Research project objectives

The aim of the proposed project is to synthesize the of 30 novel aza-BODIPY chemicals, test their properties and finally test their activity against bacteria and fungi.

Aza-BODIPY are synthetic chemicals which absorb red light efficiently, which is the reason for their intense blue color. They also have ability fluorescence properties – when illuminated, they emit light with higher wavelength, e.g. when illuminated with blue light, they may emit red light. Moreover, upon illumination they may generate reactive oxygen species. This properties make aza-BODIPYs interesting potential photosensitizers for antimicrobial photodynamic therapy (aPDT). aPDT is a modality of treatment of various infections, including bacterial, fungal or viral infections. In aPDT, non-toxic photosensitizer upon illumination with light generates reactive oxygen species. These reactive radicals and molecules, including singlet oxygen, kill microorganisms. Moreover, fluorescence of the molecules may be the basis for the diagnostic applications. Main task of the proposed project is to establish efficient synthetic procedures of aza-BODIPY and systematical investigation of its properties as photosensitizers.

Research

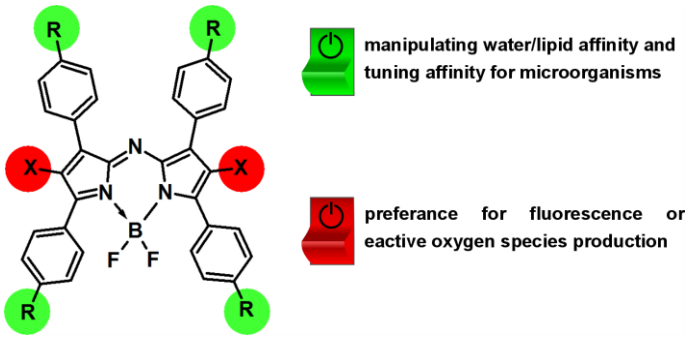

Fig. 1 Aza-BODIPY, possibilities of molecule modifications

Research project will be conducted as follows

- Synthesis of aza-BODIPYs and their precursors. Molecules with expected prevalence of fluorescence or singlet oxygen production may be obtained by introduction of specific substituents (red switch in the **Figure 1**). Similarly, chemicals affinity for water or lipid phase may be manipulated (green switch)

- Characterization of obtained chemicals by means of various techniques

- Assaying how do obtained aza-BODIPYs interact with light: how efficient is fluorescence and reactive oxygen species production

- Establishing whether aza-BODIPY re more attracted into water phase or lipid phase, which is important issue for future drugs

- Testing antimicrobial photodynamic activity of the brominated aza-BODIPYs, using various bacterial and fungal

Reasons for this research

There is general agreement, that bacterial and fungal infections are a growing threat to general health. Methicillin-resistant Staphylococcus aureus (MRSA), carbapenem resistant Klebsiella spp., and other resistant bacteria, including Pseudomonas aeruginosa are of great concern. Antimicrobial photodynamic therapy (aPDT) is seen as one of tools to control bacterial and fungal infections, it uses non-toxic photosensitizer, which upon illumination with light generates reactive oxygen species, which kill microorganisms. Effective phtotosensitizer is a pre-requisite for successful aPDT and aza-BODIPY. Aza-BODIPY fall into criteria of ideal photosensitizer; they have high molar extinction coefficients in the range of 650-800 nm, efficient singlet oxygen generation, good stability.

Therefore, this project aims to investigate new aza-BODIPY as photosensitizers against microorganisms and to rationalize structure-activity relationship.