NEAR ELECTRIC FIELD ENHANCEMENT AROUND Au@SiO$_2$ NANOPARTICLES

Luis Montaño-Priede$^1$, Umapada Pal$^1$, Ovidio Peña-Rodríguez$^2$

$^1$Instituto de Física, Benemérita Universidad Autónoma de Puebla, Apdo. Postal J-48, Puebla, Pue. 72570, Mexico.$^2$Instituto de Fusión Nuclear, Universidad Politécnica de Madrid, José Gutiérrez Abascal 2, E-28006 Madrid, Spain.

The near electric field (NEF) around plasmonic nanoparticles is very important for applications in surface-enhanced spectroscopies, where infrared absorption, Raman scattering, and fluorescence emission of molecules and ions near the nanoparticle surface are enhanced. In the present work, we have calculated the near electric field enhancement ($|E|/|E_0|$, where $E_0$ is the incident electric field) around Au@SiO$_2$ core-shell nanoparticle immersed in air as a function of the geometrical parameters. We have found that the NEF for an Au@SiO$_2$ with thick shell (thicker than 5 nm) has it maximum value near the Au core and decreases with distance until the shell surface, in which it increase again and then diminishes as it moves away from the nanoparticle. This maximum value near the core decrease as the shell thickness decrease and, in contrast, the field at the shell increases. We demonstrate that for smaller shell thicknesses (less than 5 nm) the maximum intensity of the electric field is no longer on the core, but on the shell. Additionally, we compare the near-field and far-field optical properties, demonstrating the extinction efficiency factor ($Q_{ext}$) and near-core NEF intensities behave oppositely with the increase of shell thickness, i.e., $Q_{ext}$ intensity decreases and the NEF near core increases. The results provide a better understanding of the behavior of the near electric field of Au@SiO$_2$ nanoparticles for their applications in surface-enhanced spectroscopies.

Acknowledgements: The work was supported by CONACyT, VIEP-BUAP and DITCo-BUAP, Mexico.

Keywords: Plasmonic Nanoparticle, Near Electric Field, Surface Enhanced

Presenting author's email: jmontano@ifuap.buap.mx