Trečios kartos organinių šviestukų veikimo parametrų gerinimas įvedant smulkius emiterio struktūros pakeitimus

Substantial TADF OLED performance improvement by simple emitter structure modification

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Thermally activated delayed fluorescence (TADF) compounds have received great attention for their potential to utilize both singlet and triplet excitons in OLEDs formed during charge carrier injection. [1] Rational material design has enabled TADF OLED devices with up to 100% internal quantum efficiencies mainly due to an efficient reverse intersystem crossing (RISC) that allows conversion of dark triplet excitons into emissive singlet ones. [2] While RISC is usually a slow process, TADF-OLEDs suffer from early efficiency roll-off associated with high long-lived triplet exciton population. To circumvent this issue, TADF emitters with large rISC rate facilitating triplet up-conversion are required. [3]

In this work, by introducing a subtle modification to two carbazolyls containing isophthalonitrile-based TADF emitter, we demonstrate a huge impact on its TADF properties. Explicitly, the increased dihedral angle between D and A units is found to significantly reduce ΔE_{ST}, resulting in substantial boost of RISC rate and shortening of TADF lifetime. We fabricated vacuum and solution processed TADF-OLEDs employing 7 wt% isophthalonitrile-doped emissive layer. Devices exhibited blue/sky-blue emission with external quantum efficiency (EQE) of up to 23.8% and high brightness (up to 95000 cd/m^2). Most importantly, due to the large rISC rates, TADF OLEDs demonstrated extremely low efficiency roll-off. OLEDs based on modified compound (**DMeCzIPN**) exhibited 2-fold performance improvement in terms of EQE. Figure 1 shows chemical structures of unmodified **DCzIPN** and modified **DMeCzIPN** compounds, whereas Figure 2 shows the EQE characteristics of the fabricated devices together with their electroluminescence (EL) spectra.

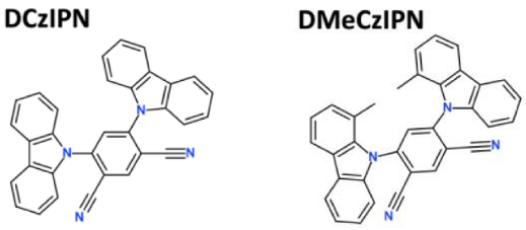

Fig. 1. Chemical structures of the isophthalonitrile-based TADF compounds

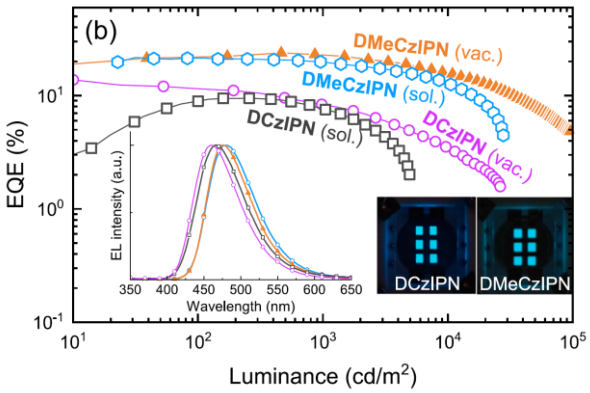

Fig. 2. EQE characteristics of the TADF-OLEDs fabricated employing isophthalonitrile-based emitters. Inset displays EL spectra along with the pictures of these devices

We were also able to fabricate stability and lifetime optimized OLED devices employing these isophthalonitrile-based emitters. Devices exhibited LT_{90} of 2 hours at high brightness of 1000 cd/m^2 which extrapolates to LT_{50} of around 200 hours at the practical brightness of 100 cd/m^2.

The obtained results demonstrate the potential of isophthalonitrile-based TADF emitters for high-brightness OLED applications.

Keywords: OLED, TADF, organiniai šviestukai, organic light-emitting diodes.

References

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