

§59. Design of Boronization System for LHD Plasma Vacuum Vessel

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Boronization system using decaborane is designed for LHD plasma vacuum vessel. Boron is one of the wall conditioning materials for plasma device to get rid of oxygen impurities. In the LHD device, baking temperature of plasma vacuum vessel is limited at 100 °C, because superconductor coils and 80K shield plates should be protected. Thus, the wall conditioning system is important for LHD experiments. Thus R&D works of boronization have been performed with SURface modification Teststand (SUT), then the boronization system for the LHD plasma vacuum vessel is designed according to these results.

Gases for boronization and caribration are supplied from the cylinders cabinet with a blower system. B₂H₆(5%)+He, H₂, CH₄ and CO are set in the cabinet. All gasses are exhausted through an poisonous gas filter system. He, N₂ and compressed air are supplied from the utility lines. During boronization, the working pressure in plasma vacuum vessel is kept under 20 mTorr of B₂H₆(5%)+He.

The gas is supplied from 5 nozzles on upper ports of LHD plasma vacuum vessel. The flow rate of supplying gas is controlled by Mass Flow Controller (MFC), the rate is 1600 SCCM. Gas sensors for each gases are set in the cylinder cabinet, in the injury excluding line and in the experimental room (environment).

The vacuum pumping system with two CMP is used exclusively for boronization. The exhaust gas is mixed with N₂ gas and the line is jointed to the injury excluding system. The vacuum pumping rate is 1000 L/s during boronization. After boronization, the gas supplying line between the cylinder cabinet and the LHD plasma vacuum vessel is cleaned by another vacuum system with TMP and RP and purged by He gas.

Then boronization is performed by a DC glow discharge system. To make thickness of 200 nm B coating film on 300 m² of plasma vacuum vessel, DC glow discharge is performed for 6 hours.

The control system for boronization operates the vacuum pumps, blower, valves of gas lines, MFC, pressure of gas lines and signal of gas sensors. Communication to the LHD central control system is held from the control system of boronization for interlock. The control system is located in the experimental room and remote control from the central control room is possible by a local terminal.

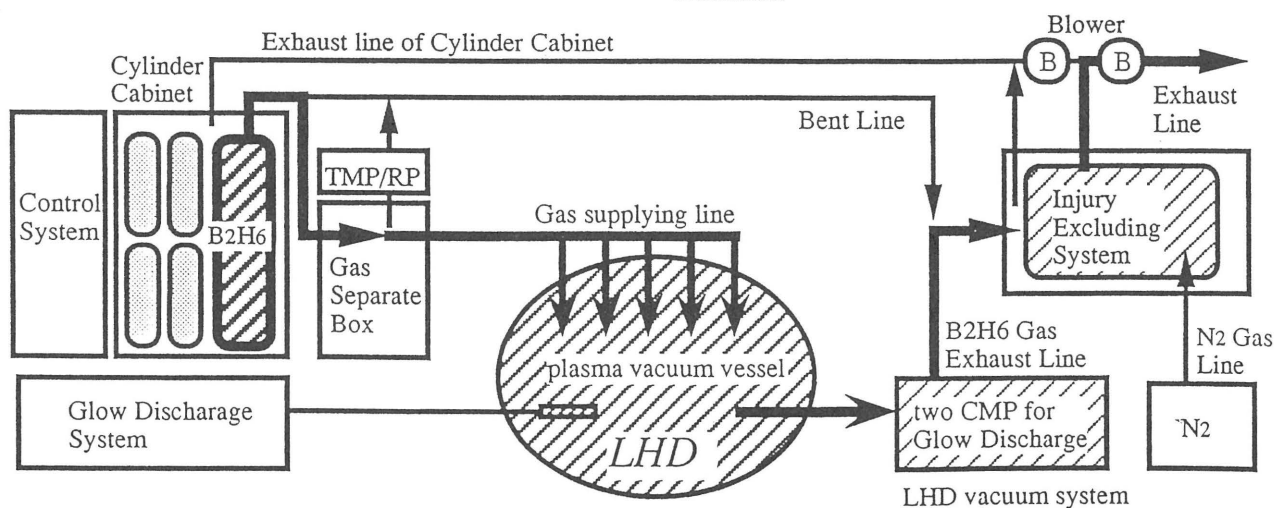


Fig.1 Boronization system for the LHD plasma vacuum vessel.