R&D of NSC KIPT in the field of superhard coatings synthesis by use of filtered vacuum-arc plasma flows

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The present report offers a short review of the results from investigations and developments performed in NSC KIPT by the authors and their co-workers in the field of vacuum-arc synthesis of a-C (DLC) films from filtered vacuum-arc plasma flows. Consideration is given to the development of key units of the process equipment, i.e., plasma sources with magnetic filters for cleaning the vacuum-arc plasma from macroparticles.

The high-efficiency large aperture L-shaped and two-channel T-shaped filters are described. With use of these filters the high-quality DLC, a-C:N coatings are received.

Results of experiments are presented on investigation of electrochemical and physical characteristics of nitrogen doped a-C:N films. Specific electrical resistance of the films measured in the direction across the layer is of $5 \cdot 10^3 \div 2.7 \cdot 10^7$ Ohm·cm. Electrochemical measurements on the electrodes coated with a-C:N films reveal more wide range of ideal polarization zone and low background current compared to uncoated glassy carbon. Under electrochemical characteristics the coatings deposited on glass carbon do not concede to the best world ones. It allows forecasting the wide opportunities of application of the synthesized coatings in the field of the electroanalysis, for electrochemical sewage water treatment, electrosynthesis and so on.

The possibility of two-component Ti-Al coating deposition by the vacuum-arc method of mixture of plasma flows from two plasma sources with cathodes made from the titanium and aluminium in system with the T-shaped two-channel plasma filter is shown. Mixture of plasma flows of two metals is achieved by creation of a magnetic field of acute-angled geometry at the system exit. Coatings deposited have uniform thickness and concentration of components in diameter about 180 mm. At average value of aluminium concentration in a coating of 40 wt %, standard deviation does not exceed 2÷3 wt %.

The results from the studies of the working properties of coatings at high-slide velocity conditions have formed the basis for developments of gas-dynamic and vacuum electrostatic supports for high-speed gyro devices of new generation. Here, a "wearless" pair of DLC-TiN coatings is used as an antifriction contacting pair. The use of these coatings holds much promise for precision dry-friction units in a wide range of relative sliding velocities of contacting surfaces in air, inert gas, hydrogen and in vacuum medium (in gyroscopes, centrifuges, gas lubricant bearings, compressor piston pairs, etc.).

Considerable advances are attained in the practical mastering of the vacuum-arc technology of superthin (~ 2.5 nm) coating deposition in the manufacture of hard discs and read-write heads of storage systems. The equipment and processes of DLC deposition are used now in an industrial production for deposition of wear resistant and corrosion resistant ultra thin films on magnetic heads of personal computers in the USA, Mexico, China, Thailand, Malaysia, Philippines and they also have found application in Republic Korea and Armenia.