In search for efficient blue-light emitters

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Stability of phosphorescent blue emitters is a major challenge for both organic light-emitting diode (OLED) display and OLED-based general lighting technologies. An alternative to phosphorescence emitters is fluorescent blue emitting compounds that can provide high emission efficiency, longer lifetime and pure blue color.

In the present work a series of pyrene-functionalized soluble 9-alkyl-carbazole and 9-alkyl-fluorene compounds have been designed, synthesized and investigated. Aiming for high efficiency emitting compounds, 2,- and 2,7- positions of the carbazole and fluorene moieties were utilized, which, particularly in the case of the pyrenyl di-substituted compounds, resulted in an elongated molecular shape favorable for controlling molecule orientation in layers, and consequently, for enhancing their emission efficiency. Introduction of the different alkyl chains, ethylhexyl and dixehyl, into carbazole and fluorene moieties, respectively, permitted to investigate their effect on the glass-forming and emission properties of the wet-casted films.

To reveal the emission properties of the compounds they were thoroughly studied by measuring fluorescence spectra, fluorescence quantum yields, fluorescence decay times in dilute solutions, polymer (polystyrene) matrixes at different chromophore concentrations and wet-casted neat films. The photophysical properties of the compounds were also assessed by density functional theory. Theoretical analysis of electronic transitions was addressed by emphasizing intramolecular twisting. The advantages of the emission properties of the pyrenyl di-substituted fluorene and carbazole compounds against mono-substituted compounds were rationalized in terms of differently twisted conformers. Intermolecular coupling peculiarities were disclosed by thorough investigations of emission concentration quenching of the compounds in a solid state. The possibility of using the mono- and di-substituted compounds as efficient blue emitters as well as optical gain media for lasing applications was explored.