Public Abstract

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Graduation Term: Fall
Graduation Year: 2006

Title: Gold Nanoparticles for Biomedical Applications: Synthesis, Characterization, *In vitro* and *In vivo* Studies

Two of the critical challenges in the prognosis and treatment of cancer are early detection and targeted therapy of cancer. Imaging techniques such as MRI, X-ray CT, Ultrasound and Optical imaging are some of the non-invasive diagnostic tools available for this purpose. Every imaging method relies on the contrast of one particular (magnetic, electronic, acoustic and optical) property of the cancer cell against its surrounding medium of healthy cells. The sensitivity of the imaging technique limits the detection of small cancers or tumors owing to their sizes. The sensitivity can be enhanced by the use of appropriate contrast agents, particularly when they are tagged with a cancer targeting molecule for site specific delivery. In the present work, we have designed and developed biocompatible gold nanoparticles that are in vitro stable and are shown to localize in target organs of swine models. Furthermore, gold nanoparticles are tagged with bombesin, a cancer-seeking molecule, and are shown to have an excellent affinity towards cancer cells. Additionally, the effectiveness of cancer treatments such as radiotherapy and photothermal therapy can be significantly improved by presence of metallic nanoparticles that efficiently absorb radiation and help kill cancerous tissue. The degree of contrast enhancement in cancer imaging or effectiveness of cancer treatments is limited by the number of nanoparticles that can be localized at the target tumor/cancer site. One way to augment this localization is to utilize gold nanochains that hold a larger number of nanoparticles. Therefore, we developed biocompatible gold nanochains through self assembly of nanoparticles on gum arabic, which we have shown to be in vitro stable. The site specific gold nanoparticles developed can serve the dual purpose of contrast enhancement in cancer diagnosis and dosage increment in cancer therapy.

Defective genes are believed to be the cause of cancer and tumors. One of the powerful tools in the identification of these defective genes is Surface Enhanced Raman Scattering (SERS). SERS is a spectroscopic method where the Raman scattering signal, which is sensitive to the molecular structure, is enhanced in the presence of gold nanoparticles. The slightly different structure of the defective genes manifests in distinct signatures in the Raman signal. Consequently, there is a need for nanostructures that enhance SERS signal. In the present project, gold nanoparticles set in agarose gel have been demonstrated to be excellent SERS substrates compared to commercially available gold nanoparticles for DNA nucleosides. The availability of these nanoparticles will give an impetus to the research and development of SERS based biosensors to detect carcinogenic agents, viruses, harmful and chemical agents.