Improving the Light Harvest of Plasmonic Based Organic Solar Cells by Utilizing Dielectric Core–Shells

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Résumé

The plasmonic properties of nanoparticles (NPs) such as silver (Ag) can be improved by utilizing core-shell materials in order to improve photon harvest in organic solar cells (OSCs). In this work, we utilized four dielectric materials, namely TiO2 , SnO2, ZnO, and SiO2, to improve the near-field and far-field enhancement in addition to pushing the LSPR of Ag NPs to the visible region. The plasmon-assisted photon harvesting in P3HT:PCBM-based inverted organic solar cell (OSC) devices was investigated using a 70 nm silver nanosphere (Ag NS) coated with dielectrics. This study employed a 3D finite-difference time-domain (FDTD) simulation software for the analysis. The results show that the PCE of P3HT:PCBM could be enhanced by more than 26% when the NPs were embedded in the active layer due to the synergistic effect of near-field and far-field enhancement, with TiO2 that has a higher dielectric constant compared to others and bare Ag NPs. Furthermore, it was observed that backscattering as the dominant scattering mechanism could be used to improve the PCE of the device by about 10% when placed at the HTL/AL interface followed by ETL/AL (4%) while placing it at the ETL/ITO interface was found to reduce the PCE, attributed to its far distance from the active layer (AL) and the dominance of backward scattering.

Mots-Clés: Plasmonic organic solar cells, Dielectric coating, Finite, difference time, domain method, Local surface plasmon resonances effect

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