514a Controlled Self-Assembly of Monodisperse Magnetic Nanoparticles

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We have prepared monodisperse magnetic nanoparticles using the organic proposed by Sun et al. (JACS, 126, 273, 2004). Using a combination of ligand exchange reactions and surface initiated polymerization, we have functionalized the surface of the nanoparticles with a variety of different responsive polymers that provide a useful method to induce reversible self-assembly of the nanoparticles in response to a change of a suitable stimulus. In particular, we have created particles bearing negative charges imparted by carboxyl groups, which are PH responsive. We have used these functionalized nanoparticles to achieve controlled clustering following two different methodologies.

The first methodology consists in exploiting the presence of carboxyl groups on the nanoparticle surface and in using classical carbodiimide-mediated amidation chemistry to link mono-functionalized Polyethylene glycol (PEG) chains to the nanoparticle surface. The presence of several PEG chains allows one to obtain stable particles independent of the PH values. However, by progressively reducing the number of chains per particle (ideally down to one chain per particle), the particle stability is progressively decreased but not completely cancelled, and a controlled self-assembly is achieved.

The second methodology consists again in using carbodiimide-mediated amidation chemistry to attach actin proteins to the particle surface. Actin is well known as being able to polymerized and form both filaments and networks. We have exploited this capability to polymerize Actin proteins linked to nanoparticles in the presence of ATP to generate thin magnetic filaments.