

where C_0 and C_p are the initial and equilibrium concentrations (activity) of the radionuclide in the aqueous phase, mg/dm^3 (imp/s);

V_{org} , V_{aq} are volumes of organic and aqueous phases, cm^3 .

The results are shown in the table.

Table

Distribution coefficients (D) and extraction coefficients (R, %) of radionuclides in the two-phase system PEG-3000 — $(\text{NH}_4)_2\text{SO}_4$ — H_2O

Radionuclide	^{137}Cs	^{90}Sr	^{238}U	^{90}Y	^{144}Ce
D	0.26	0.48	0.85	1.34	11.91
R, %	4.9	8.8	14.5	21.1	70.4

The obtained results of the studied systems show that in the series Cs^+ , Sr^{2+} , UO_2^{2+} , Y^{3+} , Ce^{4+} , the extraction ability increases, which correlates with the previously determined instability constants of the complexes of SNPO 2,6-PDA with the corresponding ions [2].

This indicates that the determining role in the distribution of metal ions between the phases of the extraction system is played by their complex formation with SNPO 2,6-PDA.

Thus, two-phase aqueous systems based on PEG with additions of the complexing agent SNPO 2,6-PDA can be used for the selective extraction of the ^{144}Ce radionuclide from aqueous solutions.

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PHOTOCHEMICALLY ACTIVE BIODEGRADABLE POLYMER HYBRIDS AND THEIR USE FOR DECONTAMINATION OF WASTEWATER

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Growing industrial activities in most countries initiates producing large volumes of wastewater [1]. Utilization of soluble wastes and wastewater recycling requires the elaboration of novel green, fast and efficient technologies for the decontamination of wastewater. Today a one of the leading research activities of scientific society is directed at using renewable energy sources for degrading inorganic and organic pollutants in the water before reuse. Great potential in this direction has inorganic photocatalysts whose oxidation/reduction activity initiate by UV or visible light irradiation [2]. Recent advances demonstrate the development of a variety of photocatalysts with different photochemical activity, chemical and atmosphere stability, wavelength working range, etc [3]. Despite many achievements in studying photocatalysis and photocatalysts, nanocrystalline titanium (IV) oxide still attracts great attention due to exhaustive photochemical activity, chemical and photochemical stability, economic and technological reasons [4]. Our previous works provided exhaustive data on the effect of the structure-dependent photochemical activity of nanocrystalline TiO_2 [5].

Here we produce two types of eco-friendly polymer composites for the light-initiated degradation of organic pollutants in aqueous media. The first type of photocatalyst was manufactured by filling polyvinyl alcohol (PVA) matrix with modified fine nanocrystalline TiO₂ followed by a high-temperature treatment to obtain composite film material. For another type of photocatalysts, the stabilized titania nanoparticles were synthesized in a mixed aqueous/organic medium followed by their heat-initiated hybridization with PVA matrix. The resulted polymer-TiO₂ composites are characterized by nanocrystalline structure of TiO₂, improved hydrophilicity and stability in aqueous media.

Studying the structure of the PVA-TiO₂ composites by DSC (Fig. 1) demonstrates depressing molecular mobility and glass transition temperature (T_g) of PVA chains in TiO₂-filled composites (T_g of neat PVA at 76 °C lowers to 71 °C). For hybrid PVA-TiO₂ system the decreasing T_g is more substantial (by 9.5 °C compared to pure matrix) which indicates strong binding of active filler with PVA macrochains.

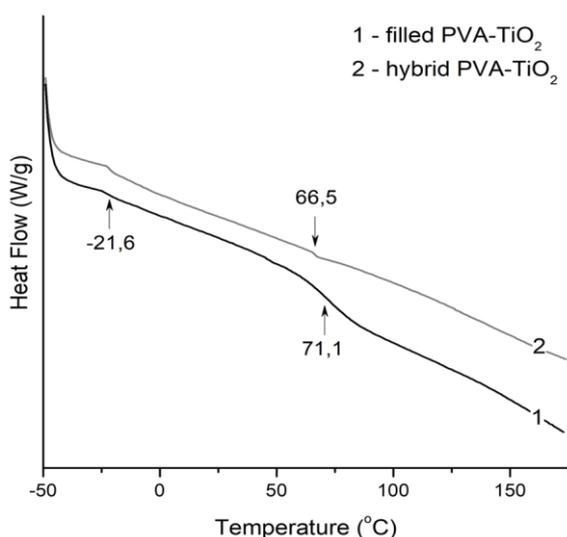


Fig.1 DSC curves of PVA-TiO₂ composites

The photochemical activity of composite photocatalysts was tested using $5 \cdot 10^{-5}$ M solution of methylene blue (MB) dye using UV-irradiation source with $\lambda_{\max} = 365$ nm and averaged intensity of $12,57$ mW/cm².

