Design challenges of donor-acceptor and multiresonant thermally activated delayed fluorescence emitters for vacuum-deposited and solution-processed organic light-emitting diodes

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The first-generation OLEDs were based on organic fluorescent emitters. Their efficiency was intrinsically capped at 25% due to only being able to recruit singlet excitons. The second generation OLEDs have employed organometallic phosphorescent emitters, which harvest both singlet and triplet excitons for emission due to the enhanced intersystem crossing mediated by the heavy metals such as iridium(III) and platinum(II). These metal complexes possess very desirable optoelectronic properties and lead to very efficient OLED devices. However, the scarcity of these metals, their high cost and their toxicity are important detracting features. The third generation OLEDs are based on small organic compounds that emit via a thermally activated delayed fluorescence (TADF) mechanism. As with phosphorescent emitters, OLEDs using these emitters can recruit 100% of the excitons. In Donor-Acceptor TADF compounds, the emission is broad to the charge transfer character of the emissive singlet state. Multiresonant TADF (MR-TADF) emitters on the other hand show significantly narrower emission. In this presentation, I will discuss our recent efforts towards the design of TADF and MR-TADF emitters that are targeted for both vacuum-deposited and solution-processed OLEDs, highlighting the unique challenges in each.