Overview of glow discharges physics and applications

From magnetron plasmas to atmospheric pressure microdischarges

Jean-Pierre BOEUF

Université de Toulouse; UPS, INPT; LAPLACE (Laboratoire Plasma et Conversion d'Energie); 118 route de Narbonne, F-31062 Toulouse cedex 9, France.
CNRS; LAPLACE; F-31062 Toulouse, France.
Email : jpb@laplace.univ-tlse.fr

Glow discharge plasmas can be generated in a wide range of pressure conditions, from a few tens of mtorr as in magnetron discharges to the 0.1-10 torr range (typical of GDOES or GDMS applications) of standard DC glow discharges, and to the conditions of microdischarges at high pressure. The purpose of this lecture is to discus the basic physics of these discharges in the context of typical applications and to show how modelling can help understand the complex coupling between charged particle transport and electric field that takes place in glow discharge plasmas.

After an introduction on the properties of standard glow discharges under conditions typical of material analysis devices, some specific issues of the generation of glow discharges at high or low pressure will be discussed. This will include, for the high pressure range, the question of plasma uniformity and formation of self-organized structures in dielectric barrier glow discharges, which is directly related to the existence of a negative slope region in the current-voltage characteristics of glow discharges. In the low pressure range, we will show how a proper distribution of an external magnetic field can be used to confine the plasma in a magnetron sputtering device or to generate an ion beam for surface processing or space propulsion applications.