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Production of WC/Co powder from the WC/Co scrap by direct-oxidation process

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Introduction

Traditionally WC/Co hard alloys are widely used for wear resistance machine parts or tools material. Cemented tungsten carbide are sintered powder metallurgical product and the mixture of the tungsten and cobalt, which are expensive and worth recycling materials.

During oxidation of WC/Co, the hard WC/Co scrap were significantly expanded and became a sponge-like mass that can be easily crushed by mechanical milling. The direct-oxidation process involves thermally oxidation in oxidation atmosphere, and pulverizing hard scrap by ball milling, and reduction/carburization of the oxide powder. In this study, we report on the new recycling method of WC/Co scrap.

Experimental

The WC/Co scrap were oxidized isothermally in flowing air or O_2 at 800℃~900℃ for 2 hours, and then this oxidized powder was crushed and mixed with carbon black by dry ball milling. The milling was performed in the air atmosphere for 48 hours. Finally, the mixed powder was reduced and carburized under a controlled flow rate of H_2 gas at the temperature of 750-900 °C to produce the final WC/Co powder.

Result and Discussion

As a result of the oxidation of WC/Co scarp, the extensive brittle porous oxide layer was formed on all sample. The shape of specimens changed considerably during the oxidaion : cylindrical specimen were transformed to rotor with sever radial "blades" and two corns of the axis(fig.1), and the final shape after oxidation was dependent on its initial shape. And after reaction was complete, the initially hard WC/Co scrap became a spong-like mass that can be easily crushed by mechanical milling.

Tungsten/cobalt oxides powders are homogeneously mixed with carbon powder, which has penetrated into the porous of oxide particles. Carbon content in that mixture is one of the most important parameters, which may influenced on the results of subsequent process of reduction and carburization. Reduction and carburization process was controlled also by hydrogen flow rate, and temperature and holding time.

After the reduction and carburization, the particles consist of 2-4 internal ones and form agglomerated structure, and average particle size was less than 300nm(Fig. 2).

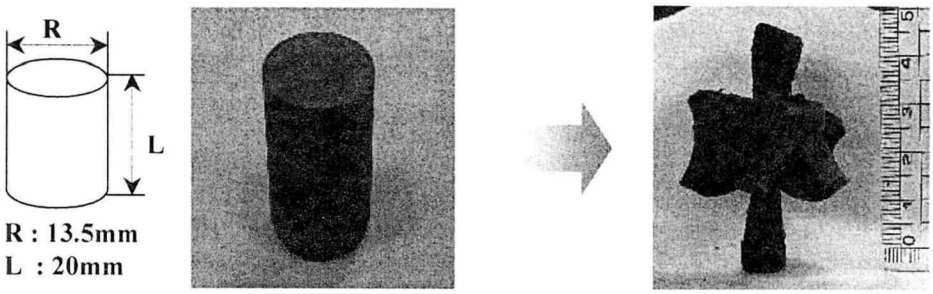
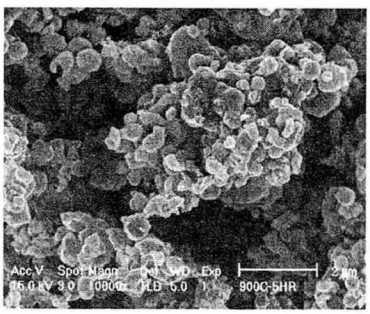


Figure 1. Shape change development of cylindrical sample during oxidation at 900℃



Figgure 2. SEM micrograph of the WC/Co powder produced from WC/Co scrap