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High yield synthesis of surfactant-free gold nanostars for biosensing, photothermal therapy and drug delivery applications

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Development of drug delivery system (DDS) plays a vital role in the field of biomedicine and healthcare, where maximum therapeutic effect and minimum undesirable side effect is the key of success for ideal DDS. Various methods of DDS using nanoparticles, microspheres and hydrogels are commercially available to treat diverse diseases ranging from cancer to fungal infection and to muscular degeneration. Among nanoparticles, gold nanoparticles demonstrate special advantages in this field due to their unique properties, small size and high surface area-to-volume ratio. These particles have been widely used in various biomedical applications and drug delivery systems due to their inert nature, stability, high dispersity, non-cytotoxicity and biocompatibility. On the other hand, researchers have been using the gold nanoparticles for fabricating nanoplasmonic-whispering gallery mode hybrid microresonators and surface enhanced Raman scattering (SERS) based biosensors for the real-time detection of single protein molecules at their natural state. This detection would be extremely useful for predicting dangerous diseases such as cancers at very early stage. A few years back, gold nanostars are found to be efficient for biosensing, photothermal therapy and drug delivery applications. A few wet chemistry methods existing in the literature for synthesizing the nanostars in one step. However, the yield of the nano-stars is found to be very low (40-45%). In contrast to this, recently we have successfully synthesized the surfactant-free gold nano-stars in one-step, using a novel wet chemistry method in contrast to the existing reports; these nanostructures have longer and sharper spikes in all directions. From scanning electron microscopic images, the estimated yield of the nano stars was more than 95%. Details of synthesis and characterization of star shaped gold nanostructures, and usefulness of these nano-stars in biosensing, photothermal therapy and drug delivery applications would be explained in detail with the help of numerical simulations based on finite element method at Nanodelivery 2017.

Biography

Akash Arya obtained his BE Degree in Electronics and Communication Engineering, and MTech (Nanoscience & Technology) Degree from Pondicherry University. Currently, he is a Senior Research Scholar at Biophotonics Laboratory at Indian Institute of Technology (IIT) Patna. His current research interests are (i) synthesizing different kinds of nanoplasmonic structures using different wet chemistry methods for biosensing and drug delivery applications and (ii) fabricating novel nanoplasmonic-photonic hybrid biosensors and demonstrating the detection and sizing of single protein molecules using the developed biosensors.

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Venkata R. Dantham is currently an Assistant Professor and the Head of Biophotonics Laboratory at Indian Institute of Technology (IIT) Patna. He obtained the Ph.D. Degree from IIT Madras and did post-doctoral Research at Polytechnique Institute of New York University, New York. His current Research Interests are (i) fabrication of ultrasensitive nanoplasmonic-photonic hybrid biosensors for the real-time detection and sizing of single protein molecules at their natural state, developing surface enhanced Raman scattering (SERS) based biosensors, (ii) synthesizing different nanoplasmonic structures using simple and novel wet chemistry methods for nanosensing, photothermal therapy, drug delivery and SERS applications, (iii) photonic nanojet mediated surface enhanced fluorescence of single molecules.

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