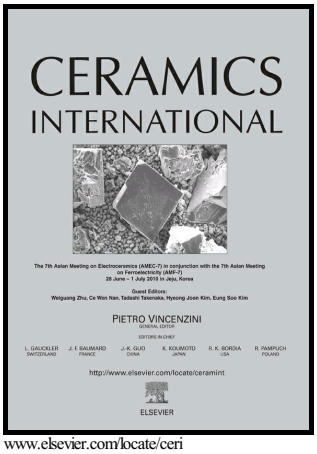

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PII: S0272-8842(17)32500-2
DOI: https://doi.org/10.1016/j.ceramint.2017.11.045
Reference: CERI16700

To appear in: *Ceramics International*

Received date: 9 October 2017
Revised date: 7 November 2017
Accepted date: 8 November 2017

Cite this article as: Jianwei Chen, Huizhong Zhao, Han Zhang, Zhengkun Li and Jiaqin Zhang, Effect of partial substitution of calcium alumino-titanate for bauxite on the microstructure and properties of bauxite-SiC composite refractories, *Ceramics International,* https://doi.org/10.1016/j.ceramint.2017.11.045

Effect of partial substitution of calcium alumino-titanate for bauxite on the microstructure and properties of bauxite-SiC composite refractories

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Abstract

Calcium alumino-titanate (CAT) is obtained by processing titanium-iron slag in an industrial process that involves melting, homogenization, de-ironing, and silicon reduction. The correlation between CAT addition and the microstructures, phase compositions, thermo-mechanical properties, and alkali resistance of bauxite-SiC refractories were investigated by X-ray diffraction (XRD) and scanning electron microscopy (SEM), as well as by thermodynamic analysis. The results show that CAT can react with SiO_2 to form a low-melting-point phase (anorthite), causing the CA_6, CA_2, and $CaTiO_3$ phases to disappear. In addition, the formation of the liquid phase in the Al_2O_3-TiO_2-CaO-SiO_2 system at high temperatures deteriorates the properties of the composite. The strength and refractoriness under load of the composite decrease with the addition of CAT. Moreover, the thermal shock resistance of the composite first increase and then decrease with the addition of CAT. For CAT concentrations ≤10.8 wt%, the composite demonstrates good alkali resistance. The alkali resistance of the CAT-containing bauxite-SiC composite is mainly dependent on the external dense regions.

Key words: Calcium alumino-titanate; Bauxite-SiC; Thermal shock resistance; Alkali resistance

1. Introduction

The rapid development of the alloy smelting industry has increased industrial waste accumulation (titanium-iron, chrome-iron, vanadium-iron, and nickel-iron slags), which pollutes the environment and occupies a large amount of cultivated land [1–4]. Therefore, the treatment and application of such industrial wastes in other composites are of great importance. Titanium-iron slag is a by-product of the aluminum-based reduction smelting of ferrotitanium alloys. This smelting process primarily uses rutile and iron ores as raw materials, aluminum powder as the reducing agent, lime as the slagging agent, and potassium chlorate as the heating agent [5, 6]. The difference in the specific gravities of ferrotitanium alloy and the slag causes the