

The Formation of Thin Copper Films on Graphite Surface Using Magnetron Sputtering Method

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Abstract : The magnetron sputtering deposition method is often used to obtain thin film coatings. The main advantage of magnetron vaporization compared to other deposition methods is the high rate erosion of the cathode material (e.g., copper, aluminum, etc.) and the ability to operate under low-pressure conditions. The structure of the formed coatings depends on the working parameters of the magnetron deposition system, which is why it is possible to influence the properties of the growing film, such as morphology, crystal orientation, and dimensions, stresses, adhesion, etc. The properties of these coatings depend on the distance between the substrate and the magnetron surface, the vacuum depth, the gas used, etc. Using this deposition technology, substrates are most often placed near the anode. The magnetic trap of the magnetrons for localization of electrons in the cathode region is formed using a permanent magnet system that is on the side of the cathode. The scientific literature suggests that, after insertion of a small amount of copper into graphite, the electronic conductivity of graphite increase. The aim of this work is to create thin (up to 300 nm) layers on a graphite surface using a magnetron evaporation method, to investigate the formation peculiarities and microstructure of thin films, as well as the mechanism of copper diffusion into graphite inner layers at different thermal treatment temperatures. The electron scanning microscope was used to investigate the microrelief of the coating surface. The chemical composition is determined using the EDS method, which shows that, with an increase of the thermal treatment of the copper-carbon layer from 200 °C to 400 °C, the copper content is reduced from 8 to 4 % in atomic mass units. This is because the EDS method captures only the amount of copper on the graphite surface, while the temperature of the heat treatment increases part of the copper because of the diffusion processes penetrates into the inner layers of the graphite. The XRD method shows that the crystalline copper structure is not affected by thermal treatment.

Keywords : carbon, coatings, copper, magnetron sputtering

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