Phospholipid stabilized gold nanorods: Towards improved colloidal stability and biocompatibility

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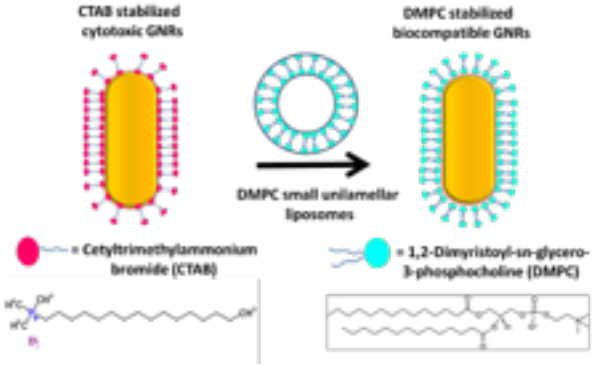
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Abstract

Biocompatible and colloidally stable gold nanorods (GNRs) of well-defined plasmonic properties are essential for biomedical and theranostic applications. The as-synthesized GNRs in the seed-mediated method are stabilized by cetyltrimethylammonium bromide (CTAB) surfactant, which is known for its cytotoxicity in many cell lines. Biocompatible GNRs synthesized from known protocols exhibit some extent of cytotoxicity and colloidal instability because of incomplete removal of CTAB. We report a facile method for the efficient removal of CTAB molecules with 1,2-dimyristoyl-sn-glycero-3-phosphocholine (DMPC) phospholipids, which are naturally present in cell membranes. The ligand exchange kinetics is studied using surface-enhanced Raman scattering (SERS) and corroborated with matrix assisted laser desorption/ionization (MALDI) mass spectrometry. From colloidal stability studies using dynamic light scattering (DLS) and UV-Vis spectroscopy, the optimal lipid concentration and duration required for successful ligand exchange of CTAB by DMPC are reported. Using thermogravimetric analysis, the surface concentration of DMPC on colloidally stable GNRs is found to be approximately 9 molecules per nm2. The 3-(4,5-dimethylthiozol-2-yl)-2,5-diphenyl tetrazolium bromide (MTT) and lactate dehydrogenase (LDH) assays show that the surface modified DMPC-GNRs have significantly better biocompatibility compared to CTAB-GNRs. Studies on ligand exchange, colloidal stability and biocompatibility of DMPC-GNRs of aspect ratios in the range of 2.2 - 4.2 demonstrate the robustness of the proposed method. The results provide insight on the important factors to be considered to design biocompatible GNRs suitable for applications in nanomedicine.

Image

Schematic representation of surface modification of as-prepared CTAB-GNRs with DMPC liposomes



Recent Publications

1. Tebbe, M., Kuttner, C., Mannel, M., Fery, A., Chanana, M. (2015) Colloidally Stable and Surfactant-Free Protein-Coated Gold Nanorods in Biological Media. ACS Appl. Mater. Interfaces. 7, 5984-5991.
2. Matthews, J. R., Payne, C. M., Hafner, J. H. (2015) Analysis of Phospholipid Bilayers on Gold Nanorods by Plasmon Resonance Sensing and Surface-Enhanced Raman Scattering. Langmuir. 31, 9893-9900.
3. 2. Orendorff, C. J., Alam, T. M., Sasaki, D. Y., Bunker, B. C., Voigt, J. A. (2009) Phospholipid-Gold Nanorod Composites. ACS Nano. 3, 971-983.



Biography

Dr. Poornima B. Santhosh has her expertise in the field of synthesizing and characterizing nanoparticles and liposomes for bio medical applications. She is interested in studying the interactions of different nanomaterials with lipid membranes and their effect of fluidity and phase transition of bilayer lipids.

Notes/Comments: