From polymer nanoparticles towards mesoporous materials: influence of the particle size and polydispersity

Karina Abitaev[1], Yaseen Qawasmi[1] and Petia Atanasova[2] and Thomas Sottmann[1]

[1] *Institute of Physical Chemistry, University of Stuttgart, Stuttgart, Germany.*
[2] *Institute for Material Science, University of Stuttgart, Stuttgart, Germany.*

Colloidal crystals of polymer nanoparticles are used for the synthesis of inverse opals or mesoporous polymers (Figure 1) following the *Nanofoams by Continuity Inversion of Dispersion* (NF-CID) principle [1]. Both mesoporous materials are interesting classes of tailor-made substrates to study the role of confinement in molecular heterogeneous catalysis, which is the main goal of the *Collaborative Research Center* 1333 "Molecular Heterogeneous Catalysis in Confined geometries". In the study at hand, the influence of the particle size and polydispersity (*PDI*) on the obtained porous polymers and inverse opals is explored. Therefore, polystyrene (PS) nanoparticles are prepared by emulsion polymerization, followed by gently drying of the dispersion, leading to the formation of a close-packed colloidal crystal. By varying the surfactant type, concentration and the polymerization temperature, the nanoparticle size, *PDI* and packing order of their colloidal crystals are adjustable. While the crystals of monodisperse particles $PDI < 0.10$ show a high packing order, the crystals of the polydisperse particles $PDI > 0.10$ are denser packed. Interestingly, foaming experiments show, that the latter lead to porous polymers with smaller pores. Inverse opals were obtained by pyrolysis after the highly ordered colloidal crystals were mineralized with ZnO via chemical bath deposition (CBD) [2].

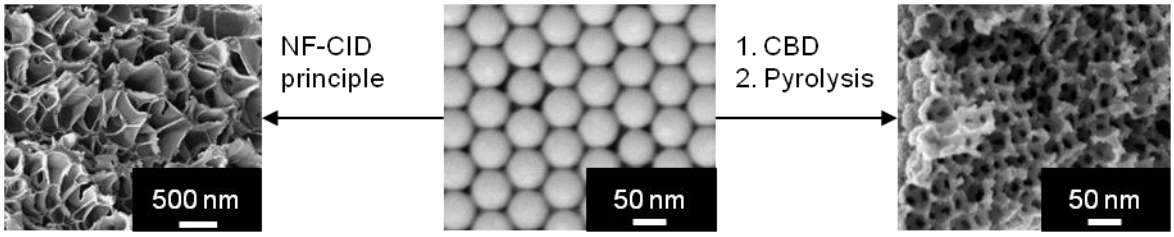

Figure 1. (Middle) SEM image of a colloidal crystal of PS-nanoparticles used to (left) synthesize nanoporous PS following the NF-CID principle or (right) ZnO inverse opals via the CBD method.

[1] R. Strey, A. Müller, 2010, DE Pat. 102 010 053 064 A1.
[2] P. Lipowsky, R. Hoffmann, U. Welzel, J. Bill and F. Aldinger, *Adv. Funct. Mater*. **17** (2007), 2151

Acknowledgement: Financial support from the German research foundation under grant no. CRC1333 is gratefully acknowledged.