

Tribological properties of CrN_x coatings

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ABSTRACT

Purpose: The purpose of this work is the characterization of the tribological properties thin Cr-N coatings, both monolayer Cr₂N, CrN coatings and multilayer Cr/CrN, Cr₂N/CrN coatings, deposited by cathodic arc physical vapour deposition (CAPVD).

Design/methodology/approach: The deposition parameters of Cr₂N and CrN were determined. Structure of the coatings were investigated using the scanning electron microscopy (SEM). The XRD examination was carried out to specify the phase structure, EDS to define the chemical composition of the coatings. The investigation includes also microhardness, roughness tests, adhesion, friction coefficient and wear rate.

Findings: Basing on the scratch test it was shown that the influence of the architecture on the coating's adhesion is dominant. It was found that the all tested coatings show high critical load $L_{c2} > 70$ N. The multilayer coatings show higher critical load when compared to monolayer coatings.

Research limitations/implications: The main limitation of this work is linked to the deposition technique itself. It is difficult to avoid surface defects and pinholes that strongly influence the tribological results.

Practical implications: Chromium based coatings present good mechanical properties which allow them to be used in several applications; from decorative to protective coatings.

Originality/value: The comparison of adhesion and wear resistance of mono- and multilayer coatings based on chromium. The deposition technology enable to obtain the coatings with high adhesion to the substrate. This may be important to advanced coatings industry.

Keywords: Tool Materials, Mechanical properties, Wear Resistance, PVD, CrN, Scratch test; Tribological test

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1. Introduction

The application of CrN and other coatings obtained by means of the PVD methods is becoming increasingly popular in industry [1-4]. This stems from their good tribological properties. These are characterised by a relatively low friction coefficient, good wear resistance and a high corrosion resistance. Due to its exceptional abrasion resistance, chrome nitride is used as a coating in cutting, milling and screw-threading tools for the elements made of titanium and its alloys, brass, copper and other non-ferrous metals. It is also employed in covering

moulding forms, punches and parts of machines. Chrome nitride shows high chemical resistance and exceptionally little affinity to the machined non-ferrous metals. These coatings may be deposited by various PVD techniques, both magnetron and arc [5].

The coatings obtained by means of the arc method are characterised by a varied phase composition and crystallographic orientation, depending on the deposition conditions. Oden [6] points to the fact that, with the bias voltage at -300 V and the nitrogen pressure larger than 5 Pa, the CrN coatings obtained by means of the arc method show a privileged orientation (220). He also points out that hardness of such coatings is strongly depend on their internal stresses. The tribological properties of the coating-substrate system are connected with the hardness, elastic