EFFICIENCY ENHANCEMENT OF ORGANIC SOLAR CELLS USING PLASMONIC STRUCTURES

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ABSTRACT. Plasmonic effects allow us to significantly improve the optical absorption of thin-film OSCs [1] and promote emerging solar cell technology meeting clean energy demands. So far, plasmonic nanostructures can offer three principles to enhance the optical absorption of OSCs. The first one is surface plasmon resonance by metallic gratings fabricated on the top or bottom of the active layer [2,3]. The second one is local plasmon resonance by metallic nanoparticles incorporated into or near the active layer [4,5]. The third one is plasmon coupling and hybridization, such as surface plasmon resonance coupled with local plasmon resonance or plasmon resonance coupled with photonic resonance [6,7].Our work aims to improve efficiency by increasing the absorption inside an organic material. We do so by incorporating metallic nanoparticles inside the absorbing layer, thus generating surface plasmon (SP). This effect leads to a strong increase in the electromagnetic field around metallic particles, which makes it possible to improve absorption in the surrounding medium. It is known that the resonance frequency varies according to the form and the diameter of the nanoparticles (NPs), the period of the considered grating, the material composing the nanoparticles and the optical constants of the surrounding medium [8]. Gold and silver nanoparticles placed in air have their resonance frequencies in the visible spectra. Here, we used silver nanoparticles. The inclusion of these nanoparticles also enables light to be scattered, which is especially useful in the active layer. In this paper, a detailed three-dimensional (3D) numerical study of the absorption in an organic active layer poly [2-methoxy-5-(2-ethyl-hexyloxy)-1,4-phenyl_ene–vinyl_ene]: 6,6-phenyl C61-butyric acid methyl ester (MEH-PPV:PCBM) bulk heterojunction containing metallic NPs bulk heterojunction is performed via a numerical analysis based on the Finite Difference Time Domain (FDTD) rigorous method.

KEY WORDS: *Organic solar cells, Surface Plasmon, FDTD.*