Plasmonic Effects in Organic Solar Cells

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Abstract— The work provides a systematic study on plasmonic effects in organic solar cells (OSCs). We first introduce the concepts, significance, and recent progress of OSCs incorporating plasmonic nanostructures. On the basis of unique features of OSCs, we exploit versatile resonance mechanisms acting on the absorption enhancement of OSCs; for example, Fabry-Pérot mode, quasi-guided mode, and plasmonic mode. Next, we present rigorous theoretical models to characterize optical properties of OSCs. The key physical quantities, as well as the pros and cons of different models, are described. After that, we show some theoretical results to unveil the fundamental and device physics of plasmonic effects in typical OSC structures. Finally, we conclude the paper and identify future opportunities in this field.

The following figures show the optical designs of plasmonic nanostructures for improving the optical absorption of OSCs.

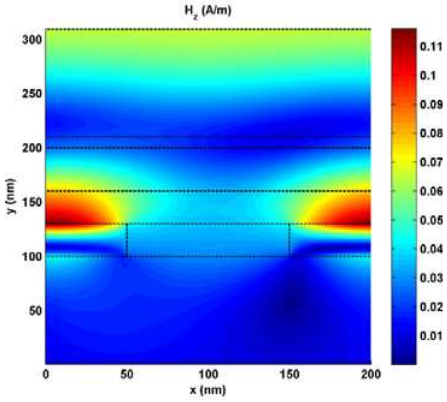

Figure 1: Surface plasmon resonance.

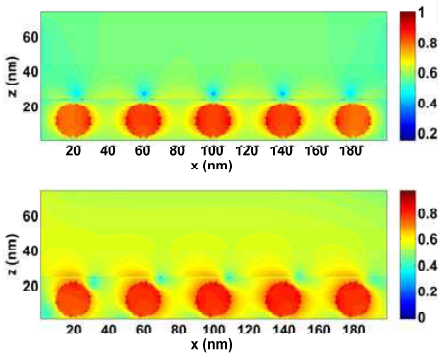

Figure 2: Local plasmon resonance.

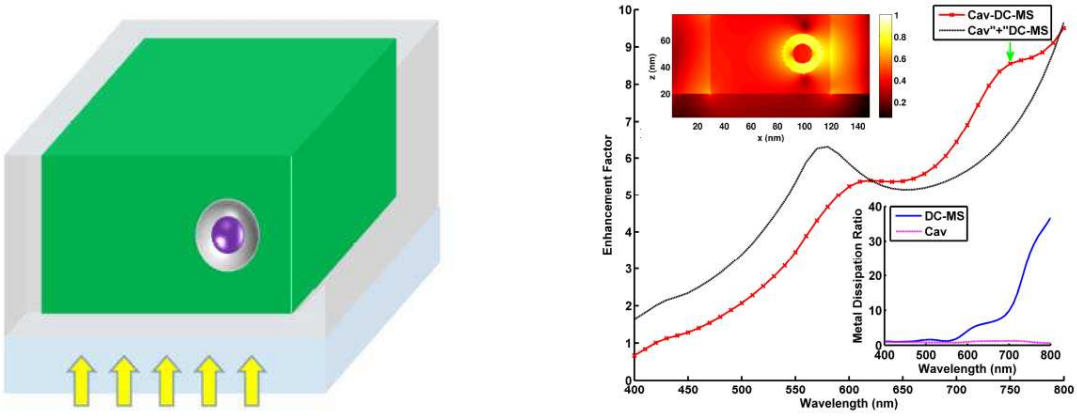

Figure 3: (a) Hybrid plasmonic system; (b) Near-field distribution and enhancement factors.