

2nd International Conference and Exhibition on

NANOMEDICINE AND DRUG DELIVERY

May 21-23, 2018 Tokyo, Japan

Development and characterization of magneto-plasmonic nanocarriers for image-guided drug delivery

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Drug delivery systems have shown promising results for various diseases owing to the development in nanotechnology. However, the therapeutic effect is still limited due to the lack of monitoring system after drug administration. Image-guided drug delivery is an emerging strategy which has a great potential to improve the therapeutic efficacy of drug delivery systems by adding image guidance. The addition of imaging enables monitoring of drug distribution after administration and quantification of the drugs at target site. Among various nanoparticles developed for biomedical applications, magnetic nanoparticles have shown promise for brain targeting and Magnetic Resonance Imaging (MRI) due to their unique magnetic properties. Gold nanoparticles possess excellent properties for various imaging modalities including X-ray Computed Tomography (CT) and photoacoustic imaging. Combining magnetic and plasmonic features in a single nanostructure gives multi-functionality which is suitable for image-guided drug delivery. In this study, we synthesized magneto-plasmonic nanocarriers by a two-step process. First, Magnetic Nanoparticles (MNPs) were synthesized by co-precipitation, followed by gold coating of MNPs by citrate reduction. The spherical magneto-plasmonic nanoparticles with the Surface Plasmon Resonance (SPR) peak in the visible range were synthesized in this step. In the second step, the morphology of the nanoparticles was modified to star shape to adjust SPR within the near infrared (NIR) range. This NIR responsiveness is suitable for optical imaging systems due to the long penetration of NIR light inside body. A Transmission Electron Microscopy (TEM) study showed successful synthesis of star shaped nanoparticles. We conducted magnetic and optical characterization of the magneto-plasmonic nanocarriers and confirmed superparamagnetic property and SPR peak within NIR region. These results indicate the capacity of magneto-plasmonic nanocarriers for drug delivery systems with highly precise image guidance using multiple imaging modalities.

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