A study of the local atomic structure of the ion-modified carbon film formed by magnetron sputtering on Fe surface

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Nano-sized carbon, graphite-carbide layers and films on metallic surfaces have a number of useful functional properties. For example, their high corrosion resistance is predicted. One of the promising methods of creating such films is ion-beam mixing of ultrathin layers of alloying material preliminarily deposited on the target surface by high energy ions. In combination with the magnetron deposition of the surface film of the doped material, this method can allow treatment of surface layers and creation of ultrathin nanometer coatings with high adhesion to the substrate under unified vacuum process conditions. The advantages of this method include a high purity of the process, the possibility of local effects, regulation of the depth of nanometer-scale processing by selecting irradiation parameters, exclusion of high-temperature effects on the material. In addition, ion-beam processing can create metastable states and structures that cannot be achieved by traditional metallurgy methods.

This paper is concerned with the study of thin carbon-nitrogen films formed on the surface of iron by the method of magnetron sputtering of carbon, followed by modification of the surface by N^+ ions. The local atomic structure is investigated by the method of extended fine structures of the electron energy loss fine spectra (EELFS). Experimental K-EELFS spectra of carbon and $M_{2,3}$ EELFS spectra of iron have been obtained. The experimental EELFS spectra were normalized to the calculated excitation intensity of the corresponding inner level. Parameters of the local atomic structure — partial coordination numbers, interatomic distances, and parameters of their dispersion — were obtained.

These results show an increase in the distance for a pair of C-C atoms, which is not typical of graphite. It is assumed that this is due to the implantation of nitrogen into the carbon film structure, which involves the formation of chemical bonds with carbon. The results obtained, coupled with XPS data, allow an assumption about the formation of a mixed structure, which consists of carbides, nitrides and iron oxides with a nonstoichiometric composition.

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