323a Functionalized Monodisperse Magnetic Nanoparticles

Marco Lattuada and T. Alan Hatton

We have prepared monodisperse magnetic nanoparticles following the organic route proposed by Sun et al. (JACS, 126, 273, 2004). This preparation method produces oleic acid stabilized magnetic nanoparticles. The first step for a surface functionalization is a ligand exchange reaction by means of which several different molecules either bearing reactive moieties or PH responsive moieties can be anchored to the nanoparticles surface replacing the oleic groups. When citric acid molecules are used, water-soluble, negatively-charged nanoparticles can be created. When ricinoleic acid molecules are used, the additional hydroxyl group of ricinoleic acid enables further reactions to take place. As an example, surface initiated ring opening polymerization (ROP) can be used to create polylactic acid capped magnetic nanoparticles. Alternatively, the reaction of hydroxyl groups with acid halides bearing halogen atoms allows one turn the nanoparticles into macroinitiators for Atom Transfer Radical Polymerization (ATRP). ATRP allows one to polymerize a large variety of monomers in controlled conditions, which can impart to the so obtained polymer-capped nanoparticles a wide range of properties. For example, by polymerizing PH or temperature sensitive monomers, one can obtain water soluble monodisperse magnetic nanoparticles showing PH or temperature induced reversible self-assembly. Using ATRP, we have grown poly(meth)acrylic acid brushes from the nanoparticle surface to yield the PH responsive poly-(meth)acrylic acid. The nanoparticles properties can be further tailored by making use of amidation chemistry to attach a variety of molecules and biomolecules to the carboxyl groups.