Self-Consistent Modeling of Particle Growth in DC Dusty Discharge

A. Michau [(*)1], G. Lombardi[1], L. Colina Delacqua[1], M. Redolfi[1], C. Arnas[2], X. Bonnin[1], and K. Hassouni[1]

[1] *LSPM, 99 avenue JB Clément, 93430 Villetaneuse, France.*
[2] *LPIIM, CNRS-Université de Provence, Centre Saint-Jérôme, Marseille Cedex, France.*
(*) armelle.michau@lspm.cnrs.fr

A self-consistent model of DC discharge containing dust particles is presented. Dust formation is described from the sputtering of molecular precursors to the nucleation of the particles and subsequent growth by molecular deposition and coagulation. Dusty discharge characteristics are obtained as function of the particle formation.

Nucleation and growth of nanostrusctured dust particules is of particular interest for different fields. In laboratory and industrial chemically active discharges, dust can affect the performance of produced electronic devices or films [1]. In the ITER reactor, for instance, they can pose important safety problems [2].

A modeling study of carbon clusters and dust particles formation through carbon graphite sputtering in argon DC discharges is presented. The model combines self-consistently the description of plasma discharge kinetics, molecular growth and transport of carbon clusters and aerosol dynamics for dust particles.

The proposed model is composed of different modules. The first one describes the DC plasma discharge containing negatively charged dust and precursors. The second is a detailed kinetic scheme for particle precursor formation. The last one solves for the dust total density, average mass and charge.

As soon as the charge density carried by precursors and dust particles becomes comparable to that carried by the electrons, dusty plasma effects can no longer be neglected. Coupling negatively charged precursors and dust in the discharge module reduces the electron density and electric confinement of these species, consequently, modifying the dynamics of particles formation and growth.

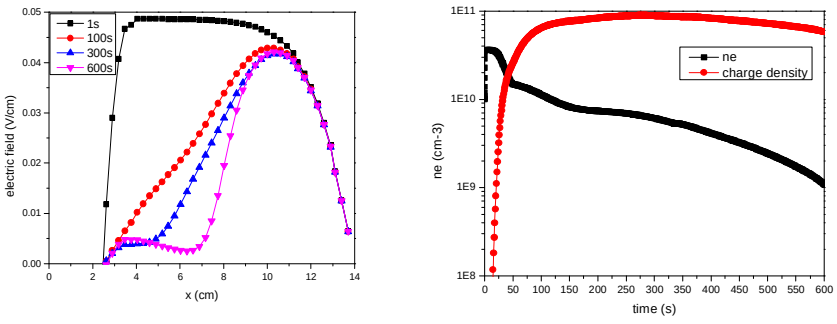

Figure 1 : (left)Electric field along the discharge and (right) electron and negatively charged precursors densities at the maximum position as functions of discharge time.

[1] S. Bouchoule, 1999 In: *Dusty plasmas: physics, chemistry & technological impacts in plasma processing* John Wiley and Sons Ltd,

[2] J. Winter, Plasma Physics and Controlled Fusion **40** (1998) 1201

*Work supported by ANR, under the project number ANR-09-BLAN-0070-01, and by FR-FCM under contract 4PWI.FR.11.05.