Characterization of Hydrogen Plasma Generated by Hybrid Method Using DC-Arc and RF Discharges

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A high heat load in the divertor is a critical issue in the development of DEMO. To investigate the physics of divertor plasma assumed in DEMO, a high-density (~10^{20} m^{-3}) and large-diameter (~10 cm) hydrogen plasma device is required [1]. In particular, the significance of larger-diameter plasmas for understanding plasma-gas interactions, including the effects of photon absorption, in DEMO divertors is emphasized. We are then developing a hybrid discharge method using a hot cathode arc discharge and an RF discharge as one of the plasma sources to meet such requirements. By filling the periphery area around high-density arc plasma with RF plasmas, high-density and large-diameter plasma generation will be realized.

Hybrid discharges were carried out using a hot cathode arc discharge source and an RF helical antenna in CTP device, a linear device with a 1.2 m length. We have already obtained initial results of expanding the plasma diameter and density increase in a hybrid argon discharge [2]. Here we show a recent result of an experiment with a hydrogen plasma. Radial electron density n_e profile in cases of arc only and hybrid discharge are shown in Fig. 1. In the case of hybrid discharge, the plasma diameter (FWHM) is about four times as large as that of arc discharges. As shown in Fig. 2, the RF power dependence of n_e (center peak position) and suggests that the RF field contributes to both particle diffusion loss and plasma generation. In the presentation, the mechanism of hybrid discharges will be discussed, showing the dependence of n_e profile on magnetic field strength and arc discharge current.

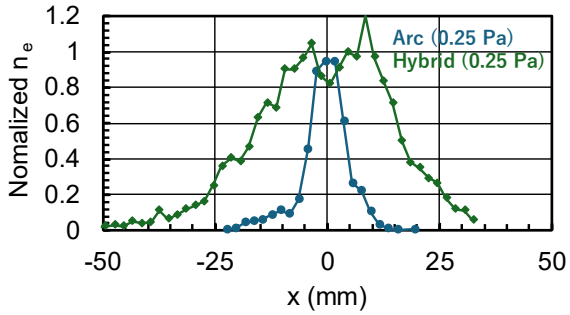

Fig. 1. Radial profile of n_e normalized by peak density. 15 A discharge current, 500W RF power.

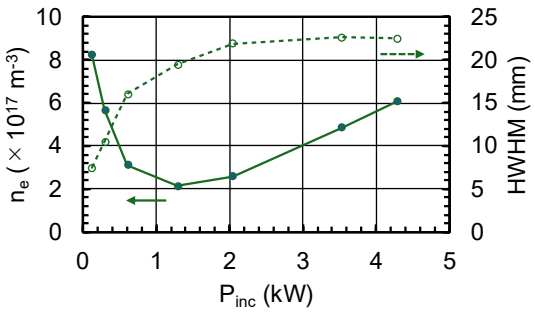

Fig. 2. RF power dependence of n_e and HWHM in hybrid discharges. Discharge current was 25 A.

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