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The plasma gas – kinetic temperature in the synthesis of titanium dioxide microparticles with deposited copper nanoparticles

V. P. Logvinenko, I. Yu. Vafin, A. A. Letunov, A. V. Knyazev, E. V. Voronov, N. N. Skvortsova, V. D. Borzosekov, A. S. Sokolov, V. D. Stepakhin, I. R. Nugaev, A. K. Kozak and E. A. Obraztsova

Prokhorov General Physics Institute of the Russian Academy of Sciences
38 Vavilov st., Moscow, 119991, Russia
E-mail: ildar@fpl.gpi.ru

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The plasma gas kinetic temperature in the reaction of synthesis of titanium dioxide (TiO_2) microparticles with nanoparticles of copper (Cu) deposited on them was estimated from the radiation of a titanium oxide (TiO) molecule. The synthesis reactions were initiated by microwave radiation of a powerful gyrotron in a mixture of titanium dioxide and copper powders. As a result, materials were obtained that include micro-sized particles of titanium dioxide of rounded shape ranging in size from 10 microns to 200 microns with nano-particles of copper deposited on their surface. The concentration of copper in the powder mixtures var-ied from 0.1 % to 20 % by weight. The microwave breakdown in the mixtures was provided by the use of a steel initiator. The gas kinetic temperature was estimated from the radiation spectrum of the TiO molecule γ-system in the range from 700 nm to 720 nm. The bands in this range are caused by electronic transitions between the $A^3\Phi$–$X^3\Delta$ molecular states. It is shown that the synthesis is carried out at the same gas kinetic temperatures of 5500 ± 500 K, which do not depend on the copper content in the powder mixture.

Keywords: plasma, plasma chemistry, molecular spectroscopy, gyrotron, microwave discharge, plasma temperature, synthesis of micro- and nanomaterials.

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