

ABSTRACT

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Title of Doctoral Thesis

Synthesis and study of properties of aza-analogues of phthalocyanines

Phthalocyanines (Pc) and their azaanalogues azaphthalocyanines (AzaPc) are planar macrocyclic compounds with significant absorption band at 620-720 nm finding application in the areas such as photodynamic therapy, chemical catalysis and solar cells. Photophysical (fluorescence) and photochemical (singlet oxygen production) parameters are important in above mentioned applications. Peripheral substituents of Pc/AzaPc play key role in this case. Alkylsulfanyl and alkyloxy derivatives exerted high fluorescence quantum yields (Φ_F) as well as quantum yields of singlet oxygen (Φ_Δ). On the other hand, alkylamino substitution led to almost zero values of both Φ_F and Φ_Δ . These derivatives have recently found new application as dark quenchers in DNA hybridization probes.

The first part of this thesis demonstrated that intramolecular charge transfer (ICT) is responsible for zero values of quantum yields of alkylamino AzaPc and that the lone electron pair of peripheral nitrogen is a donor for ICT in AzaPc. Absorbing the energy of light, the AzaPc is excited to higher energy state from which the charge separated state is formed very rapidly followed by relaxation into the ground state. This process significantly competes with the other possible relaxation mechanisms, thus Φ_F and Φ_Δ are of zero values. The efficacy of ICT is very high, because only one donor centre is responsible for almost complete quenching of the excited states. ICT can be blocked either sterically (J-dimer formation) or by protonation of donor nitrogen. In both cases Φ_F a Φ_Δ increase of several orders and reached values of similar AzaPc without ICT. The final part of the thesis deals with a series of pH sensitive AzaPc, whose Φ_F a Φ_Δ were controlled by pH of environment. These compounds can find their application in the area of cell imaging, especially where the higher sensitivity to lower pH is desired (i.e. lysosomes).

The second part of the thesis was focused on some synthetic problems at Pc/AzaPc and their higher homologues, 6,7-tetraquinoxalinoporphyrazines (6,7-TQP). The suitable general methods for symmetrical aryloxy/alkyloxy AzaPc and unsymmetrical aryloxy/alkyloxy AzaPc were found. The latter ones were published for the first time. The effect of peripheral substituents on the properties of 6,7-TQP (Φ_F , Φ_Δ , λ_{\max} , ϵ) was described also for the first time. 1,3-dipolar azide alkyne cycloaddition was showed as a suitable method for the conjugation reactions of Pc/AzaPc with biomolecules. All prepared final Pc/AzaPc were studied from the spectroscopic, photophysical and photochemical point of view and the results were compared with structurally similar compounds.