§10. H/D Ratio Measurement

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Ion cyclotron range of frequency (ICRF) heating has been applied in Compact Helical System (CHS) which is a low aspect-ratio helical device (R/a=5). The magnetic configuration of helical system is more complicated than that of tokamak. It is reported that the confinement of ions accelerated perpendicularly to the magnetic field is not good in CHS because of the existence of large loss cone region.[1,2] Therefore, the electron heating using the mode conversion in the ICRF experiment with two-ion resonance heating method is utilized as a main heating process rather than the ion heating. For this scenario the hybrid resonance structure is sensitive to the minority ratio. It is an important issue to investigate the relation between the ratio of hydrogen to deuterium (H/(H+D)) and ICRH heating efficiency.[3]

The boronization using decaborane ($B_{10}H_{14}$) has been performed to reduce impurities and to improve the plasma parameter. The metal and oxygen impurities can be reduced by the boronization rather than the titanium gettering in case of ICRF plasma. Much hydrogen gas, however, comes out from the vacuum wall because the decaborane gas is a hydride. Therefore, it is important issue to control the H/(H+D) ratio using ECR discharge cleaning and gas-puff control in the ICRH experiments as shown in Fig. 1. We observe the H/(H+D) ratio from the intensities of H_α (656.10 nm) and D_α (656.28 nm) spectra. In this method, the H/(H+D) ratio near the edge is obtained because the H_α and D_α are mainly located at the plasma edge. The visible spectroscopic measurement is more simple than the conventional neutral particle analyzer with electric-magnetic field. Unfortunately, our neutral particle analyzer can not separate the hydrogen from the deuterium as it consists of only the electrostatic analyzer. Then, it is needed, at least, to measure the H/(H+D) ratio with the large toroidal asymmetry due to the gas-puffing, ICRF antennas and other in-vessel components. The purpose of this study is to make clear the influences of the wall conditioning after the boronization and to investigate the relation between the heating mechanism and the minority ratio. When the hydrogen minority decreases, the ion heating is expected. The maximum stored energy is obtained with the minority ratio of 30 % at a line-averaged density of 3.3×10^{13} cm^{-3} as shown in Fig. 2.

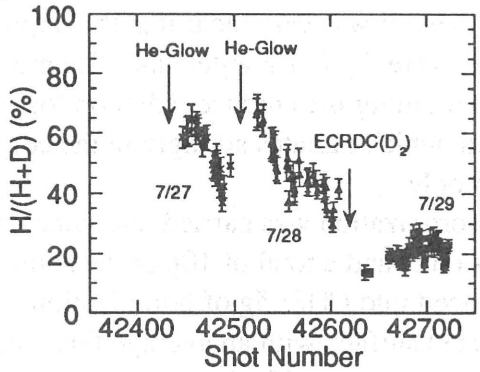

Fig. 1. History of the H/(H+D) ratio after the boronization. The boronization has been done from 20th to 22nd on July. ECR-DC has been carried out at evening on 28th.

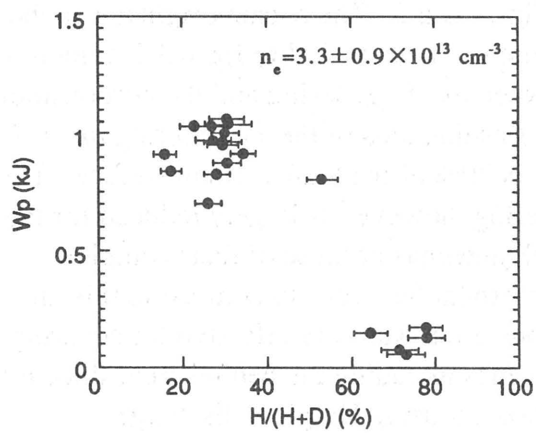

Fig. 2. H/(H+D) ration in the ICRH experiments. (The stored energy).

References

1) Okamura, S. et al., IAEA-CN-56/C-2-4 (1992).

2) Ozaki, T. et al., Bull. APS, 6Q10, 38 (1993).

3) Ozaki, T. et al., proc. Toki Conf. 94.(1994).