Sub-microsecond Delayed Fluorescence Enabled by Molecular Engineering of Triazatruxene Emitters for High-Performance OLEDs with Suppressed Efficiency Roll-off

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Purely organic thermally activated delayed fluorescence organic light emitting diodes usually suffer from strong efficiency roll-off, defined as the decrease in external quantum efficiency at high luminance. One of the primary causes of this roll-off is the long excited-state lifetime and slow reverse intersystem crossing process of emitters. To voercome this issues we have designed a series of donor-acceptor-type TADF emitters by gradually increasing the acceptor substitution around a central triazatruxene donor. Increasing acceptor substitution resulted higher percentage of locally excited character in the triplet state, resulted in a progressively shorter excited state lifetime, faster rISC rate, and better spin-orbit coupling. Doped film of the emitters displayed sub-microsecond time scale delayed fluorescence (DF) and showed the shortest lifetime and a fastest k_{rISC} of 9.61 x 10^5 s^{-1}. The EQEs of OLEDs were achieved in range of 20-29% with the lowest efficiency roll-off and maintains an EQE of 23.0% at 1000 cd/m^2. Our findings reveal that both a faster rISC and a comparatively smaller DF contribution collectively help in getting minimum efficiency roll-off.

References:

[1] G. P. Nanda, R. Suraksha, P. Rajamalli, *ACS Materials Au*, **2024**, *4*, 604.

[2] G. P. Nanda, R. Suraksha, B. Sk, T. Viswanathan, P. Rajamalli, *J. Mater. Chem. C,* **2025,** *13*, 14953.

[4] U. Deori, V. Kumar, P. Gandeepan, P. Rajamalli, *ACS Appl. Mater. Interfaces,* **2026**, *18*, 8559.

[5] N. Yadav, A. M. Tedy, M. A. Shana Shirin, T. Viswanathan, A. K. Manna and P. Rajamalli, *ACS Appl. Mater. Interfaces*, **2026**, *18*, 2176.

[6] T. Viswanathan, S. Maity, U. Deori, R. Nikhitha, Nandish SH, S. Pal, N. Yadav, A. Mondal, P. Rajamalli, *Small*, **2026**, doi.org/10.1002/smll.73625.