Interactions of polyaspartic-b-poly(ethylene glycol) copolymer with magnetite nanoparticles

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Surface engineering of magnetite nanoparticles (MNPs) is a key aspect of their effective application as therapeutic and diagnostic systems.[1] The coating should impart high colloidal stability, bio-repellent properties for stealth behavior and drug loading ability. The block copolymer of polyaspartic-b-poly(ethylene glycol) (pAsp-b-pEG), with the free caraboxylates is considered appropriate for coordination on the surface Fe atoms of the MNPs, while it's PEG block secures the high steric stability and low protein bonding (stealthiness).

In this study a pAsp block of 8 monomers and PEG (Mw of 5kDa) was added during or after the synthesis of MNPs. Alkaline precipitation with a single FeII or FeII-FeIII precursors were studied and several synthetic conditions were varied, such as the type and amount of base, metal salt and polymer concentrations. The nanoparticles produced were purified by isolation with centrifugation, and addition of new amount of distilled H2O, twice. The products were evaluated with colloidal stability assays in neat H2O and high ionic strength aqueous solutions.

A few pAsp-b-pEG derivatized magnetic nanoparticles were identified to be stable for several months in neat H2O, with hydrodynamic diameters in the range of 100-50 nm. The best performing product regarding stability and size was only obtained after the post-reaction addition of the polymer to the preformed MNPs. Nevertheless the systems were destabilized after two successive washing and redispersion steps. Therefore, an alternative pathway was explored by first synthesizing cationically charged magnetite colloids and following their interaction with the anionic carboxylates of pAsp-b-pEG was studied. It was found that this pathway produced assemblies stable not only after successive washings, but in high-ionic media as well. The latter is critical for evaluating the effective PEGylation of the systems.[2]

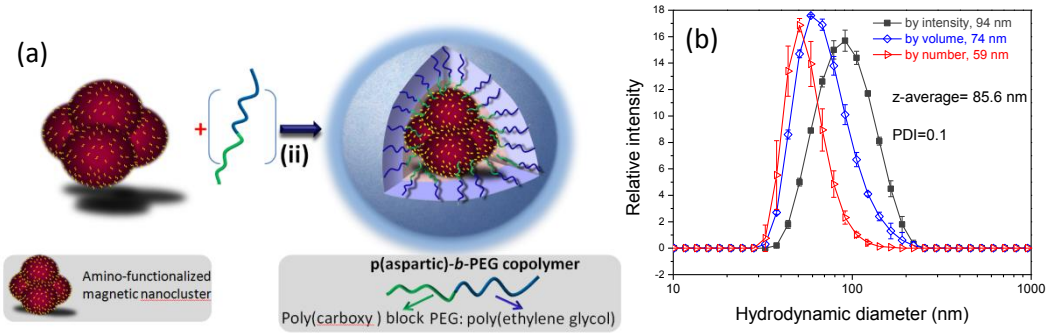

Figure1: (a) Schematic illustration of the probable interaction between cationic magnetic nanoparticles and the anionic block of poly(aspartic-b-ehtylene glycol) copolymer, and (b) the respective dynamic light scattering results of the assemblies.

References

[1] Ling, D.; Hyeon, T. Chemical Design of Biocompatible Iron Oxide Nanoparticles for Medical Applications. Small **9**, 1450 (2013).
[2] Honda, S.; Yamamoto, T.; Tezuka, Y. Nat. Commun. **4**, 1574 (2013).