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Fabrication of Nano-sized WC/Co Mixed Powders by Reduction and Carburization with Graphite Powder

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I .INTRODUCTION

Synthesis of nano-sized WC/Co mixed powder has been studied widely for the wear resistance materials due to its high hardness. Tungsten carbide powders are made by carburizing tungsten powder with graphite powder in the presence of hydrogen or argon gas.[1] Recently the solution technique has been developed to make nano WC/Co particles from 60 to 300 nm in size.[2]

The reduction and carburization process of mixed powders, tungsten oxide, cobalt oxide and graphite, was known as a key step in successful mass production of nano-sized WC/Co mixed powder.[3] The process parameters were temperature, time and gas species and flow rate in producing nano-sized WC/Co powders.[4]

In our study, nano-sized WC/Co mixed powders were made by the direct reduction and carburization of mixed powders of oxides and graphite considering mixing conditions, temperature, time, and Ar gas flow rate. We attempted to find out the best conditions to make nano-sized WC/Co mixed powders.

II .EXPERIMENTAL

WO_3 (Korea Tungsten TaeguTec Ltd, 1.5㎛), Co_3O_4 (Kojundo Chemical Laboratory Co. Ltd, 1㎛) and graphite (Canada Cancarb Co. Ltd) powders were used as raw materials. These powders were mixed with the planetary mill for 30 hours at 150 rpm. The weight ratio of tungsten carbide balls to powders was about 10 to 1. The milling medium was ethyl alcohol. The powders were heated under flowing argon(99.999%) gas. The gas flow rate was maintained at 300mL/min. To find the moderate temperature of reduction for the mixed powders TG analyse was carried out from room temperature to 1000℃ under flowing argon gas. The reduction and carburization procedures were carried out two-step in furnace. Monitoring the reduction and carburization of mixed powders was carried out by XRD and carbon analyser.

The powders were examined by using x-ray diffraction(Philips Co., PW1730), scanning electron microscopy(JEOL Co., JSM-6330F) and carbon/sulfur analyzer(Leco CS-300). The average size of WC particles was measured by Fullman formula and the image analyzer.[5]

III.RESULTS AND DISCUSSION

The particle size of the oxides was reduced to about 100 nm after 30 hours wet milling in the mixed powders of WO_3, Co_3O_4 and graphite. The high energy ball milling was very effective in reducing the particle size of raw powders. The reduction temperature of the mixed powder was lower about 100℃ than WO_3-graphite or Co_3O_4-graphite mixed powder.

The XRD data showed that reduction of cobalt oxide started first, then tungsten oxide followed. The cobalt supposed to help the reduction of tungsten oxide.

Ⅳ. REFERENCES

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