Stimuli-Responsive Triblock Copolymer For Biomedical Applications

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Iron oxide nanoparticles are generally synthesized in a one-step process by alkaline coprecipitation of iron (II) and iron (III) precursors in aqueous solutions (Massart process). However iron oxide nanoparticles suspensions produced by Massart process are not stable enough in physiological conditions to be used as such. A stabilizing coating is needed to avoid aggregation and consequent precipitation of the colloids in body fluids. Such coating should also confer stealthiness to the nanoparticles in order to avoid their rapid removal from the body by the opsonization process. For this purpose, the high flexibility and hydrophilicity of poly(ethylene oxide) (PEO) chains make it a candidate of choice to coat the surface of the nanoparticles. In order to strongly bond the coating to the magnetic nanoparticles, a poly(acrylic acid) (PAA) block is used as anchoring block. Finally, in order to improve the tumor treatment, it is expected that the release of a drug simultaneously to hyperthermia would act synergistically. Therefore, the use of a thermoresponsive polymer with a thermal transition close to 37°C, i.e. poly(N-isopropyl acrylamide) (PNIPAM) for the coating of the magnetic nanoparticles, is required.

In this work, we perform this preparation in one step by in situ synthesis and stabilization. Triblock copolymer was synthesized by a Reversible Addition Fragmentation Transfer Polymerization (RAFT) process combining poly(acrylic acid) PAA, poly(N-isopropylacrylamide) and poly[acrylate methoxy poly(ethylene oxide)]. Moreover, the stealthiness of these aggregates was assessed ‘‘in vitro” by the hemolytic CH50 test. No response of the complement system was observed, such biomedical applications can be envisioned for these magnetic nanoparticles [1-2]. The size of the coated nanoparticles was obtained by a combination of dynamic light scattering (DLS) and transmission electron microscopy (TEM). The thermoresponsive behaviour of these colloids was investigated by DLS and DSC performed at temperatures between 25° and 60 °C. The triggered release of a drug during hyperthermia is in under current investigation. Moreover, we tried to elabore PAA-b-PNIPAM-b-PAMPEO nanofibers by electrospinning.

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