Electronic Supplementary Material (ESI) for Nanoscale Advances.

Supporting Information

Manipulating Acoustic and Plasmonic Modes in Gold Nanostars

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1. X-ray Energy Dispersive Spectroscopy (XEDS) of synthesized AuNS:

X-ray energy dispersive spectroscopy (XEDS) of the synthesized AuNS is shown below. In the spectrum the most intense peak corresponds to carbon due to the carbon substrate used. This spectrum confirms the presence of Au in the synthesized nanostars.

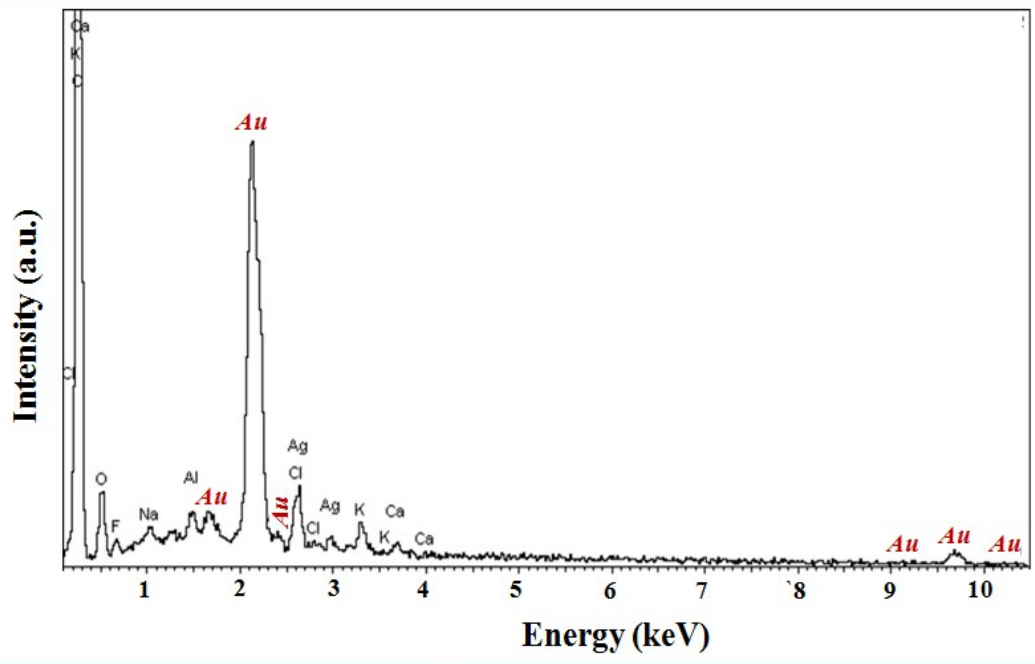

Figure S1. X-ray energy dispersive spectroscopy (XEDS) of the synthesized stable AuNS is shown here. The most intense peak in the XEDS spectrum corresponds to carbon due to the carbon support film. The peak observed at 2.12keV, corresponding to Au, is confirming the presence of Au in the synthesized nanoparticle (from reference [4]).

2. Numerical Investigation on the Extinction Cross Section of Au Nanosphere of 60 nm size:

Theoretical extinction cross-section of a 60 nm Au nanosphere is shown here. Radio frequency (RF) module of FEM based comsol 5.4 is used for this calculation which shows that the localized surface plasmon resonance (LSPR) is at 550 nm. According to electron energy loss spectroscopy (EELS) investigation, the mode predominating in the nanostars core was at 2.2 eV (~564 nm). According to TEM

study the average core size of synthesized AuNS is 60 nm. So the theoretical evaluation of LSPR at 550 nm of this Au nanosphere is indicating that indeed 2.2 eV mode is the nanostar core mode without significant contribution from the other parts of AuNS. For this study the wavelength dependent permittivity of gold is taken from the Johnson and Christy measurements.[1]

