Seminar

Institute for Plasma Research

Title : Physics and Application of Sheaths Involving Negative Ions

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Date : 28th February 2020 (Friday)

Time : 10.30 AM

Venue : Seminar Hall, IPR

Abstract :

The present thesis devotes to fundamental study on sheath and its application towards electrostatic probe diagnostic in presence of negative ions. In particular, the characteristics of sheath in presence of a negative ion emitting electrode has been analytically studied and its impact on the quasi-neutral pre-sheath is investigated. It is found that the emission has remarkable impact on the transport of negative ion across the sheath, as a consequence of which the Bohm speed for positive ions, sheath thickness and the pre-sheath potential structure are greatly influenced. The negative ion emission from a plasma facing electrode has important application in plasma based negative ion sources for producing MeV range of neutral beam and in magnetron sputtering discharges during oxide coating of optical instruments. A comprehensive part of the thesis assists in an in-depth understanding of sheath and pre-sheath phenomena in the above scenario.

In conjunction to the above, the sheath models for a non-emitting cylindrical wire have been developed to estimate the negative ion parameters in electronegative plasma by means of electrical probes. Two new techniques have been developed for the first time. These are; (a) Using floating potential of a cylindrical Langmuir probe to determine negative ion temperature and; (b) a unique DC biased hairpin resonance probe to infer plasma parameters namely plasma potential, sheath width, electron temperature and negative ion concentration in an argon/oxygen discharge. Determining negative ion parameters is important in etching/deposition process using electronegative plasma, where the heat flux provided by the positive ions on the substrate is greatly influenced due to presence of negative ions. Moreover, the dc bias hairpin in particular, is a unique device for validating various sheath models, which are otherwise difficult to measure due to sheath dimensions being extremely small. This presentation will provide the outline of the present thesis and briefly discuss the important results obtained from this research work.