The magnetron sputtering deposition process is largely used in many industrial applications. It is possible to form a wide range of useful compound thin films by adding the reactive gas to the deposition process. Adding the reactive gas to the deposition chamber results not only in the formation of the compound on the substrate but the compound is formed also on the magnetron target. It is said that the target is getting poisoned. Unfortunately, in many cases the sputtering yield of the compound is much lower than the sputtering yield of the elemental metallic target material [1]. When the reactive gas flow is increased the deposition rate of the target material decreases slowly. However, when the growing thin film reaches its gettering capacity, deposition rate steeply drops and one need to decrease the reactive gas flow substantially to retrieve the reverse steep increase of the deposition rate [2,3]. So, the reactive sputtering deposition process controlled by the flow of the reactive gas exhibits the hysteresis behaviour with two sudden changes of processing conditions which are usually referred to as a transition from metallic to compound regime and a transition from compound to metallic regime. Such behaviour has been well explained by the famous Berg’s model [4,5].

Current models of reactive magnetron sputtering assume the uniform shape of the discharge current density. They are able to explain the general behaviour of the reactive magnetron sputtering. However, deviations between experiments and theory are usually attributed to the strong non-uniformity of the discharge current, which is not taken into account in the models. Recently, the evidence of the pronounced lateral variation of the target composition during the reactive sputtering deposition process has been shown [6]. We are presenting an extended model of reactive magnetron sputtering which assumes the non-uniform discharge current density. In order to keep number of free parameters low, we assumed cylindrical magnetron target and a triangle shape of the discharge current density normalized to acquire the same total discharge current as the Berg’s model [5]. The only additional parameter is the position of the triangle maximum, which was assumed to be in the middle of the target radius. Outputs of this model are compared to those, which assume uniform discharge current density. Particular attention is paid to the modeling of the radial variation of the target composition near the transitions from metallic to compound regime and vice versa (see Figure 1 and Figure 2).

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Fig. 1 Modelled radial variation of the target composition for four cases - shortly before (1) and after (2) the transition from the metallic to the compound regime; shortly before (3) and after (4) the transition from the metallic to the compound regime.

Fig. 2 Modelled dependency of the target composition at four different radial positions as a function of the reactive gas supply.

Reference