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Nanoparticle Ensembles for Cancer Imaging and Therapy

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Abstract

Both inorganic and organic (or polymeric) nanoparticles have been widely explored for therapeutic and diagnostic applications. Among others, inorganic nanoparticles are attractive for the treatment, diagnosis, and detection of tumors, because of their unique features as compared with their organic and polymeric counterparts. For this purpose, single nanoparticles are often used and functionalized with organic or polymeric ligands to improve their stability, biocompatibility and functionality. While individual nanoparticles are no doubt exciting, ensemble of interacting nanoparticles can exhibit a rich variety of novel and extremely useful collective properties that can be radically different from their individuals. These new synergistic properties are originated from the coupling interactions between metallic, semiconductor or magnetic nanoparticles in the ensemble. For example, the organization of gold nanoparticles allows for tuning the absorption of nanoparticle ensembles in the near-infrared window which is highly desired for *in vivo* applications. The clustering of magnetic nanoparticles within micelles dramatically increases the magnetic resonance imaging contrast and responsiveness to external magnetic field. It is, therefore, expected that the ability to design assembled structures with tailored spatial arrangement of nanoparticles may facilitate the utilization of inorganic nanoparticles in biomedical applications. In this talk, I will present our efforts to develop new strategies for the self-assembly of polymerfunctionalized inorganic nanoparticles into hybrid nanostructures and to evaluate these materials for enhanced cancer imaging and treatment. Specifically, I will focus on the design and application of vesicular structures containing gold nanoparticles, magnetic nanoparticles or both for effective multimodality cancer imaging (i.e., photothermal, photoacoustic, and magnetic resonance imaging) and combinational cancer therapy (i.e., photothermal ablation of tumor, photodynamic therapy, and targeted delivery-based chemotherapy).