Design of Multidentate Ligands for Biocompatible Inorganic Nanoparticles with Enhanced Stability

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Inorganic nanoparticles (NPs) exhibit unique size- and composition-dependent properties, and they offer great promises for use in biomedical imaging. High quality NPs can be prepared using high temperature reaction of organometallic precursors, and surface processing is essential to render these NPs biocompatible and further endow them with functionalities. Here, a versatile design strategy is introduced to develop multidentate ligands for an array of inorganic NPs, including QDs, Au and iron oxide NPs. The strategy is based on assembling a set of multifunctional oligomers, consisting of a short backbone, on which were laterally grafted several poly(ethylene glycol), and either thioctic acid (TA), dihydrolipoic acid (DHLA) or dopamine. TA and DLHA groups allow strong anchoring onto AuNPs and QDs, while catechols exhibit a specific affinity to iron oxide NPs. These ligands results in aqueous dispersions of NPs that exhibit remarkable colloidal stability over a broad range of conditions. Furthermore, by inserting controllable fractions of end-functionalized PEGs (-COOH, $-N_3$, $-NH_2$) they become reactive to couple to a variety of target biomolecules.