

PO4080

Time Resolved Optical Emission Spectroscopy Measurements during PIII High Voltage Pulses

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PIII is characterized by a pulsed emission of secondary electrons and sputtered atoms is added periodically to the plasma. Whereas the majority of the secondary electrons, after being immediately accelerated to high energies in the plasma sheath near the substrate, are impinging into the chamber walls without interaction with the plasma, the sputtered atoms are much slower and more prone to interactions with the plasma. Compared to a more conventional experimental setup for GDOES, the PIII experiment is characterized by higher ion energies used for sputtering, lower pressures with a larger mean free path, shorter pulses and a higher relative energy density deposited by the passing secondary electrons. Using time resolved OES during PIII high voltage pulses, detailed insights into the interactions of sputtered atoms, secondary electrons and the low pressure plasma discharge are possible. The experiments were performed in an argon discharge powered by a 150 W ECR source at 0.3 – 0.8 Pa with 1.5 – 7.5 kV voltage pulses of 15 – 45 μ s length. The main component of the additional observed, transient optical emission beyond the baseline plasma is observed 20 – 80 μ s after the end of the high voltage pulse for already present Ar I lines. Moreover, neutral metal lines of Ag, Al and Cu – for the respective target materials – corresponding to low lying excited states are being detected. No emission of nitrogen or oxygen atoms sputtered from nitride or oxide materials have been observed. These effects scale with the mean free path of the secondary electrons, i.e. the more interaction of the secondary electrons with the background gas the higher the additional excitation of species. At the same time, a complex and varying peak shape points of the detected lines towards a behavior beyond a single excitation and thermalisation process inside the plasma with several time constants being involved. Thus, PIII cannot be used as a simplified GDOES experiment. Despite the wealth of data, a clear modelling of the active processes is presently not possible.

Keywords

OES

PIII