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Syntheses and Application of Wide-Energy-Gap Boron Materials

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Three-coordinate boron atom, with its vacant p-orbital, is a strong π-electron acceptor in conjugated organic molecules. Therefore, it is well known that organoboron compounds are useful as electron transporting layer in organic light emitting devices (OLEDs).

We synthesized a novel electron transporting material, tris[2-(3-pyridyl)-mesityl]borane (3TPYMB), with wide energy gap and high triplet energy level containing trimesityl borane structure and applied to electron transport layer of OLEDs having phosphorescent emitter. The glass transition temperature of 106°C, which is enough high for device application, was observed from differential scanning calorie analysis. The triplet energy level of about 2.9 eV was estimated from the onset of its phosphorescence spectrum at 4.2K. This value is higher than that of iridium (III) bis[(4,6-difluorophenyl)-pyridinate-N,C2']piconate (FIrpic), a typical blue phosphorescent guest. This result suggests that the triplet energy transfer from FIrpic to 3TPYMB is suppressed, leading to high device efficiency. In blue OLED using FIrpic as a dopant and 3TPYMB as an electron transporting material, power efficiency of 39.1 lm/W and external quantum efficiency of 21.0% were obtained at 100 cd/m^2. Further, in fac tris[2-phenylpyridine] iridium (Ir(ppy)$_3$)-based green OLED, 92.7 lm/W and 22.0% were also obtained at 100 cd/m^2. From the transient photoluminescence decay measurement of FIrpic doped 3TPYMB film, single exponential decay was observed, suggesting that triplet energy transfer from FIrpic to 3TPYMB is suppressed completely to give high device efficiency.