A COMPARISON OF ELECTRICAL AND MAGNETIC MEASUREMENTS ON WC/Co HARDMETALS

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ABSTRACT

A study has been made of the variation of electrical resistivity with carbon content of typical WC/Co hardmetals. Carbon content is important in the quality control of WC/Co hardmetal parts because it influences the composition of the Co binder-phase and hence the overall hardmetal properties. Carbon content is usually monitored through magnetic measurements, either or both magnetic moment or magnetic coercivity. In this study the electrical conductivity of WC/Co hardmetals with controlled carbon contents has been measured using a four probe constant dc current technique. The conductivity increased with increasing carbon content, but was fairly independent of Co content and there was a good correlation with magnetic properties. The values of electrical conductivity were also probably affected by the WC grain size. The sensitivity of the conductivity measurements was compared with the sensitivity of the magnetic measurements. Measurements were also made on Co-W-C alloys and compared with models of the hardmetal resistivities. Comments are provided on the ease of use of the dc resistivity measurement technique, which is cheaper to apply than magnetic methods, and the potential for measurements of spatial variation of electrical properties.

INTRODUCTION

Hardmetal products that have consistent properties are vital to many sectors of engineering industry. The use of non-destructive (NDE) methods to assess consistency of structure is important because hardmetals have microstructures on a very fine scale that are difficult to inspect and they are strong and not easy to test mechanically. Hardmetals generally contain cobalt which is ferromagnetic. Consequently, measurements of magnetic properties are widely used in the industry to assess consistency. Both coercive force and magnetic moments are measured for this purpose. If interpreted correctly, they can be linked to the cobalt composition and hence overall properties and performance.

Magnetic measurements, however, require expensive equipment and there are constraints on the ability of the technique to measure structural variations across large products. Consequently, in the present