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HIGH-RATE DEPOSITION OF COPPER OXIDE COATINGS USING MAGNETRON SPUTTERING OPERATED IN A METALLIC MODE*

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Coatings based on copper oxides (CuO_x) are of great interest due to high demand in many technological applications. For example, high absorption coefficient, good electrical conductivity and low cost make CuO_x films excellent material candidates for solar absorbers and p-n diodes [1, 2]. Nowadays, a lot of coating methods, such as sol-gel process, pulsed laser deposition and magnetron reactive sputtering, are used. The latter method has the wide application due to high quantity of control parameters and low cost of coating deposition. However, the presence of reactive gases in a vacuum chamber can lead to forming a thin layer of chemical compound (e.g., CuO_x) on target surface. It can induce change of the emission characteristics of the target surface in reactive atmosphere [3]. To solve this problem, we propose to separate the processes of target sputtering and coating condensation using separated supply of gases (Ar and O_2) and applying additional plasma source for dissociation and ionization of reactive gas near the substrate.

This study is aimed to determine the influence of process variables (oxygen flow, discharge power density and substrate rotation rate) on deposition rate and structure properties of CuO_x coatings deposited by magnetron sputtering in a metallic mode.

In this study the vacuum plasma of the Weinberg Research Center of Tomsk Polytechnic University was used. The scheme of the system is described in [4].

According to XRD study, CuO and Cu_2O phases and no Cu phase were identified in the deposited coatings. The intensities of CuO (110) and CuO (220) are noticeably higher for the coating which was deposited using a discharge power of 1 kW than that of 2 kW (Fig. 1). The sample obtained at O_2 flow rate of 27 sccm has Cu_2O (111) phase. The last results show that the phase composition of the copper oxide coatings can be controlled by changing the O_2 flow rate as well as the discharge power applied to the copper target.

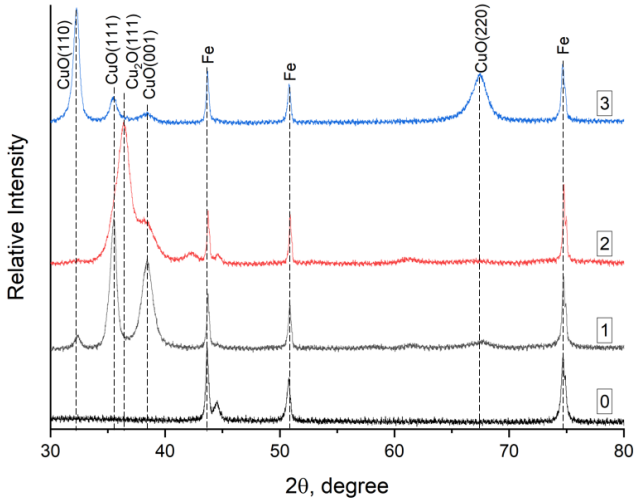

Fig. 1. XRD patterns of CuO_x coatings obtained at different discharge power and oxygen flow: 0 – uncoated substrate; 1 – 2 kW and 54 sccm of O_2; 2 – 2 kW and 27 sccm of O_2; 3 – 1 kW and 20 sccm of O_2.

Next deposition experiments demonstrated the role of the substrate rotation rate on the structural properties of copper oxide coatings, when magnetron sputtering in a metallic mode was used to deposit CuO_x coatings.

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