Seminar

Institute for Plasma Research

Title : Magnetic field effects on Cold Hollow Cathode DC Discharge - An Experimental and Modeling Study

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Date : 16th March 2020 (Monday)

Time : 10.15 AM

Venue : Seminar Hall, IPR

Abstract :

An experimental and modelling study of a Cold Hollow Cathode discharge operated in a DC mode in the presence of an external magnetic field is presented. In particular, two distinct plasma sources having electrode configurations; (1): cylindrical hollow cathode with an axially placed constricted anode and (2): cone-shaped hollow cathode with a constricted anode at its minor end has been designed and investigated. It is found that the magnetic field has a phenomenal effect on the discharge performance of these devices as well as it also impacts the properties of the produced plasma column. A detail characterization of the plasma column has been performed using a single Langmuir probe, which provides key insight into the role of primary electrons in the sustenance of the downstream plasma column. It was demonstrated that the secondary electron emission yield can be enhanced by providing an oblique cathode surface w.r.t B-filed instead of applying it tangential to the cathode. The current closure through the plasma column to the opposing electrode by the primary electrons has been depicted through an equivalent electrical analogy. On the basis of electrical discharge parameters a phenomenological model has been given for explaining the formation of an elongated plasma column under the application of axial magnetic field in a linear device. Moreover, an in-depth analysis of Langmuir probe characteristics to extract the information of the hot electron population has been recommended for the case when the reference electrode is partially conducting to the ground.

A significant part of the work is focussed on the development of an analytical model to characterize the DC hollow cathode discharges for cylindrical/cone-shaped cathodes. These analytical results are found to be in excellent agreement with the experiments. The formulated discharge models validate the radial plasma density profiles in the presence of axial B-field. From the engineering perspective, the modeling results in this study are extremely useful for the design and optimization of DC plasma sources based on the concept of magnetized hollow cathodes. This talk will present the outline of the thesis and briefly discuss the important results obtained from this research work.