Nanocomposites and nanomaterials

Effect of pressure working environment and high pulse stimulation on the structure, substructure and mechanical characteristics of vacuum-arc ZrN coatings

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Interest in the use of zirconium nitride as a protective coating on the details of assemblies in the instrument result of a combination of high corrosion and radiation resistance with high hardness and wear resistance. In general the functional properties of ZrN coatings depend on their structural state. Effective means of modifying the structure and stress state of the vacuum arc coatings are: changes in gas pressure and energy precipitable particles in the formation of the coating. In work (using the modernized installation "Bulat-6") were obtained coating of zirconium nitride in the pressure of the working atmosphere of nitrogen P_N = (0,003 – 0,7)Pa when the constant negative bias potential on the substrate (U_S) from 30 to 300V and extra high voltage pulsed stimulation (U_I) with an amplitude of 0.8-2.0 kV at a frequency of 7 kHz in order to clarify the laws of such "structural engineering".

By methods of a x-ray diffractometry in combination with a microindentation it is established that the increase in U_S leads to structure change from almost not textured to a biaxial texture state. At the level of the substructure U_S rise leads to an increase the average crystallite size (L) of 15 to 300 nm, with microstrain (<e>) at 0,59-0,68%. The use of additional pulse stimulation mobility of atoms during the deposition by filing U_I continue to rise L with increasing U_S. The value microstrain with increase pressure (when using pulsed stimulation) tends to decrease. Hardness of such coverings changes with U_S increase from 31 to 44 GPa P_N change at constant U_S = - 150B without stimulation leads to reduction <e> at nonmonotonic change of L. Use of pulse stimulation keeps a tendency to reduction <e> at increase of P_N and gets a tendency to increase of the average size of crystallites. Stimulation leads to the hardness increase which maximum (from 37 to 43 GPa) with increase in U_I are displaced in area of big P_N.

The received results are explained with two-level radiation influence in the course of sedimentation with stimulation at different P_N.