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Plasmonics in polymer and perovskite solar cells: Optical and electrical contribution

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Solution processed thin-film photovoltaic (PV) solar technologies, such as polymer and perovskite solar cells (PSCs), may provide low-cost electricity generation. These technologies suffer from insufficient light absorption due to thin absorbers. Metallic nanoparticles (NPs) exhibit a localized surface plasmon resonance (LSPR) and act as scattering centers and sub-wavelength antennas, so metallic NPs can be incorporated into thin-film solar cells to effectively improve the light absorption of light harvesting devices. We have embedded various metallic nanocomposites into the electron transport layer (ETL) or the hole transport layer (HTL) of polymer and perovskite solar cells to investigate the photovoltaic effects of the PV cells with metallic nanostructures. The PSC device achieved a significant enhancement of the UV stability and 34.2% improvement of the power conversion efficiency (PCE) by combinational use of Au NPs and insulating MgO in mesoporous TiO_2. The polymer PV device demonstrated improved stability and 14.5% improvement of PCE by embedding AgAl nanostructures into the HTL. Solar cell performance observations and results indicate that the LSPR and electrical effects of metallic nanostructures enhance the photovoltaic response of both kinds of PV cells, by causing an incredible improvement in the photocurrent density as a dominant factor. The fundamental optics and physics behind the plasmonic polymer and perovskite solar cell was studied

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