PO1023

Characterization of a High-Power Impulse Magnetron Sputtering discharge by Laser Induced Fluorescence Spectroscopy

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The High-Power Impulse Magnetron Sputtering (HiPIMS) discharge operating at 0.5-10 kHz of frequency with short pulse duration ranging from 5 to 30 μs was studied by means of Laser Induced Fluorescence (LIF) spectroscopy.
The relative densities of neutral and ionic sputtered species (e.g. Ti and Ti^+) have been measured at several spatial positions. The time evolution of the shape of selected plasma absorption lines during the pulse duration was evaluated by scanning the excitation frequency of the laser in order to follow the change of the particles energy distribution in time. Some of these results were compared to those obtained during DC magnetron sputtering experiments of the same materials in the same working conditions (i.e. the pressure, applied mean power, magnetron geometry).
In addition, the time-resolved imaging of the sputtered species was performed using a high-speed ICCD camera in order to visualize the evolution of the sputtering process.
The presented data are compared with those previously obtained in the DC and the HiPIMS discharges, in particular with the data obtained by optical emission spectroscopy [1]. Obtained LIF data allows apprehending the dynamics of the HiPIMS discharge, at the early stage of the sputtering process (i.e. when short pulses are used), in terms of gas rarefaction effect [2], energy distribution of particles, and deposition rate.
References:
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Keywords
high power pulse
laser induced fluorescence
spectroscopy
magnetron