

Confined water – Melting point depression as function of different surface polarities in nanopores

Uta Sazama¹, Sandra König¹, Jakob Benedikt Mietner¹ and Michael Fröba^{1,2*}

¹Institute of Inorganic and Applied Chemistry, University of Hamburg, Martin-Luther-King-Platz 6, 20146 Hamburg, Germany

²The Hamburg Centre for Ultrafast Imaging, Luruper Chaussee 149, 22761 Hamburg, Germany

Water is the precondition for life on earth the way we know it. One reason among others is that water can be found under various conditions in all three states of matter. In many cases these conditions are determined by the interaction with surfaces or the confinement in nanopores. Well defined host structures are needed to study the phase behavior of confined water. M41S silica host structures are ideal candidates due to their ordered monomodal cylindrical pore structure and tunable pore size in the interesting range of 2-6 nm. [1] In addition to the geometrical confinement it is also important to probe the influence of the surface chemistry on the phase behavior of a pore fluid. Periodic mesoporous organosilicas (PMOs) are ideal candidates because of their same pore structure but different adjustable surface polarities compared to pristine M41S silicas. [2,3]

Here different mesoporous silicas and PMOs with a MCM-41 type pore structure and narrow pore size distributions were synthesized using various cationic surfactants of different chain lengths. In case of PMOs precursors of the type $(R'O)_3Si-R-Si(OR')_3$ with R = ethane-, benzene-, biphenyl- or divinylaniline-bridge were used to introduce hydrophobicity or hydrophilicity into the pore walls. In case of the aromatic moieties materials with a modulated surface polarity were synthesized, too.

Thermodynamic properties of water confined within the nanopores were studied by heat flux differential scanning calorimetry (DSC). These measurements revealed that the suppression of the melting and freezing points is not only strongly depending on the pore size of the material, but also on the surface chemistry.

References

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