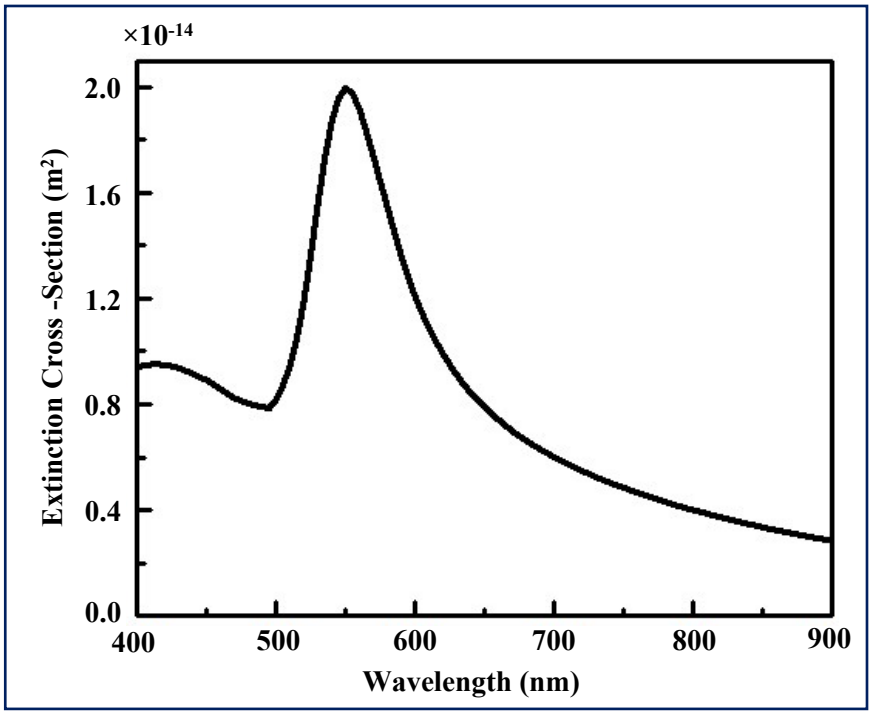

Figure S2. Extinction cross-section of 60 nm Au nanosphere is shown. The theoretical LSPR is seen to occur here at 550 nm.

3. Numerical Investigation on the Extinction Property of Single AuNS with LSL:

A theoretical extinction spectrum of AuNS of 60 nm core and 88 nm spike (LSL) is shown here. RF module of Comsol 5.4 is used for this analysis. LSPR of AuNS in water media is found to be at 1060 nm (1.17 eV). Thus, the 1.17 eV mode seen in the EELS study, in AuNS tip area is a dipolar edge mode. Here the incident light wave has polarization along the semi-major axis of the 88 nm spikes of the AuNS. For this study the wavelength dependent permittivity of gold is taken from the Johnson and Christy measurements.[1]

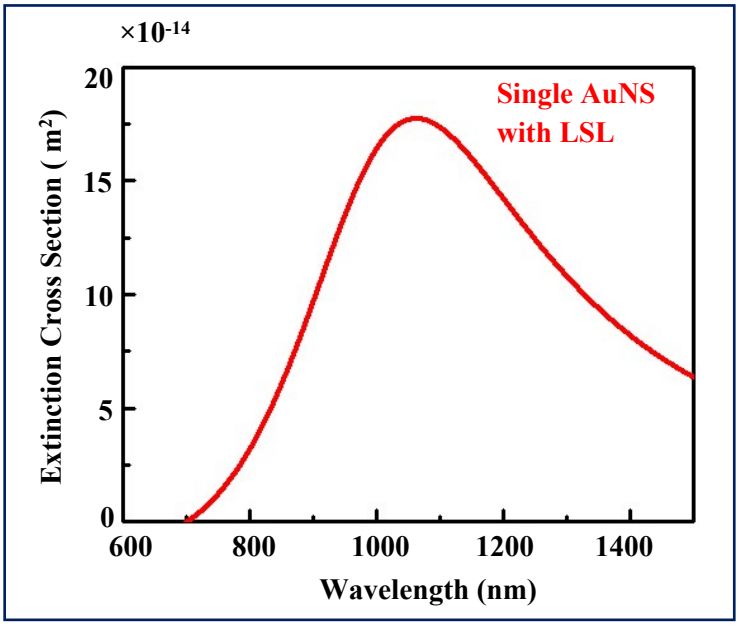

Figure S3. Extinction property of single LSL AuNS in water is shown.

References:

[1] P. B. Johnson, and R. W. Christy, *Phys. Rev. B* 1972, **6,** 4370–4379.

[2] M. K. Krug, M. Reisecker, A. Hohenau, H. Ditlbacher, A. Trugler, U. Hohenester, and J. R. Krenn, *Appl. Phys. Lett.* 2014, **105,** 1711031-1711033.

[3] P. G. Etchegoin, and E. C. Le Ru, *Surface Enhanced Raman Spectroscopy: Analytical, Biophysical and Life Science Applications. Chapter I – "Basic Electromagnetic Theory of SERS";* WILEY-VCH Verlag GmbH & Co. KGaA: Weinheim, 2010.

[4] S. Chatterjee, L. Ricciardi, J. I. Deitz, R. E. A. Williams, D. W. McComb, and G. Strangi, *Micromachines* 2018, **9,** 664.