Application of Thermal Analysis Technique to New Ferrochrome Reduction Process with Aluminum Powder

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Metallothermic reactions are very important for many special metal producing processes. Although it is well known that carbothermic reduction process is one of the most economical and widely used refining process for ferroalloys, several carbides are formed in this reduction process evolving carbon dioxide. The kinetics of the carbothermic reductions mechanism of Cr_2O_3 and Chromite ($FeCr_2O_4$) has been investigated and the reaction models were successfully proposed.

Although ferrochrome of high purity can be obtained by aluminothermic reduction, the reduction mechanism of $FeCr_2O_4$ with aluminum is not clear. The present work aims to clear the reduction mechanism of $FeCr_2O_4$ with aluminum, as well as to reduce the emission of carbon dioxide and energy consumption through the processing.

In the present investigation, simultaneous TG-DTA technique was used. The mixture of $FeCr_2O_4$: Al = 1.5: 10 (molar ratio) was prepared. Samples quenched from several chosen conditions were used for identifying the phases by means of SEM and XRD. On the DTA curve, three peaks were observed corresponding to the endothermic peak for melting of aluminum, the exothermic heat change for oxidation of excess aluminum, and heat change for reoxidation of ferrochrome, respectively. The analysis of the product indicated the presence of Al_2O_3, Cr_2O_3, Fe-Cr and unreacted Al. After that, Fe-Cr and unreacted Al were oxidized gradually. The reaction models were proposed.