§20. H⁻ Density Measurement in the 1/6-Sized Negative Ion Source with Magnetic Filter

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In most negative hydrogen ion (H^-) sources, weak magnetic field is applied in front of the extraction system for the high-energy-electron filter. Investigation of the behavior of H^- in this magnetized region called extraction region must give an important information to optimize the extracted H^- beam. Therefore, we are studying the characteristics of H^- density in the extraction region. For this purpose we have used the ion source which was primarily developed as the 1/6-scaled test source for N-NBI of Large Helical Device at NIFS[1]. It has the size of 35 cm x 35 cm in cross-section and 18 cm in depth and is surrounded by multicusp magnetic field (Fig. 1). At the extraction region, there is an external-typed filter magnetic field of 500 Gauss•cm. The photodetachment technique [2] is applied to measure the H^- density in the extraction region. A Nd-YAG laser (wavelength; 1064 nm) and L-shaped probe of 0.7 mm in diameter are employed for this method. The longer part of the probe (10 mm in length) is coaxial with the laser path. The laser is introduced into the ion source through quartz windows on the side walls.

Figure 2 shows the time evolution of the electron density and the H^- density measured with filling pressures of 0.9 Pa and 1.4 Pa. At 0.9 Pa H^- density reached a rather high value at the beginning of a discharge faster than electron density did, but the ratio rapidly decreases. At higher pressure, H^- density gradually increased. This observed time variation of H^- density is due to the change of the density of neutral spiecies during a discharge by pumping from the ion source.

It was also found that the optimum gas pressure existed for H^- production in the extraction region, and that it became higher as the arc power. This result corresponds to many researches which report the optimum gas pressure for the extracted H^- beam current tends to be higher at higher arc power under pure hydrogen discharge.

References;
1) Takeiri, Y., Ando, A., Kaneko, O., Oka, Y., et al., Proc. the 16th Symp. on Fusion Technology, London, (1990), p. 1012
2) Devnck, P., Auvray, J., Bacal, M., et al., Rev. Sci. Instrum. 60(9) 2873 (1989)

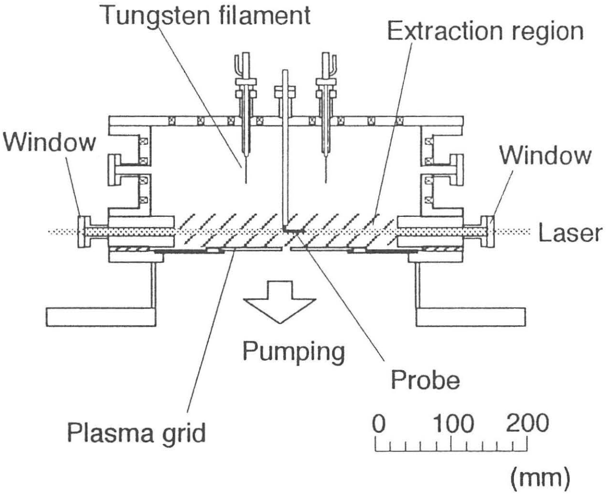

Fig. 1. A schematic diagram of the 1/6-sized ion source, including the laser and the probe for photodetachment method.

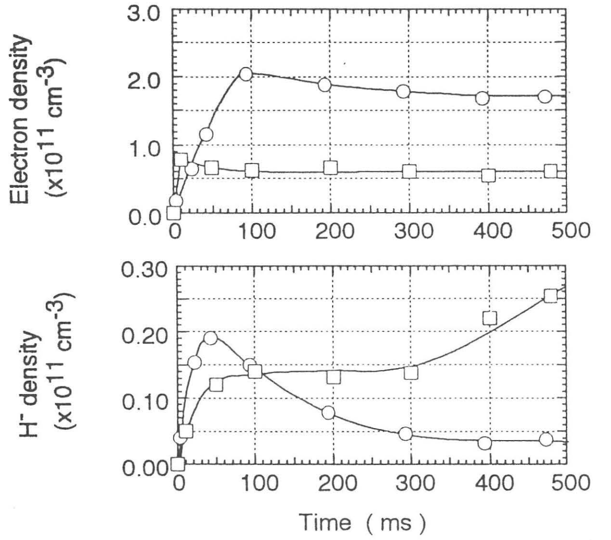

Fig. 2. The time evolution of the electron density and the H^- density (circle; 0.9 Pa, square; 1.4 Pa).