Both PVA-TiO₂ composites demonstrate improved photocatalytic activity under UV light. The level of dye degradation by both composite photocatalysts reached 90 %. It was found some differences in dye degradation rate (v_{MB}) at different stages of photocatalytic process. Filled PVA-TiO₂ composite demonstrates higher v_{MB} at the beginning of UV-irradiation followed by substantial slowing MB degradation rate after 300 min of degrading process. Probably, it can be explained by the impact of adsorption of MB molecules on the surface of sub-micron TiO₂ particles of the composite during its immersing in polluted media. Otherwise, the PVA-TiO₂ hybrid has shown a more controlled MB degradation process due to the absence of porosity and, respectively, adsorption stage for immobilized nano-sized TiO₂.

Thus, new highly hydrophilic biodegradable composite photocatalysts were prepared by combining nanocrystalline TiO₂ of different dispersity and polyvinyl alcohol polymer binder in aqueous media. Thermal pre-treatment of composite films was performed for hybridization of organic and inorganic constituents as well as stabilization of PVA-TiO₂ composites for their use as composite catalysts for decontamination of wastewater from hazardous organics. Obtained materials demonstrate high photocatalytic activity under artificial UV illumination and initiate the degradation of MB dye by 90 % within 20 hrs time interval.

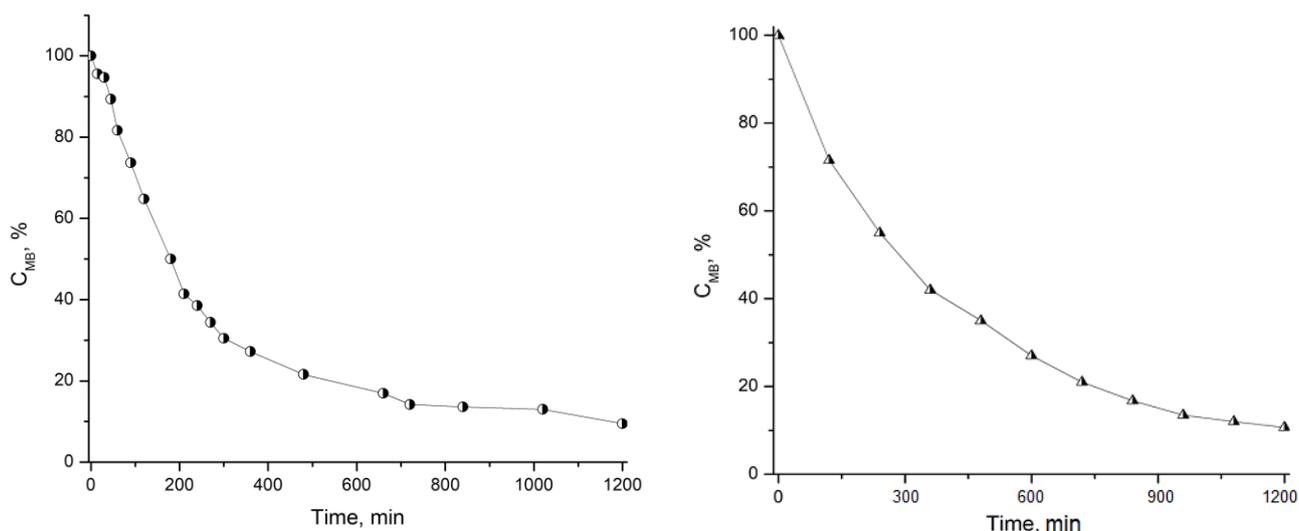


Fig. 2 Kinetic curves of photocatalytic degradation of MB dye by TiO₂-filled (*left*) and TiO₂-hybridized (*right*) PVA composites

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