

Investigation of detectability of amphiphilic gold dimer nanoparticle : Influence of Quantum effects and PMMA

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Due to localized surface plasmon resonance (LSPR), which is a peculiar optical phenomenon of metal nanoparticle, gold nanoparticle was used for various types of applications, including photocatalyst, optoelectronics, sensing system. In focusing on the sensing application, we investigate the role of three quantum effects (i.e., intrinsic size effect, non-local effect, and electron tunneling effect) and PMMA for the detectability (i.e., detection accuracy and sensitivity) of self-assembled amphiphilic gold nanoparticle. We employed the discrete dipole approximation (DDA) method. Although influences of quantum effects and grafted polymer-brush shell are very much essential issues for the precision of the sensor system, there are no reports considering about these points. Our results indicated that quantum effects and polymer-brush shell reduced the detectability of gold nanoparticle. Especially, the electron tunneling effect becomes crucial role in the dimer structure. For high sensing capability of self-assembled gold nanoparticle, effects of the gold nanoparticle core size, polymer-brush shell thickness, and distance of gold nanoparticle cores in dimer structure have been considered.