PO2013

Production and characterization of carbon-based nanocomposite tribological coatings obtained by High-power DC magnetron sputtering

Pavels Nazarovs[1], Valery Mitin[1], Roberts Zabels[2], Vladimirs Kovalenko[1]

[1]SIA "Naco Technologies", Riga, Latvia [2]Institute of Solid State Physics, University of Latvia, Riga, Latvia

nazarow@gmail.com

Carbon-based nanocomposite coatings for tribological applications are of great interest in the automotive and other industries. High-power (>60 W/cm2) DC magnetron sputtering [1] is a promising technology for industrial application due to its high deposition rate and low production costs. With such high power densities the utilization of mosaic targets ensures equalization of sputtering rates for different target materials thus subsequently providing control over composition of the final product [2]. In this study a-C/Cu nanocomposite coatings (thickness ranging from 5 to 10 μm) with a carbon content from 7 to 40 at. % were deposited from mosaic-type circular planar targets onto different substrates (steel, glass and silicon) at rates up to 0.17 μm/min. Transmission and scanning electron microscopies demonstrate that films consist of copper nanograins (~20 nm) embedded in the matrix of amorphous carbon. Nanoindentation tests show a reasonable hardness of films (2 - 4 GPa) and low residual stress (0.25 - 0.3 GPa). The main advantage of the copper-rich nanocomposite films is their comparatively high plasticity in the investigated range of the copper content. The ratio of plastic work to total work of indentation is in the range of 76-85%. The study of the zone of plastic deformation around indents reveals formation of localized shear bands typical for the interfacial sliding mechanism [3]. Optimal tribological parameters with friction coefficient of 0.06 were obtained at 0.4 Pa pure Ar pressure, -100V bias voltage and carbon content in the range of 16 — 22 at.%.Obtained results characterize a-C/Cu nanocomposite films as a promising solid lubricant or as a plastic component in complex tribological nanocomposites.

1. V. Mitin, E. Sharipov, A.Mitin. Surface Engineering, 22/1, 5-10 (2006)

2. Yu. A. Mankelevich et al. Technical Physics Letters 39/1, 39-41 (2013)

3. J. Maniks et al. Surface & Coatings Technology 276, 279–285 (2015)

Keywords
a-C/Cu nanocomposite