Tribological performance of Cr/CrN and Cr/CrN/CrAlN multilayer coatings deposited by r.f. magnetron sputtering

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1. Introduction

The objective of this work was to analyze the surface states of the coated samples in terms of the friction coefficient evolution during dry sliding using two (02) different static partners (alumina balls & WC-Co balls). Samples were elaborated by R.F sputtering magnetron. The chemical compositions and some characteristics of samples are given in table 1.

The friction tests conducted on the surface of (CrN /CrAlN) samples are analyzed and compared to (Cr/CrN/CrAlN) samples. The results are interpreted basing on previous works [1] and are discussed with other reports [2].

2. Tribological tests

Tribological experiments were carried out using a real time ball-on-disk test machine from CSM instruments. Dry wear resistance tests were performed and the following experimental parameters were kept constant for all tests: Sliding velocity = 0.01 m s-1; Wear track diameter = 4 mm; Diameter of balls = 6 mm; Applied force = 1 N; Total sliding distance =200 m; Temperature=20°C and the relative humidity about 40±5%.

After the tribotests, wear rates of balls and the wear rates of the coatings were determined using standard equations. The wear mechanisms and the chemical composition of the wear debris and of the worn surfaces were studied using SEM/EDS analysis.

3. Results

The counterpart material has a distinctive influence on the tribological behavior of the coatings; consequently different wear mechanisms are shown. The Cr/CrN/CrAlN multilayer coatings present best resistance wears than CrN/CrAlN; The Cr under layer reduces the wear severity. The highest wear rates of disc were estimate for tribological contacts with Al2O3.

Table 1 Characteristics of multilayer coatings

Samples	Chem. Composition (at.%)			Thick. (nm)	Hard. (Gpa)
	N	Al	Cr		
1 Cr/CrN/CrAlN	51.8	4.2	42.9	1500	26
2 CrN/CrAlN	50.8	4	43.1	300	22
3 Cr/CrN/CrAlN	50.5	4.7	42.5	300	32
4 CrN/CrAlN	52	5	41.3	1500	17

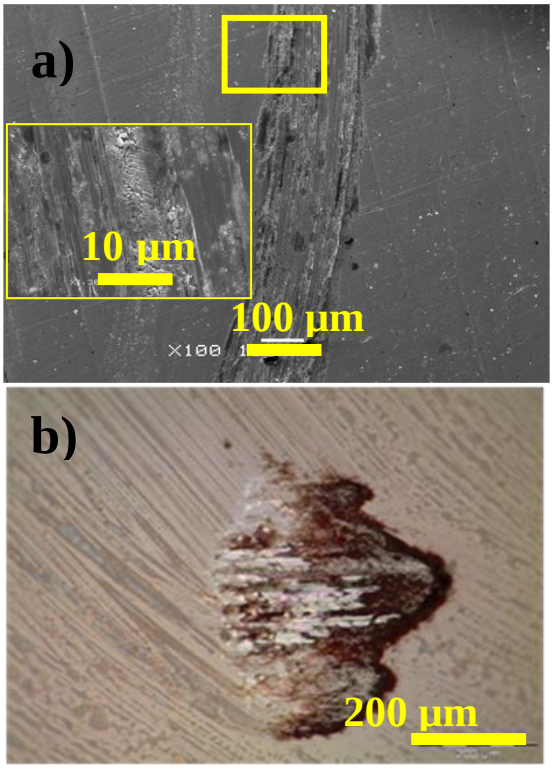

Fig. 1 (a)- Example of typical appearance of wear track on Cr/CrN/CrAlN after 200 m sliding distance against alumina balls; (b)-Corresponding wear scar on alumina ball; (c)-3D final wear track topographies corresponding to (a).

4. References

[1] B. Tlili, C. Nouveau, M.J. Walock, M. Nasri, T. Ghrib "Effect of layer thickness on thermal properties of multilayer thin films produced by PVD; Vacuum 86 (2012) 1048-1056

[2] J.E. Sanchéz, O.M. Sanchéz, L. Ipaz, W. Aperador, et al. "Mechanical, tribological, and electrochemical behavior of Cr1−xAlxN coatings deposited by r.f. reactive magnetron co-sputtering method"Applied Surface Science, 256, Issue 8, 1 (2010), 2380–2387