Abstract of the Doctoral Thesis: «Phthalocyanine-based photoactive layers: formation, characterization and application as singlet oxygen source»

The continued development of novel smart materials is directly related to improving global welfare. Examples of the most profound global issues include a lack of environmental sustainability, increasing unregulated biospheric pollution, and development of antibiotic pathogen resistance. New photoactive materials can play an important role in solving these issues. Those photoactive materials can act as a source of singlet oxygen that is of high interest for application in photodynamic therapy, pathogens inactivation, fine chemicals' synthesis or wastewater treatment. In the photodynamic therapy, singlet oxygen act as a cytotoxic agent, in fine chemicals – as a *green* and efficient oxidating agent, while in the case of microbes – it shows high activity against various bacteria, viruses and fungi.

One of the possible ways to produce singlet oxygen is the photosensitization process, in which phthalocyanines, being the subject of this work, can be applied. Phthalocyanines are extensive π-conjugated molecules with four isoindole units linked by nitrogen atoms. The introduction of various substituents or change of a central metal atom allows for modification and optimization of the phthalocyanines' properties. Based on the phthalocyanine core, it is possible to develop a great variety of materials for different applications, not only for singlet oxygen photogeneration, but also for organic electronics - photovoltaic devices or sensors. For all of these applications, phthalocyanine-based layers are promising subject of research with a number of papers being published every year.

The presented work aims to investigate the phthalocyanine-based photoactive layers as a source of singlet oxygen. The series of phthalocyanine derivatives with various central metal atom and functional groups were synthesized. The photoactive layers were formed using electrochemical deposition or spin-coating techniques, and the resulting films were broadly characterized by spectroscopic (infrared, Raman, X-ray photoelectron spectroscopies) and microscopic (atomic force microscopy, scanning electron microscopy) techniques. Within the work, the influence of phthalocyanine structure - central metal atom and type of substituents, on optical and photosensitizing properties was assessed for phthalocyanines being in a solution phase or deposited in a form of layer. Finally, the photoactive layers containing phthalocyanines were applied as a source of singlet oxygen in the synthesis of fine chemicals and as antimicrobial coatings. It was shown that the selected phthalocyanines deposited on solid support can be effectively used in the oxidation of α-terpinene to obtain ascaridole. Moreover, electrodeposited zinc phthalocyanine coating inhibits the *Staphylococcus aureus* biofilm growth when activated with visible light.

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