Nanocomposites and nanomaterials

The effect of temperature on tribological characteristics of (Ti-Zr-Hf-V-Nb-Ta)N nanocomposite coatings

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Frictional properties of multielement nanocomposite coatings has been studied by means of tribometry methods at a temperature of 500 °C. Balls of Al_2O_3 with 6.0 mm diameter were used as counterbodies. The structure of the wear grooves on the sample and the diameter of wear spots on the ball were studied by means of optical and scanning microscopy (NanoScan 450). Fig. 1 shows the image of the friction tracks at T = 25 and 460 °C.

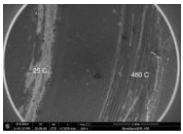

Fig. 1. Image of the friction tracks on the surface of the coating (Ti-Zr-Hf-V-Nb-Ta)N

The surface of the friction tracks contains of ZrO_2, TiO_2, etc. oxides. Unlike the friction at room temperature, high temperature friction has provided more intensive oxidation and subsequent restoration of the destroyed oxide films.

Table 1. Frictional properties of the coatings (Ti-Zr-Hf-V-Nb-Ta)N

Composition	Friction coefficient, μ	Wear of the coating, $mm^3/N/m$	Wear of the counterbody, $mm^3/N/m$	Remark
(Ti-Zr-Hf-V-Nb-Ta)N	1,06	$3{,}36\times10^{-5}$	$2{,}97\times10^{-6}$	T = 25 °C
(Ti-Zr-Hf-V-Nb-Ta)N	0,82	$2{,}23\times10^{-5}$	$7{,}36\times10^{-6}$	T = 460 °C

Tribooxidation of the coatings (Ti-Zr-Hf-V-Nb-Ta)N has the structural adaptation of the surface layers to the difficult conditions of high temperature friction as a result [1]. Oxygen-containing compounds on a metal base, which were formed in the process of friction, can act as a shield, protecting the surface from wear.

1. Pograbnjak A.D., Pshyk A.V., Beresnev V.M. et al. Protection of Specimens against Friction and Wear Using Titanium-Based Multicomponent Nanocomposite Coatings // Jour. of Friction and Wear. – 2014. – Vol. 35, No. 1. – P. 55-66.