DOI 10.25205/978-5-4437-1667-1-9

Investigation of optical properties of catalytic particles synthesized by pulsed laser ablation in liquid

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Colloidal solutions, due to their properties such as stability, gel formation, and the ability to transport and distribute various substances in liquids, find application in many industries [1]. In this work, a colloidal solution of titanium dioxide was used because it occupies an important niche in photocatalysis, for example, in the photocatalytic decomposition of harmful organic compounds. The most commonly used modification of titanium dioxide as photocatalysts is anatase, which is associated with its high photocatalytic activity.

For the synthesis of the colloidal solution in this work, Pulsed Laser Ablation in Liquid (PLAL) was used due to several advantages, including the flexibility of parameter selection, localized action, and compatibility with other technologies. Despite large amount of data on controlling the crystalline phase described in the literature, obtaining samples using pulsed laser ablation remains a challenging task, as rutile is predominantly the dominant oxide phase in colloidal solutions synthesized by this method. This is explained by the fact that the phase transition from anatase to rutile occurs at high pressure and temperature and is irreversible.

It was hypothesized that there is an energy window in which the use of picosecond pulses can produce stable colloids with anatase as the dominant oxide phase [2].

The experimental setup consisting of a controlled coordinate mechanism and a laser system was used for the synthesis of the colloidal solution. Fluence was varied in the range of 10-14 J/cm^2 for nanosecond pulse duration and was 2.2 J/cm^2 for picosecond pulse duration.

The optical properties of the obtained colloidal system were analyzed using an SF-2000 spectrometer. It is assumed that the modification of titanium dioxide obtained is anatase. It was demonstrated that with nanosecond pulses, rutile is the predominant oxide phase, while with picosecond pulses, anatase is the most prevalent form at an fluence of 2.2 J/cm^2.

The work was performed under the state contract with the Institute of Thermophysics SB RAS (No. 121031800214-7).

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