PO1076

Effect of nitrogen on tribological properties of X-ray amorphous carbon films with added titanium

Martin Hromadka[1], Petr Novak[1], Jindrich Musil[1]

[1]Dep. of Physics, Univ. of West Bohemia, Plzen, Czech Republic

martinh@kfy.zcu.cz

Recently, in many laboratories all over the world nc-TiC/a-C nanocomposite films with low friction μ (≤0.1) and low wear k (≤$2x10^{-7}$ mm^3/Nm) were successfully prepared by the magnetron sputtering; here nc- and a- denotes the nanocrystalline and amorphous phase, respectively. These nanocomposites are composed of TiC nanograins dispersed in the a-C matrix. The thermal stability of TiC is, however, low of about 450°C and therefore it is interesting to replace TiC nanograins with more thermally stable TiN nanograins. Such material can be easily created by the reactive magnetron sputtering from a composed C/Ti target in the argon + nitrogen discharge because the titanium nitride is preferentially formed in consequence of a difference in the formation enthalpy ΔH_f of TiC and TiN ($\Delta H_{f\,TiC}$=-183.8 kJ/mol and $\Delta H_{f\,TiN}$=- 336.6 kJ/mol). This way nc-TiN/a-C nanocomposite films were prepared. It was found that nc-TiC/a-C nanocomposite films exhibit better values of both the friction μ and wear k compared to nc-TiN/a-C nanocomposite films. The reason why the tribological properties of nc-TiC/a-C nanocomposite films are better than those of nc-TiN/a-C is explained using recently found correlation between the film hardness H and its effective Young´s modulus E^* [1].

References:

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Keywords
Tribology
Friction
Wear
Mechanical properties
Nanocomposite coatings