

https://dspace.org/

Influence of carbon content and sintering temperature on the green and sintered properties of cemented carbide tool grades

Maseko, Thandazi Makhosazana

2015-05-06
http://hdl.handle.net/10539/17636

Downloaded from a DSpace repository. https://dspace.org/

Abstract

A research study was done on four different cemented carbide cutting tool grades, which had different Co contents and different compositions of additional carbides such as TiC, TaC, NbC, Cr_3C_2 and TiCN. The tool grades were manufactured using the powder metallurgy process. The aims of the research were to investigate how carbon content and sintering temperature influences the material properties, and if possible to select the optimum parameters to yield the best sintered properties for each tool grade. The chemical analysis of the starting and milled powders with three different C contents were done using X-ray Fluorescence (XRF) and Inductively Coupled Plasma- Optical Emission Spectroscopy (ICP-OES), with phase identification and morphology done using X-Ray Diffraction (XRD) and Scanning Electron Microscopy (SEM) analysis. The milled and dried powders were pressed and sintered at three different sintering temperatures. Microstructural characterization of the sintered alloys included phase analysis, and measurement of the WC grain size, WC contiguity and Co binder mean free path. The hardness, toughness, coercivity, density, porosity and magnetic cobalt was determined using relevant standards. In general, as the C content increased, graphite formed in the alloys which resulted in lower hardness and toughness. The hardnesses of the different grades were affected in different ways and were dependent on the level of mixed carbides added and the Co content. It was also clear that as the Co content increased with the increase in C level, the hardness of the alloys decreased. The density for all the alloys decreased with an increase in C content. The porosity for all the alloys increased with an increase in C content. As the sintering temperature increased grain growth increased. However, with the addition of Cr_3C_2, which is a grain growth inhibitor, some alloys could be sintered at higher temperatures with limited grain growth. For all four tool grades the best material properties were obtained with the stoichiometric C content. With respect to sintering temperature, two grades showed the best properties at 1430°C while the other two grades had their best properties at 1510°C.