# OXYGEN CONCENTRATION INFLUENCE ON THE PHASE CONTENT OF THE PLASMA DYNAMIC SYNTHESIS PRODUCT IN Ti-O SYSTEM

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Titanium dioxide $TiO_2$ has gained tremendous attention as a non-conventional material for application in photocatalysis due to a wide range of properties, such as high catalytic activity, chemical stability, non-toxicity and low cost [1,2]. Among the known structural modifications of $TiO_2$, anatase is more preferred due to the low recombination rate of electron-hole pairs [3]. However, obtaining pure anatase is a rather time consuming task, and $TiO_2$ synthesis products are a mixture of various crystalline phases frequently. Some papers indicate that a mixture of anatase and rutile has increased photocatalytic activity in comparison with pure anatase [4].

Nowadays various synthesis methods are used to create the $TiO_2$ nanocrystalline material. There are the sol-gel method, the solvothermal method, chemical vapor deposition, etc. [5]. However, none of these methods is universal in terms of time and energy costs. Earlier in papers [6], the possibility of obtaining dispersed titanium dioxide by means of plasma dynamic synthesis method was shown. The advantages of method are simplicity, one-step and synthesis time of less than 1 ms. One of the important parameters of the plasma dynamic synthesis system for obtaining $TiO_2$ is the ratio of the components in the gas mixture ($O_2$+Ar), which directly affects the final product characteristics. Therefore, in this paper, the effect of the oxygen concentration in the gas mixture ($O_2$+Ar) on the phase composition of the product is investigated.

A series of experiments was conducted to study the effect of oxygen concentration; the change in the oxygen content in the gas mixture with argon was carried out in the range from 5% to 80%, respectively. According to the results of X-ray diffractometry, only two crystalline modifications of $TiO_2$ — anatase and rutile — were identified in the powder material. It was found that the rutile phase is dominant (~ 80%) at the lowest oxygen concentration. It is due to the fact that argon is a denser gas in comparison with oxygen. Thereby, argon interferes with the movement of the plasma flow and, as a result, the quasi-stationary mode duration increases, which is accompanied by the formation of large particles with a rutile structure. However, after an increase in the oxygen concentration, anatase content monotonously increases. At the level of $O_2$ concentration ~30–40%, the anatase and rutile contents in the powder material are stabilized – their phase contents are 78% and 22%, respectively.

The possibility of regulating the phase composition of the $TiO_2$ powder material synthesized by the plasma dynamic method by changing the oxygen concentration in the gas mixture ($O_2$+Ar) is shown. It was found that the maximum anatase content in the final product at the level of 78% is stabilized at $O_2$ concentration ~ 30–40%.

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