

Spectral features of conjugated bichromophores: porphyrins with curcumin

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Abstract. Conjugated bichromophores of porphyrins with natural compound curcumin were synthesized and studied by methods of spectroscopy. The fluorescence spectra of bichromophore consist of four bands covered almost a whole visible spectrum from 450 to 700 nm. A relatively weak interaction between curcumin and metalloporphyrin allows to combine both effects: high generation efficiency of singlet oxygen by metalloporphyrin and an anticancer treatment of curcumin.

Design and characterization of novel types of polyheterocyclic compounds have a huge impact on development of methods for the selective transportation of photosensitizers to tumour cells, - a crucial point of photodynamic therapy. Well known, that porphyrins are widely used as effective photosensitizers of singlet oxygen generation in photodynamic processes [1,2]. The idea to design a conjugated bichromophore based on porphyrin macrocycle with a natural compound - curcumin, isolated from the *Curcuma longa* plant, seems very promising. Nowadays curcumin isomers and derivatives attract a lot of attention of specialists in the field of medicine and biochemistry, primarily as an effective antitumor drugs [3]. Number of publications devoted to the study of the optical and photophysical properties of curcumin [4], as well as its structure modifications have been appeared recently.

In this report we presented of the first results of the synthesis of a structure based on metallocomplexes derivatives of tetraphenylporphyrin linked to curcumin molecule and studying of optical parameters newly-synthesized compounds at ambient and liquid nitrogen temperatures. The structures of Zn-5-(4-aminophenyl) 10,15,20-(triphenyl) porphinato (ZnATPP) and Zn-5-(4-aminophenyl)-1-(4-N-curcumin) 10,15,20-(triphenyl) porphinato (ZnATPP-CURC) are presented on Fig. 1 (a, b).

Fluorescence excitation, fluorescence and phosphorescence spectra of ZnATPP and ZnATPP-CURC have been recorded at ambient and liquid nitrogen temperatures. Fluorescence excitation and fluorescence are presented on Fig. 2 (a, b). As evidently from absorption and fluorescence excitation spectra (Fig. 2 a) absorption bands of curcumin and ZnATPP are practically coincided in the spectral range of 400-500 nm.

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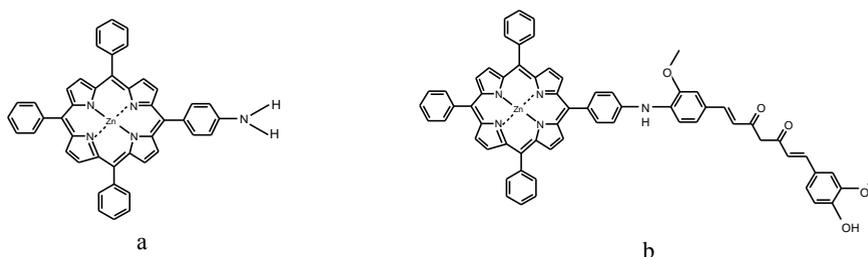


Fig. 1. Chemical structures of ZnATPP (a) and ZnATPP-CURC (b) compounds.

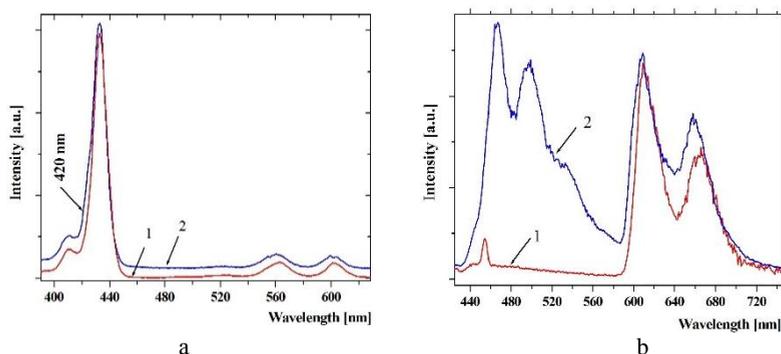


Fig. 2. Fluorescence excitation (a) and fluorescence (b) spectra of ZnATPP (1) and ZnATPP-CURC (2) in toluene at 77 K.

The absorption bands of ZnATPP-CURC bichromophore exhibits a minor difference compare to ZnATPP in the range of 420 nm. While, the fluorescence spectrum of ZnATPP consists from two bands similar to well-known ZnTPP. In contrast, four bands in the spectral range from 450 to 700 nm (Fig. 2b.2) have been observed in the fluorescence spectrum of ZnATPP-CURC. Two “blue” bands in the spectrum (at 465 and 497 nm) refer to the curcumin emission, and two “red” bands at 608 and 659 nm correspond to the luminescence of ZnATPP. Upon formation of bichromophore with curcumin, the bands in the fluorescence spectrum of ZnATPP are shifted by more than 2 nm to the range of short wavelengths. A relatively weak phosphorescence of ZnATPP and ZnATPP-CURC were detected with a maximum at about 790 nm.

The complex of ZnATPP-CURC combines a high efficiency of singlet oxygen generation by one part of the complex (ZnATPP) with an anticancer effect of curcumin, that can provide to high efficiency of these species as therapeutic agents in the treatment of oncological diseases.

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