundamental insight allows for prediction power on what should be done in order to improve the catalytic activity and how we optimize their presence? In particular the importance of particle size will be elucidated both for mass selected clusters deposited on planar surfaces, where they can be investigated by STM and tested for activity in our newly developed micro-reactor platform [4]. Furthermore, we will also demonstrate that this principle can be extended to control selectivity and optimization of electro- and photo-chemical reactions, for which we are exploring alternative catalyst for either reducing [5,6] or entirely replacing the scarce and expensive Platinum group catalysts [7,8].

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