

THERMALLY ACTIVATED DELAYED FLUORESCENCE OF MULTI-CARBAZOLE DERIVATIVES WITH DIFFERENT ACCEPTOR MOIETIES

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Thanks to the molecular design of thermally activated delayed fluorescence (TADF) compounds, their lowest excited singlet and triplet states lie very close energetically since charge donating and accepting moieties are spatially separated. This features of these compounds can lead to the thermally activated upconversion from the latter to the former state through reverse intersystem crossing which is actually the inverse transition processes of Phosphorescence compounds [1]. In our previous work, we developed various asymmetric multi-carbazole-based emitters by utilizing two different types of electron-withdrawing moieties which helped to tune their TADF properties and to achieve efficient blue emission. The compounds contained benzonitrile as the general accepting unit and the different additional acceptor moieties. [2] With this fundamental concern, we designed a series of highly efficient blue TADF emitters based on 3,6-di-tert-butylcarbazole as donors and two electron acceptors. Unlike the previous work which compounds consisted of benzonitrile as the general electron-withdrawing moieties, in this work general electron acceptor for all synthesized compounds was trifluoromethyl (CF₃) which is strong electron-withdrawing group and the difference of the compounds and aim of the work mostly were related to the variety of additional acceptor moiety attached through para substitution. The temperatures of thermal transitions of synthesized materials were measured by thermogravimetric analysis (TGA) and differential scanning calorimetry. During the TGA experiments compounds exhibited complete weight loss indicating sublimation. Their temperatures of the onsets of weight loss ranged from 433 to 462 °C. UV-VIS absorption and photoluminescence spectra of five compounds in both dilute solutions and neat films were recorded and non-structured photoluminescence spectra of compound neat films with peaks at 482, 508, 482, 490 and 480 nm for CN1-5, respectively, were observed. Additionally, Photoelectron emission spectroscopy was used for measuring ionization potentials of the solid-state of compounds in air and showing values in a relatively close range of 5.61–5.72 eV. The best optimized mCBP doped blue OLED exhibited maximum external quantum efficiency of 15.9%, maximum current efficiency of 42.6 cd A⁻¹, maximum power efficiency of 24.1 lm W⁻¹ along with stable electroluminescence spectrum with an emission peak of 477 nm and the CIE1931 colour coordinate of (0.16, 0.25).

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References

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