Synthesis and characterization of new emitters for blue OLEDs (*Organic Light-Emitting Diodes*)

Organic light-emitting diodes (OLEDs) have attracted much interest of researchers for a few decades. OLED devices have become a much promising alternative to the currently used light sources and all kinds of displays made in the liquid crystal display (LCD) technology and are expected to phase out this technology in the nearest future. The great importance of OLED technology is illustrated by the fact that over the past few years it has successfully been introduced onto the consumer electronics market. High hopes for further development and expansion of this technology are related to the commercialization of flexible and transparent displays that can additionally be produced by means of inexpensive printing techniques. Currently available OLED screens feature better black levels, higher contrast, wider viewing angles, better color reproduction, better image uniformity, lower panel thickness, and comparable or even lower power consumption in comparison to the commonly used LCD screens. These advantages are the result of many years of research, during which three major generations of OLEDs have been developed. Because of the distribution of the excited states population, the first generation of fluorescence diodes was theoretically limited to 25% of electricity to light conversion yield, which was unsatisfactory for commercial applications. The breakthrough came up with the development of more efficient phosphorescent diodes which could theoretically reach an internal quantum yield up to 100%, which resulted in the substitution of fluorescent red and green emitters with phosphorescent ones meeting market expectations. Unfortunately, in contrast to red and green ones, efficient blue phosphorescent emitters have very low lifespan. It is caused by the high energy of emitted blue light and the relatively long duration of light emitting process, which increases the probability of their destruction as a result of a non-radiative dissipation of accumulated energy. According to numerous literature reports, the development of the third-generation emitters based on the phenomenon of thermally activated delayed fluorescence (TADF) also failed to solve this important problem. The current lack of stable and efficient blue OLEDs is the major obstacle inhibiting further commercial development of OLED technology. This issue is both a challenge and an inspiration to carry out research aimed at expanding the knowledge of the functioning of blue OLED emitters, focused on solving this issue.

The aim of the project is the synthesis of the new homoleptic *C,C*-cyclometalated iridium(III) complexes, in which carbene ligands will be equipped with groups supporting the transport of holes and electrons, as well as donor and acceptor moieties. Spectroscopic and photophysical characterization of the compounds obtained, e.g. measurements of excited states lifetimes, emitted wavelength and energy levels of frontier molecular orbitals, as well as quantum yields of photoluminescence and electroluminescence, will enable finding correlations between the structure of ligands and the above-mentioned parameters. Detailed analysis of spectral and thermal properties of the new OLED emitters based on the organometallic core will be carried out. In addition, the project involves the preparation of OLED devices based on the new emitters and characterization of their basic work parameters. On the basis of the obtained experimental data, a relationship between the emitters chemical structure and properties will be determined. Description of the phenomena and the dependencies studied will be a very important contribution to the expansion of the knowledge in the field of OLEDs, and will stimulate other researchers to progress in achieving stable and efficient blue OLEDs. In addition, the gained "know-how" on effective functionalization of iridium(III) complexes will constitute an important added value for the development in the field of OLEDs.