

Charge Carrier Mobility Dependent Open-Circuit Voltage in Organic and Hybrid Solar Cells

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Abstract : A better understanding of the open-circuit voltage (V_{oc}) related losses in organic solar cells (OSCs) is desirable in order to assess the photovoltaic performance of these devices. We have derived V_{oc} as a function of charge carrier mobilities (μ_e and μ_h) for organic and hybrid solar cells by optimizing the drift-diffusion current density. The optimum V_{oc} thus obtained depends on the energy difference between the highest occupied molecular orbital (HOMO) level and the quasi-Fermi level of holes of the donor material. We have found that the V_{oc} depends on the ratio of the electron (μ_e) and hole (μ_h) mobilities and when $\mu_h > \mu_e$ the V_{oc} increases. The most important loss term in the V_{oc} arises from the energetics of the donor and acceptor materials, which will be discussed in detail in this paper.

Keywords : charge carrier mobility, open-circuit voltage, organic solar cells, quasi-fermi levels

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