Electronic Supplementary Material (ESI) for Materials Horizons.

Supplementary Information

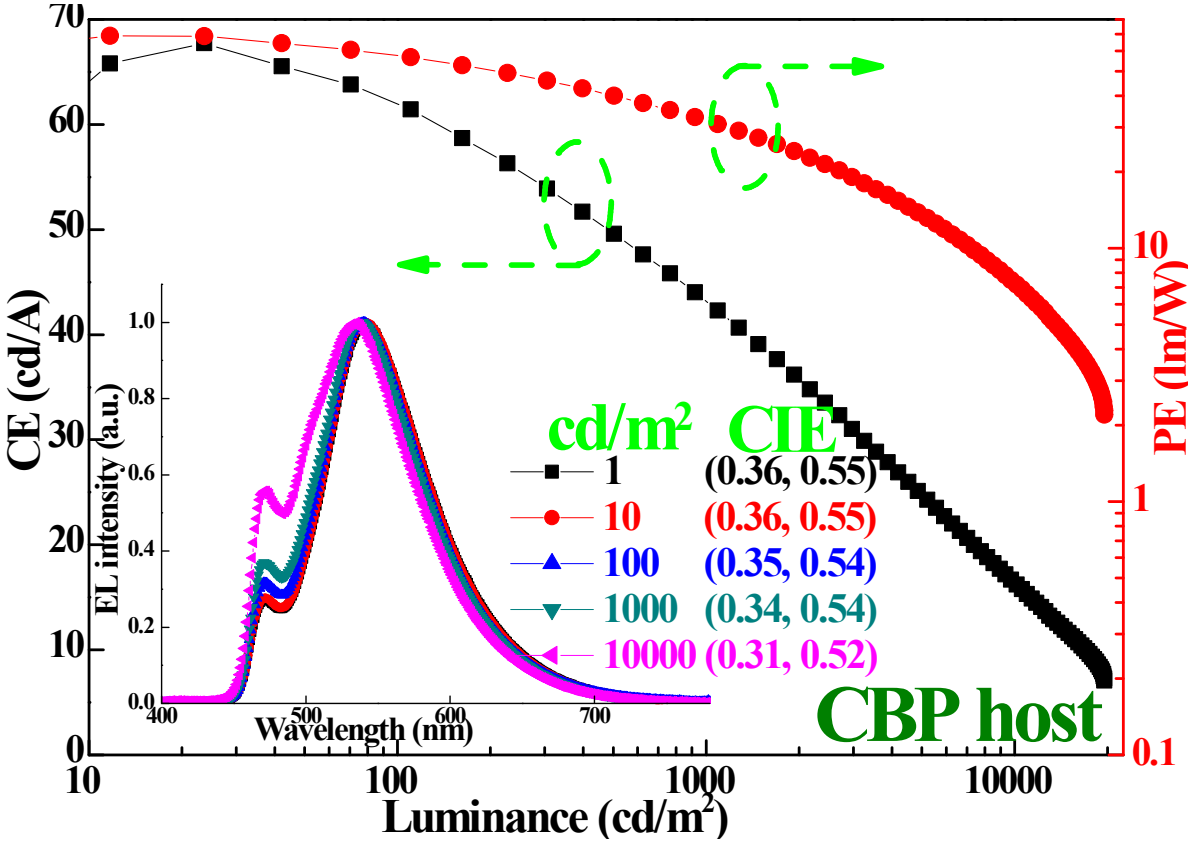

Figure S1. Forward-viewing CE and PE in dependence of luminance for the device using CBP host. Inset: Normalized EL spectra of the device using CBP host. The configuration is ITO/ MeO-TPD: F4-TCNQ (100 nm, 4%)/ TAPC (20 nm)/ CBP: FIrpic: $Ir(dmppy)_2(dpp)$ (11 nm, 1: 10%: 1.1%)/ TmPyPB (50 nm)/ LiF (1 nm)/ Al (200 nm). Since the T_1 of CBP is only 2.56 eV,[1] which is lower than that of FIrpic (2.65 eV), the reverse energy transfer from FIrpic to CBP can occur and triplets in the whole EML cannot be effectively confined, lowering the performance. In other words, the blue emission can be quenched by the CBP host. Therefore, no white emission can be obtained and the color is unstable, as shown in the figure S1 inset. At 1000 cd/m^2, the forward-viewing CE and PE are 43.0 cd/A and 31.9 lm/W, respectively, which are

much lower than those of 26DCzPPy based device. Such achieved results indicate that the T_1 of host is important to the device performance.

