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Formation of microcrystalline corundum in hydrothermal conditions

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Abstract

By methods of X-ray analysis and electronic raster microscopy were studied features phase- and grainformations in the «oxide of aluminum(III) – oxide of iron(III)» system in hydrothermal conditions. For this purpose samples was synthesized by joint sedimentation by the alkaline agent from water solutions of salts of aluminum(III) and iron(II) with the subsequent hydrothermal processing of the received rainfall at 450 °C within 4 hours. Al_2O_3:Fe_2O_3 ratio in draft was 20:1. Besides, sedimentation of Al(III) salts was carried out without addition of salts of iron.

It is shown that joint sedimentation of solutions of Al(III) and Fe(II) salts and the subsequent hydrothermal processing of the received deposit promotes formation of a monodisperse oxide of aluminum of α-modification (corundum), possessing a hexagonal facet and the average size ~ 1 micron in the diameter and 150-200 nanometers thick.

Equality of sizes of parameters of an elementary cell in corundum samples with an additive of compounds of iron and without them has allowed to draw a conclusion that in these hydrothermal conditions solid Fe_2O_3 solution in the structure of α-Al_2O_3 is n't formed. At the same time, according to numerous literary data, at heat treatment of coprecipitation samples on air, at temperatures over 1100 °C formation of corundum is followed by formation of solid solution as indicated by changes of parameters of an elementary crystal cell of the structure of corundum.

Was made the assumption that owing to isodegree of the structure of α-oxide of iron(III) with corundum, the crystal which is formed at lower temperatures α-Fe_2O_3 act as germs for thermodynamic steadier phase α-Al_2O_3 what leads to decrease in the average size of crystals of the phase α-Al_2O_3, and increase in degree of monodispersion.

Without the addition of compounds of iron, in similar conditions, the polydisperse corundum consisting of tablet crystals, from 5 to 20 microns in the diameter and up to 5 microns thick, tending to a hexagonal facet is formed.

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