

Curcuminoid borondifluoride for preparation of efficient TADF near infrared OLEDs and organic solid-state lasers

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Thermally-activated delayed fluorescent (TADF) emitters have been successfully used in organic light-emitting diodes (OLEDs) with up to 100% internal quantum efficiencies and are now considered as the third generation of OLED materials.¹ However, the developed dyes, to date, are pretty much limited to visible wavelengths (going from blue to the red part of the spectrum). In this context, it remains challenging to obtain Near InfraRed (NIR) dyes² with high photoluminescence quantum yields and electroluminescence external quantum efficiency (EQE).

In this context, I will report on the fabrication of NIR TADF OLEDs with a maximum EQE of nearly 10%. The devices used a solution-processable heavy-metal-free donor-acceptor-donor borondifluoride curcuminoid derivative^{3,4,5} as NIR emitter. Photophysical study and density function theory were used to characterize the dye. This compound shows large ground state and excited state dipole moments. Furthermore, a rather high photoluminescence quantum yield (up to 69%) in solid matrices with an emission maximum wavelength typically in the range between 720 and 750 nm was obtained. Time-resolved photophysical measurements show that the TADF mechanism of this NIR emitter is due to a reverse intersystem crossing from triplet charge transfer (CT) to singlet CT excited states. In addition, the TADF emission wavelength and efficiency are found to strongly depend on the dye concentration in the emissive layer due to the large dipole moments of this compound. In the last part of this talk, I will demonstrate that this new TADF materials exhibits amplified spontaneous emission in the NIR region, suggesting the possibility to harvest triplet excitons for stimulated emission.

References

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