

Thermosensitive and magnetic polymer microgels: structural studies of the volume phase transition by SANS and *in situ* VSANS under magnetic field hyperthermia

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The aim of our work is to study the outer size of biocompatible and thermoresponsive microgels based on oligo(ethylene glycol) methyl ether methacrylate (OEGMA), di(ethylene glycol) methyl ether methacrylate (MEO2MA) and methacrylic acid (MAA) (P(MEO₂MA-co-OEGMA-co-MAA) microgels) and of the corresponding hybrid analogues loaded with iron oxide magnetic nanoparticles (MNPs).^[1] Three different cross-linkers, ethylene glycol dimethacrylate (EGDMA), oligo(ethylene glycol) diacrylate (OEGDA) or N,N-methylenebisacrylamide (MBA) were used for the synthesis of the microgels.^[2] Due to different reactivity ratio of cross-linkers compared to monomers, three different microgel structures differing by their distribution of crosslinks were assumed by macroscopic consumption of the reactants using ¹H NMR. These hypothetical structural differences impacts the swelling-to-collapse transition of these microgels in response to T and pH.^[2]

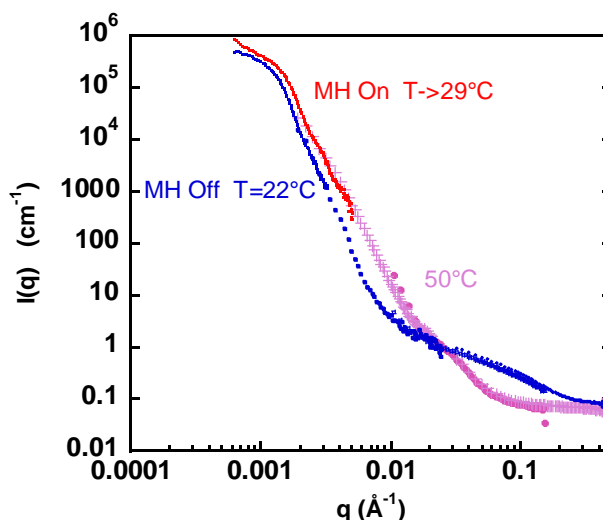


Figure 1 : Merged (V)SANS curves of magnetic microgels crosslinked with MBA and loaded with 5wt% γ -Fe₂O₃ MNPs.

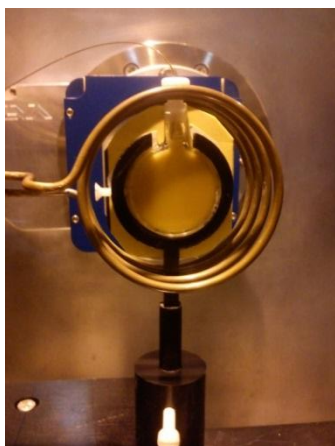


Figure 2: Inductor coil on TPA

A SANS study on the PAXY spectrometer has permitted to investigate the inner structure of these microgels (either core-shell or homogeneous crosslinked spheres) depending on the choice of cross-linker and on temperature. In parallel, a VSANS study on TPA enabled to measure overall size change (*i.e.* gyration radius) vs. temperature, be it varied macroscopically (with a water bath) or by magnetic induction. After the recently reported magnetic field hyperthermia (MFH) combined with DLS,^[3] this novel *in situ* coupling of MH with VSANS is another world-premiere!

[1] M. Boularas, E. Gombart, J-F. Tranchant, L. Billon, M. Save, *Macromol. Rapid Commun.* **36**, 79-83 (2015)

[2] M. Boularas, E. Deniau-Lejeune, V. Alard, J-F. Tranchant, L.

Billon, M. Save, *Polym. Chem.* **7**, 350-363 (2016)

[3] G. Hemery, E. Garanger, S. Lecommandoux, A. Wong, E. Gillies, B. Pedrono, T. Bayle, D. Jacob, O. Sandre, *J. Phys. D.* **48**, 494001 (2015)