

# Magnetic PNIPAM Microgels: Towards multi responsive materials

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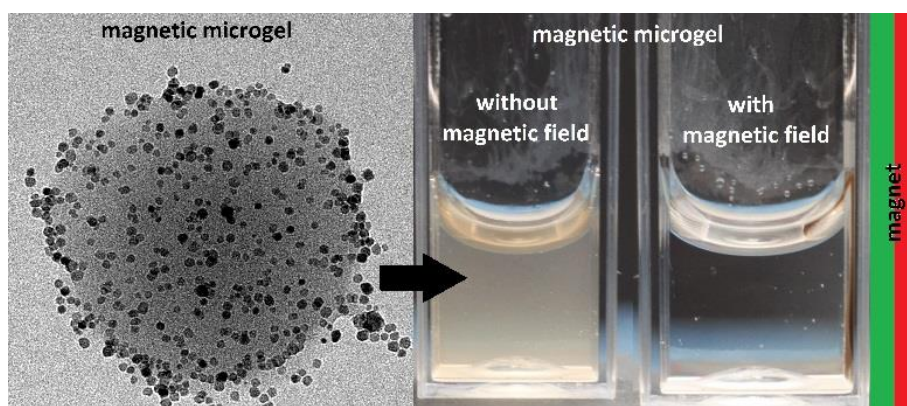
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Multi responsive Microgels are of great interest for sensoric and actuatoric devices and for drug delivery systems. Microgels based on N-isopropylacrylamid (NIPAM) are promising candidates for this purpose since they respond fast to outer stimuli. Depending on the microgel composition the stimuli can be manifold. NIPAM based microgels are temperature sensitive and exhibit a volume phase transition (VPT) at about 32°C (VPTT) due to expulsion of water above the VPTT. The gel structure is collapsing. This process can be reversed by decreasing the temperature below the VPTT where the gel swells again. By adding different co-monomers the volume phase transition can be triggered with the change of pH or ionic strength. In order to let migrate the PNIPAM microgels in an external magnetic field the microgels are doped with magnetic nanoparticles (MNP) in the present work [1].

We control the distribution of the MNP inside the magnetic microgel (Fig. 1) by modification of the microgel structure. The structure of the microgel is varied by changing the cross-linker density and the charge density of the microgels. Furthermore, we report the response of the magnetic microgel to an external static magnetic field both in bulk (migration, UV-VIS spectroscopy) and after adsorption at a surface (deformation, atomic force microscopy (AFM)). The challenge is to optimize the amount of uptaken magnetic nanoparticles that the microgels show pronounced sensitivity to the magnetic field but that the original gel properties (like temperature sensitivity) are still preserved. Therefore the elasticity is studied by indentation experiments with AFM. Temperature sensitivity is investigated with dynamic light scattering (DLS)/zeta potential in bulk and with AFM on the surface before and after embedding of MNP.



**Figure 1:** TEM picture of magnetic microgel and the separability by static magnetic fields.

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- [1] S.Backes, M. U. Witt, E. Roeben, L. Kuhrts, S. Aleed, A. M. Schmidt, R. v. Klitzing, *J Phys Chem B*, 2015, **36**, 119.