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Reaction Mechanism for Thermite Combustion

Synthesis of Ni₃Al

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ABSTRACT

We investigated the reaction sequence and melting behavior of products during thermite combustion synthesis of Ni-25 mol% Al alloy (Ni₃Al). The overall reaction is represented by the equation: $3a_t\text{NiO} + 3(1 - a_t)\text{Ni} + (1 + 2a_t)\text{Al} = \text{Ni}_3\text{Al} + a_t\text{Al}_2\text{O}_3$.

The reaction temperature can be varied arbitrarily by changing the fraction of the thermite reaction in the thermite combustion synthesis reaction. The mechanism of the reaction is summarized as follows. (1) In the green compacts of the reactants, most of NiO-powder particles form microscopic agglomerates. (2) The thermite combustion synthesis reaction of Ni₃Al is a two-step reaction of the combustion synthesis reaction between Ni and Al, and the thermite reaction between the Al-Ni melt and NiO agglomerates. (3) When the temperature of the specimen rises over the melting temperature of NiAl at the first reaction stage, the thermite reaction occurs and fluid products are produced.