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SYNTHESIS OF ZINC DOPED WITH CADMIUM FROM NITRATE SOLUTIONS UNDER THE ACTION OF A GLOW DISCHARGE*

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Usually, oxides of zinc, cadmium, tin, and indium nanoparticles are used in microelectronics [1-2]. At the same time, doping of these oxides led to improved electrical conductivity without deteriorating their other properties of these materials. Zinc and cadmium, transition metals belonging to the same group of the periodic table. The study of the Cd – Zn – O system is of fundamental and practical interest, since this semiconductor material combines many useful characteristics of both Cd and Zn. Cadmium oxide is an n-type semiconductor with a band gap of 2.5 eV is widely used in optoelectronics. In turn, zinc oxide, a direct-gap semiconductor with a band gap of 3.3 eV, is used as sensor materials. There are a large number of different methods for obtaining nanoparticles; one of the new and promising is the synthesis based on the interaction of plasma with salt solutions.

In this work, we used aqueous solutions of zinc and cadmium nitrates (analytical grade) with a concentration of 50 mmol/l for each component. The experimental setup used in the study is described in detail by us in [3]. External electrodes were made of titanium. The electrode-solution distance was 5 mm. The discharge current could vary within 30-70 mA.

The kinetics of the formation of colloidal particles was investigated by the turbidimetric method. It turned out that the rate of formation increases with an increase in the discharge current from 30 to 70 mA. The results of the kinetic curve are shown in Figure 1. At concentrations of zinc and cadmium nitrates 50 mmol/l the rate constant of the process increases from $1.3 \cdot 10^{-3}$ to $12 \cdot 10^{-3}$ s^{-1}.

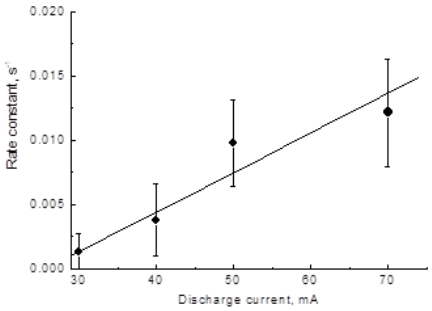

Fig.1. The dependence of the effective rate constant on the discharge current

Analysis of the results obtained by XRD and EDS analyzes showed that the resulting substance has a complex structure consisting of crystalline phases $Cd(NO_3)OH \cdot H_2O$, β and γ $Cd(OH)_2$, and for zinc - from $Zn(NO_3)OH \cdot H_2O$ and $Zn(OH)_2$. DSC analysis confirmed the data obtained by XRD analysis.

The sediment particles, as shown by SEM, have a spheroidal shape with a characteristic size of about 1 μm. Thermal decomposition of the resulting precipitate proceeds in several stages and ends at a temperature of ~300 °C. As a result of calcination, a mixture of crystalline zinc and cadmium oxides is formed. According to EDX data, at a molar ratio of 1:1 of zinc and cadmium in the initial solution, the obtained solid particles contain 8 mol% cadmium and 92% zinc.

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