Control of host-matrix morphology to achieve efficient deep-blue organic light-emitting devices

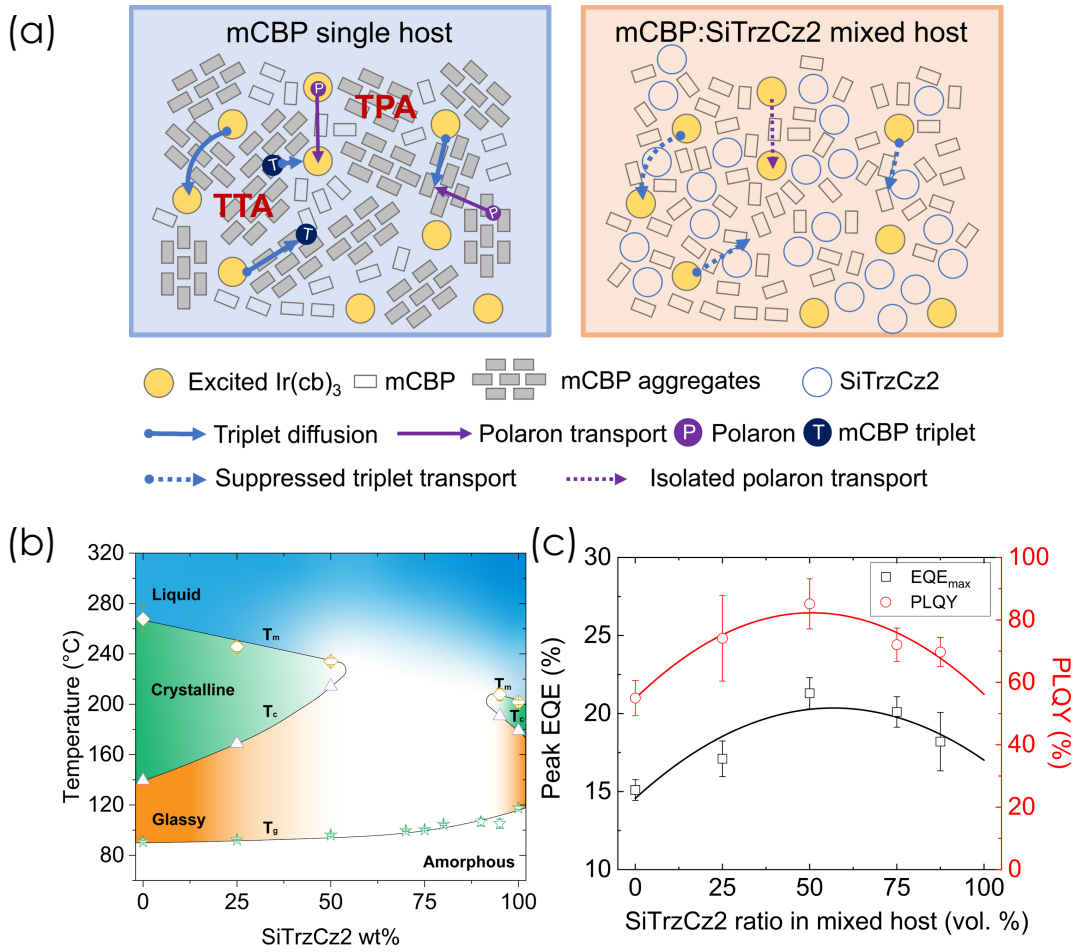

Figure: (a) Triplet-triplet (TTA) and triplet-polaron annihilation (TPA) processes in the mCBP host emissive layer (left) and the suppressed processes in the mCBP:SiTrzCz2 mixed host layer. (b) Phase diagram determined by differential scanning calorimetry (DSC) of mixed films comprising mCBP and SiTrzCz2 at several weight ratios. (c) Measured photoluminescent quantum yield (PLQY) (red) and peak external quantum efficiency (EQE, black) vs. concentration (volume %) of SiTrzCz2 within the emissive layer.

Objective

➢ To achieve high efficiency in deep-blue OLEDs and minimize the nonradiative recombination by controlling the host-matrix morphology

Impact

The photoluminescent quantum yield (PLQY) of a dopant is a function of its optical properties and morphological environment. That is, the PLQY is critically affected by molecular aggregation that can lead to increased exciton quenching or triplet–triplet and triplet–polaron annihilation (TTA and TPA, respectively). Mixing a sterically bulky, electron-transporting host material into a conventional single host–guest emissive layer can suppress phase separation of the host matrix while increasing the EQE by 120 ± 6% and doubling the operational lifetime of deep-blue phosphorescent organic light-emitting diodes (PHOLEDs). We also study the device dynamics from the suppressed single host aggregation; a significant loss channel of nonradiative recombination. The goal of this study is to control the host matrix morphology via mixing hosts and achieve high efficiency and long lifetime in the emissive layer.

Facilities and Methods Used

- Vacuum thermal evaporation
- Differential scanning calorimetry
- Time-resolved electroluminescence/photoluminescence spectroscopy

Relevant Papers

- H. Zhao*, J. Kim*, *et al.*, *Advanced Materials,* DOI: 10.1002/adma.202210794 (2023)

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