PO4001

Exploring sheath and pre-sheath models of magnetrons with wavelength resolved imaging

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Until recently, the Penning-Thornton mechanism (PTM) of sputtering, which assumes that secondary electrons are accelerated exclusively in the plasma sheath was considered for describing Magnetron sputtering. However Anders et al [1] recently estimated that the acceleration of the electrons in the PTM represents only 30% of the energy transferred to electrons, since further electron heating occurs by acceleration in the quasi-neutral pre-sheath. At high density, the drift of electrons in the quasi-neutral region makes a substantial contribution. This leads to ionisation humps both in HiPIMS and in DC Magnetron discharges.
Here we investigate energy transfers in magnetised discharges with a view to incorporating the appropriated physics in the modelling of magnetron sputtering systems. Wavelength filtered optical imaging (with an ICCD camera) has been used to map the excitation of different elements from target (Al, Cu, Ti) or gas (Ar). This has been done for different operating conditions (target, pressure, power). These data are interpreted in light of the local magnetic field (numerically simulated and experimentally verified). This technique is being used to explore the sheath and pre-sheath regions under different operating conditions (magnetic field, pressure and power) which have been compared with numerical simulation of the magnetron using different sheath models.
This work is part of a program sponsored by Innovate UK/EPSRC on Modelling of Magnetron Sputtering for High Value Manufacturing
[1] A. Anders Appl. Phys. Lett., 105, 244104 (2014)

Keywords
Magnetron Sputtering
Plasma Diagnostics
Modelling