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Synthesis and Surface Engineering of Lanthanide Nanoparticles for NIR Luminescence Imaging and Photodynamic Therapy

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Abstract : Luminescence imaging is an important technique used in biomedical research and clinical diagnostic applications in recent years. Concurrently, the development of NIR luminescence probes / imaging contrast agents has helped the understanding of the structural and functional properties of cells and animals. Photodynamic therapy (PDT) is used clinically to treat a wide range of medical conditions, but the therapeutic efficacy of general PDT for deeper tumor was limited by the penetration of excitation source. The tumor targeting biomedical nanomaterials UCNP@PS (upconversion nanoparticle conjugated with photosensitizer) for photodynamic therapy and near-infrared imaging of cancer will be developed in our study. Synthesis and characterization of biomedical nanomaterials were completed in this studies. The spectrum of UCNP was characterized by photoluminescence spectroscopy and the morphology was characterized by Transmission Electron Microscope (TEM). TEM and XRD analyses indicated that these nanoparticles are about 20~50 nm with hexagonal phase. $NaYF_4$:Ln^{3+} (Ln= Yb, Nd, Er) upconversion nanoparticles (UCNPs) with core / shell structure, synthesized by thermal decomposition method in 300°C, have the ability to emit visible light (upconversion: 540 nm, 660 nm) and near-infrared with longer wavelength (downconversion: NIR: 980 nm, 1525 nm) by absorbing 800 nm NIR laser. The information obtained from these studies would be very useful for applications of these nanomaterials for bio-luminescence imaging and photodynamic therapy of deep tumor tissue in the future.

Keywords : Near Infrared (NIR), lanthanide, core-shell structure, upconversion, theranostics
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