

GOLD NANOPARTICLES FOR BIOMEDICAL APPLICATIONS: SYNTHESIS, CHARACTERIZATION, IN VITRO AND IN VIVO STUDIES

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ABSTRACT

Biocompatible gold nanoparticles have gained considerable attention in recent years for potential applications in nanomedicine due to their interesting size dependent chemical, electronic and optical properties. In particular, the prospective use of gold nanoparticles as contrast enhancement agents in X-ray Computed Tomography (CT) and Photo Acoustic Tomography for early diagnosis of specific tumors is being extensively researched. Additionally, gold nanoparticles show promise in enhancing the effectiveness of various targeted cancer treatments such as radiotherapy and photothermal therapy. For these applications, biocompatible gold nanoparticles labeled with specific tumor targeting biomolecules are needed for site specific delivery. In the present project, gold nanoparticles stabilized and labeled with carbohydrate (starch) and glycoprotein (gum arabic) have been generated, characterized and tested for in vitro and in vivo stability. They are found to localize in specific tissues in the animal models. Additionally, gold nanoparticles labeled with a cancer seeking peptide, bombesin, exhibited excellent binding affinity towards prostate and breast cancer cells. 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 the localization of nanoparticles at the target tissue is to utilize gold nanochains that hold more number of nanoparticles. Therefore, we developed biocompatible gold nanochains formed by self assembly of nanoparticles on gum arabic and they were shown to be in vitro stable.

The change of optical properties of gold nanoparticles upon slight modification of the surrounding environment is the basis for the development of biosensors. Therefore, Surface Enhanced Raman Scattering (SERS), a spectroscopic method where the Raman scattering signal, which is sensitive to the molecular structure, is enhanced in the presence of gold nanoparticles has emerged as a powerful tool for the detection of specific molecules. Consequently, there is need for nanostructures that give maximum 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.