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Restructuring of organic solvents around iron oxide nanoparticles capped by oleic acid

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Recently, the existence of solvation shells around nanoparticles (NP) was given proof by pair distribution function analysis (PDF) in colloidal suspensions.[1] The building of solvation shells was found to be a universal phenomenon widely independent of capping agent, solvent polarity and particle size. However, a systematic study on how the single parameters influence this restructuring process is still lacking.

We performed a synchrotron X-ray study on oleic acid capped iron oxide nanocubes dispersed in toluene, cyclohexane, THF and heptane and corresponding dried powder. The NPs were synthesized via the established thermal decomposition of an iron oleate precursor in solution, which yields highly monodisperse truncated cubic nanocrystals. [2]

By subtracting both the solvent background as well as the NP contribution from the PDF of the NP suspension, information on the local molecular ordering of the solvent molecules at the NP interfaces is obtained. Hereby, we detected different restructuring behavior for the investigated organic solvents. A correlation of interfacial ordering and self-assembly behavior of the iron oxide NPs to macroscopic mesocrystals seems at hand. Finally, we will elucidate the formation mechanism and structuration of the mesocrystals, which is not understood so far. [3]

[1] Zobel, M. et al.; Science, 2015, 347, 292

[2] Brunner, J. et al.; Adv. Mater. Interfaces 2017, 4, 1600431

[3] Sturm, E. Cölfen H.; Chem. Soc. Rev., 2016, 45, 5821

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