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Simulation of Energetically Bilayer Organic Solar Cells: New Policy Concerned

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Abstract

Organic solar cells (OSCs) have attracted considerable attention as promising alternatives to conventional photovoltaic technologies because of their lightweight nature, mechanical flexibility, low-temperature processing, and potential for large-area fabrication. This study focuses on the simulation and performance analysis of energetically optimized bilayer organic solar cells, with particular emphasis on the influence of energy-level alignment and device architecture on photovoltaic performance. A numerical simulation approach is employed to investigate the effects of donor and acceptor materials, active-layer thickness, energy-level offsets, carrier mobility, recombination mechanisms, and electrode work functions on key device parameters. The simulated current–voltage characteristics are analyzed in terms of open-circuit voltage, short-circuit current density, fill factor, and power conversion efficiency. Special attention is given to the energetic alignment between the donor, acceptor, and charge-transport layers to minimize energy losses and improve charge generation and extraction. The study also examines potential policy concerns related to the scalable deployment of organic photovoltaic technologies, including material sustainability, environmental impacts, recycling requirements, and manufacturing standards. The results demonstrate that careful energetic optimization of bilayer structures can significantly enhance charge separation and reduce recombination losses, thereby improving overall device efficiency. The findings provide useful guidelines for designing efficient, stable, and environmentally responsible bilayer organic solar cells while supporting their future commercialization and sustainable energy applications.

Keywords: Organic solar cells, bilayer structure, energy-level alignment, numerical simulation, charge transport, power conversion efficiency, energy loss, sustainability, photovoltaic policy.