Synthesis of WC/TiC/Co Composite Powder by Spray Thermal Conversion Process

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1. Introduction

Tool materials were generally composed of hard materials such as WC, TiC, TaC, TiCN and others, and soft binder materials such as Co and Ni. The mechanical properties of the tool materials depend not only on the constituent materials but also on their microstructure. The hardness, fracture toughness and wear properties of the tool materials were strongly influenced by the size of the hard particles and distance of the mean free path among the hard particles at the same constitution composition. These mechanical properties increased simultaneously with decreasing particle size and the distance of the mean free path. To manufacture high performance tool material with an ultrafine microstructure, raw powder materials with an ultrafine particle should be used. In the present study, the focus is on the synthesis of ultrafine WC/TiC/Co composite powder by the spray thermal conversion process.

2. Experimental procedure

The tungsten-titanium-cobalt-oxygen based oxide powder prepared by the combination of the spray drying and desalting process using the metallic salts as the raw material. The tungsten-titanium-cobalt-oxygen based oxide powder was mixed with carbon black, and then this mixture was carbothermally reduced under a flowing argon atmosphere. The changes in the phase structure and thermal gravity of the mixture during carbothermal reduction were analysed using XRD and TGA.

3. Results

The synthesized tungsten-titanium-cobalt-oxygen based oxide powder has a mixture of WO_3, TiO_2 and $CoWO_4$. This oxide powder was transformed to a mixed state of tungsten carbide, titanium carbide and cobalt by the solid carbon with increasing temperature. The tungsten oxide phase carbothermally reduces at about 900℃ with remarkable decrease in the thermal gravity. The titanium dioxide phase, however, was slowly transformed to titanium carbide by the carbothermal reaction. The synthesized WC/TiC/Co composite powder at 1250℃ for 6 hours has an average particle size of 0.3㎛.

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