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dedicated to the memory of Academician A.N. Terenin (1896–1967)

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Memorial section

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Photophysical properties of push-pull molecules for organic electronics

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Organic light-emitting diodes (OLEDs) have attracted increasing interest in both the scientific and commercial fields due to their applications in high-resolution, multicolor displays and solid-state lighting. Extensive studies have demonstrated that D–(π)–A structures are useful for developing high-efficiency emitters, because such push–pull systems usually show strong intramolecular charge-transfer (ICT) emission and their optoelectronic properties can be facilely modulated through tuning the electron donor (D) and/or acceptor (A) strengths. During recent years, pyrazine and quinoxaline derivatives have been intensively studied because as building blocks of π-conjugated compounds for use in multiple optoelectronic and photovoltaic applications .

Pyrazine and quinoxaline themselves are commonly used as an electron-acceptor unit (A) which, being combined with different electron-donor blocks, make up for donor-acceptor type systems. Such push-pull structures are promising materials for different photovoltaics and optoelectronics applications like dye-sensitized solar cells (DSSCs), organic field-effect transistors, and emitting material for OLEDs.

A series of novel D–A and D–π–A push-pull systems based on a pyrazine and quinoxaline acceptor, bearing various electron-donating triphenylamine and carbazole moieties, are compared (Fig.1). A significant difference in electrochemical and photophysical properties was found depending on molecular structure. The compounds have strong solvatochromic properties. The dipole moment in the ground and excited states was estimated. The fluorescence quantum yield in solutions and films of thermal vacuum deposition is measured. The fluorescence and phosphorescence spectra in ethanol and thermovacuum deposited films were studied at a range of 296 – 77 K. Quinoxaline-containing systems exhibit delayed fluorescence (DF) in thermal vacuum deposition films. Despite the low quantum yield of fluorescence in the solid state (less than 10%), organic light-emitting diodes with sufficiently high efficiency (4.2 cd/A) have been fabricated on the basis of this push-pull systems. The best results were obtained for compounds exhibiting DF. The possible channel for increasing the efficiency of OLED can be associated with the "hot excitons" mechanism.

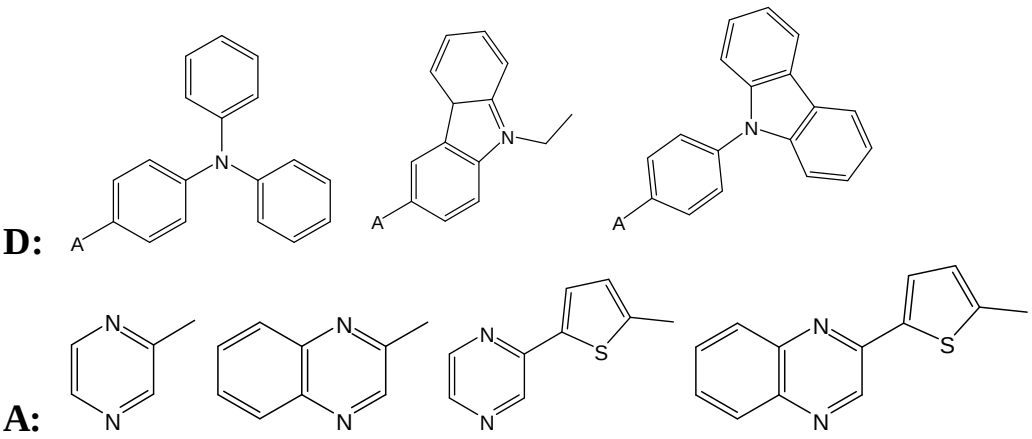

Figure 1. Electron donating and acceptor blocs for pull-push molecules.