

DONOR-ACCEPTOR ORGANIC RADICALS: SYNTHESIS AND PHOTOPHYSICAL CHARACTERISTICS FOR OPTOELECTRONICS

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Stable organic radicals have attracted increasing attention as a new class of luminescent materials due to their unique combination of electronic and magnetic properties, along with their spin-allowed doublet-doublet ($D1 \rightarrow D0$) transitions [1]. These characteristics open up diverse applications, including organic light-emitting diodes (OLEDs), bioimaging, organic magnets, spintronics, fluorescent probes, chiral optical materials, magnetoluminescence, X-ray imaging, and others [2, 3]. Unlike traditional closed-shell luminophores, the emission from organic radicals originates from an unpaired electron residing in a doublet excited state ($D1$). The radiative transition to the ground doublet state ($D0$) is spin-allowed, which contrasts with the spin-forbidden nature of triplet emission in conventional fluorophores. As a result, radical emitters are not constrained by the 25% singlet exciton limit dictated by spin statistics, making them promising candidates for high-efficiency optoelectronic applications [3]. Moreover, since the emission occurs directly from $D1$ to $D0$ without intersystem crossing, heavy atom effects and related non-radiative losses are minimized, which is another advantage over traditional singlet-based fluorescence mechanisms [1, 4]. Most luminescent radicals possess a donor-acceptor ($D-A\cdot$) structure, in which an electron-withdrawing radical center is covalently linked to an electron-rich donor group. This configuration facilitates intramolecular charge transfer during the $D1 \rightarrow D0$ transition, enhancing radiative decay and leading to high photoluminescence quantum yields [3, 5]. In this work, the synthesis and characterization of a series of such organic radicals will be presented. Their photophysical behavior will be explored in detail, highlighting their potential as efficient luminophores for emerging optoelectronic technologies.

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