Nanocomposites and nanomaterials

Mechanical properties of multielement nanostructured coatings based on nitrides of refractory metals, obtained by means of vacuum-arc deposition method

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In recent times in order to ensure performance of machine details, a very promising method is to apply multielement coatings based on carbides, borides, nitrides and silicides of transition metals, combining high hardness, wear resistance, and heat resistance simultaneously [1,2]. The paper focuses on the structural-phase state of multielement coatings (TiZrSi)N, (TiZrCrNbSi)N, and (TiZrHfVNbTa)N, on their mechanical characteristics, such as hardness and tribological properties, on friction coefficient and on wear resistance. The coatings based on nitrides were obtained by means of vacuum-arc sputtering of unite-cast cathodes of the certain composition in the reaction atmosphere of nitrogen.

The influence of physical and technological deposition parameters (pressure of nitrogen, bias potential) on structure and phase composition of the coatings has been studied. Increasing bias potential up to 300 V leads to the intense nitride formation for (TiZrSi)N, thus increasing the hardness of the resulting coatings. It was shown that annealing (TiZrCrNbSi)N coatings at 700 °C leads to formation of new structural-phase state, thus changing Young's modulus and hardness of the coatings. Adhesive/cohesive strength of the coatings, scratch resistance and fracture mechanism were studied by means of Revetest scratch tester by "plane-ball" scheme (ball, d = 6.0 mm, made of sintered certified material Al_2O_3) in the atmosphere of air by the international standards (ASTM G99-959, DIN50324, ISO 20808). The load was 6.0 N, and the sliding speed 10 cm/s.

1. *Pogrebnjak A.D., Azarenkov N.A., Beresnev V.M., Litovchenko S.V.* Influence of deposition parameters on the structure and properties of nitride coatings // Ch.11 Books “Manufacturing Nanostructures”.-2014 **-**P. 294-320.
2. *Pogrebnjak A.D., Bagdasaryan A.A. Yakuhchenko I.V. Beresnev V.M.* The structure and properties of high-entropy alloys and nitride coatings based on them. // Russ. Chem. Rev **-83**, N 11, P. 1027 (2014).