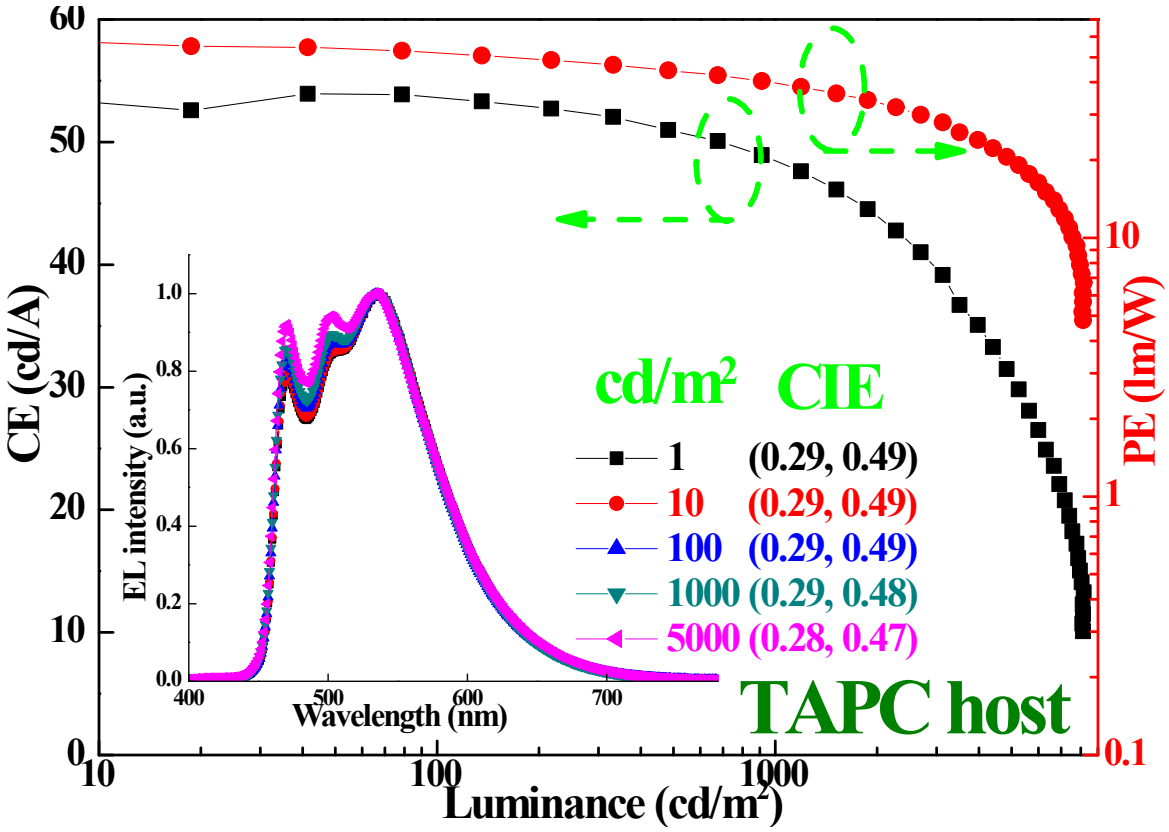

Figure S2. Forward-viewing CE and PE in dependence of luminance for the device using TAPC host. Inset: Normalized EL spectra of the device using TAPC host. The configuration is ITO/ MeO-TPD: F4-TCNQ (100 nm, 4%)/ TAPC (20 nm)/ TAPC: FIrpic: $Ir(dmppy)_2(dpp)$ (11 nm, 1: 8%: 1.1%)/ TmPyPB (50 nm)/ LiF (1 nm)/ Al (200 nm). Since TAPC is a p-type material, the exciton generation zone is located at the EML/ ETL interface, which is not wide enough, lowering the device performance. Although white emissions can be obtained, the maximum luminance of this device is only 8139 cd//m^2 and the color is unstable. At 1000 cd/m^2, the forward-viewing CE

and PE are 48.2 cd/A and 39.5 lm/W, respectively. Such achieved results indicate that the bipolar property of host is important to the device performance.

