EFFICIENT THIRD-GENERATION BLUE OLEDS USING DIBENZOFURAN-BASED HIGH-TRIPLET-ENERGY HOSTS

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In the field of organic light-emitting diodes (OLEDs), thermally activated delayed fluorescence (TADF) has become an established pathway toward 100% internal quantum efficiency [1]. However, optimal device performance typically requires emitter to be doped in a suitable host matrix to suppress aggregation. The host should also provide balanced charge-carrier transport and a sufficiently high triplet energy to confine triplet excitons on the emitter and prevent back energy transfer to the matrix [2].

The aim of this research was to investigate four molecules composed of biphenyl core and dibenzofuran fragments with or without tert-Butyl units (Fig. 1A) as potential OLED host materials. OLED's and single carrier devices were fabricated by physical vapour deposition with DMeCzIPN employed as the emitter [3].

All organic diodes exhibited a turn-on voltage of 3.25 V and had emission peak in range 483–488 nm. The OLED's with 4FH matrix reached external quantum efficiency of 23.4% (Fig. 1B), luminous efficiency of 59 lm/W and had LT50 lifetime of 17.5 h at 1000 cd/m2 initial brightness. Having highest triplet energy of 2.87 eV this host was able to successfully confine excitation on emitter thus reducing exciton buildup preventing device nonradiative relaxation and degradation.

While the remaining compounds 2FH, 2FBu and 4FBu poses similar triplet energies to the emitter the differences in lifetime and efficiencies can be attributed primarily to carrier imbalance in the emissive layer. The addition of tert-butyl groups increased electron mobility up to four orders of magnitude (Fig. 1C) which results in localizing the exciton recombination zone close to hole transport layer [4]. This crowding increases the probability of destructive bimolecular interactions that accelerate device degradation.

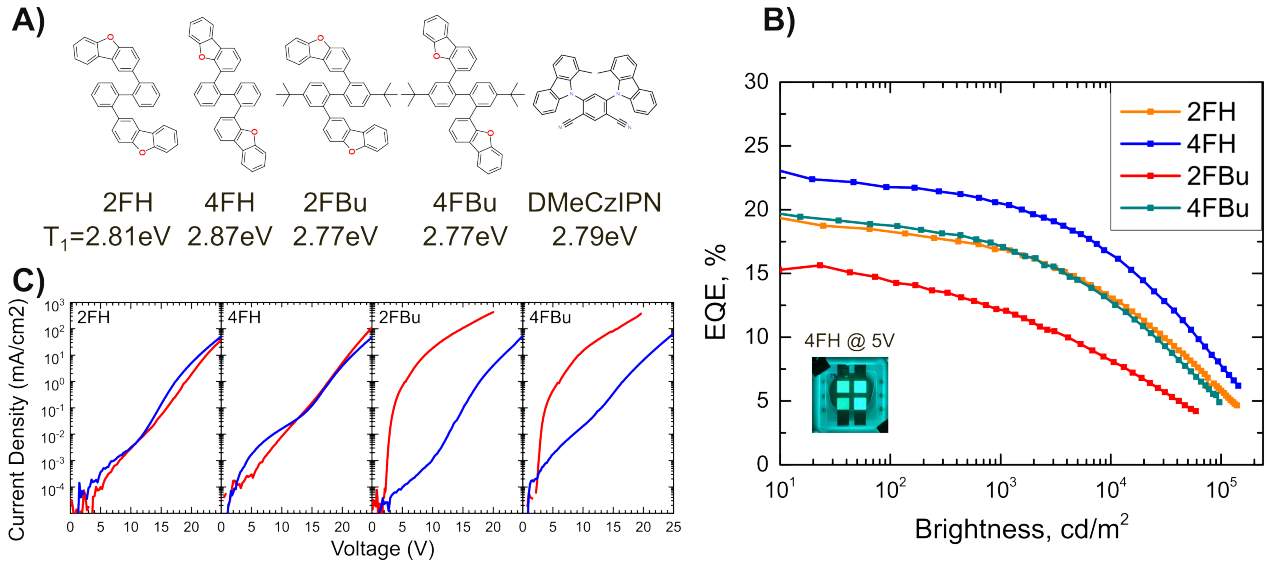

Fig. 1. A) the chemical structures and triplet energies of hosts and emitter molecules, B) OLED external quantum efficiency dependence on brightness, C) Current densities of electron and hole single carrier devices

The specific connection of the dibenzofuran unit to the biphenyl core in the 4FH molecule results in a higher triplet energy, making this host particularly well suited for blue emitters. While, the introduction of tert-butyl groups in this class of molecules promotes more n-type transport behaviour and can lead to a reduction in triplet energy.

Keywords: OLED, TADF, Blue, Hosts

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