Plasmonic Nanoparticle Enhancement in Thin Organic Solar Cells

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ABSTRACT
Thin film solar technologies can potentially provide energy at a very low device cost, because of lower material consumption. However, given their thin absorbing layer there is a need for absorption boosting measures, such as light trapping or management techniques. This problem is particularly important for organic solar cells, since the active layer thickness is often limited by the exciton diffusion length. Here, we examine a recent promising light trapping scheme, which consists of incorporating small metallic nanoparticles into the organic active layer. It turns out that the localized plasmon resonance of the particles can significantly enhance the optical fields and absorption. We examine the potential of this technique in a thin solar cell with P3HT:PCBM as the active material, by performing rigorous numerical simulations. Ultimately, we find that a layer of only 33 nm thick with silver particles of 24 nm diameter, can provide the same solar absorption efficiency as a layer of 61 nm thickness without particles. Such enhancements may pave the way towards cheaper energy harvesting devices.