Thermally Activated Delayed Fluorescence (TADF) Emitters for Organic Light Emitting Diodes (OLEDs)

Abhishek Kumar Gupta
University of St Andrews, Scotland

Developing purely organic emissive materials to achieve highly efficient organic light emitting diodes (OLEDs) with the desired color range remains a significant challenge. Efficient OLEDs with desired color emission require precise control over the molecular orbital and excited-state energies of the organic emitter, which can be realized through rational design of the molecular structure–property relationship. To address this challenge, my talk will mainly focus on the strategies to control the highly occupied and lowest unoccupied molecular orbitals (HOMO and LUMO), and to enable harvesting of both singlet and triplet excitons in organic emitters. These emitters are typically identify as thermally activated delayed fluorescence (TADF) materials. Furthermore, I will discuss multiple approaches to harvest dark triplet excited states in organic molecules and explore their potential in OLEDs as well as in other advanced optoelectronic applications.[1-5]

References

1. Highly efficient organic light-emitting diodes from delayed fluorescence, *Nature*, 2012, **492**, 234–238, DOI:10.1038/nature11687.
2. The golden age of thermally activated delayed fluorescence design and exploitation. Chem. Rev. 2024, **124,** 13736− 14110. https://doi.org/10.1021/jacs.5c02096.
3. Highly efficient green and red narrowband emissive organic light-emitting diodes employing multi-resonant thermally activated delayed fluorescence emitters. Angew. Chem. Int. Ed. 2022, **61**, e202213697. https://doi.org/10.26434/chemrxiv-2022-1j3np-v2.
4. Deep-red to NIR solution-processed OLEDs of donor-decorated quinoxaline-based TADF aggregates. *J. Mater. Chem. C*, 2025, **13**, 6123-6135. https://doi.org/10.1039/D4TC05238B.
5. Thermally activated delayed fluorescence emitters with intramolecular proton transfer for high luminance solution-processed organic light-emitting diodes, ACS Appl. Mater. Interfaces 2021, **13**, 13, 15459–15474. https://doi.org/10.1021/acsami.1c02248