Synthesis and characteristic of nanoparticle composite complexes for near-infrared fluorescence and thermotherapy.

The goal of this project is to design and develop a novel nanoagent that will synergistically incorporate multiple functionalities, including imaging and therapy, all within the same nanoprobe. This new, breakthrough paradigm is hence termed as “theranostic”, which simultaneously entails the incorporation of therapeutic and diagnostic moieties into a single nanoagent. For bio-medical applications, it is better to use the near-infrared (NIR) region due to low absorption and autofluorescence from the tissues. Human tissues are made up of several organic molecules that naturally absorb and emit light in the ultraviolet to the visible region. Therefore, researchers are developing fluorescent materials possessing both the excitation and emission bands confined within the biological transparency window (750–900 nm). NIR window reduces the scattering and absorbance of the light and resulting in deep penetration in biological tissues. It is highly important to select the optical transmission window of the skin for NIR imaging. Achieving bright emission with photostable and biocompatible NIR fluorescent nanoparticles has proved to be extremely difficult. An alternative approach is to enhance the emission and stability of currently available NIR fluorescent nanoparticles by combining them with appropriately designed metallic nanoparticles to take advantage of enhanced luminescence induced by the metal. A schematic illustration of our hollow gold nanoshell complex with the highly probable theranostic application is shown in Fig.1. Our nanoagent will be based on a gold nanoshell covered with a controlled layer of silica to which fluorescent nanoparticles will be attached (Fig.2).

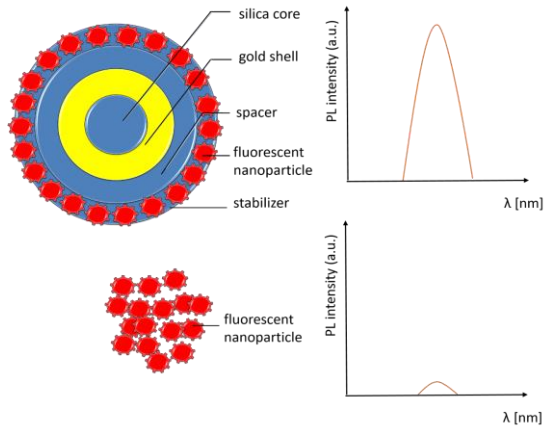

Fig. 1 Schematic representation of hollow gold nanoshell complex with the highly probable theranostic application. The fluorescence enhancement is imaged.

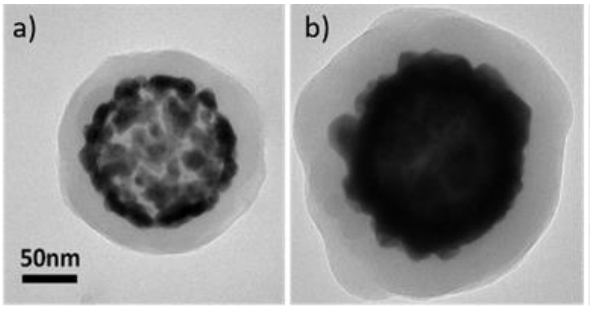

Fig. 2 Transmission electron microscopy pictures of gold nanoshells coated with silica layers.