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Swelling kinectics of N-n-propylacrylamide based microgels studied by time-resolved Small Angle Neutron Scattering

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Temperature responsive microgels are particles in the size range between 100 nm and 1 μm that undergo a reversible microphase separation at a specific temperature, the so called volume phase transition temperature (VPTT). Structure, size and phase transition properties can be controlled by the synthetic conditions, e. g. crosslinker content, surfactant concentration or different monomers/comonomers. This makes them outstanding candidates for various applications, such as drug delivery, catalytic particle carriers or nanoactuators. A precise understanding of the underlying processes is necessary to tune the network properties precisely for the different applications. Therefore, we investigated the swelling and deswelling kinetics of N n propylacrylamide (NNPAM) based microgels upon periodic pressure jumps across the phase transition by time-resolved small angle neutron scattering (SANS). Preceding photon correlation spectroscopy (PCS) measurements showed, that the phase transition shifts towards higher temperatures with increasing pressure, i.e. a swelling of the particles is induced upon compression. Due to the sharp phase transition [1], NNPAM based microgels are especially suited for this experiments, as both the swollen as the collapsed state can be accessed at the same temperature by applying different pressures. While the swelling occurred on a time scale of around 1 ms the deswelling was much slower (~ 10 ms). Together with static SANS and PCS spectroscopy we could show that the differences in the phase transition dynamics can be associated the underlying complex particle architecture, which exhibits a core region with a high density surrounded by a loosely connected shell.

[1] B. Wedel, Y. Hertle, O. Wrede, J. Bookhold, T. Hellweg, Polymers, 2016, 8, 162.

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