MAR05-2004-020058

Abstract for an Invited Paper
for the MAR05 Meeting of
the American Physical Society

Electron-hole capture in polymer heterojunction light-emitting diodes

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Polymer light-emitting diodes based on blends of polyfluorene derivatives show very high efficiencies and low drive voltages. Electron-hole capture in these devices directly produces long-lived exciplex states where the electron and hole are predominantly localized on opposite sides of the heterojunction. The exciplex may then be thermally excited to form an intra-chain exciton, which can itself either emit, or be recycled to reform the exciplex. I will review the physics of exciplex formation and emission in these devices, and will show that exciplex formation rates are consistent with low free charge densities at the heterojunction. I will present evidence that the rate of charge transfer at polyfluorene heterojunctions can be modulated with an applied electric field, leading in some cases to an increase in photoluminescence efficiency with applied field. I will also present recent results showing enhanced triplet exciton formation after photoexcitation in polyfluorene blends, and will discuss the implications of the results for polymer light-emitting and photovoltaic devices.