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Features of DC magnetron sputtering of mosaic copper-graphite targets

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DC magnetron sputtering of mosaic targets is a convenient method for production of multi-component coatings. However, the preferential sputtering of one of the target elements makes it difficult to reproduce the required coating composition. This work devoted to studying the magnetron sputtering of copper-graphite targets resulted in finding the regimes with equal sputtering rates of copper or graphite elements. Therefore, the composition of the produced coatings was determined by the given ratio of the areas of target elements.

A planar dc magnetron was used in our experiments. The targets were copper discs of 75 mm in diameter and 8 mm in thickness with cylindrical graphite inserts. The inserts were flush-mounted in a matrix in the area of the maximal erosion at the circle with $R=2.1$ cm. The discharge power density was in range of $P=16-90$ W/cm², pressure of the working gas – argon – 4 mTorr, the distance between the target and the substrate was 60 mm. At the initial stage of sputtering the mentioned rates considerably differ, as a result of which there arises a growth step about 1 mm between the surfaces of carbon and copper. The further sputtering with a power density greater than 45 W/cm² leads to the equal surfaces velocities about 10-1 mcm/s with constant step size.

The obtained data about the plasma composition and the results of the EDX analysis of the target surfaces show that there occurs embedding of argon and copper ions bombarding the target into the graphite surface.

A mechanism was proposed for the equal sputtering rates of the target elements with different sputtering yields. The mechanism takes into account the difference in depth among the mosaic elements, redistribution and focusing of ion flows between higher and deeper elements as well as mass-transfer in plasma and ion implantation into mosaic elements of another kind, which lead to the known sputtering yield amplification effect.

Keywords

magnetron
sputtering yield
mosaic target