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Space Resolved Langmuir Probe Characterization of a DC Magnetron System for Titanium-Aluminum Thin Film Deposition

Direct current (DC) magnetron sputtering is a physical vapor deposition (PVD) method that is widely used in metal thin films deposition for industrial applications. It outperforms other PVD techniques because it is easy to control and is a low-cost option in depositing metal films. The technique utilizes magnets which are often used in the magnetron to confine energetic electrons which eventually increases ionization efficiency and effectively improves the deposition rate of the film onto the substrate. This paper reports on characterization of the plasma parameters of a DC magnetron glow discharge plasma in an annular magnetron system in argon. The DC magnetron sputtering system is assembled in the laboratory and houses the magnet assembly which is composed of annular magnets and target confined in the cathode. The plasma is produced by a high voltage DC power supply set at V=400-490 volts, working pressure of 1.88x10-2 to 7.5x10-2 torr, argon flow rate of 16-20 sccm and discharge power of 20-23 watts. Space-resolved measurement via cylindrical Langmuir probe is used as diagnostics for the estimation of plasma parameters such as electron temperature, electron density, floating potential, and plasma potential. Ti and Al thin films have been deposited unto Si substrates. Surface properties such as film thickness, hardness and adhesion strength are determined and analyzed with respect to the measured plasma parameters.

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