Characteristics of TPD Arc Plasma Source Using Large Diameter LaB_6 Cathode for Pilot GAMMA PDX-SC

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Divertor simulation experiments using linear plasma devices are required to support the DEMO divertor design. We have constructed a new linear device, the Pilot GAMMA PDX-SC (PGX-SC), designed to generate steady-state, high-density plasma equivalent to that of a DEMO reactor divertor.

The PGX-SC has two superconducting coils, generating a steady magnetic field of up to 1.5 T, and uses a plasma source that employs a hot cathode arc discharge to generate steady-state high-density, large-diameter hydrogen plasmas (Fig. 1a). The hydrogen plasma generated by hot cathode arc hydrogen discharge was previously unstable, had low density, and a small diameter. The PGX-SC dc plasma source consists of a LaB_6 cathode with a 150 mm diameter, a copper anode, and five intermediate floating electrodes (Fig. 1b). The inner diameters of these electrodes are designed to align with the magnetic field lines generated by the superconducting coils and contribute to the large-diameter plasma. The size of the cathode, aligned with magnetic field geometry, contributes to the generation of large-diameter plasma.

A steady-state hydrogen plasma with an electron density of approximately 10^{18} m^{-3} and a throat diameter of about 2 cm has been successfully generated. However, a hollow electron density profile has emerged as a new challenge, underscoring the need for more precise control over the spatial distribution of electrons. To achieve the target density of 10^{20} m^{-3}, we are currently exploring new plasma control techniques and refining our operational procedures. Furthermore, to obtain a uniform density distribution, sufficient and uniform heating of the large-diameter cathode is required.

The presentation will explain the progress made so far and discuss the prospects for future developments.

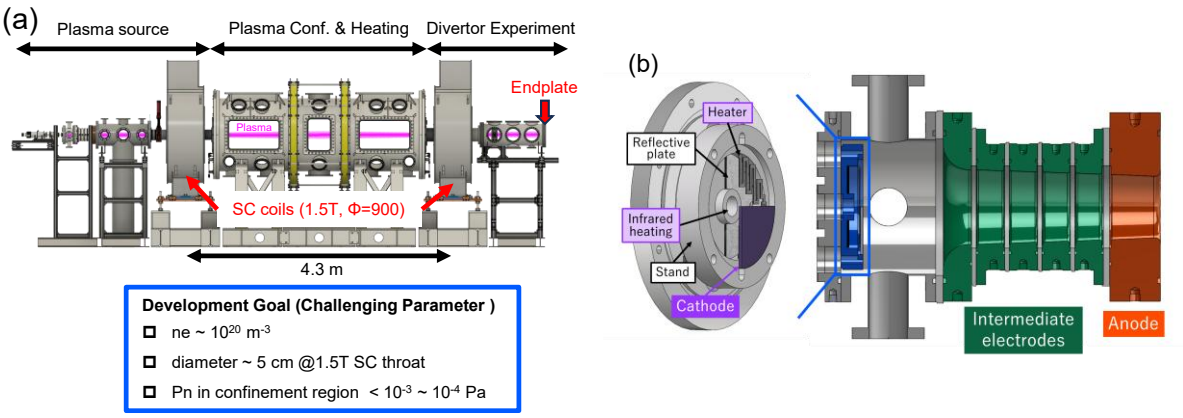

Fig. 1. (a) Schematic of the Pilot GAMMA PDX-SC and (b) the hot cathode arc plasma source used for hydrogen plasma generation.

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