The 16th U.S.-Korea Forum on Nanotechnology: Nanomedicine Focusing on Single Cell Level and Sensors Related to Human Cognition and Brain Research
University of California, San Diego, September 23 - 24, 2019

Interfacing Inorganic Nanocrystals with Biological Systems Using a Coordinating Polymer Coating

Hedi Mattoussi

Department of Chemistry and Biochemistry, Florida State University, 95 Chieftan Way, Tallahassee, Florida 32306

Colloidal nanocrystals made of inorganic cores, prepared via bottom-up solution grown approaches have sizes that are comparable to those of biomolecules (proteins and DNAs). Nanocrystals made of semiconductor, metal and metal oxide cores exhibit several unique size- and composition-dependent photo-physical and chemical properties. These materials offer great promises for use in wide range of applications and as functional platforms for use in biomedicine. They have attracted much attention in the past three decades.

To facilitate their integration within biological systems, we have developed a set of multifunctional, high affinity metal-coordinating polymers that are optimally-suited for surface functionalizing a variety of inorganic nanocrystals. The ligand design exploits the effectiveness of the one-step nucleophilic addition reaction to simultaneously introduce several anchoring groups, hydrophilic blocks and reactive functionalities into a single macromolecule. These ligands are applicable to luminescent quantum dots, Au nanoparticles, Au nanorods, Au nano-shells and iron oxide nanocrystals alike. This surface-functionalization strategy yields reactive platforms that exhibit long-term colloidal stability over a broad range of biological conditions, while preventing corona formation. We have used the resulting hydrophilic platforms to develop a range of applications, which include biosensor design and imaging of live cells.

Keywords: Quantum dots, Au nanocrystals, coordinating polymers, biomedicine, sensing, cell imaging