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COMPOSITE MATERIALS BASED ON POLYOXOMETALLATES

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Introduction. Recently, much attention has been paid to the study of polyoxometallates. The properties of these cluster compounds are found application in many different fields such as catalysis, photocatalysis, electrocatalysis, developments in energy improvement [2], studies of supramolecular assemblies and self-assemblies [3] etc. Increasingly, polyoxometallates are becoming a subject of scientific discussion due to their exceptional electron transport capabilities, which, for example, allow the use of these compounds as dopants [4] (modifying additives that increase the specific electrical conductivity or optical properties of the material). The understanding of the supramolecular formation mechanism of polyoxometallates opens up new opportunities in the development of composite materials and their characteristic features [5].

Main part. Two polyoxometallates were synthesized as part of the study [1]: sodium phosphotungstate $Na_3PW_{12}O_{40}$ and sodium molybdochromate $Na_3CrMo_6O_{24}H_6$. Sodium phosphotungstate has the Keggin structure, while molybdochromate has the Dawson structure. Both polyoxometallates were characterized by optical microscopy and X-ray diffraction analysis.
The fabrication of titanium oxide-coated glasses with polyoxometallates was made as followed:
1) The 1% solution of titanium (IV) isopropoxide in isopropyl alcohol is prepared. Polyoxometallate is added at a rate of 1 mg/ml.
2) The purified glass is attached to the spin coater. The insulin syringe was used to spread the solution evenly over the surface. It is necessary to set the mode of 2000 rpm.
3) The glass is removed and placed in a muffle furnace at 170 °C 30 min. Titanium isopropoxide turns into titanium (IV) oxide followed during sintering.
4) Each of titania layer was deposited 5 times. The next step was the photocatalytic decomposition reaction by irradiation of rhodamine B solution under the glasses with titania/polyoxometallate coating. The aliquots of rhodamine B solution were taken after 10, 20, 30 and 40 min of irradiation. The obtained solutions were examined using a UV-VIS spectrometer. Thus, the effectiveness of these two catalytic coatings was compared.

Conclusion. It was determined that an increase in the number of deposited titanium dioxide layers from 5 to 10 leads to an increase in photoactivity. Modification of titanium dioxide surface by polyoxometallate particles of $Na_3PW_{12}O_{40}$ composition does not lead to an increase in photoactivity, and deposition $Na_3CrMo_6O_{24}H_6$ contributes to the synergetic effect of the photocatalytic activity. The results of the study demonstrated that polyoxometallates influence photochemical processes. This is confirmed by the reaction of decomposition of rhodamine B by ultraviolet. The development of photocatalytic materials can help to save ecosystems, for example, a safe catalyst for the decomposition of the dye auramine in water bodies has been developed on the basis of polyoxometallates. Through the study of the spontaneous formation of complex large molecules (such as polyoxometallates), it is possible to make conclusions about living biological systems. For instance, research in this area helped to advance the understanding the processes of transcription and translation involving RNA and DNA. Any serious basic research is beneficial to more applied developments. It expands human knowledge in particular areas, which drives technological progress. Referring to the present study, in the future it is planned to calculate the speed of the reaction, and on the basis of these data to try to introduce composite materials based on polyoxometallates in biological systems.

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