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Design principle for efficient charge separation at the donor-acceptor interface for high performance organic solar cell device WANYI NIE, GAUTAM GUPTA, BRIAN CRONE, HSING-LIN WANG, ADITYA MOHITE, Los Alamos National Lab, MPA-11 MATERIAL SYNTHESIS AND INTEGRATED DEVICE TEAM, MPA-CHEMISTRY TEAM — The performance of donor (D) /acceptor (A) structure based organic electronic devices, such as solar cell, light emitting devices etc., relays on the charge transfer process at the interface dramatically. In organic solar cell, the photo-induced electron-hole pair is tightly bonded and will form a charge transfer (CT) state at the D/A interface after dissociation. There is a large chance for them to recombine through CT state and thus is a major loss that limit the overall performance. Here, we report three different strategies that allow us to completely suppress the exciplex (or charge transfer state) recombination between any D/A system. We observe that the photocurrent increases by 300% and the power conversion efficiency increases by 4-5 times simply by inserting a spacer layer in the form of an a) insulator b) Oliogomer or using a c) heavy atom at the donor-acceptor interface in a P3HT/C60 bilayer device. By using those different functional mono layers, we successfully suppressed the exciplex recombination in evidence of increased photocurrent and open circuit voltage. Moreover, these strategies are applicable universally to any donor-acceptor interface. And we demonstrated such strategies in a bulk-heterojunction device which improved the power conversion efficiency from 3.5% up to 4.6%.

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