Karlsruher Institut für Technologie

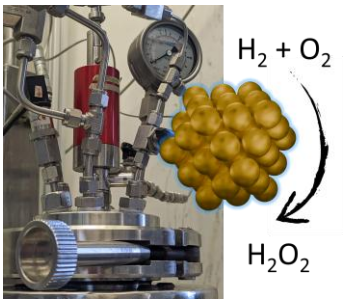
Institute of Catalysis Research and Technology (IKFT)

Model systems and nanoscale functional materials in catalysis
Prof. Dr. Silke Behrens / https://www.ikft.kit.edu/english/237.php

Master thesis

Synthesis and characterization of NHC-stabilized materials as catalysts for direct H_2O_2 synthesis

Motivation:



Our group at IKFT is part of the collaborative research group *HyPerCat*, which focuses on bridging concepts in the thermo- and electrocatalytic direct synthesis of hydrogen peroxide (DSHP), i.e. the synthesis from O_2 and H_2. In our subproject, we are focusing on developing different DSHP catalysts and screening their activity in a semi-batch setup.

The main goal of this Master thesis will be the synthesis and characterization of Pd compounds stabilized with N-heterocyclic carbene (NHC) ligands. Such materials present very interesting model systems for the direct synthesis of hydrogen peroxide due to the specific ligands and the enhanced stability they induce. Based on previous work on these NHC systems from our group, the influence of NHC ligands on the catalyst properties will be evaluated. A further objective is the development of stable heterogeneous catalysts by supporting the NHC compounds on suitable carrier materials, such as carbon or metal oxides.

The main work packages of this Master thesis will be:

- Synthesis, isolation and characterization (UV-Vis, NMR, ESI-MS) of Pd-based NHC compounds (e.g., complexes, clusters, nanoparticles)
- Preparation of heterogeneous catalysts by immobilizing these NHC compounds on different support materials & characterization of the final catalysts (for example by XRD, (S)TEM, elemental analysis)
- Catalytic tests of these materials in the direct synthesis of hydrogen peroxide in a semi-continuous stirred tank reactor, as well as evaluation of catalyst stability

Requirements:

- Interest in inorganic chemistry and heterogeneous catalysis, as well as knowledge of the basic concepts of inorganic synthesis
- Independent and conscientious approach to work

Further information:

We offer excellent opportunities to learn about the colloidal chemical synthesis of nanoparticles and cluster compounds and to gain practical experience in characterizing these materials and testing of the resulting catalysts.

Work on the Master thesis can be started anytime. If you are interested in the topic or in case of questions, please contact Vera Truttmann (vera.truttmann@kit.edu).