Simulation of Energetically Bilayer Organic Solar Cells: An Overview

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Abstract

Energetic bilayer organic solar cells (OSCs) have emerged as promising photovoltaic devices due to their potential for lightweight, flexible, and low-cost solar-energy conversion. This overview focuses on the simulation and analysis of bilayer organic solar-cell structures, with particular emphasis on the energetic alignment between donor and acceptor materials. Device performance is strongly influenced by factors such as energy-level matching, active-layer thickness, exciton generation and dissociation, charge-carrier transport, recombination, and interfacial properties. Simulation techniques provide an effective approach for investigating these parameters and predicting important photovoltaic characteristics, including short-circuit current density, open-circuit voltage, fill factor, and power conversion efficiency. The study highlights how appropriate selection of energy levels and optimization of the bilayer architecture can improve charge separation and reduce recombination losses. Overall, simulation-based analysis provides valuable insights into the physical mechanisms governing bilayer organic solar cells and supports the development of efficient and optimized organic photovoltaic devices.

Keywords: Bilayer organic solar cells, organic photovoltaics, device simulation, donor–acceptor interface, energy-level alignment, exciton dissociation, charge transport, recombination, photovoltaic performance, power conversion efficiency.