High-efficiency and low-driving voltage solution-processed orange-red OLEDs based on dibenzo[a,c]phenazine-based TADF emitters

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[Introduction] Thermally activated delayed fluorescent (TADF) emitters based on purely organic elements have attracted much attention for the superior ability to achieve 100% internal quantum efficiency in organic light-emitting devices (OLEDs). Among visible color region, the development of orange-red TADF OLEDs is far behind blue and green TADF OLEDs, especially in solution-processed devices[1)]. In this work, we present novel orange-red TADF emitters based on dibenzo[a,c]phenazine (DBP) named **2DMAC-DBP-2tBuCz** and **2SPAC-DBP-2tBuCz**. Solution-processed device of **2SPAC-DBP-2tBuCz** exhibited a record-high EQE of 23.7% with an extremely low turn-on voltage at 2.3V.

[Experiments] Chemical structures of **2DMAC-DBP-2tBuCz** and **2SPAC-DBP-2tBuCz** are shown in Figure 1. Both emitters were prepared via a nucleophilic aromatic substitution followed by a Buchwald-Hartwig amination reaction, and characterized by NMR, mass spectrometry, and elemental analysis. The photoluminescence quantum yields (PLQY) of **2DMAC-DBP-2tBuCz** and **2SPAC-DBP-2tBuCz** in films with a series of doping concentrations were measured. Solution-processed OLEDs with a structure of [ITO(130nm)/ PEDOT:PSS(30nm)/ Poly-TPD/PVK(20nm)/ 20%Emitter :Co-Host(30nm)/ B4PYPPM(50nm)/LiF(0.5nm)/Al (100 nm)] were prepared and the performances were tested. The co-host is composed of 26DCzPPY and TCTA.

[Results and discussion] mCPCN-doped films of **2DMAC-DBP-2tBuCz** and **2SPAC-DBP-2tBuCz** exhibited orange-red emission around 580 nm and high PLQY of 88% and 94%, respectively. From the onsets of fluorescence and phosphorescence spectra, the ΔE_{ST} are calculated to be 0.04 eV for **2DMAC-DBP-2tBuCz** and 0.03 eV for **2SPAC-DBP-2tBuCz**, respectively. By using a polymer HTL and co-host system, **2SPAC-DBP-2tBuCz**-based OLEDs achieves an EQE of 23.7% with a low V_{on} of 2.3V, which is among the best performance in solution-processed orange-red TADF OLEDs. We will discuss the influence of molecular structure on photophysical properties and device performances.

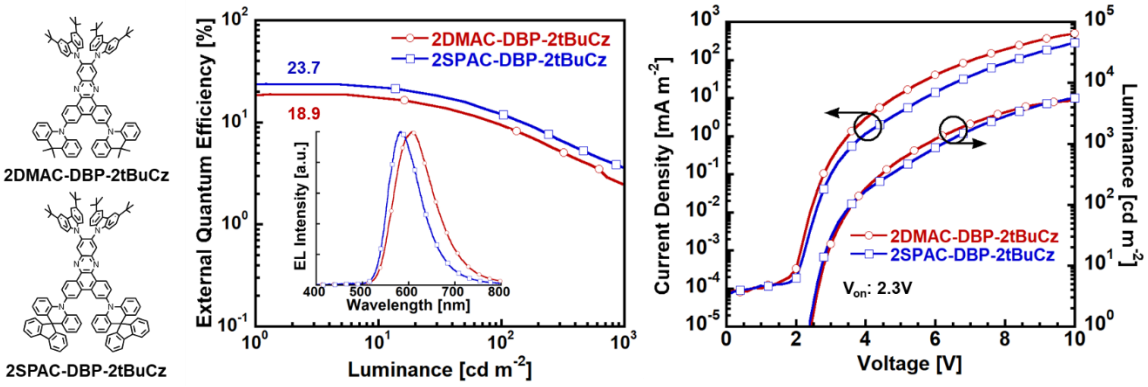

Fig 1. Chemical structures of 2DMAC-BP-2tBuCz and 2SPAC-BP-2tBuCz and OLED performances.

[References] 1) W. Zeng, T. Zhou, W. Ning, C. Zhong, J. He, S. Gong, G. Xie, C. Yang, *Adv. Mater* **2019,** 31, 1901404.