Thermosensitive and magnetic microgels: SANS study of the volume phase transition and VSANS combined to RF magnetic field hyperthermia

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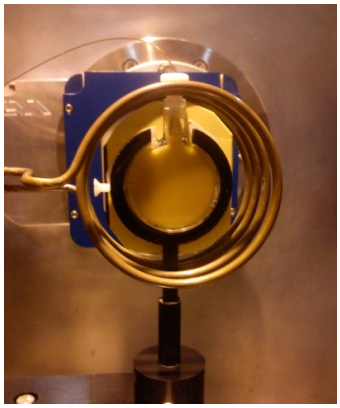
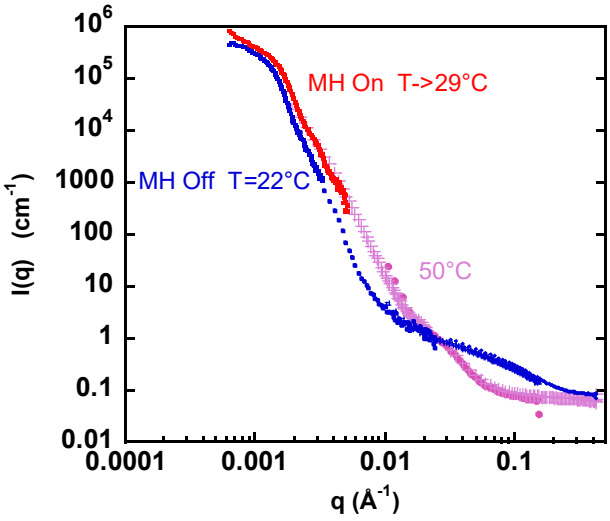
The aim of our work is to study the outer size of biocompatible and thermoresponsive microgels based on oligo(ethylene glycol) methyl ether methacrylate (OEGMA), di(ethylene glycol) methyl ether methacrylate (MEO_2MA) and methacrylic acid (MAA) (P(MEO_2MA-*co*-OEGMA-*co*-MAA) microgels) and of the corresponding hybrid analogues loaded with iron oxide magnetic nanoparticles (MNPs).[1] Three different crosslinkers, 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 crosslinkers compared to monomers, three different microgel structures differing by their distribution of crosslinks were assumed by macroscopic consumption of the reactants using ^{1}H NMR. These hypothetic structural differences impacts the swelling-to-collapse transition of these P(MEO_2MA-*co*-OEGMA-*co*-MAA) microgels in response to both temperature and pH.[2] 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.



Sample in inductor coil at the nose of TPA spectrometer.



Merged (V)SANS curves of magnetic microgels crosslinked with MBA and loaded with 5wt% γ-Fe_2O_3 nanoparticles.

After the recently reported magnetic hyperthermia (MH) 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 (13pp) 2015