New bipolar host materials with indenocarbazole chemical moiety for yellow phosphorescent organic light-emitting diodes

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Bipolar, proper high triplet energy, and high carrier mobility characteristics of host materials are required to make highly efficient phosphorescent organic light-emitting diodes. In this study, we report two bipolar host materials, ICBP1 (11-[4'-(12,12-dimethyl-11a,12-dihydro-6aH-11-aza-indeno[2,1-a]fluoren-11-yl)-biphenyl-4-yl]-12,12-dimethyl-11,12-dihydro-11-aza-indeno[2,1-a]fluorene) and ICBP2 (6-[4'-(12,12-dimethyl-10a,12-dihydro-6aH-6-aza-indeno[1,2-b]fluoren-6-yl)-biphenyl-4-yl]-12,12-dimethyl-6,12-dihydro-6-aza-indeno[1,2-b]fluorene) for highly efficient yellow phosphorescent organic light-emitting diodes. Herein, indenocarbazole moiety as a hole-transporting unit and biphenyl moiety as an electron-transporting unit were designed and synthesized for good host materials. The indenocarbazole is expected to provide high hole transporting property as well as better charge carrier stability due to longer conjugation length than CBP (4,4′-bis(N-carbazolyl)-1,1′-biphenyl). We investigate thermal, photo-physical and electrochemical properties of our newly synthesized these two host materials. The measured triplet energy values of ICBP1 and ICBP2 are 2.63 and 2.58 eV, respectively. These energy values are proper to transfer triplet energy from new host materials to yellow phosphorescent dopant (~2.2 eV). Fabricated yellow phosphorescent OLEDs with a following structure, ITO / hexa-azatriphenylene-hexanitrile (HATCN, 7 nm) / di-[4-(N,N-ditolylamino)phenyl]-cyclohexane (TAPC, 75 nm) / Host : 7 wt% iridium(III)bis(4-(4-t-butylphenyl)thieno[3,2-c]pyridinato-N,C2')acetylacetonate) ($Ir(tptpy)_2acac$, 20 nm) / 1,3,5-tris[(3-pyridyl)phen-3-yl]benzene (TmPyPB, 60 nm) / LiF (1.5 nm) / Al (100 nm), show excellent maximum external quantum efficiency of 26.4% (Fig. 1). Detail results on newly synthesized host materials and device performances will be discussed.

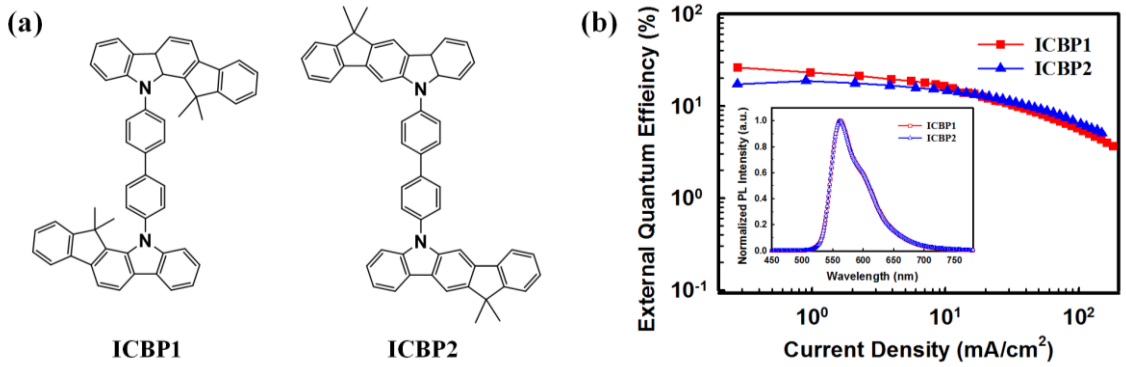

Fig. 1. (a) Molecular structures. (b) External quantum efficiency-current density characteristics of bipolar host devices. Inset: Electroluminescence spectra.

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