CARBAZOLE-BENZOCARBAZOLE FRAGMENTS HAVING DERIVATIVES AS VERY EFFICIENT HOST MATERIAL FOR TADF BASED OLEDs

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Organic light-emitting diodes (OLEDs) have emerged as a transformative technology in modern display and lighting applications, spanning smartphones, televisions, tablets, and automotive systems. Multiple functional and interfacial layers have been incorporated to enhance the efficiency of OLEDs. While numerous emitter materials for thermally activated delayed fluorescence (TADF) OLEDs have been developed and documented, comparatively little attention has been directed toward the systematic design and advancement of suitable host materials. To address this, we designed and synthesized a carbazole–benzocarbazole-based derivative, DM323, as a potential host material for green TADF OLEDs. DM323 exhibits exceptional thermal resilience, with a decomposition temperature surpassing 400 °C and a glass transition temperature (Tg) of approximately 194 °C, highlighting its suitability for high-temperature processing and stable device operation. In addition to its thermal robustness, the compound possesses a wide optical bandgap of 3.6 eV and exhibits rapid exciton decay dynamics, both of which are critical attributes for efficient management and utilization of excitons in thermally activated delayed fluorescence (TADF) systems. Leveraging these advantageous properties, DM323 was employed as the host material in green TADF OLED devices. The resulting devices demonstrated remarkable electroluminescent performance, delivering a maximum external quantum efficiency (EQE) of 10.4%, a current efficiency (CE) of 20.6 cd/A, and a power efficiency (PE) of 12.7 lm/W, all achieved at relatively low driving voltages. These results underscore the effectiveness of DM323 as a high-performance host, combining excellent thermal stability, favorable electronic characteristics, and efficient exciton management to enhance overall device efficiency and operational stability. These findings underscore the potential of carbazole–benzocarbazole frameworks as versatile host platforms, combining straightforward synthesis, superior thermal stability, and excellent optoelectronic properties. Overall, DM323 emerges as a strong candidate for the next generation of cost-effective and high-performance OLED display technologies.

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