PÔSTER - RESUMO - MATERIAIS E BIOMATERIAIS

DELAYED FLUORESCENCE IN THE CP6 COPOLYMER

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The development of organic light-emitting materials has emerged as a promising alternative to inorganic semiconductors employed in light-emitting devices (LEDs), particularly due to their potential for low-cost fabrication, structural versatility, and tunable photophysical properties. In organic emitters, however, the formation of triplet excited states imposes a fundamental limitation on the internal quantum efficiency, since radiative decay from triplet states is spin-forbidden in purely fluorescent systems. Consequently, strategies that enable the harvesting of triplet excitons have become central to the development of high-efficiency organic light-emitting devices [1], [2]. In this context, a detailed understanding of radiative and non-radiative processes, energy transfer mechanisms, and excited-state dynamics is essential for optimizing material performance and device efficiency. This work presents a photophysical study of CP6, a copolymer containing donor and acceptor segments designed to promote thermally activated delayed fluorescence (TADF), a mechanism that enables the upconversion of triplet excitons into emissive singlet states, thereby allowing near-unity internal quantum efficiency

without the use of heavy metals. Optical characterization in solution and in thin films revealed emission bands attributed to fluorene and to the PTZ–DBTO2 chromophore. Time-resolved photoluminescence measurements enabled the identification of prompt fluorescence, delayed fluorescence, and phosphorescence, confirming the occurrence of TADF in both degassed solution and thin-film form. Spectral analysis allowed the estimation of the singlet charge-transfer state energy at 2.41 eV and indicated a small energetic gap between the locally excited singlet and triplet states, a key feature of efficient TADF materials. Low-temperature measurements further corroborated the thermally activated nature of the process. Additionally, computational simulations were employed to analyze the molecular orbital distribution and energy levels of CP6, confirming the donor character of PTZ and the acceptor character of DBTO2, as well as the formation of an intramolecular charge-transfer state. Taken together, the experimental and theoretical results demonstrate the potential of the investigated material for application in organic LED devices based on metal-free TADF emitters.

References:

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[2] R. S. Nobuyasu et al., “Rational Design of TADF Polymers Using a Donor-Acceptor Monomer with Enhanced TADF Efficiency Induced by the Energy Alignment of Charge Transfer and Local Triplet Excited States”, Adv. Opt. Mater., vol. 4, no 4, p. 597–607, abr. 2016, doi: 10.1002/adom.201500689.

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Palavras-chave: copolymer; tadf; time-resolved gated luminescence.