

## Effect of Metal Nanoparticles on Metallic Grating Electrodes in Organic Thin-Film Solar Cells

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Organic thin-film solar cells are promising technologies for photovoltaic devices. In term of enhanced optical absorption of thin films, plasmonic effects have been recently introduced for increasing light trapping and improving the efficiency of the solar cells. In this work, the propagating surface plasmon resonance (SPR) on grating structures has been studied to enhance the device performances. Moreover, the incorporation of the localized SPR with the propagating SPR with metal nanoparticles has also been investigated for more improvement. The incorporation of gold nanoparticles (AuNPs) or silver (Ag) nanoplates in poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS) or hole transport layer was performed to fabricate the developing cell. The PDMS pattern from Blu-ray disk recordable (BD-R) was transferred by nanoimprinting technique on the top surface of active layer via thermal imprinting technique. The device consisted of Al/P3HT:PCBM/NPs:PEDOT:PSS/ITO/glass substrate structure as shown in Figure 1. The photovoltaic properties of the fabricated solar cell have been studied. Figure 2 shows the surface morphology of developed solar cell with a pattern from BD-R grating and reference flat cells. The power conversion efficiency (PCE) of solar cells with grating structures and AuNPs or Ag nanoplates provided a better %PCE with 3.15%, 3.36%, and 3.59% respectively. In this case, the synergic effects between the propagating SPR and localized SPR, attributed to a higher efficiency due to the increased absorption property.

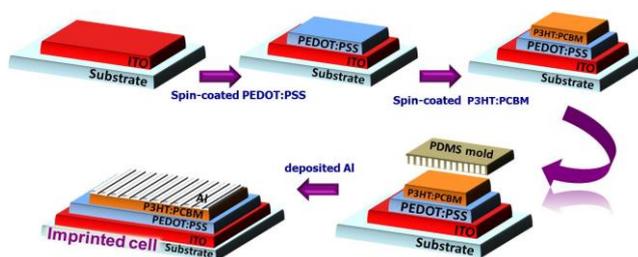


Figure 1 Schematic diagram of the device fabrication

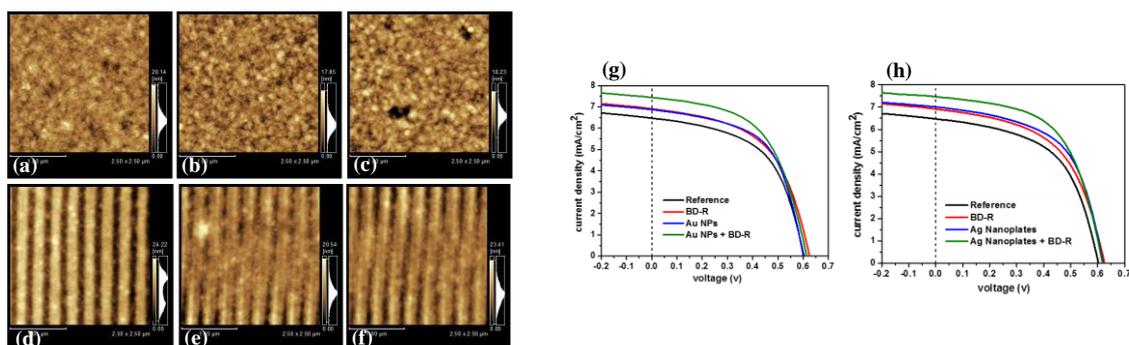


Figure 2 AFM morphology of PEDOT:PSS film (a), PEDOT:PSS with AuNPs (b) or with Ag Nanoplates (c), the pattern with BD-R grating (d), PEDOT:PSS with AuNPs (e) or with Ag Nanoplates (f), J-V curve of AuNPs (g) and Ag nanoplates (h)