

https://dspace.org/

An investigation into the causes of the differece in the corrosion behaviour of WC-Co and WC-VC-Co hardmetals

Sebeya, Thabo Thomas

2013-08-28
http://hdl.handle.net/10539/13100

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

Abstract

The aim of this work was to investigate the cause of the difference in the corrosion behaviour of WC-Co and WC-VC-Co alloys. Two alloys of WC-Co and WC-10VC-Co with increasing Co content of up to 30 wt% and a WC-67VC-10Co alloy were analyzed in 1N sulfuric acid at room temperature.

The binder composition of the alloys was analyzed by scanning and transmission electron microscopy with energy dispersive X-ray analysis, and X-ray diffraction. Additionally, density, hardness and magnetic properties were measured and potentiodynamic polarisation scans were undertaken. The following possible causes of the differences in corrosion behaviour were also investigated: differences in the composition of the binder, differences in the fcc/hcp Co ratio, and differences in the binder surface fraction exposed to the corrodant. The addition of VC to WC-Co lowered the density of the resulting component compared to straight WC-Co grades, due to the lower density of VC. The hardness of the specimens decreased with higher Co content, and increased with increasing VC content. Magnetic saturation measurements showed no significant difference between the WC-10Co and WC-67VC-10Co alloys, indicating that the high VC content did not change the solubility of W in Co. Rietveld analysis showed that the fcc/hcp Co ratio was higher in WC-10VC-30Co than in WC-30Co. Corrosion occurred mainly by the oxidation of the cobalt binder phase. A corrosion surface film formed only on the high VC content alloy. All the specimens exhibited pseudopassivity, but the extent of the pseudopassivity region for the WC-grade was 2.4 times than for the WC-VC-grade material. The corrosion current densities for WC-10Co and WC-67VC-10Co were similar, as were the magnetic saturation results. However, the fcc Co: hcp Co ratios of these and other samples, indicated that the high fcc: hcp ratio mirrored the greater corrosion depth, which occurred with VC additions and reduced with increasing Co additions. This is in disagreement with the conclusion of Broccardo (2003) that the corrosion current densities were similar.