Production of carbon-based nanocomposite films by high-power DC magnetron sputtering

U. Kanders[1], V. Mitin[1], D.Jevdokimovs[2], V. Kovalenko[1], P. Nazarov[1]

[1] Naco Technologies, Riga, Latvia

[2]Institute of Chemical Physics, University of Latvia, Riga, Latvia

e-mail: daniels.jevdokimovs@lu.lv

Obtaining and characterization of carbon-based nanocompocite films has become active areas of research due to their enhanced physical, mechanical and functional properties. A development of high deposition rate techologies provides an oportunity for their industrial applications. However, mechanisms of formation and properties of nanocomposite films obtained at high deposition rates have been investigated insufficiently until now. In this study high-power (>60 W/cm^2) DC magnetron sputtering technique [1] was used for the production of tribological copper-carbon nanocomposite films and nanostructured carbonitride Ti-Nb-C-N and multilayered Ti-C-N/Ti-N films. Coatings (5-14 μm thick) were deposited using mosaic-type circular planar targets onto different substrates (steel, glass and silicon) at rates up to 0.17 μm/min. Optimal tribological parameters for copper-carbon nanocomposites were obtained at 0.4 Pa Ar (99.999%) pressure, -100V bias voltage, power density in the range of 100-140 W/cm^2 and carbon content in the range of 16-22 at.%. Carbonitride films were sputtered in a reactive atmosphere of Ar and N_2 mixture at a total pressure of 0.35 Pa. SEM, AFM and TEM studies, mechanical and tribological tests show that the structure and main properties (hardness, coefficient of friction, wear resistance, adhesion) of films, obtained at high-rate deposition are similar or even better than those obtained by conventional sputtering technologies. In summary the results characterize the technique of high-power DC magnetron sputtering fit for industrial applications in areas of tribology and surface engineering.

Reference

1. S.A. Shiryaev, M.V. Atamanov, M.I. Guseva, Y.V. Martynenko, A.V. Mitin. V.S. Mitin, P.G. Moskovkin, JTP, **72**, 99 (2002).