Influence of grinding speed and balls diameter on the microstructure of a WC-10% wt doped binder

Victor I. Stanciu, V. Vitry, Fabienne Delaunois

1. Université de Mons, Mons, Belgique, ***victorioan.stanciu@umons.ac.be***

Présentation souhaitée (à sélectionner): Orale

Most of the time, in the studies dealing with the properties of WC-Co alloys, the powders are mixed in a ball mill without quantifying the influence of this operation on the properties of the powders. To study the effect of the homogenization operation on the characteristics of two components, we prepared a mixture of tungsten carbide and 10% by weight of binder. As binder was used a cobalt powder previously doped with 10% by weight of chromium carbide, the latter playing the role of inhibitor of grain growth during sintering.

The tungsten carbide powder used had a particle size of up to 2 µm and a crystallite size of 377 nm. The cobalt powder has an average size (D50) of about 20 µm and a crystallite size of 39 nm.

The powders were loaded into a planetary mill in a 4:1 powder to ball ratio. Tungsten carbide balls (WC-6Co) of 10 and 12 mm in diameter were used as the grinding bodies. To reduce the agglomeration of the powder, 10 ml of ethanol was added. The grinding was carried out at two rotation speeds: 300 and 600 rpm, for a duration of 6 hours.

The powders were investigated by laser granulometry to determine the particle size distribution. The size of crystallites was determined by X-ray diffraction, the data being processed with the software MAUDE. After milling, the size of the WC crystallites was lowered to 177 nm for the powder milled with 12 mm diameter balls at a rotation speed of 600 rpm.

Subsequently, in order to check the homogeneity obtained by grinding for each powder produced, samples were manufactured by uniaxial pressing in a 1 cm² mold. The applied pressure was 10 t/cm². Subsequently, the samples were sintered under vacuum and under controlled atmosphere at a temperature of 1400°C.

After sintering, the samples underwent the standard metallographic procedure: resin mounting, polishing and microscopic observation before and after etching with the Murakami reagent.

A first conclusion after the observations without metallographic attack is that the samples crushed at a speed of 300 rpm have a porosity greater than those crushed at 600 rpm.

Moreover, as regards the distribution of the carbides in the cobalt matrix, it can be observed that for the samples ground at 600 rpm, the distribution is clearly more homogeneous. Free cobalt zones are more rare and reduced in dimensions.

The present work shows the first sintering tests carried out on powders prepared in the laboratory in order to optimize the sintering process. SPS sintering tests are being carried out.

Key words: cemented carbides, nanostructured powder, milling parameters, sintering, densification.

BIBLIOGRAPHIE

V.I. Stanciu, V. Vitry, F. Delaunois, Nonostructured Nanostructured mix of tungsten carbide with cobalt for wear parts, in World PM 2017 Congress Proceedings, 9-13.10.2016, Hamburg, Germany.