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BOOK OF ABSTRACTS

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SYNTHESIS AND STUDY OF PHOTOCATALYTIC AND PIEZOPHOTOCATALYTIC PROPERTIES OF PEROVSKITE-TYPE LAYERED OXIDE Bi_3NbTiO_9

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Photocatalysis is considered to be one of the most promising green and efficient technologies for water purification from toxic water pollutants. Due to this in the 21st century the design of photoactive materials to convert solar energy into chemical energy became the one of general direction in the investigations. One of the serious problems which to be solved to increase the efficiency of the photocatalytic destruction of organic pollutants is to suppress the electron-hole recombination. On this way there are several strategies, for example creation of different heterojunctions providing the space separation of carriers widely used [1] but met difficulties of constructing perfect surface on phase boundary in heterostructures.

In the last few years the introducing an external field to reduce carrier recombination and accelerate carrier separation and migration is recognized as an effective approach to enhance the photocatalytic activity [2]. In such case the application of photoactive ferroelectric semiconductors opens the way for the synergistic catalysis – piezophotocatalysis [3,4]. Moreover, if photo-induced process is activated by visual light the photocatalysis provides a sustainable solution to environmental problems.

In this contribution we report results of the investigation of photocatalytic and piezophotocatalytic properties of perovskite-type layered oxide Bi_3NbTiO_9 with different morphology in the process of the decomposition of methylene blue as target organic pollutant.

Two sampales of Bi_3NbTiO_9 have been synthesized by two methods: solid state high temperature synthesis (900°C, 5 h) and molten salt method (800°C, 2 h). In both cases oxides of each metal in stoichiometric ratio have been used as precursors, molten mixture NaCl–KCl has been used as flux. The methods of X-ray phase analysis, scanning electron microscopy, X-ray photoelectron spectroscopy, analysis of specific surface area, diffuse-reflectance spectroscopy were used to characterize the obtained samples. Finally, single phase samples Bi_3NbTiO_9 of nanosheet morphology with different regularity and size, slight difference in band gap energy have been obtained.

Photocatalytic activity of as-prepared samples was tested by the degradation of methylene blue under irradiation of xenon lamp using as simulator of solar light. Piezocatalytic activity of the samples was tested under ultrasonic irradiation in the dark. Piezophotocatalytic decomposition of methylene blue has been tested under light and ultrasonic irradiation simultaneously. The control for the degree of the degradation of dye has been carried out by spectrophotometry.

As the results, the differences in the morphology of particles synthesized by different methods are reflected significantly in the photocatalytic properties and has less influence on piezocatalytic and piezophotocatalytic activity. A more noticeable difference in photocatalytic, piezocatalytic and piezophotocatalytic properties has been found for sample Bi_3NbTiO_9 with high regular nanosheets, large surface area and smaller porosity. However, for both samples, a synergism enhanced by light and ultrasonic irradiation on catalytic activity is clearly observed.

The research was conducted using the equipment of the Saint Petersburg State University Research Park: Center for X-ray Diffraction Studies, Interdisciplinary Center for Nanotechnology, Center for Optical and Laser Research, Center for Studies in Surface Science, Center for Diagnostics of Functional Materials for Medicine, Pharmacology and Nanoelectronics.

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