W C H Choy, J Laser Opt Photonics 2018, Volume 5
DOI: 10.4172/2469-410X-C1-022

W C H Choy

The University of Hong Kong, China

Distinct multi-physical effects of plasmonic metal nanostructures for high performance optoelectronic devices

The remarkable enhancement of plasmon -optical and -electrical effects by metal nanostructures will be described in detail for high performance optoelectronic devices such as light emitting diodes and solar cells. Taking plasmonic organic solar cell as an example, the power conversion efficiency can reach over 10.5%. The plasmon-optical effects have been utilized to optically enhance active layer absorption in organic solar cells (OSCs). The exploited plasmonic resonances of metal nanomaterials are typically from the fundamental dipole/high-order modes with narrow spectral widths for regional OSC absorption improvement. The conventional broadband absorption enhancement (using plasmonic effects) needs linear-superposition of plasmonic resonances. Moreover, with appropriate incorporation of metal nanostructures into the multilayered OSCs, plasmon-electrical effects can be introduced to improve the electrical properties of carrier transport layer and eliminate the space charge limit of organic active layer. In this talk, we will describe the details of the plasmon -optical and -electrical effects by introducing metal nanostructures on different layer of OSCs. Recently, through strategic incorporation of gold nanostars (Au NSs) in between hole transport layer (HTL) and active layer, the excited plasmonic asymmetric modes offer a new approach toward broadband enhancement. Remarkably, the improvement can be explained by energy transfer of plasmonic asymmetric modes of Au NS. Moreover, Au NSs simultaneously deliver plasmon-electrical effects which shorten transport path length of the typically low-mobility holes and lengthen that of high-mobility electrons for better balanced carrier collection. Meanwhile, the resistance of HTL is reduced by Au NSs. Consequently, PCE of 10.5% has been achieved through cooperatively plasmon-optical and -electrical effects of Au NSs. With the understanding of the multi-physical (optical and electrical) effects, we will also demonstrate significant performance improvement of plasmonic nanostructures for organic light emitting diode applications.

Biography

W C H Choy is a full Professor in the Department of EEE, HKU. His research interests cover organic/inorganic optoelectronic devices, plasmonic structures, metal oxides, and nanomaterial devices. He has published more than 180 peer-reviewed papers, several book chapters, patents, and edited one book. He was recognized as top 1% of most-cited scientists in Thomson Reuter's Essential Science Indicators from 2014 to 2017. He has served as Member of Engineering panels of Hong Kong Research Grant Council, Editorial Board Member for Nature Publishing Group on *Scientific Reports*, Wiley on *Solar RRL* and Institute of Physics on *J Physics D*, Senior Editor of *IEEE Photonics Journal*, Topical Editor of OSA *Journal of the Optical Society of America B*, and Guest Editor of OSA *Journal of Photonic Research* and *Journal of Optical Quantum Electronics.* He is an elected fellow of OSA.

chchoy@eee.hku.hk

Notes: