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# Characterization of Carbazole-Based Host Material for Highly Efficient Thermally Activated Delayed Fluorescence Emitter

**Authors :** Malek Mahmoudi, Jonas Keruckas, Dmytro Volyniuk, Jurate Simokaitiene, Juozas V. Grazulevicius

**Abstract :** Host materials have been discovered as one of the most appealing methods for harvesting triplet states in organic materials for application in organic light-emitting diodes (OLEDs). The ideal host-guest system for emission in thermally delayed fluorescence OLEDs with 20% guest concentration for efficient energy transfer has been demonstrated in the present investigation. In this work, 3,3'-bis[9-(4-fluorophenyl) carbazole] (bFPC) has been used as the host, which induces balanced charge carrier transport for high-efficiency OLEDs.For providing a complete characterization of the synthesized compound, photophysical, photoelectrical, charge-transporting, and electrochemical properties of the compound have been examined. Excited-state lifetimes and singlet-triplet energy gaps were measured for characterization of photophysical properties, while thermogravimetric analysis, as well as differential scanning calorimetry measurements, were performed for probing of electrochemical and thermal properties of the compound. The electrochemical properties of this compound were investigated by cyclic voltammetry (CV) method, and ionization potential (IPCV) value of 5.68 eV was observed. UV–Vis absorption and photoluminescence spectrum of a solution of the compound in toluene (10-5 M) showed maxima at 302 and 405 nm, respectively. Photoelectron emission spectrometry was used for the characterization of charge-injection properties of the studied compound in solid. The ionization potential of this material was found to be 5.78 eV, and time-of-flight measurement was used for testing charge-transporting properties and hole mobility estimated using this technique in a vacuum-deposited layer reached 4×10-4 cm2 V-1s-1. Since the compound with high charge mobilities was tested as a host in an organic light-emitting diode. The device was fabricated by successive deposition onto a pre-cleaned indium tin oxide (ITO) coated glass substrate under a vacuum of 10-6 Torr and consisting of an indium-tin-oxide anode, hole injection and transporting layer(MoO3, NPB), emitting layer with bFPC as a host and 4CzIPN (2,4,5,6-tetra(9-carbazolyl)isophthalonitrile) which is a new highly efficient green thermally activated delayed fluorescence (TADF) material as an emitter, an electron transporting layer(TPBi) and lithium fluoride layer topped with aluminum layer as a cathode exhibited the highest maximum current efficiency and power efficiency of 33.9 cd/A and 23.5 lm/W, respectively and the electroluminescence spectrum showed only a peak at 512nm. Furthermore, the new bicarbazole-based compound was tested as a host in thermally activated delayed fluorescence organic light-emitting diodes are reaching luminance of 25300 cd m-2 and external quantum efficiency of 10.1%. Interestingly, the turn-on voltage was low enough (3.8 V), and such a device can be used for highly efficient light sources.

**Keywords :** thermally-activated delayed fluorescence, host material, ionization energy, charge mobility, electroluminescence
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