Selective Synthesis and Plasmonic Properties of Polyhedral Au Nanoparticles

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The localized surface plasmon resonance (LSPR) peak is strongly affected by the size, shape, and the dielectric properties of surrounding environment of the plasmonic nanostructures. LSPR of metal nanoparticles (NPs) has been extensively demonstrated to exhibit large electromagnetic field enhancement localized near the surface of the NPs, especially on the corners and edges, which can be used in applications, such as surface-enhanced Raman scattering (SERS) or fluorescence studies with single molecule sensitivity.[1,2]

In this study, we synthesized highly monodisperse Au cubes (44 nm), rhombic dodecahedra (RD, 32 nm), and octahedra (Oh, 53 nm) by a seed-mediated growth approach[3] (Fig. 1a-c), and used the FDTD method to do a comparative study of the electric near-field simulations on their corners and edges. From the FDTD simulation, Au RD showed the highest electric field intensity and were found to give the strongest signal enhancement as SERS substrates.[3] Then, the Au@Cu_2O core-shell NPs were synthesized by simply mixing polyhedral Au NPs, $Cu(NO_3)_2$, sodium dodecyl sulfate (SDS) surfactant, NaOH, and $NH_2OH{\cdot}HCl$ aqueous solution (Fig. 2a-c). Because the LSPR peak of Au NPs could be tuned from visible to NIR region owing to the change of the dielectric constant of the surrounding medium (Cu_2O) (Fig.1d, 2d), these Au@Cu_2O NPs are expected to serve as a new structure of SERS substrate.

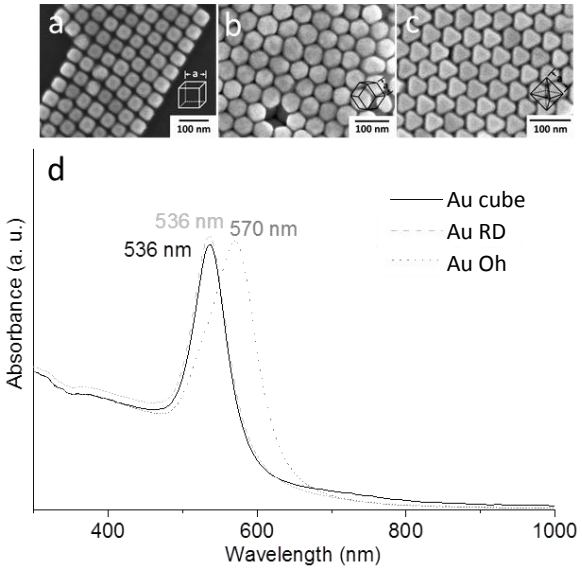

Fig.1 SEM images of Au a) cube, b) RD, and c) Oh and d) their UV-vis-NIR spectra.

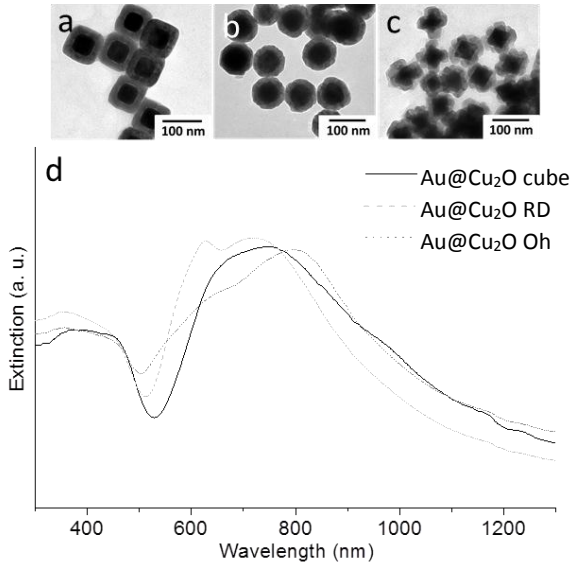

Fig.2 TEM images of Au@Cu_2O a) cube, b) RD, and c) Oh and d) their UV-vis-NIR spectra.

References:

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