➢ Synthesis of inorganic mesoporous support materials with tunable pore size for heterogeneous catalysis

The goal is the synthesis of series of stable monodisperse silica nanoparticles (NPs) with tunable size (12 – 30 nm) via sol-gel method. They shall be further used as main building blocks for the assembly of mesoporous silica and silica inverse opals with adjustable pore diameter between 5 and 10 nm. The pore walls of the assembled mesoporous materials will be functionalized with catalyst molecules and the catalysis in confinement will be studied.

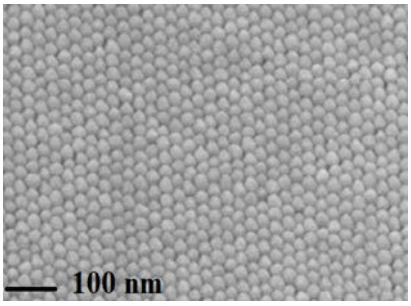
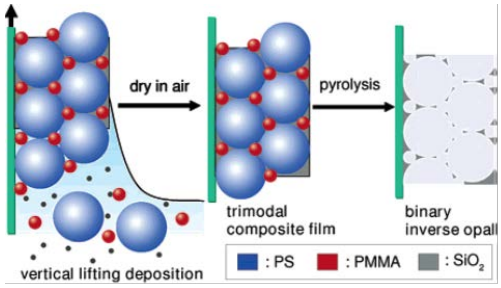


Figure 1. SEM image of SiO_2 NPs assembled in a mesoporous silica.

(in cooperation with Prof. Laschat, Institute of Organic Chemistry, University of Stuttgart and Prof. Buchmeiser, Institute of Polymer Chemistry, University of Stuttgart)

1. T. Yokoi *et al.*, *JACS*, **2006**, *128,* 13664.

➢ Synthesis of oxide-based inverse opals as support materials for catalytic applications



Various oxide nanoparticles will be co-assembled with polymer template nanoparticles in 3D mono- or bimodal colloidal crystals. Then, the polymer particles will be removed to form the corresponding oxide inverse opals. The synthesis of the inorganic porous materials will be accompanied by a thorough characterization including SEM, XRD, BET analysis, etc.

2. J. Wang *et al.*, *JACS*, **2006**, *128*, 15606.

➢ Mineralization in confinement – study on mineralization mechanism of oxides in a confined model system

A model system resembling a confined space shall be prepared. It will be used to gain insights into the mineralization mechanism of various oxides in confinement compared to oxide formation in bulk. The structure, morphology, composition and crystallinity of the obtained products will be characterized via various spectroscopic methods.

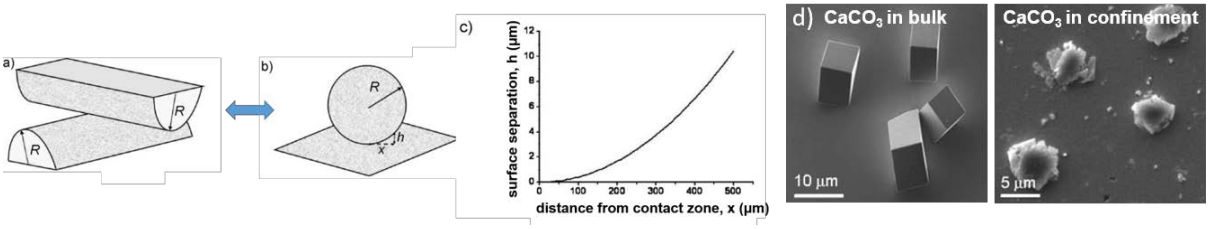


Figure 2. Illustration of a) crossed–cylinder and b) sphere-on-a-flat configuration with radius of curvature R and surface separation h. c) The surface separation h plotted as a function of distance x to the contact point (modified). d) SEM images of CaCO3 precipitated at h of about 1 mm and 10 µm.

3. C. J. Stephens *et al.*, *Adv. Funct. Mater.* **2010**, 20, 2108.

➢ Self-assembled monolayer (SAMs) formation on thin oxide films (TiO_2, ZrO_2, ZnO)

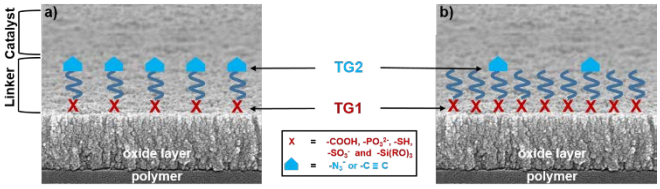


Figure 3. Schematic representation of self-assembled monolayer (SAM) formation to organic/inorganic thin films. a) SAM of linkers with two terminal groups and b) mixed SAM of linkers with one and two functional groups.

Oxide thin films shall be grown on polymer substrates and used as a model system to study the SAM formation of linker molecules with various terminal groups on the inorganic surface of the hybrids. The SAM formation and stability on different oxide films will be systematically characterized applying methods like contact angle goniometry, ellipsometry, IRRAS, photoluminescence measurements and XPS.

4. B. Feichtenschlager *et al.*, *Journal of Colloid and Interface Science*, **2011**, *360,* 15.

➢ Synthesis of organic-inorganic (hybrid) micro/nanotubes as solid supports for catalytic applications

Template-based approach will be used for the fabrication of the hibrid micro/nanotubes. Polycarbonate (PC) membranes with straight channel-like pores shall be used as porous template to construct the tubes. The pore diameter of the template shall be varied to optimize the pore diameter and the wall thickness of the corresponding assembled tubes. The organic part of the tubes will be assembled via Layer-by-Layer (LbL) deposition, while the inorganic phase will be deposited using wet chemistry.

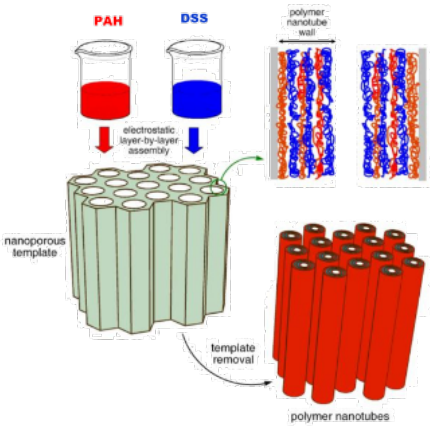


Figure 4. Schematic representation of Layer-by-Layer deposition of polymer films.[5]

5. O.Azzaroni *et al. Soft Matter.*, **2011**, *7(19)*, 8709.

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