Invited Speaker

Operation mechanism of Hyperfluorescence OLEDs

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Abstract:

Through the extensive R&D of organic light-emitting diodes (OLEDs) for more than 30 years, plenty of well-elaborated novel organic optoelectronic materials and device architectures have been extensively developed, resulted in the unique commercial utilization of OLEDs for cutting-edge smartphones, large-area TVs, and further new future display applications by taking advantage of light-weight and flexibility. From the aspect of materials science, the creation of novel light-emitting materials in OLEDs has been the central issue aimed for high electroluminescence quantum efficiency (EQE). Starting from the development of conventional fluorescence materials (**1st generation**) during 1990-2000th, the room-temperature phosphorescence (2000-) (**2nd generation**) and thermally activated delayed fluorescence (TADF) (2012-) (**3rd generation**) continuously pioneered the novel possibilities of organic emitters, resulted in not only high-performance OLEDs but also enriched organic photochemistry. In recent days, there have been a wide variety of studies on TADF-OLEDs because of the unlimited possibilities of TADF molecular design. Further, hyperfluorescence (HP)-OLEDs have been developed since they can realize the compatibility of high efficiency and narrow spectral width, which is ideal for practical display applications. Here we report our recent cutting-edge HP-OLEDs demonstrating high OLED performance by optimizing host, TADF, and terminal emitter (TE) molecules[1-3]. In particular, we focus on the blue-emission, which is capable of showing narrow FWHM and high EL quantum yield. Blue HP-OLEDs based on two new TEs are fabricated, resulting in high external quantum efficiency (EQE) of over 20%, high color purity, and high brightness. By analyzing the transient PL characteristics of the HP-OLEDs, we found that the presence of efficient FRET between TADF-assistant dopant (TADF-AD) and TE molecules. Further, transient EL analysis confirmed that a smaller E_{HOMO} difference between TADF-AD and TE efficiently helps to decrease hole trapping inside the emitting layer, hence resulting in a lower efficiency rolloff and a longer operational device lifetime. This report provides a designing principle for a TADF and TE in HP-OLEDs with well-matched energy levels, leading to efficient FRET and no significant carrier trapping.

References:

[1] C-Y. Chan et al., *Nat. Photonics*, **15**, 203 – 207 (2021)

[2] Y-T. Lee et al., *Advanced Electronic Materials*, **7**, 4, 2001090 (2021)

[3] M. Tanaka et al., *ACS Applied Materials & Interfaces*, **12**, 45, 50668 – 50674 (2020)