Seminar

Institute for Plasma Research

Title : Development of a cesium coated dusty negative hydrogen ion source

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Date : 1st May 2015, Friday

Time : 03.00 PM

Venue : Committee Room 3 (New Building), IPR

Abstract:

ITER relevant high current negative ion sources rely on surface production technique, where impinging hydrogen particles (H and/or H^+_x) reflect back as a negative hydrogen (H^-) ion by picking up electrons from a surface with a low work function [1]. In general, Cesium (Cs) coated tungsten (W) grid is used as a low work function surface for H^- ion production. An experimental setup to verify a novel concept regarding surface assisted volume H^- ion production using cesium (Cs) coated tungsten (W) dust into a hydrogen plasma, is described here. In the present work, cesium coated W dust particle are injected into the hydrogen plasma to produce H^- ions through surface production route. The hydrogen plasma is generated by a hot cathode filament discharge method in a dusty plasma device. A full line cusped magnetic field cage of surface field at the cusp ~ 1.2kG is used to confine the plasma elements. Cs coated W dust particle is produced in-situ in a Cs coating unit, which is fitted vertically on the plasma chamber. The Cs coated W dust particles are allowed to fall into the plasma due to gravity. A cylindrical Langmuir probe with tungsten probe tip having 0.15 mm diameter and 10.0 mm length is used to study the plasma parameters for various discharge conditions. Negative ion density is estimated using a cylindrical Langmuir probe [2 - 4] and the production of negative hydrogen ion is confirmed by measuring H_α, H_β intensity ratio using optical emission spectroscopic (OES) technique [5]. To measure the Cs vapor density in the coating unit, a surface ionization detector (SID) is used [6]. Since Cs coated W dust particle act as a birth spot for negative hydrogen ion production in our present work, so the dust charging play a vital role in the production mechanism. Therefore, different controlling parameters are studied for plasma parameters and dust charging to optimize the H^- ion production from Cs coated W dust particles. The effects of secondary electron emission, cesium monolayer, confining wall potential, argon addition and working pressure on dust charging in hydrogen plasma are mainly studied. The effect on EEPF in presence of dust grains in plasma at different discharge conditions is also summarized. From the recent experimental observation, the H^- ion density is estimated as of the order of $10^{15}/m^3$ for the plasma density of $10^{16}/m^3$.

References:

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