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TRIBOLOGICAL PROPERTIES OF TiAlCrN THIN FILMS

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Abstract. The dry sliding wear of monolayer TiAlN, TiAlCrN and multilayer TiAlN/CrN coatings have been investigated against alumina counterpart. All tested films were deposited using cathodic arc evaporation with Ti/Al and Cr cathode. All coatings were deposited on Cr and CrN sublayers, which reduces stresses between film and substrate and causes adhesion increasing. Coatings with chromium show lower friction coefficient when compared with TiAlN film and meaningful lower wear rate of the coating. Increasing the normal force and bilayer thickness of multilayer coating causes reduction the friction coefficient from 0.85 to 0.77 and from 0.90 to 0.77 respectively. Wear rate for TiAlN was measured as $5x10^{-6}$ mm^3/Nm, for TiAlCrN $5x10^{-7}$ mm^3/Nm, for TiAlN/CrN $3x10^{-6}$ mm^3/Nm. Wear rate for alumina counterpart was at least an order of magnitude lower than tested coatings.

1. INTRODUCTION

End users of cutting tools require better efficiency for complex cutting operation, high speed, lack or minimum lubrication and highly abrasive materials. The use of TiAlCrN coatings for cutting tools both mono- and multilayer films has increased rapidly. This coating is very promising for its wear resistance caused its excellent high temperature corrosion and oxidation resistance which results in higher chemical stability when compared to TiN.

Deposition of thin films based on TiAlCrN using cathodic arc evaporation enables creation coatings with excellent adhesion and dense structure. These features are base of its application reducing production costs and increasing the output in many high speed or dry machining.

Ti(X)N coatings where X stands for metallic element introducing to the TiN lattice have been subjected to great interest. The group of titanium nitride coatings can be divided in three generations [1]. The first generation, titanium nitride monolayer coatings show many industrial applications connected with their attractive properties – high hardness, chemical stability, good wear resistance [2]. The second generation forms by introducing metallic element(s) to TiN coatings. The most important of them are TiAlN [3-6], TiAlCrN [7-9] showing excellent wear and oxidation resistance when compared with TiN [6]. These coatings predominantly shows higher hardness when compared with first generation films. Multilayer coatings are frequently named as the third their generation. With this group of coatings is connected technological progress because of their very high hardness [1,9].

Multilayer coatings show high hardness and toughness when compared with monolayer coatings. The latter of these features is very important because in many applications the cracking of the coating is unacceptable. Metal - ceramic composite multilayer coating show higher toughness and crack resistance as compared with single layered ceramic coatings. This has been at the expense of a reduced hardness and wear resistance [10].

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