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SYNTHESIS OF ZnO NANOPOWDER BY COMBUSTION OF ZINC NITRATE-GLYCINE GEL AND ITS PHOTOCATALYTIC ACTIVITY IN PHENOL DECOMPOSITION*

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Zinc oxide (*ZnO*) nanopowder exhibits significant photocatalytic activity during the decomposition of such a toxic water pollutant as phenol under the action of ultraviolet radiation and visible light without the formation of secondary toxic products [1]. In this paper, the possibility of using such a simple, energy-saving and high-performance method as the synthesis in gel combustion of reagents mixture of a self-sustaining exothermic redox reaction, in which the oxidizer is zinc nitrate $Zn(NO_3)_2$ and the fuel is glycine $C_2H_5NO_2$, for the production of *ZnO* nanopowder is considered [2, 3]. The equation of the redox reaction is:

$$Zn(NO_3)_2+\frac{10}{9}\varphi C_2H_5NO_2+\frac{5}{2}(\varphi-1)O_2=ZnO+\frac{25}{9}\varphi H_2O+\frac{20}{9}\varphi CO_2+(\frac{5}{9}\varphi+1)N_2,$$

where the dimensionless criterion φ, characterizing the ratio of fuel and oxidizer, shows that excess oxygen is released or, conversely, oxygen missing for complete oxidation of the elements is consumed from the surrounding gas environment during synthesis in combustion of the reagents gel. In this case , the gel of the reagents mixture can be formed in two ways: 1) from a mixture of aqueous solutions of reagents when heating and removing water at its boiling point (Solution Combustion Synthesis) or 2) when mixing dry reagents, accompanied by their spontaneous humidification from the ambient air due to hygroscopicity, and subsequent drying by heating at a temperature below the boiling point of water (Gel Combustion Synthesis) [2-4]. A theoretical and experimental study of the *ZnO* synthesis process has been carried out with a change in the values of the criterion φ in the range $0.25\leq\varphi\leq3$ with a step of 0.25.

Thermodynamic calculations using the THERMO computer program made it possible to determine the adiabatic temperatures and the equilibrium composition of the reaction products, to find the optimal values of the criterion $\varphi\approx1$ for the synthesis of pure *ZnO*. However, an experimental study when heating a vessel with an aqueous solution of reagents on an electric stove with an average surface temperature of 800 ^{o}C showed that after boiling water and gel formation at $0.5\leq\varphi\leq1.5$, the reaction takes place in a very fast volumetric combustion mode with a sharp ejection of the reacting mixture and reaction products from the vessel. With a reduced fuel content φ=0.25, the reaction proceeds in a flameless mode with smoke emission and partial product ejection, and with an increased fuel content $\varphi\geq1.75$, the reaction takes place in the form of slow smoldering without product ejection, but in both these cases, the combustion products contain a significant amount of free carbon: 6.45 wt.% at φ=0.25, 10 wt.% at φ=2 and 25.5 wt.% at φ=3. Calcination at 650 ^{o}C of these products reduces the impurity content of free carbon to 0.67 wt.% at φ=2, and 0.86 wt.% at φ=3. The average particle size of calcined powders found by the Scherer method is in the range from 30 to 35 nm. Similar results on the composition and structure of combustion products were obtained in the synthesis of *ZnO* by burning gel from mixtures of dry reagents, only here the delay time of combustion is much less (about 1 min) compared with burning gel from an aqueous solution of reagents (about 8 min).

The evaluation of the photocatalytic activity of synthesized *ZnO* during the decomposition of phenol under the action of ultraviolet radiation was carried out in an experiment with an initial concentration of phenol in water of 1 mg/l, a concentration of suspended zinc oxide particles of 1 g/ l, a wavelength of ultraviolet irradiation of 365 nm. After 4 hours of irradiation, the phenol concentration decreased by 18% in the case of non-calcined *ZnO* and by 92% in the case of calcined *ZnO*.

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