§ 35. Boronization in LHD

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In Large Helical Device (LHD), boronization (boron coating) using diborane gas was started as a part of wall conditionings from FY2001 (5th campaign of experiments). Oxygen and metal impurities were reduced and the operational density limit exceeded $1x10^{20}$ cm^{-3} In 2002 two new nozzles for the diborane gas supply were installed in LHD. More than 60% of the vacuum chamber surface was expected to be coated with the boron. Figure 1 shows a layout of the new Boronization system. New two supply nozzles are connected to the original diborane supply unit with co-axial tubes for safety. Flow rate of supplying diborane gas is controlled by a mass flow controller (MFC) in the diborane supply unit.

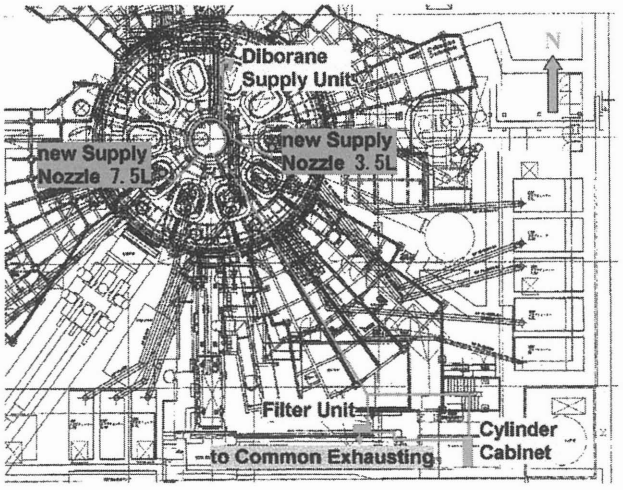

Fig. 1. Layout of the Boronization system.

During the 6th experimental campaign, boronization was carried out three times, December 3, December 16 and January 7. Duration of boronization was 5 - 7 hours and supplied volumes of diborane were about 20 NL in each boronization. Averaged thickness of the coated boron film estimated from supplied diborane volume was 25 - 50nm. In this estimation, we used the following data; total surface of the vacuum vessel is about 760 m^2 and the density of the boron film is about 1.2 g/cm^3.

Figure 2 shows comparison of line intensities of Oxygen (OV) and Carbon (CIII) divided by the averaged density between before and after boronization. The oxygen intensity reduced to less than 1 % of that before boronization. Total radiation power also reduced to 40-60% of that before boronization.

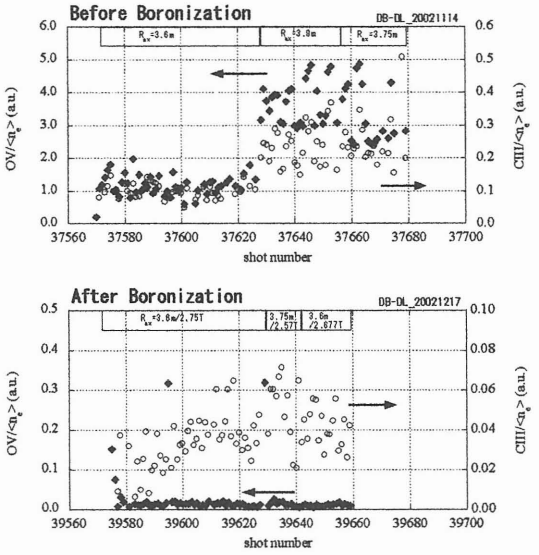

Fig. 2. Comparison of emission lines of Oxygen (OV) between before and after Boronization.

Figure 3 shows an operational regime of density and stored energy before and after boronization. The solid symbols and the open symbols show the data before and after boronization, respectively. Gas was supplied by gas puff. Although the stored energy in R_{ax} = 3.6 m tends to saturate in a high density regime, the electron density exceeds $1x10^{20}$ cm^{-3} after boronization in both R_{ax} = 3.6 m and R_{ax} = 3.75 m cases.

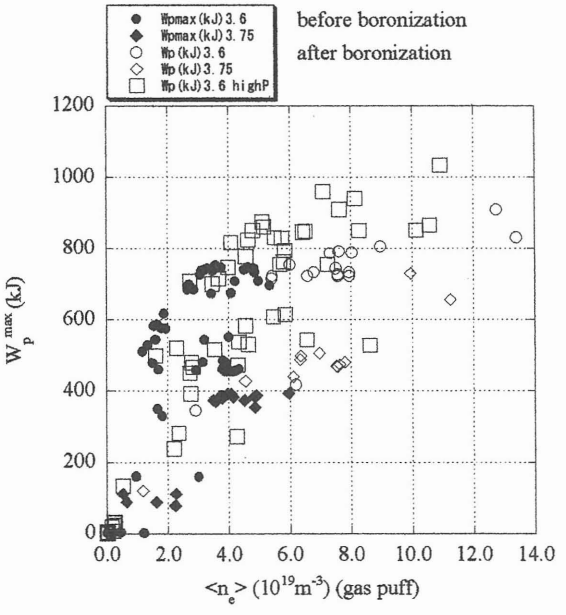

Fig. 3. Operational regime of density and stored energy before and after boronization.