Priority Programme

“Material Synthesis near Room Temperature”

Project Description – Project Proposal

Base Metal Nanostructures via Ionic-Liquid-based Synthesis (BaseMet-IL)

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Summary of proposal

Aiming at intermetallic clusters and nanoparticles, we obtained highly reactive carbonyl clusters (e.g. [BMIm]2[{PbMn(CO)5)}6I8], {GeI3Fe(CO)3}2FeI4, (GeI3)2Fe(CO)4, Ge12{Fe(CO)3}8I4, [EMIm][Sn2I7Fe(CO)3], [Co{1,4-C6H4(CN)2}2{NTf2}2][SnI{Co(CO)4}3]2) and intermetallic nanoparticles (e.g. systems Fe-Sn, Co-Sn, Ni-Ir, Ni-Os, Pd-Sn, Pt-Sn) via IL-based synthesis. We could also show the formation of bimetallic nanoparticles via direct IL-based synthesis or via decomposition of IL-made carbonyl clusters. Besides detailed characterization of composition and structure, we have validated the catalytic properties of the respective bimetallic nanoparticles. The specific properties of the ILs (i.e. redox stability, thermal stability, weakly coordinating properties) turned out as essential for obtaining the reactive carbonyl clusters and bimetallic nanoparticles.

Based on our results of the first funding period, we will now address the IL-based synthesis of highly reactive and strongly oxophilic base metal nanostructures. Specifically, we will focus on metalloid clusters and nanoparticles of Ti, Nb, Si and Ge. Besides the explorative synthesis and fundamental structural characterization we will study the material properties, especially including quantum-size effects and fluorescence (e.g. for Si, Ge, Si-Ge) as well as catalytic properties (e.g. for bimetallic Ti-Pd, Ti-Pt, Nb-Pd, Nb-Pt systems) based on hydrogenations as a test reaction. Aiming at highly reactive and oxophilic base metals such as Ti, Nb, Si and Ge, IL-based synthesis seems ideal in principal, but was barely addressed by now. In fact, such IL-based strategy could offer a new and reliable access to highly reactive base metal nanostructures.