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Effect of the Cobalt Content on the Carbothermal Reduction of the Mixture of the Titanium Oxide and Cobalt Oxide synthesized by the Spray Dry Process

Pukyong National University, Chang-Min Moon*, Gil-Geun Lee
Korea Institute of Machinery and Materials, Byoung-Kee Kim

1. Introduction

Titanium carbide is used for tool, die materials and wear resistance materials because of its high hardness(28~35GPa), strength and melting point(3260℃). Recently, as the strength of materials for machining has increased, and die and mold require higher strength and wear resistance, it is required to improve the tool ability of TiC based powder materials. The ultra-fine or nanocrystalline TiC based powder materials are considered to be the best solutions to enhance the performance of traditional TiC based tool materials. In this study, the cobalt was used to overcome grain growth of TiC particles during carbothermal reduction. It was attempt to synthesize ultra-fine TiC/Co composite powder by the spray drying of mixture of TiO_2 powder and cobalt nitrate solutions, and investigate the effect of the cobalt content on the carbothermal reduction of Ti/Co based oxide powder.

2. Experiment procedure

TiO_2 powder and cobalt nitrate solution were mixed for TiC, TiC-5wt.%Co and TiC-15wt.%Co composition, and then the mixtures were spray dried. The spray dried powders were desalted at 800℃ under the air atmosphere. These oxide powders were mixed with carbon black, and then these mixtures were heat treated under a flowing argon atmosphere. The changes in the thermal gravity and the phase structure of the mixtures during carbothermal reduction were analysed using TG-DTA and XRD. The particle size and crystalline size of the synthesized TiC/Co powder were analysed using FE-SEM, TEM and XRD.

3. Results

TiC/Co composite powder with average particle size of about 40nm can be synthesized by the combination of the spray drying process and carbothermal reduction process. The reduction temperature of the Ti/Co based oxide powder and carburization temperature of Titanium oxide were decreased with increasing cobalt content. Also, the crystalline size and lattice constant of the synthesized TiC were increased with increasing cobalt content.

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