

BENZOPHENONE-(BENZO)CARBAZOLE-BASED HOST MATERIALS ENABLING EFFICIENT RED PHOSPHORESCENT OLED THROUGH CO-HOST ENGINEERING

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Organic light-emitting diodes (OLEDs) have rapidly gained widespread commercial adoption, however, efficiency losses and stability issues remain persistent challenges, particularly for long-wavelength emitters. Motivated by the increasing demand for efficient energy transfer and effective exciton management in phosphorescent OLEDs, we designed and synthesized four new benzophenone-(benzo)carbazole based host materials, namely BP-Cz2, BP-BCz2, BP-BCz, and BP-CzBCz, incorporating carbazole and extended π -conjugated benzo[a]carbazole electron-donating units, either individually or in a combination. All synthesized compounds exhibited excellent thermal stability and a strong tendency to form stable amorphous thin films, with glass transition temperatures exceeding 100 °C for most materials. Photophysical characterization revealed singlet energy levels ranging from 2.90 to 3.61 eV and triplet energy levels between 2.50 and 3.10 eV, corresponding to singlet-triplet energy gaps of 0.35–0.51 eV. These energy characteristics confirm that the benzophenone derivatives provide sufficient exciton confinement for red phosphorescent emitters. Furthermore, charge-transport measurements indicated hole and electron mobilities spanning from 10^{-3} to 10^{-12} cm² V⁻¹ s⁻¹, highlighting the tunability of charge-transport properties through molecular design. The donor-acceptor compounds were evaluated as host materials in red OLED devices. Notably, devices employing a co-host configuration consistently outperformed their single-host counterparts. In particular, the BP-BCz-based co-host system utilizing OLED achieved a maximum external quantum efficiency of 17.9% with a reduced efficiency roll-off at high luminance. These results demonstrate that benzophenone-(benzo)carbazole based host materials, when implemented within a co-host architecture, facilitate balanced charge transport, suppress exciton quenching, and enable high-performance red OLEDs.

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