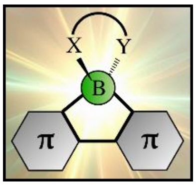


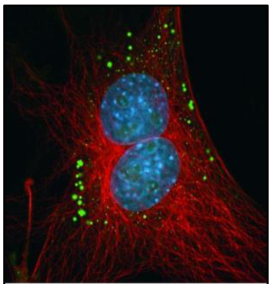
Four-coordinate organoboron complexes with rigid scaffolds as efficient light-emitting materials

Dr Krzysztof Durka


OLED TV displayes

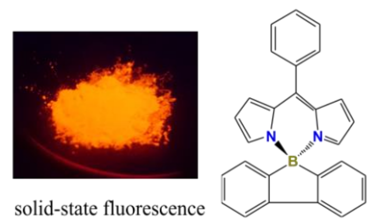
One of the most important current issues in material science is development of highly-efficient light-emitting materials for applications in optoelectronic devices including organic light-emitting diodes (OLEDs), organic field-effect transistors, photovoltaic systems, photoresponsive materials, sensors, and imaging materials for biological systems. For instance, OLED technology is currently widely used in commercial applications such as displays for mobile phones, tablets, smartphones, portable digital media players, car radios and digital cameras. Such portable applications favor the high light output of OLEDs for readability in sunlight and their low power drain. The other applications of OLEDs include long-life and brightness light panels, watches and car lights. The flexible and rollable displays such electronic paper are now of current interest of many companies. The global OLED displays market in 2012 reached c.a. 5 billion dollars (about 100 companies) and it is expected to increase to about 25 billion dollars in 2018. The development and technology transfer of new OLED materials is extremely fast. The another very important group of applications of fluorescent compounds is bio-imaging of tissues. The fluorescence imaging has emerged as one of the most powerful tools for protein labelling and monitoring bioprocesses in real-time and in the natural environment, especially for sensing of analytes in living cells. The Nobel Prize in Chemistry in 2014 was awarded for important developments in these fields.


Mobile phone with curved AMOLED matrix

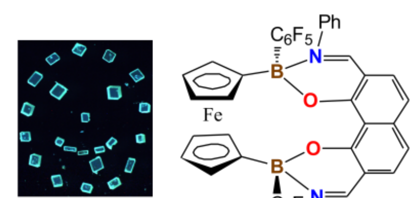

Bovine Pulmonary Endothelial cells imaged using BODIPY dyes (red)

solution fluorescence

The issues related to light-emitting materials can be addressed to inorganic and organometallic complexes. From these groups of compound very promising are four-coordinate organoboron complexes such as diphenylborinic 8-oxyquinolinate. However, the increasing of optical parameters of such materials (quantum yield of emission) as well as chemical and thermal resistance still remains a big challenge towards their practical applications. On the other hand, in our very recent studies we have found that the intervention in the organoboron core by rigidifying its structure can significantly boost their parameters. Therefore we propose to use rigid organoboron scaffolds for the construction of new efficient luminescent materials. The physicochemical parameters can be fine-tuned by the modification of the organoboron core or ligand through variations in the pattern of the substituent. We also propose to apply a latest techniques for the developing of new materials including solvent-free grinding of materials and formation of solid-state mixture of two different compounds (cocrystals). The full physicochemical characterization of obtained compounds by using different methods will give us opportunity to understand their specific behavior and will show us the way for further applications. It should be stressed that all properties of luminescent devices strictly depend on physicochemical properties of a light emitting compound. It is expected that the obtained organoboron systems due to their specific structural properties (rigid molecular structure = intense fluorescence and high quantum efficiency parameter + good thermal stability and chemical resistance) would become a good alternative to currently used materials and can draw an attention of high-technology industry.



solid-state fluorescence



'happy crystals'