Bimetallic Au@Ag nanoparticles: plasmonic and vibrational properties

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Au@Ag nanoparticles (NPs) are synthesized through a stepwise Ag reduction on Au NPs synthesized through organometallic route. Their optical properties can be modulated by either tuning the Ag shell thickness or changing the size of Au core NPs. The core-shell structure was confirmed by HR-TEM, STEM-HAADF and EELS (Figure 1a). By UV-Vis spectroscopy, NP localized surface plasmon resonance (LSPR) was investigated. The measured absorption spectra were in good agreement with the calculated absorption spectra using discrete dipole approximation (DDA) of core-shell model (Figure 1b-c). Due to their low size distribution, core-shell NPs are self-organized in 3D fcc superlattices (figure 1c). The vibrational properties of Au@Ag NPs superlattices were studied by low-frequency Raman spectroscopy (LFRS) (Figure 1e-f). The LFRS spectra are in good agreement with those calculated using an elastic sphere with a core-shell structure[2]. These results highlight a good control of the crystallinity of core and strong coupling between Au core and Ag shell in Au@Ag bimetallic NPs in agreement with HR-TEM results.

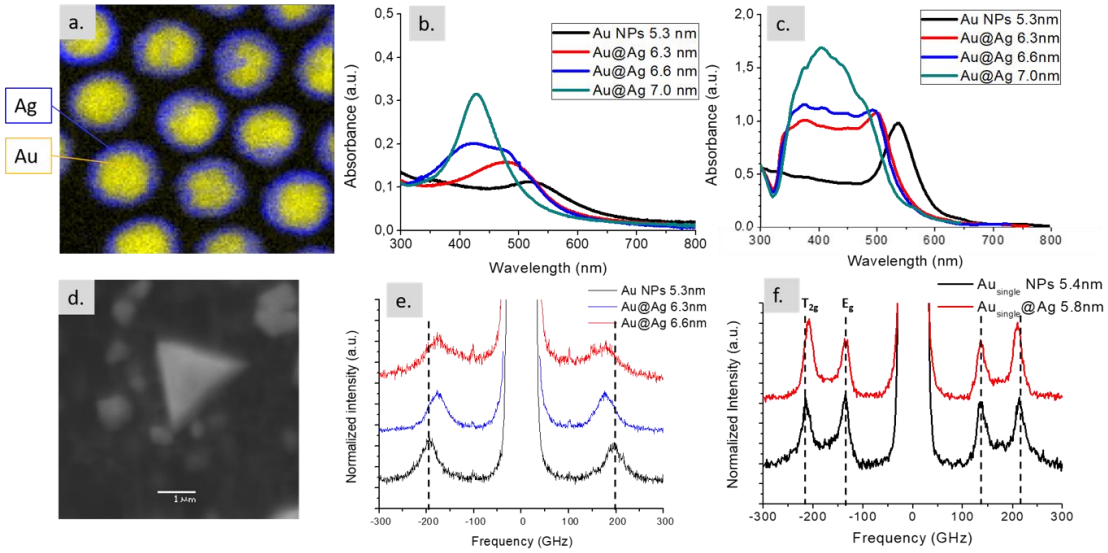

Figure 1. (a) EELS cartography on Au@Ag NPs of 6.3 nm where silver appears in yellow color and gold in blue color. (b) Absorption spectra of Au@Ag NPs with different silver thicknesses. (c) Calculated absorption spectra of Au@Ag using DDA method. (d) triangular 3D superlattices of Au@Ag NPs with Au single crystalline core. (e) LFRS spectra of Au@Ag NPs. (f) LFRS spectra of Au@Ag NPs with Au single crystalline core.

Références:

[1] A. Andrieux-Ledier, and al., *Langmuir*, **29**, 13140 (2013).
[2] H. Portalès, and al., *Phys. Rev. B*, **65**, 165422 (2002)