

Natural environment is increasingly contaminated with drugs, preservatives and pesticides. Except industrial and agricultural pollution a major contribution to environmental contamination are waste and sewage from households. It is associated with the increasing use of drugs, dietary supplements, cosmetics and pesticides. It should be emphasized, that these substances are present in the effluents in unaltered forms, as well as metabolites exhibiting their own activity. Unfortunately, current methods of water treatment and wastewater management reduce the concentrations of these pollutants, but do not eliminate them completely from circulation. As it is known from the literature, pollution of water - even in nanogram per liter concentrations - can have disastrous consequences. Accumulation of pesticides, preservatives and drugs in the environment has become a serious problem. A high biological activity and properties of some molecules raises a problem with the selection of appropriate water purification methods. The increase of pollution is significantly affected by (i) increase of drug consumption in human and veterinary medicine combined with lack of efficient methods for elimination thereof from wastewater (such as metronidazole – an antibacterial compound which also accelerates growth in poultry), (ii) use of pesticides and herbicides (often contaminated with toxic dioxins), (iii) insecticides (e.g. PCBs, carcinogenic substances that are very slowly degraded in the environment), (iv) persistent additives in cosmetics, (v) permeation of industrial waste to the environment (bisphenol A).

In the last few years novel environmental decontamination methods are being developed. One of the methods of cleaning the environment is the use of photosensitizers. A photosensitizer is a chemical which is able to convert light energy into another form of energy, due to its specific properties. In this way titanium(IV) oxide particles, when exposed to the ultraviolet light, trigger the formation of free radicals. They are very reactive and act in an oxidizing manner and thus they are destructive to tissues, cells, and even chemicals. For this reason, photosensitizers (including titanium(IV) dioxide) are starting to be used in the construction of solar cells, to fight bacteria and cancer. Porphyrazines and phthalocyanines (compounds related to hemoglobin) are also photosensitizers. In their case the formation of reactive oxygen species occurs as a result of irradiation with visible light.

To meet these challenges, we plan to obtain new hybrid material consisting of porphyrinoid photosensitizers and titanium(IV) oxide. This material will be used to develop a system for removing compounds polluting the environment, as well as microorganisms. The material will undergo assessment of toxicity against healthy cells. If used hybrids are safe for people and the environment, it will be used in the future to develop new methods of water treatment.

