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Physicochemical characteristics of oxide melts of $MgO–Al_2O_3–SiO_2–CaO–Cr_2O_3–FeO$ system

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Abstract

In the present study the complex of physicochemical characteristics were studied. Phase composition, viscosity and crystallization temperature of oxide melts of the $MgO–Al_2O_3–SiO_2–CaO–Cr_2O_3–FeO$ system were studied. The system is corresponds to composition of commercial slags obtained in the result of production of high-carbon ferrochrome made of chromium-ore materials of different types, namely, imported rich ores from Kempirsaysk massif (Kazakhstan) and poor domestic concentrates from Saranov deposit.

Viscosity measurements were carried out using electovibrational viscometer with molybdenum crucibles in the flow of inert gas. Crystallization temperatures were calculated by relationship between viscosity logarithm and inverse absolute temperature. Phase composition of oxide melts were calculated using specially developed mathematical model of phase diagram for a composition of the $MgO–Al_2O_3–SiO_2–CaO–Cr_2O_3$-FeO six-component system. Chemical composition of studied oxide melts were following (% mass): 26-35 of MgO; 16-22 of Al_2O_3; 26-33 of SiO_2; 1-5 of CaO; 6-16 of Cr_2O_3; 3-8 of FeO.

It was established that the oxide melt containing (% mass): 35 MgO; 19 Al_2O_3; 26 SiO_2; 4.8 CaO; 7.5 Cr_2O_3; 2.7 FeO is a refractory slag, its crystallization temperature is about the triple eutectic of periclase-spinel-forsterite having crystallization temperature 1710 °C. This composition corresponds to slag obtained at high-carbon ferrochrome production with the use of Kempirsaysk massif ores. It has low viscosity at melting due to a forsterite is its predominant phase, which is comprised of isolated $(SiO_4)^{4-}$tetrahedrons.

It was found that the substitution of rich ore by domestic one causes a drop of forsterite content in slag, while spinel content is almost similar. Hence slag crystallization temperature is decreased down to 1600 °C. Some increase of slag viscosity was detected due to enhancement of content of free SiO_2 having wireframed structure of $(SiO_4)^{4-}$ anion. However, this effect becomes negligible small at the small quantity presence of CaO due to formation of triple calcium aluminosilicate The presence of Cr_2O_3 and FeO in slags is not favourable due to formation of $FeO·Cr_2O_3$ compound with strong coupling, this incurs a decrease of transfer degree of valuable components into metal.

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