

Synthesis and electronic structure of surface of CVD diamond films

Okotrub A.V.*, Polyakov O.V., Asanov I.P., Bulusheva L.G.

Nikolaev Institute of Inorganic Chemistry SB RAS, 6303090, Novosibirsk, Russia

**e-mail: spectrum@niic.nsc.ru*

The surface structure of diamond nanoparticles and films arouse an active interest, since just the chemical functionalizing of diamond surface exerts influence upon physicochemical and electric properties of diamond material. The synthesis of diamond films was performed employing AX5250 microwave plasma reactor (5kW power, Seki Technotron, Japan). The growth rate was amounting to about 10 $\mu\text{m}/\text{h}$ and acetone vapor was used as a reactant source of carbon. For monitoring the process of diamond film growth, substrate temperature was measured and plasma optical emission spectra were registered.

The best quality films have been obtained on polished silicon surface after preliminary sputtering the suspension of nanodiamonds using an aerographic spray method. The films obtained were characterized by the methods of Raman spectroscopy, IR absorption spectroscopy, etc. It was revealed that varying the substrate temperature and the composition of the gas phase provides changing in the orientation of crystallites at the film surfaces as well as in the structure of surface layer.

CK-edge absorption spectra of diamond films have been measured at the Russian-German beamline of synchrotron radiation source BESSY-2. Simultaneously, measurements were performed within the framework of X-ray absorption spectroscopy with the use of internal photocurrent and Auger electron emission techniques. Thus, it could be possible to observe the difference between electronic structures of the surface layer 1 nm thick as well as that at the depth up to 100 nm. The features surface spectra indicate an increase in the contents of C-H of bonds and somewhat increase in sp^2 carbon fraction. The measurements of photoelectron valence band and C1s XPS spectra of the same samples allowed us to reveal the correlation between an increase in sp^3 C-H bonds and sp^2 carbon content. Comparing the spectra corresponding to different ratio between surface atoms existing in different electronic states, we have revealed the features of spectra related to precisely these conditions. Cluster approximation quantum-chemical calculations have been performed in order to interpret the spectra measured.