THE EFFECT OF pH ON THE FORMATION OF NANOCRYSTALLINE PHASES IN THE Bi_2O_3-P_2O_5 SYSTEM

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"Soft chemistry" has gained considerable popularity due to the wide variety of techniques and strategies for obtaining compounds and materials with unique properties. This, in turn, dictates the importance of studying the effects of various parameters on the specifics of chemical reactions at relatively low temperatures. Special attention is paid to the role of acid-base equilibria on the processes of phase formation in aqueous-salt media.

In this regard, the work is devoted to studying the effect of the pH value of an aqueous-salt medium on the formation of compounds in the Bi_2O_3–P_2O_5–H_2O (NaOH, HNO_3) oxide system.

The synthesis of samples by treatment of aqueous-salt suspensions with pH values of 2.0, 8.0 and 5.0 was carried out by two methods: precipitation at T = 25 °C, and hydrothermal treatment at T = 200 °C for 20 hours.

It was shown that in an acidic medium (pH 2) at a temperature of 25 °C, hexagonal $BiPO_4$ is formed, and at pH values of 8 and 12, X-ray amorphous substances are formed at the deposition stage. After hydrothermal treatment of these suspensions at 200 °C, hexagonal bismuth phosphate is transformed into a monoclinic modification in an acidic medium, and nanoscale particles of $Bi_3O(OH)(PO_4)$ compounds are formed from amorphous precursors in slightly alkaline and alkaline media (with a crystallite size of about 62 nm) and Bi_2O_3 (with a crystallite size of about 70 nm).

By thermodynamic analysis, the dependences of the equilibrium molar solubility of these crystalline compounds on the pH value of the aqueous-salt suspension were obtained, taking into account the formation of mononuclear aquahydroxoplexes. Based on thermodynamic analysis, it was shown that the $BiPO_4$ compound is characterized by the highest stability in the pH range from 0 to 5.8 at temperatures of 25 and 200 °C. The pH range from 5.8 to 9.8 is characterized by the stability of the compound $Bi_3O(OH)(PO_4)_2$ at 25 °C, and a further increase in the pH value leads to the formation of Bi_2O_3, BiOOH or $Bi(OH)_3$.

The data obtained as a result of thermodynamic analysis are in satisfactory agreement with experimental data on the stability limits of compounds $BiPO_4$, $Bi_3O(OH)(PO_4)_2$ and Bi_2O_3 under the conditions considered.

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