Nanocomposites and nanomaterials

The influence of composition, thermal and radiation effects on the structure, substructure and strained state of ion-plasma coatings of Ti-W-C system

O.A. Shovkoplyas[1], O.V. Sobol'[2]

[1] *Department of Complex Systems Modeling, Sumy State University, 2, R-Korsakov Str., 40007 Sumy, Ukraine*
E-mail: sana@mss.sumdu.edu.ua

[2] *Department of Materials Science, National Technical University "Kharkiv Polytechnical Institute", 21, Frunze Str., 61002 Kharkov, Ukraine*
E-mail: sool@kpi.kharkov.ua

Application of carbide coatings for new equipment and devices under influence of intense fluxes of electromagnetic radiation, accelerated particles, high temperatures and high pressure presents special requirements for radiation and thermal structure stability of these materials. Coatings of quasi-binary systems interstitial phases based on 4th and 6th groups metals are among the promising materials resistant to thermal and radiation effects. This combination can be used as the basis to obtain materials with unique structural state and high functional properties.

It is shown that using phases with different heat of formation (TiC – relatively high heat of formation 183.8 kJ/mol and WC – with relatively low heat of formation 37.7 kJ/mol) as components of quasi-binary system allows to change phase structure from monocarbide, which is stable to high temperature, to multiphase state from phases of lower carbides. Increasing the temperature of the substrate during deposition leads to the growth of crystallites with primary size in the direction of incidence of the particles.

On the substructure level higher deposition temperature leads to a decrease of microstrain. Increase of TiC-component with a strong covalent bond also leads to decreasing of microstrain. Effect of TiC-component on makrostrain coating condition manifests itself in increasing quantities of residual elastic makrostrain which kept by coating.

Under irradiation by protons with an energy of 200 keV to a dose of $6.5 \cdot 10^{17}$ cm^{-2} relaxation growth makrostrain compression, which is best shown in the coatings enriched WC-component and reaches at the composition of 20 mol.% TiC – 80 mol.% WC relative change of 58%. On the structural and substructural levels coating showed stability of parameters that defined a good prospect of their use as radiation-resistant materials.