SHS OF PIGMENTS BASED ON COBALT AND MAGNESIUM TITANATES

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At present, titanium dioxide is widely used in the paint industry. Due to its extremely high technical properties such as a whitening ability and heat and light resistance, it is the most popular white pigment. In addition, colored TiO_2-based spinel pigments are widely used in the manufacture of ceramic paints, plastics, chemical fibers, rubber, paper, printing inks, building materials, inorganic glazes and enamels, cosmetical and other products [1].

TiO_2, MgO, Co_3O_4 oxides, $Mg(NO_3)_2{\cdot}6H_2O$ magnesium nitrate and aluminum powder (ASD-4) were mixed to obtain green pigments in the MgO-CoO-ZnO-TiO_2 system by self-propagating high-temperature synthesis (SHS).

Self-propagating high-temperature synthesis was conducted in metal-mesh cups placed into a gradient resistance furnace under an air atmosphere at atmospheric pressure. The bulk density samples were used for the synthesis of spinels. They were ignited beginning from the lateral surface, where the furnace temperature was maximum. The heat transferred from the spiral initiated a chemical reaction, resulting in a combustion wave.

Figs. 1a, b show thermograms of SHS of pigments No.1 and No.2 in the MgO-CoO-ZnO-Al_2O_3 and MgO-CoO-ZnO-TiO_2 systems, respectively.

Fig. 1. Thermograms of SHS of pigment No. 1 with a starting reaction mixture of Al_2O_3, Al, Co_3O_4, MgO, ZnO, $Mg(NO_3)_2{\cdot}6H_2O$ (a), and pigment No. 2 with a starting reaction mixture TiO_2, Al, Co_3O_4, MgO, ZnO, $Mg(NO_3)_2{\cdot}6H_2O$ (b).

A comparative analysis showed that the replacement of Al_2O_3 oxide with TiO_2 in the starting reaction mixture increases the maximum temperature of the synthesis of pigments from 1750 °C to~ 1900 °C, melting the surface of products and changing the color from blue to green. The thermogram in Fig. 1b is more complex, which is associated, along with the chemical reactions of direct oxidation of aluminum and the thermite reaction with cobalt oxides, with the thermite reaction of aluminum with TiO_2.

X-ray diffraction analysis showed that the main phases of pigment No. 1 were aluminum-cobalt and aluminum-magnesian spinels, and those of pigment No. 2 were $MgTi_2O_5$, $CoTi_2O_5$ and $MgTi_2O_4$, as well as the presence of Mg_2TiO_4 and Co_2TiO_4, $Zn_xMg_yCo_{1-x-y}Al_2O_4$ phases and a perovskite phase. α-Al_2O_3 and Co were found as impurities. No metallic titanium was detected.

The structural features of the synthesized pigments were studied using an Axiovert 200M optical microscope. A micrograph of a pigment based on titanium-containing spinels is shown in Figure 2. Grayish-green sections of the $CoTiO_3$ - based perovskite-like phase as well as blue-green sections related to solid solution spinels of titanates and cobalt and magnesium aluminates were found. Some inclusions of metallic cobalt are observed.

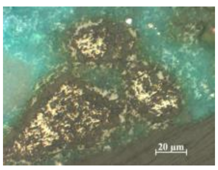

Fig. 2. Micrograph of a section of green spinel pigment based on cobalt and magnesium titanates obtained from the MgO-CoO-ZnO-TiO_2 system (Axiovert 200M).

Thus, titanium-containing pigments obtained by the SHS method can be used as ceramic pigments.

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REFERENCES

[1] Maslennikova G.N., Pishch I.V. Ceramic pigments. Moscow: RIF «Strojmaterialy». 2009. 224 p.