Magnetic hydrogels with chemically bound nanoparticles

S. van Berkum, J.T. Dee, A.P. Philipse, and B.H. Erné,

Van ’t Hoff Lab. for Physical and Colloid Chemistry, Debye Inst. for NanoMaterials Science, Utrecht University, Padualaan 8, 3584 CH Utrecht, The Netherlands
* e-mail: s.vanberkum@uu.nl

Magnetic hydrogels that swell or shrink due to changes in their chemical environment are required for a new type of biosensor that detects chemical changes magnetically.[1] Our objective is to make hydrogels with irreversibly anchored magnetic nanoparticles. The anchoring is a key point for in vivo applications, because loose nanoparticles could leak out, which would be highly undesirable. We are currently incorporating nontoxic iron oxide nanoparticles into pH-responsive hydrogels, well known for their biomedical applications.[2] The nanoparticles are first surface-coated with acrylic acid molecules; their carboxylic acid group adsorbs to the nanoparticles and their double bond is expected to take part in the polymerization process during hydrogel preparation. These chemical transformations are characterized by infrared spectroscopy. To demonstrate that all the magnetic nanoparticles in the hydrogel are fixed, several experiments are carried out and compared to the results for a control system: a hydrogel in which the nanoparticles are intentionally loose. Our first approach is to study nanoparticle release resulting from water flow through the gel, active flow or flow due to repeated swelling or shrinking of the gel. Our second approach is to examine whether diffusive motion of the individual nanoparticles can be detected, for instance by diffusing wave spectroscopy (translational diffusion) or by magnetic susceptibility spectroscopy (rotational diffusion).
