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## Features of mass transfer in the dual magnetron sputtering system

M. Tikhanovskiy, prof. A.Kuzmichev

*The work is devoted to calculation of mass transfer of sputtered species from two sputtering gas discharge magnetrons to a common substrate in the mode of free-molecular motion of the species in the space between the magnetrons and the substrate. Thickness profiles of films deposited onto the substrate are obtained for alternative and simultaneous work of the magnetrons.*

The magnetron sputtering method has significant advantages when it is used for deposition of thin films and coatings; it effectively sputters different materials and produces films of various composition and with multi-layer microstructure as well as precisely controls the deposition process.. We deal with the dual magnetron sputtering system since such system allows to obtain films with complex composition by mixing two sputtered materials or to deposit films with alternated layers of different materials. The question is: what thickness profile of the deposited films can be obtained in the dual magnetron system with sputtering targets inclined relatively each other and relatively a substrate. We have gotten the answer by modelling the transfer of sputtered material to the common substrate. Fig. 1

depicts the scheme of the sputtering set-up.

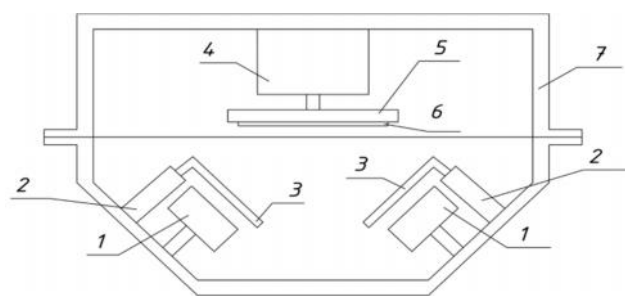


Fig. 1. Scheme magnetron sputtering set-up: 1 - magnetrons; 2 - shutter drives; 3 - shutters; 4 – substrate drive; 5 – substrate holder; 6 - substrate; 7 –chamber

The calculation is made by using the double cosine law [1] for free-molecular transport of species sputtered from points, disposed on the annular erosion zones of the flat magnetron targets, onto the flat substrate surface that is by integrating all partial sputtered species flows toward substrate surface points from each target point.

Unfortunately, there is a strong heterogeneity of the deposited film thickness profile due to the inclined position of the substrate relatively the targets, so a special drive configured for rotation and swinging of the substrate during the deposition process for aligning the thickness profile and composition of

films has been offered. The considered dual magnetron system is employed in Frantsevich Institute for Materials Science problems for producing multi-nanolayer coatings [2].

#### Reference

1. L. Maisell and R. Gleng, *Thin Film Technology. Handbook. Vol. 1*. Moscow: Soviet Radio, 1977. (Rus.).
2. P. L. Skriskii, A. I. Kuzmichev, V.I. Ivashchenko, et al., “Structural and Mechanical Properties of TIN/BCN Coating,” *Powder Metallurgy and Metal Ceramics*, vol. 52, pp. 73-82, 2013.