BENZOPHENONE-BASED TWISTED DONOR-ACCEPTOR-DONOR DERIVATIVES AS BLUE EMITTERS FOR HIGHLY EFFICIENT FLUORESCENT OLEDS

Dovydas Blazevicius[1], Iram Siddiqui[2], Prakalp Gautam[2], Gintare Krucaite[1], Daiva Tavgeniene[1], Mangey Ram Nagar[2], Krishan Kumar[3], Subrata Banik[4], JwoHuei Jou[2], Saulius Grigalevicius[1]

[1]Department of Polymer Chemistry and Technology, Kaunas University of Technology, Lithuania
[2]Department of Materials Science and Engineering, National Tsing Hua University, Taiwan
[3]School of Chemical Sciences, Indian Institute Of Technology-Mandi, Kamand 175005, Himachal Pradesh, India
[4]Department of Chemistry, School of Chemical and Biotechnology, SASTRA Deemed University, Thanjavur 613401, Tamil Nadu, India
dovydas.blazevicius@ktu.lt

Organic light-emitting diodes (OLEDs) technology has outperformed other technologies in recent decades [1]. OLEDs are the ultimate technology for display and are stepping rapidly into lighting. At present, there is an intensive need for high-performance deep-blue emitters in full-color display and solid-state lighting . However, as the emission peaks shift towards the deep-blue region, the nonradiative transition rate of metal d-orbitals tends to increase, making it difficult to achieve a high efficiency altogether [2]. To solve the problem, small-molecules fluorescent materials have re-gained attention due to their high color purity and low cost. The synthesis of bicarbazole-based host materials was carried out by the three-step synthetic route as shown in Figure 1. Herein, we introduce a series of donor-acceptor-donor (D-A-D) twisted derivatives based on carbazole-benzophenone moieties.

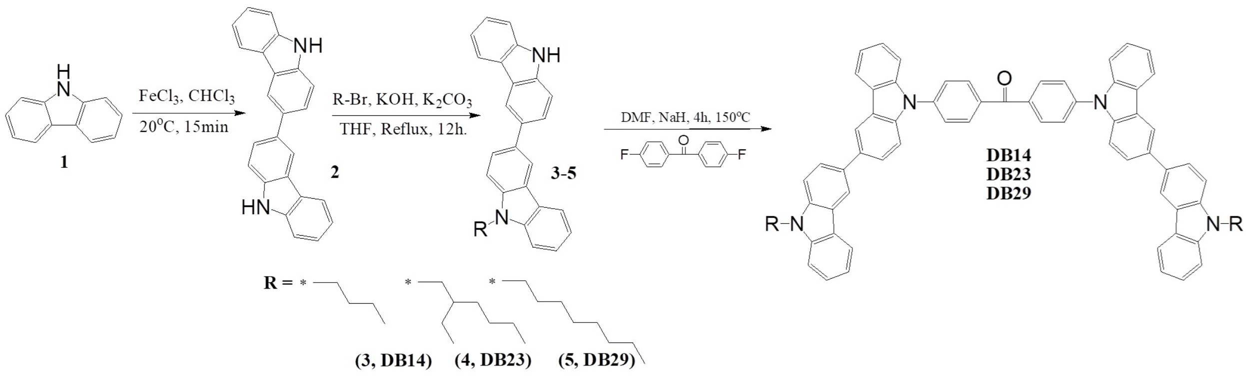

Fig. 1. Synthetic pathway of bicarbazole-based materials.

This work was dedicated to development of a group of twisted donor-acceptor-donor (D-A-D) derivatives incorporating bicarbazole as electron donor and benzophenone as electron acceptor for potential use as blue emitters in OLEDs. The derivatives were synthesized in a reaction of 4,4′-difluorobenzophenone with various 9-alkyl-9′H-3,3′-bicarbazoles. The materials, namely, DB14, DB23, and DB29, were designed with different alkyl side chains to enhance their solubility and film-forming properties of layers formed using the spin-coating from solution method. The new materials demonstrate high thermal stabilities with decomposition temperatures >383 °C, glass transition temperatures in the range of 95–145 °C, high blue photoluminescence quantum yields of over 52%, and short decay times, which range in nanoseconds. Due to their characteristics, the derivatives were used as blue emitters in OLED devices. Some of the OLEDs incorporating the DB23 emitter demonstrated a high external quantum efficiency (EQEmax) of 5.3%, which is very similar to the theoretical limit of the first-generetion devices.

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[2] J.H. Lee, C.H. Chen, P.H. Lee, H.Y. Lin, M.K. Leung, T.L. Chiu, C.F. Lin. Blue Organic Light-Emitting Diodes: Current Status, Challenges, and Future Outlook. Journal of Materials Chemistry C 7, 5874–5888 (2019)