Confinement of holes and electrons in white organic light-emitting diodes with additional emissive layer

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To achieve white emission, various methods have been used, such as excimer/exciplex emission, mixing of three (red, blue, and green) or two (complementary) colors in a single host matrix or in physically separate layers. Among these various devices, numerous doped-type white organic light-emitting diodes (WOLEDs) using two mixed complementary colors to produce white emission have been fabricated. In this study, WOLEDs were composed of 4,4′-cyclohexylidenebis [N,N-bis(4-methylphenyl) benzenamine] (TAPC) as a hole transport layer (HTL), 1,3-bis(N-carbazolyl) benzene (mCP) as host material in EML, bis[2-(4,6-difluorophenyl)pyridinato-C2,N](picolinato)iridium(III) (FIrpic) as the blue phosphorescent dopant in EML, Tris[1-phenylisoquinolinato-C2,N]iridium(III) ($Ir(piq)_3$) as the red phosphorescent dopant in EML, 1,3,5-tris(N-phenylbenzimiazole-2-yl)benzene (TPBi) as an electron transport layer (ETL) and 8-Hydroxyquinolinolato-lithium (Liq) as an electron injection layer (EIL), respectively. These two emissive materials have different energy barrier gap between highest occupied molecular orbital (HOMO) and lowest unoccupied molecular orbital (LUMO) energy levels.

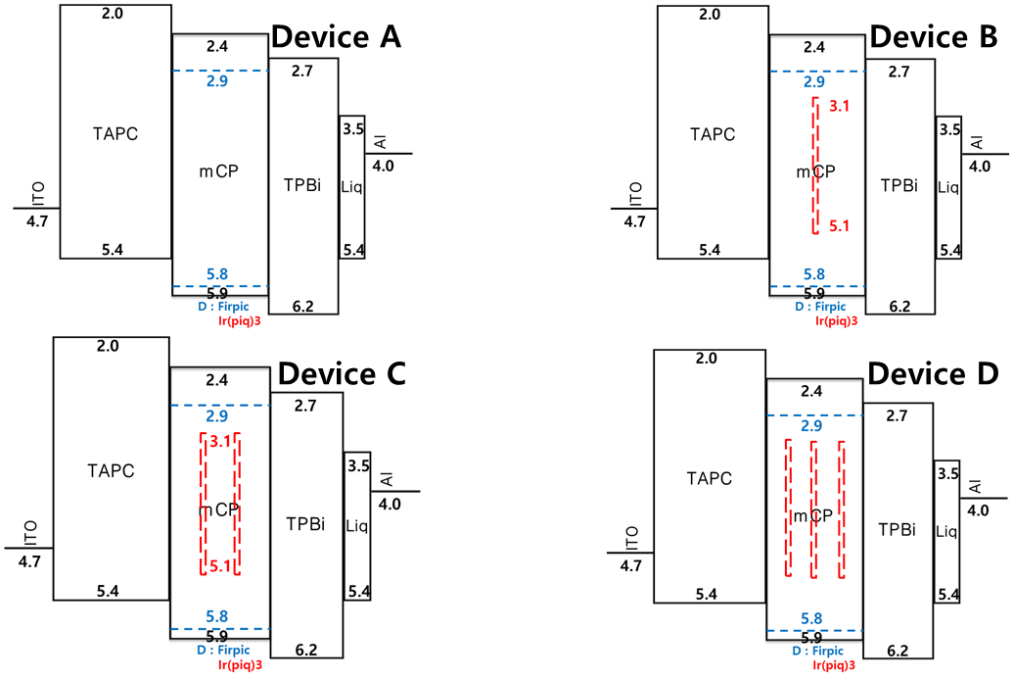

Fig. 1. Energy band diagrams of WOLEDs

Then, we examined their electrical and optical characteristics to determine current density, luminance, and luminous efficiency according to different position and numbers of red ultrathin layers. Red ultrathin EML was inserted in between the blue EMLs was effectively confined holes and electrons to increase recombination rate. In order to compare characteristics of WOLEDs, the total thickness of EML were kept at 30 nm.

References

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