Optimizing core-satellite superstructures as highly bright SERS-encoded particles

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Near-field coupling between localized surface plasmon resonances of individual nanoparticles is at the heart of the unique optoelectronic properties of nanoparticle assemblies.[1] Such properties can be tailored via rational design of well-defined plasmonic architectures built from metallic units of specific composition, shape, and size.[1] Production of high-quality nanoparticle assemblies with tunable plasmonic responses is one of the most exciting and fast-moving areas of nanomaterial research with a vast impact on medicine, sensing, and catalysis.[2] Remarkably, plasmon coupling of closely-spaced nanoparticles concentrates giant electromagnetic fields at the interparticle gap.[1] This unique phenomenon is often exploited by plasmon-enhanced spectroscopies, such as surface-enhanced Raman scattering (SERS) to maximize the amplification of molecular optical responses.[3] Among different morphologies, core-satellite superstructures are particularly suited to be used as plasmonic constructs in SERS as they can concentrate in a small volume a dense collection of hot-spots symmetrically arranged. Thus, this class of assemblies potentially fulfils all requirements in terms of brightness (i.e.; high SERS activity), feasibility for optically linear quantitative determination, and implementation in size-limiting applications such as in vivo and in vitro bioimaging. However, fabrication strategies have been traditionally inefficient in the production of core-satellite constructs as plasmonic substrates. Recently, we described a novel and versatile approach to generate SERS encoded core–satellite particles with minimal interparticle distances (<2–3 nm) and maximum satellite loading (i.e., maximum number of hot spots per assembly).[4] In this new study, we build on these previous findings to focus on the optimization of the SERS performances of core-satellite particles at different excitation wavelengths (i.e., 514, 633, and 785 nm) while employing diverse building blocks of different plasmonic materials to generate multiple classes of assemblies.

References

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[3] L. Guerrini, et al., Chemical Society Reviews, 41 (2012) 7085
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Figures

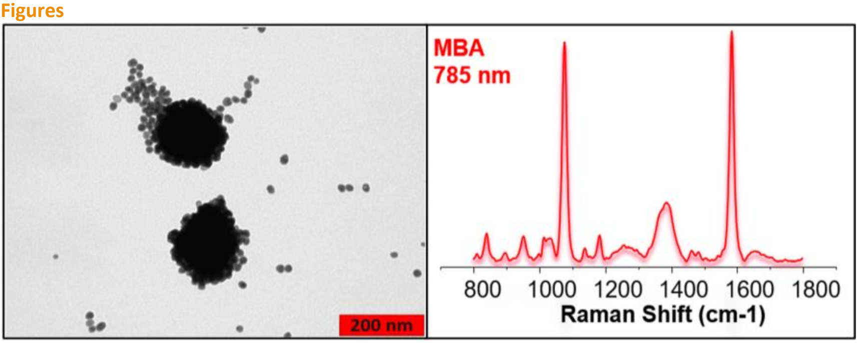

Fig. 1. Representative TEM image Au@Ag core-satellites and corresponding SERS spectra of 4-mercaptobenzoic acid encoded in Au@Ag core-satellites (excitation wavelength = 785 nm).