IPID4all Doctorate Research Exchange with Phillip Christopher (University of California Riverside)

Feedback report

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DRIFTS studies of oxide supported colloidal noble metal nanoparticles

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Introduction

For the industrial application of heterogeneous catalysts, supported nanoparticle systems are known as most common materials. In contrast to systems obtained from conventional impregnation and calcination techniques, the deposition of colloidal nanoparticles is a promising way to fabricate tailor-made catalyst materials under mild conditions (figure 1). Essential for the catalyst properties is the interaction between metal nanoparticles and the oxide surface und the ligand shell containing long chain amines on the noble metal surface. Particularly the temperature dependent strong metal support interaction (SMSI) can lead to changes in particle charging and the nanoparticle surface composition may influence the amount and character of active surface sites by adsorbing on others. Moreover, these ligands with their sterical demand are known for inhibiting unsuitable reactants from reaching the active centres. These effects are thereby crucial for the catalyst activity and selectivity.

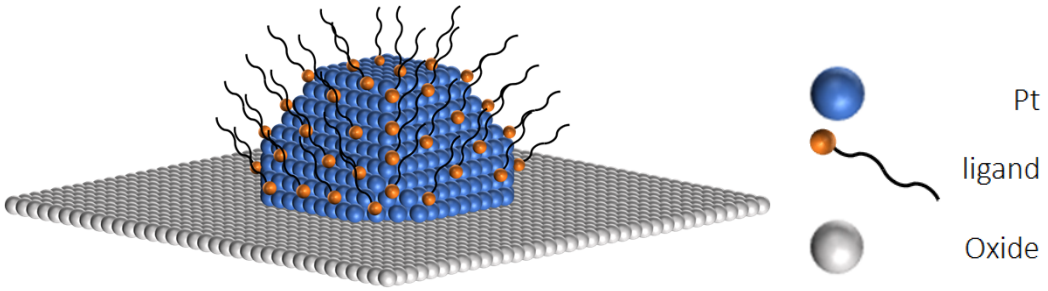

Figure 1: Scheme of an oxide supported ligand capped nanoparticle.

Research Undertaken

During my stay at Mr. Christopher's lab, I performed in-situ diffuse reflectance infrared fourier transform spectroscopy (DRIFTS) on different catalyst materials containing platinum and gold on several oxides. They have been produced in Oldenburg before. In the experiments, the catalyst properties have been determined by heat treatment in inert and catalytic environment as well with a sensing probe molecule. To support the DRIFTS results, the outgoing gas stream has been examined by a residue gas analyser.

Personal Experience

By joining Mr. Christopher's group, I had the chance to work in an international group. Moreover, I got insight in the working philosophy and organization of this group to be most efficient. This also includes the benefit of weekly reports to the principal investigator. Besides learning about catalyst surface processes, I made contact with many colleagues and our cooperation will continue in the future. Additional, I learned about the lab safety precautions and their organization structure in the US.

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Conclusions

With these studies, new properties of the materials were found, that, as far as we know, haven't been published yet. This includes the influence and behaviour of ligands, particle size and metal support interaction. Deeper analysis of these effects is still in progress.

Outlook

This exchange was the starting point of my Ph.D. studies. Also, it is the beginning of a cooperation between both groups and another stay at Mr. Christopher's group, then in his new lab in Santa Barbara, is already in discussion. After further analysis in Oldenburg, it is planned to publish about the work related to this stay in California in a research journal.