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Article

Synergistical Use of Electrostatic and Hydrophobic Interactions for the Synthesis of a New Class of Multifunctional Nanohybrids: Plasmonic Magneto-Liposomes

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Abstract: By carefully controlling the electrostatic interactions between cationic liposomes, which already incorporate magnetic nanoparticles in the bilayers, and anionic gold nanoparticles, a new class of versatile multifunctional nanohybrids (plasmonic magneto-liposomes) that could have a major impact in drug delivery and controlled release applications has been synthesized. The experimental results confirmed the successful synthesis of hydrophobic superparamagnetic iron oxide nanoparticles (SPIONs) and polyethylene glycol functionalized (PEGylated) gold nanoparticles (AuNPs). The SPIONs were incorporated in the liposomal lipidic bilayers, thus promoting the formation of cationic magnetoliposomes. Different concentrations of SPIONs were loaded in the membrane. The cationic magnetoliposomes were decorated with anionic PEGylated gold nanoparticles using electrostatic interactions. The successful incorporation of SPIONs together with the modifications they generate in the bilayer were analyzed using Raman spectroscopy. The plasmonic properties of the multifunctional nanohybrids were investigated using UV-Vis absorption and (surface-enhanced) Raman spectroscopy. Their hyperthermic properties were recorded at different frequencies and magnetic field intensities. After the synthesis, the nanosystems were extensively characterized in order to properly evaluate their potential use in drug delivery applications and controlled release as a result of the interaction with an external stimulus, such as an NIR laser or alternating magnetic field.

Keywords: multifunctional nanohybrids; magneto-liposomes; superparamagnetic nanoparticles; gold nanoparticles; hyperthermia

1. Introduction

The use of different types of multifunctional nanoparticles (NPs) for biomedical applications, a field known as nanomedicine, is in the limelight of current research activities. Its principal aim is to use