Modelling and Simulation of the Advanced Plasma Source


1 Electrical Engineering and Information Sciences, Ruhr-University, Bochum, Germany
2 Leibniz Institute for Plasma Research and Technology, Greifswald, Germany

Plasma Ion Aided Deposition (PIAD), a combination of thermal evaporation deposition and plasma-beam surface modification, is a well-established technology for the deposition of high quality optical coatings on mirrors, lenses, and other optical devices. (See schematic in Fig. 1). This presentation investigates a particular plasma beam source employed for PIAD, the Advanced Plasma Source (APS). A magnetic field enhanced glow discharge generates a radially expanding plasma flow with a final ion energy of 80 – 120 eV. Charge exchange collisions with the neutral background gas (pressure below 0.1 Pa) generate a cold secondary plasma which radially expands as well. A model is developed which describes the primary ions by a Boltzmann equation, the secondary ions by a fluid model, and the electrons by the condition of Boltzmann equilibrium and quasineutrality [1]. Solving the model yields central discharge features such as fluxes, densities, and the electrical field. An add-on Monte-Carlo simulation is employed to calculate the energetic particle distribution functions at the substrate. All results compare well to electrical and optical measurements conducted at a commercial APS system [2, 3, 4, 5].

References