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PLA Synthesis and Photocatalytic Properties of Bismuth Silicates

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Bismuth silicates (BSO) are of great interest for application in photocatalysis due to the low recombination rate and high mobility of the photogenerated charge carriers [1]. BSO is prepared by solid-state reactions, mechanical activation, or the hydrothermal method. As a result of these synthetic approaches, micron and submicron particles are usually obtained. In this work, bismuth silicates were obtained by pulsed laser ablation in a liquid (PLA).

Pulse laser ablation was performed using a Q-switch Nd:YAG laser with the following parameters: 1064 nm, 7ns, 20 Hz, 160 mJ/pulse [2]. Separate colloids were preliminarily obtained by PLA of bulk targets of crystalline silicon and metallic bismuth in water. Then, the colloids were mixed in an atomic ratio for Bi:Si of 2:1, and additional irradiation with focused laser radiation for 2–3 hours was carried out [3]. As a result, bismuth silicate composite particles were formed. Colloids were dried in air at 60 °C for further research. The obtained powders were also annealed at the temperatures up to 600°C.

Figure 1a shows the UV-Vis spectra of BSO powders, showing the formation of an exciton absorption band already in the initial powder. This band becomes more intense upon annealing. The initial and annealed at 400 °C powders are amorphous for X-ray radiation and, presumably, may consist of various types of bismuth silicates. After annealing at 600 °C, the powder shows a well-pronounced crystalline structure of bismuth metasilicate Bi_2SiO_5. The initial BSO particles have a nearly spherical shape with an average diameter of about 20 nm (Figure 1b), which increases upon annealing: ~ 40 nm at 400 °C and ~ 500 nm at 600 °C.

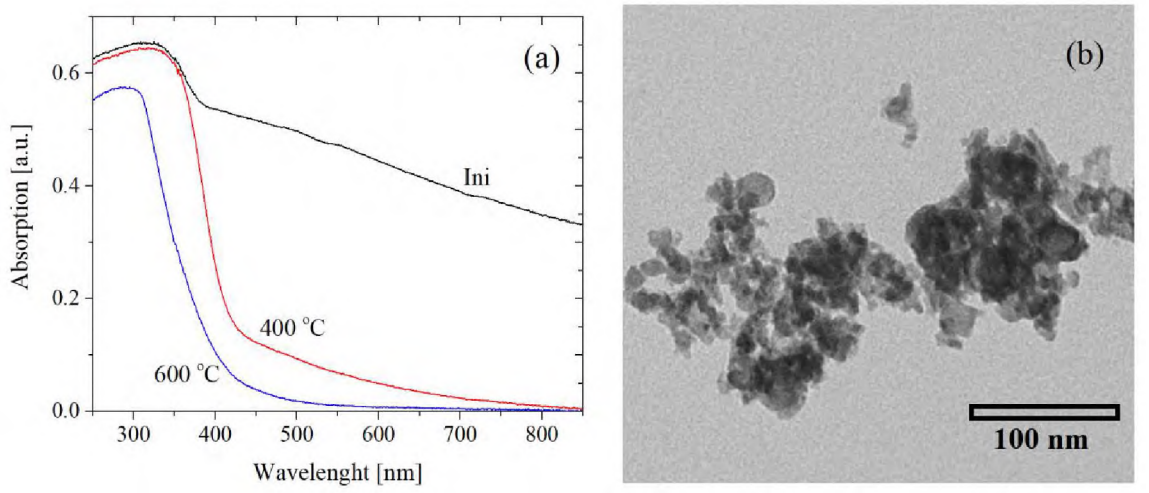

Figure 1 UV-Vis absorption (a) and TEM images of nanopowders BSO.

The photocatalytic properties of BSO powders in the decomposition of the rhodamine B dye under irradiation with an LED source (λ=378 nm) were investigated. The best photocatalytic activity was demonstrated by X-ray amorphous BSO samples having a large specific surface area.

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[1] Z. Peiyang, H. Juncheng, J. Li, Controllable Morphology and Photocatalytic Performance of Bismuth Silicate Nanobelts/Nanosheets, RSC Adv., vol. 1, pp. 1072-1077 (2011).

[2] V.A. Svetlichnyi, A.V. Shabalina, I.N. Lapin, D.A. Goncharova, T.S. Kharlamova, A.I.Stadnichenko, Comparative Study of Magnetite Nanoparticles Obtained by Pulsed Laser Ablation in Water and Air, Appl. Surf. Sci., vol. 467-468, pp. 402-410.

[3] S. Ten, E.A. Gavrilenko, V.A. Svetlichnyi, O.V. Vodyankina, Ag-Pd nanoparticles prepared by laser ablation for selective oxidation of propylene glycol to lactic acid, IOP Conf. Ser.: Mater. Sci. Eng., vol. 597, 012010, (2019).