Tailoring the photopysical properties of multifunctional molecular systems

Saulius Jursenas, Karolis Kazlauskas

Institute of Applied Research, Vilnius University, Lithuania

e-mail: saulius.jursenas@ff.vu.lt

Search for the new materials with advanced properties is one of the major tasks of the rapidly developing field of organic optoelectronics. Currently much attention is being focused on the multifunctional compounds, i.e. molecules composed of several fragments carrying different functionalities. Multifunctional materials are expected not only to increase the device performance but also to simplify their architectures and fabrication procedures.

On the other hand, multifunctionality unavoidably involves an increase in complexity of their properties giving rise to new collective effects, such as intramolecular charge transfer, intramolecular twisting and isomerization, formation of complexes etc. In a solid state, molecular complexity results in different packing morphology, and thus, in various intermolecular interactions, which considerably affect excitation localization, energy transfer and emission properties. Hence, further development of the multifunction molecular compounds for device applications requires thorough analysis and optimization of the emerged collective properties.

Here we review our recent work on tailoring the photophysical properties of various multifunctional emissive systems. We start with glass-forming carbazole dyad and triad systems displaying excellent electron and hole transport properties, and emphasize variation of their photophysical properties invoked by different linking topology, e.g., by 2-, 2,7- or 3-, 3,6- substitution of the carbazole. Further we discuss properties of highly fluorescent novel compounds containing singly bonded carbazole, fluorene and benzothiadiazole functional units in one core. The sterically hindered donor-acceptor compounds are shown to exhibit well-expressed intramolecular charge-transfer and flattening upon excitation resulting in unusual emission properties. We also introduce more complex fluorescent pyrrolopyrimidine derivatives with various molecular rotors attached for biosensing applications. Additionally, we debate properties of a series of multifunctional iridium-based triplet emitters featuring a different number (from 0 to 28) of hole-transporting carbazole moieties for OLED applications. Finally, a few examples of new fluorescence sensing systems based on the aggregation induced emission color and intensity changes are presented.