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Submitted on Jule 23, 2017.

Aluminium interaction with multicomponent oxide system consisting of zirconium, titanium, silicon, iron

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Keywords: oxides, titanium, zirconium, silicon, iron, rare-earth elements, aluminothermic reduction, phase formation, intermetallic compounds.

Abstract

A theoretical and experimental study of the aluminum interaction with a multicomponent system containing oxides of zirconium, titanium, silicon, iron, niobium and rare earth elements is performed. The probability and sequence of metallic and oxide compounds formation was conducted with thermodynamic modeling method for the aluminothermic reduction of eudialyte concentrate. The results of the thermodynamic calculations revealed the influence of the temperature, consumption of the reducing agent and the additives in the charges of calcium and iron oxides on the metal reduction process, and were tested during the melting of the concentrate in the resistance furnace. According to the experimental results, the reduction of zirconium, titanium and niobium into the metal is about 70 wt. %. Rare earth elements and strontium after the reduction transferred (more than 90%) into oxide phase (slag), which can be further processed by known hydrometallurgical technologies. In the experiments, a fairly good separation of the metal and slag phases was achieved. To estimate the interfacial interaction, the surface tension and the density of the metallic and oxide phases were studied, which made it possible to evaluate the effect of these properties on the formation of the metal phase and, accordingly, the separation of metal and slag.

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