Abschlussarbeit Bachelor/Master:
Nanoporous polymer derived Ceramics from Polysilazanes In situ Modified with Metals Nanoparticles

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Silicon-based polymer-derived ceramics (PDCs) with desired porosity has received considerable attention in the last decades mainly due to their promising functionalities as hydrogen storage materials, molecular sieves and catalysts. The polysilazane-derived ternary Si-C-N and quarternary Si-C-N-(O) systems are promising candidates of the silicon-based PDCs, with excellent thermal and chemical stability. However, in order to tailor the porosity in Si-C-N and Si-C-N-(O) ceramics, the native polysilazanes polymers are usually mixed with micrometer-sized Si_3N_4, SiC and AlN fillers and subsequent thermolized at 700-900 °C in gaseous ammonia. The drawback of this approach is the susceptibility of the resulting silicon imidonitride structure to hydrolysis. Furthermore, the micrometer-sized fillers applied in the synthesis limit the application of the obtained PDCs products. Therefore, the use of metal nanoparticles such as Ni, Fe, Co and Cu could be a good alternative approach to tailor the porosity and enhance the applications of PDCs.
The aim of this work is to obtain Metal/Si-C-N-(O) nanocomposites with desired porosity derived from Metal-polysilazane precursors. Ni, Fe, Co, Cu, Ag, Pt are some of potential metals can be used in this approach. In the first step, *trans*-Bis(acetato-κ*O*)bis(2-aminoethanol-κ^2 *N*,*O*)Me(II) (i.e. Me= Ni, Fe, Co, Cu, Ag, Pt) single crystals will be grown. In the next step Me/Si-C-N-(O) nanocomposites will be synthesized by reacting polysilazane polymer and the obtained trans- [bis(2-aminoetanol-N,O)diacetato-Me(II)] crystals followed by thermolysis at 700-1000 °C. The resulted Me/Si-C-N-(O) nanocomposites will be characterized by FTIR, BET, TEM, SEM, single crystal XRD and will be tested for catalytic applications.

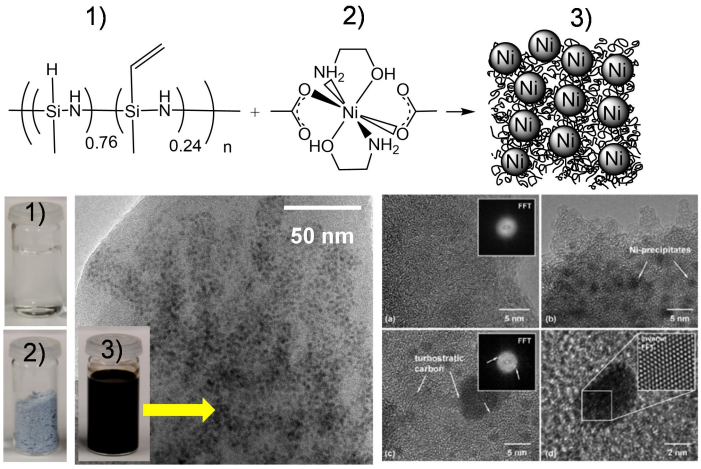

Fig. 1. The formation of Ni-polysilazane precursors (3) by reacting of polysilazan polymer (1) with Ni-comple single crystal (2). TEM shows the produced Ni/SiCNO nanocomposite by thermolysis at 700 °C

The students will learn the following:
Methods:

- Synthesis of ordered mesoporous silica
- Surface modification with functional organic groups as $–NH_2$, -SH, -COOH
- Surface modification with graphene oxide
- Membrane fabrications
- Batch adsorptions experiments of heavy elements and organic dyes
- Permeability test of fabricated membranes

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Characterization

- Nitrogen adsorption, Small-angle X-ray diffraction, Transmission electron microscopy, Scanning electron microscopy, Attenuated total reflection infrared spectroscopy, Thermal analysis, UV spectrophotometer, Inductively coupled plasma spectrometry, Membrane permeability tests.

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