HOST-EMITTER ENGINEERING FOR WHITE OLEDS BASED ON ORANGE TADF AND BLUE MR-TADF

Melika Ghasemi[1], Joseph Cameron[2], Dmytro Volyniuk[1], Peter J. Skabara[2], Juozas V. Gražulevičius[1], Gjergji Sini[3]

[1]Lithuania, Kaunas, Kaunas University of Technology, Department of Polymer Chemistry and Technology, K. Baršausko St. 59, LT-51423

[2]United Kingdom, Glasgow, University of Glasgow, School of Chemistry, University Avenue, G12 8QQ

[3]France, CY Paris Cergy Université, Laboratoire de Physicochimie des Polymères et des Interfaces

melika.ghasemi@ktu.edu

Since the first demonstration of organic light-emitting diodes (OLEDs) in 1987, molecular design has played a central role in advancing the performance of both host and emitter materials [1]. In particular, thermally activated delayed fluorescence (TADF) materials with donor–acceptor architectures have attracted significant attention due to their ability to harvest triplet excitons efficiently via reverse intersystem crossing [2, 3]. Recently, the development of white OLEDs (WOLEDs) based entirely on organic materials has become a major research focus. One effective strategy to achieve white emission is the controlled combination of blue and orange emitters in an appropriate ratio, yielding Commission Internationale de l'Éclairage (CIE) coordinates close to (0.33, 0.33) [4, 5].

In this work, we report a newly synthesized phenothiazine-based compound exhibiting strong orange emission, a high photoluminescence quantum yield, a small singlet–triplet energy gap, and balanced bipolar charge transport. These properties make the material a highly suitable orange TADF emitter. In addition, we present the characterization of a novel carbazole–triazine derivative that functions as an ultrafast green TADF material, featuring an average delayed fluorescence lifetime of 101 ns, which enables rapid triplet exciton utilization. The compound also demonstrates excellent thermal stability, high triplet energy, and balanced hole and electron transport, making it a promising host material for WOLED applications.

By combining this host with the orange TADF emitter and a multiresonance blue emitter, efficient white electroluminescence was achieved. The resulting WOLEDs exhibited external quantum efficiencies in the range of 11–20% and CIE coordinates of (0.35, 0.31), which are close to ideal white light. These results highlight the effectiveness of rational molecular design in achieving efficient and color-balanced WOLEDs.

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