KN0400

Understanding of HiPIMS through modeling and measurements

Nils Brenning[1], Michael Raadu[1], Huo Chunqing[1], Daniel Lundin[2], Ulf Helmersson[2], Catalyn Vitelaru[3], Gabi D. Stancu[3], Tiberiu Minea[3]

[1]Royal Institute of Technology, Stockholm, Sweden [2]Linköping University, Linköping, Sweden [3]Universite Paris-Sud, Orsay-Ville, France

nils.brenning@ee.kth.se

Over the last 1-2 years, a new level of high quality experimental data from HiPIMS sputtering magnetrons has been reported from several different groups. For example, emitting and swept Langmuir probes have yielded space- and time resolved electric potential profiles and electron energy distribution functions; Rogowski coils have been used to obtain space- and time resolved current densities, and tunable lasers for absorbtion and laser induced fluorescence (LIF) techniques has been used for non-intrusive measurements, highly relevant for the time evolution of the neutral gas density and temperature during the HiPIMS pulses. This combined data set makes it possible to test with new precision, bench-mark, and fine tune plasma models that have been constructed for HiPIMS discharges. Special attention is given to two issues. The first is how to correctly model the ionization region during the breakdown and plasma growth phases. Here central issues are the degrees of ionizations of the working gas and the sputtered material, the time variations in the electron density and effective temperature (including the role of the hot component of secondary electrons), and the gas depletion and refill in front of the target. The second issue is the electric field in the bulk plasma, and its effect on the transport of ionized sputtered material. Here, the central issue is the degree of anomalous electron mobility across the magnetic field, and how it is related to macroscopic parameters as the plasma density, the discharge current density, and the magnetic field strength.

Keywords
HiPIMS
Plasma Modelling
Plasma diagnostics