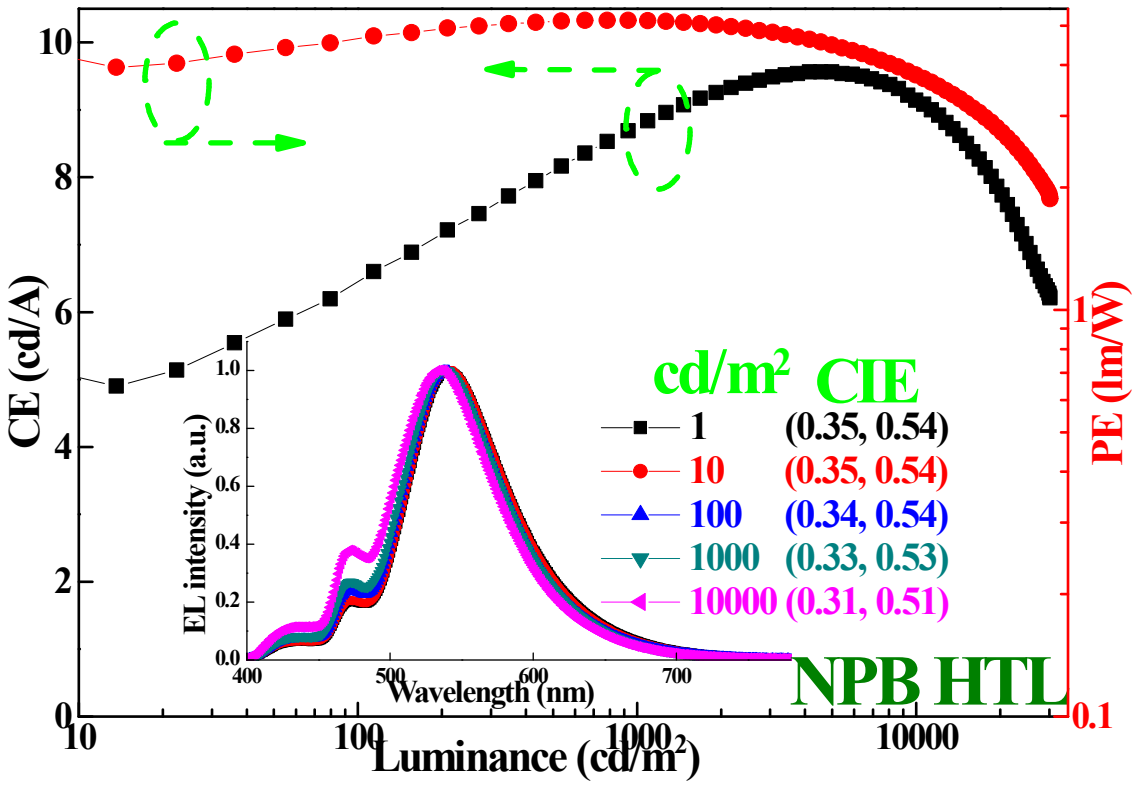

Figure S3. Forward-viewing CE and PE in dependence of luminance for the device using NPB HTL. Inset: Normalized EL spectra of the device using NPB HTL. The configuration is ITO/ MeO-TPD: F4-TCNQ (100 nm, 4%)/ NPB (20 nm)/ 26DCzPPy: FIrpic: $Ir(dmppy)_2(dpp)$ (11 nm, 1: 22.5%: 1.1%)/ TmPyPB (50 nm)/ LiF (1 nm)/ Al (200 nm). Since the T_1 of NPB is only 2.3 eV,[2] much lower than that of FIrpic, triplets can be quenched by this HTL, lowering the device performance. Besides, since the LUMO of NPB is 2.6 eV,[2] close to that of 26DCzPPy (2.65 eV), electrons can be easily escaped from the EML. As a result, an emission of ~440 nm can be easily observed, which is originated from the NPB, indicating that NPB shows a poor

electron-blocking ability. Therefore, only low efficiencies (i.e., the maximum forward-viewing CE and PE are 9.6 cd/A and 5.2 lm/W, respectively) and unstable colors are obtained.

