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Dual-magnetron open field sputtering system for sideways deposition of thin films

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Closed field co-axial dual-magnetron sputtering systems are used for synthesizing denser films with significant ion bombardment during the growth. On the other hand, open field co-axial dual-magnetron systems do not show promising results. Since, in this configuration plasma is extended towards the side, often towards the chamber walls. However, this side-transport of the plasma opens the door for the investigation of sideways deposition of thin films especially in the HiPIMS regime where recently an enhanced side-transport of ionized material has been discovered. In this work we used this side-transport to develop a dual-magnetron open field sputtering system for sideways deposition of thin films employing two identical Ti target cathodes. Both target cathodes were driven synchronously at the same voltage. The separation distance between the magnetrons was varied to optimize the deposition rate. The microstructure of the resulting films and the deposition rate were investigated by a scanning electron microscope (SEM). Optical emission spectroscopy (OES) was employed to investigate the ionized fraction of the sputtered material while the Langmuir probe method was utilized for the determination of plasma density by determining the electron energy distribution function (EEDF). It was found that the sideways deposition of good quality films can be made at reasonable deposition rates. High electron density of the order of 10^{-18} m^{-3} can be obtained which in turn provides highly ionized fraction of the sputtered material. The conclusion is that the system works well for the sideways deposition and provides a solution for coating tubular and complex shaped surfaces such as the interior of cylindrical shaped objects.

Keywords
Dual-magnetron
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Sideways deposition
HiPIMS
HPPMS