SINGLE SILVER NANOPARTICLES AS REAL-TIME OPTICAL SENSORS WITH ZEPTOMOLE SENSITIVITY

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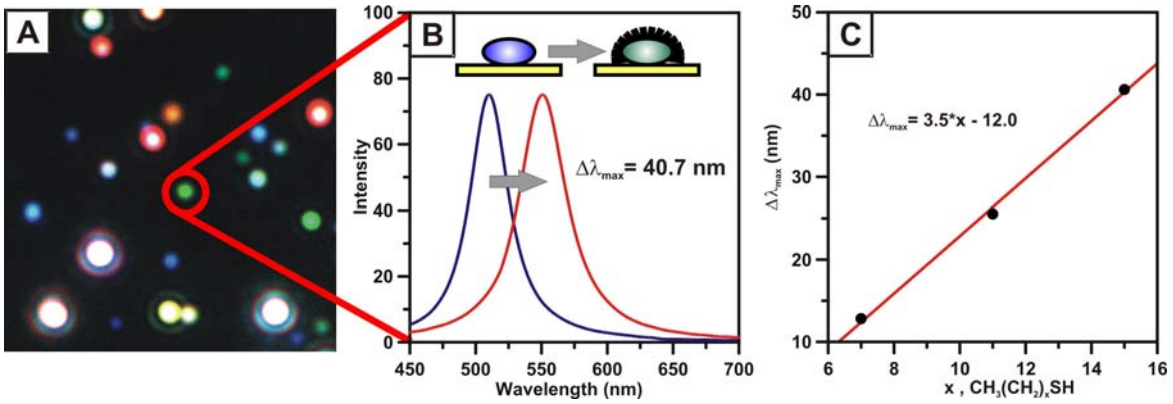
Resonant Rayleigh scattering spectroscopy was used to investigate the localized surface plasmon resonance (LSPR) response of individual Ag nanoparticles to the formation of a monolayer of small-molecule adsorbates. The adsorption of fewer than 60,000 1-hexadecanethiol (HDT) molecules (~100 zeptomole) on single Ag nanoparticles resulted in a localized surface plasmon resonance shift of 40.7 nm. The shift was also shown to be linearly dependent on the alkyl chain length of the adsorbate. This work demonstrates that detection limits of fewer than 1,000 small molecule adsorbates are possible and suggests detection limits of only a few molecules for large biomolecules. Additionally, the kinetics of the single nanoparticle response was shown to be comparable to other real-time sensor technologies.



(A) A dark-field optical image of Ag nanoparticles immobilized on a glass substrate. (B) The resonant Rayleigh scattering spectrum of an individual Ag nanoparticle before and after modification with HDT. (C) Plot depicting the linear relationship between the LSPR response and alkyl chain length of the absorbate.