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Phospholipid stabilized gold nanorods: Towards improved colloidal stability and biocompatibility

Poornima Budime Santhosh[a], Neethu Thomas[a], Swathi Sudhakar[a], Anju Chadha[b,c*], Ethayaraja Mani[a*]
PolyIndian Institute of Technology Madras, India

Biocompatible and colloidally stable gold nanorods (GNRs) of well-defined plasmonic properties are essential for biomedical and ther-anostic 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. Bio-compatible 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 re-moval of CTAB molecules with 1,2-dimyristoyl-sn-glycero-3-phos-phocholine (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 dura-tion required for successful ligand exchange of CTAB by DMPC are reported. Using thermogravimetric analysis, the surface concentra-tion of DMPC on colloidally stable GNRs is found to be approxi-mately 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. Stud-ies 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.

poorni_balaji@yahoo.com