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Numerical simulation of plasma immersion ion implantation of a finite-length cylindrical bore with auxiliary electrode by two-dimensional fluid model

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Plasma immersion ion implantation of the interior surface of an infinite length cylindrical bore with an auxiliary electrode has been studied in some detail. The geometry considered so far is one dimensional with all variables as functions of the radial direction in cylindrical coordinates. If we consider a cylindrical bore with finite length, then the PIII process becomes a two-dimensional case that is a totally different class of problem. All the variables will depend on the radial and longitudinal directions in cylindrical coordinate. In this article, plasma immersion ion implantation (PIII) of the inner surface of a finite length cylindrical bore with a coaxial, grounded auxiliary electrode is modeled using a two-dimensional fluid simulation. A thin ring shape cylindrical bore is used in our simulation. It is found that the sheath structure resulting from the auxiliary electrode focuses ions from both inside and outside the bore onto the inner surface. To provide uniform implantation of the inner surface, it is recommended that the implantation process ends after the initial charge of ions is emptied from the bore.

3A05-06 *Invited*

Simulation of fundamental kinetic processes in dusty plasmas

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Dusty plasmas [1] are systems where a particulate is dispersed in plasmas. In most cases, the dust particles are smaller than either the ion or the electron Debye length and the plasma is partially ionized. Dusty plasmas have traditionally been studied in the context of astrophysical or space problems. More recently, the importance of dust in plasma reactors for semiconductor manufacturing have been recognized [G.S. Selwyn in Ref. 1].

Dusty plasmas exhibit complex collective effects. In some experiments dust particles introduced in glow discharges have shown a high degree of order, comparable to the regular lattice structure of solid crystals. The collective behavior includes the interplay of long range and short range interactions.

The long range interactions are due to the charging of the dust particles immersed in plasmas composed by electrons and ions with very different mobilities. Charged dust particles can interact via the Coulomb force and collective effects mediated by the electric field. The short range interactions include collisions between dust particles and plasma species (leading to the charging of the dust particles) and the friction force between dust and gas or plasma.

The simulation of such complex systems requires the inclusion of long range and short range interactions in the same model. In the present invited presentation, a method to simulate dusty plasmas including all the primary effects is described. The method uses a kinetic approach and allows a detailed microscopic description of the system [G. Lapenta in Ref. 1]. The most characteristic feature of the method is the use of the immersed boundary method [2] to describe the short range interactions between plasma species and dust particles.

The application of the method to simulate dust charging [3] and interactions among dust particles is described for realistic conditions found in experimental devices used to investigate dust crystals in glow discharges.

References

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