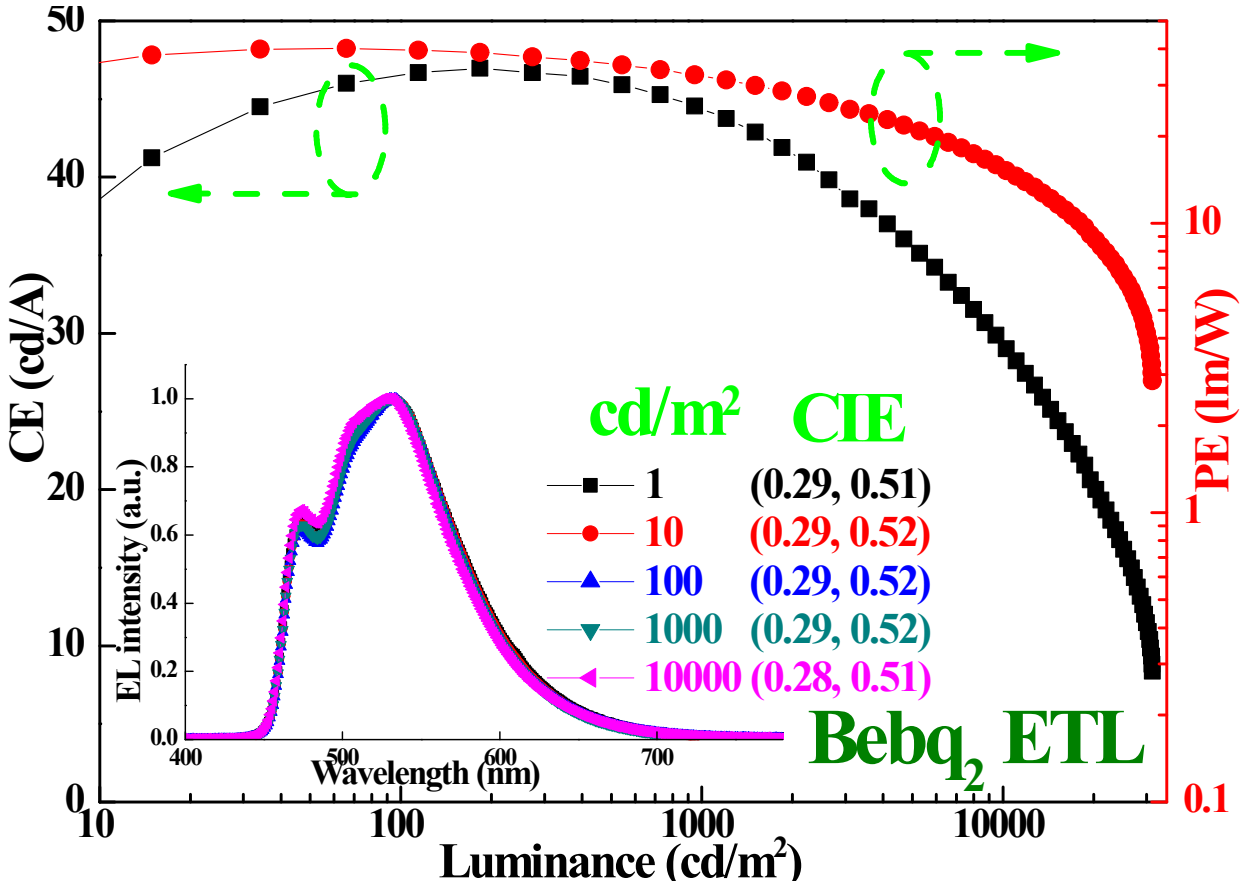

Figure S4. Forward-viewing CE and PE in dependence of luminance for the device using $Bebq_2$ ETL. Inset: Normalized EL spectra of the device using $Bebq_2$ ETL. The configuration is ITO/ MeO-TPD: F4-TCNQ (100 nm, 4%)/ TAPC (20 nm)/ 26DCzPPy: FIrpic: $Ir(dmppy)_2(dpp)$ (11 nm, 1: 22.5%: 1.1%)/ $Bebq_2$ (50 nm)/ LiF (1 nm)/ Al (200 nm). Compared with TmPyPB, $Bebq_2$ exhibits lower T_1 and poorer hole-blocking ability,[3] the $Bebq_2$ based device shows poor performance. At 1000 cd/m^2, the forward-viewing CE and PE are 44.2 cd/A and 32.2 lm/W, respectively.

Besides, the device exhibits unstable colors.

References

1 X. Wang, S. Zhang, Z. Liu, S. Yue, Z. Zhang, Y. Chen, G. Xie, Q. Xue, Y. Zhao, S. Liu, *J. Lumin.* 2013, **137**, 59.

2 Q. Wang, C. Ho, Y. Zhao, D. Ma, W. Wong, L. Wang, *Org. Electron.* 2010, **11**, 238.

3 T. Tsuboi, *J. Non-Cryst. Solids* 2010, **356**, 1919.