

Synthesis and assembly of semiconductor nanoparticles

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The development of pathways for the synthesis of nanoparticles with reduced dimensionality and their assembly into organized networks is a main objective of nanochemistry. These nanomaterials exhibit unique electronic and mechanical properties, which can be used for applications in catalysis, photovoltaics, sensing, and energy storage. This project aims at the synthesis and characterization of ultrasmall semiconductor nanoparticles in a microwave-assisted heating procedure. This approach allows us to create nanoporous networks of various morphologies and pore sizes.

The basis of this experimental approach is a non-aqueous sol-gel protocol for the synthesis of nanoscale transition metal oxide particles. By adjusting the reaction parameters in the microwave synthesis, the particle properties such as crystallinity and small size should be further improved. The nanoparticles will be used for the preparation of thin porous films on various substrates, such as glass, silicon or transparent conducting oxides.¹ After the successful film preparation, the films' properties will be tested regarding their efficiency in dye-sensitized solar cells.

The work of the candidate will focus on the optimization of the microwave synthesis procedure and the assembly of the nanoparticles in mesoporous films. The candidate will further characterize the nanoparticles and the mesoporous films by methods such as X-ray diffraction, dynamic light scattering (DLS), small-angle X-ray scattering (SAXS), and vibrational spectroscopy. Electron microscopy will be used to obtain images of the samples both by scanning the surface (SEM) and in transmission mode (TEM). Furthermore, the candidate will be involved in the assembly and testing of dye-sensitized solar cells.

The research group of Professor Thomas Bein is located at the Campus Großhadern in the southwest of Munich (<http://bein.cup.uni-muenchen.de/index.php>). Currently the group has about 30 group members and the fields of research center on the synthesis, physical properties and applications of porous nanostructures. The Ludwig-Maximilians University is one of the leading universities in Germany; it offers a broad range of programs in the fields of humanities, medicine, law, and particularly in natural sciences. The Munich area offers many cultural highlights and major events. It is located in one of the most beautiful parts of Germany in the southern part of Bavaria close to the Alps.

1 J. M. Szeifert et al., *Chem. Mater.* **2009**, *21*, 1260.