

Tytuł projektu
Synteza i badania spektralne wydajnych fluoroforów zawierających bor
Project title
The synthesis and spectral measurements of highly fluorescent boron fluorophores
Dyscyplina /Area of science
Nauki chemiczne
PROJECT DESCRIPTION
Project goals • The synthesis of the precursors of fluorophores and their conversion of compounds carrying boron atom • The measurements of the photophysical properties for obtained compounds. • Modification of the fluorophores with variable substituents and groups to tune their properties. • Tests of the synthesized compounds towards sensing based on photoisomerization and intermolecular interactions. • Studies of the two-photon absorption for selected fluorophores characterized by high brightness. Outline The fluorescence is one of the most often techniques used in microscopy and molecular sensing due to its high sensitivity and relatively low concentration of the probe. However, some commercially available fluorophores are characterized by small Stokes shift that result in lowering of their fluorescence quantum yield. Thus, it is desirable to design and synthesize new compounds that would be tunable in the light of their properties and applications in several fields of science. The main topic of the project is the development of boron-carrying highly fluorescent compounds. Some of those compounds were previously successfully used in radical polymerization[1], as a spectral probes for polarity of the environment[2] and as a two-photon absorbing compounds.[3] These could be used in fluorescent microscopy (bioimaging). There are two ways to overcome mentioned drawback related to small Stokes shift. One is the functionalize the organic compounds in order to obtain charge-transfer molecules with large Stokes shift and the other is to design molecules capable for two-photon absorption preserving high fluorescence quantum yield. The last method allows the large shift of the absorption, but the two-photon absorption cross-section is

mandatory. Independently from the method the synthesis of new compounds should be realized, and their structure confirmed before any tests in advanced applications. The spectral measurements will allow drawing conclusions on the methods of the functionalization (optimization of the structure in the light of substituent, benzannulation, atom replacement and other) of next series of compounds. The PhD project will be guided at Nicolaus Copernicus University and in cooperation with Wrocław University of Science and Technology and University of Nantes, France. The research is supported by National Science Centre (Harmonia project).

Work plan

1. The synthesis of chosen precursors and fluorophores that belong to several series of B-carrying molecules.
2. The structure confirmation and spectral measurements of the synthesized compounds.
3. Extension of the series in the light of a) substituent, b) atom replacement in fluorescent core, c) substitution of the strong electron-acceptor in their structure.
4. Measurements of the photophysical properties and two-photon absorption.

Literature

- 1 B. Jędrzejewska and B. Ośmiałowski, Polym. Bull., 2018, 75, 3267–3281.
- 2 B. Jędrzejewska, A. Grabarz, W. Bartkowiak and B. Ośmiałowski, Spectrochim. Acta A Mol. Biomol. Spectrosc., 2018, 199, 86–95.
- 3 J. Bednarska, R. Zaleśny, M. Wielgus, B. Jędrzejewska, R. Puttreddy, K. Rissanen, W. Bartkowiak, H. Ågren and B. Ośmiałowski, Phys. Chem. Chem. Phys., 2017, 19, 5705–5708.

Required initial knowledge and skills of the PhD candidate

- ➔ Analytical thinking
- ➔ Eager to learn and work hard
- ➔ Understanding of organic synthesis and methods for separation and purification
- ➔ Ability to work in the laboratory (synthesis and basic spectral measurements)

Zgłaszający projekt/ Author of the project

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