**Nanoplasmonic Probes for Biomedical Applications**

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Designing, synthesizing and controlling plasmonic metal nanostructures with high precision and high yield are of paramount importance in optics, nanoscience, chemistry, materials science, energy and biotechnology. In particular, synthesizing and utilizing plasmonic nanostructures with ultrastrong, controllable and quantifiable signals is key to the wide and practical use of plasmonic enhancement-based spectroscopies including surface-enhanced Raman scattering (SERS) and metal-enhanced fluorescence (MEF), but highly challenging. Here, I will introduce the design and synthetic strategies for molecularly tunable and structurally reproducible plasmonic nanostructures (particularly, plasmonically coupled structures with a nanogap) with strong, controllable and quantifiable SERS, MEF and dark-field light scattering signals. I will also show their potentials in addressing some of important challenges in science, and discuss how these new plasmonic materials can lead us to new breakthroughs in biotechnologies including biosensing, bioimaging and theranostic applications.