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Optimization of the ways of synthesis of the catalysts based on titanium dioxide by the thermal decomposition of titanium tetrabutoxide

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Abstract

Due to the high catalytic importance of titanium dioxide, the characteristics of the allotropic modifications which are formed in the course of its synthesis, phase ratio (anatase, brukite, rutile) and structure is of a great importance. The best catalytic properties is assigned to a mixture of polymorph modification of titanium dioxide (anatase – rutile as 4-to-1) which significantly depends both on the precursor and on the conditions of its thermal treatment at alkoxide synthetic method. To distinct the allotropic modifications of titanium dioxide, the X-ray powder analysis is used. The anatase allotropic modification is characterized by intence peaks with the 2θ values as 25.3; 36.9; 37.7; 38.5; 48.0; 51.9; 53.9; 55.1; 62.6; 68.7 and 75 deg. The rutile allotropic modification is detected by the existence of the peaks at 27.4; 39.0; 43.8 and 58.0 deg. By the method of X-ray powder analysis, the composition of the phases obtained by the thermal decomposition of the tetrabutoxy titanum precursor obtained at different temperatures (450; 550; 650 и 750 °C) within different time interval (2, 4, 6, 8, 12, 24, 36, 48 hours) was studied. The ratio of the allotropic modifications anatase – rutile was detected by the relative change of the intensities of the peaks 25.3 and 27.4 deg. in the spectra of the products of thermal decomposition. As it was established, the optimal conditions to obtain a significant catalytically active titanium dioxide form (mixture containing 80% of anatase and 20% of rutile) are heating of the precursor at 550 °C for 8 hours which is proved by the relative intensities of the mentioned above peaks (25.3 and 27.4 deg.). The increase in the temperature to 750 °C leads to the preliminary formation of the rutile allotropic modification (the major peak is observed at 2θ = 27.4 deg.). The decrease of the temperature to 450 °C together with the decrease in time of heating leads to formation of titanium dioxide powders on the base of the anatase allotropic modification (the major pear is observed at 2θ = 25.3 deg.). The optimization of the synthetic routs helps to obtain titanium dioxide samples of a high catalytic activity.

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