§2. H^- Photodetachment by Nd-YAG Laser at 1064, 532 and 355nm

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The fundamental frequency (1064 nm), the 2nd harmonic (532 nm) and the 3rd harmonic (355 nm) of a Nd-YAG laser have been used to investigate the influence of the photodetached electron energy upon the determination of the H^- density and the H^- drift velocity in a hydrogen plasma.

The discharge chamber consists of a stainless-steel vessel of 270 mm in length and 210 mm in diameter. Ten rows of ferrite magnets, surrounding the vessel, and four ferrite magnets on the end plate are arranged to produce a multicusp magnetic field for plasma confinement. The influence of the magnetic field on the H^- density and the H^- drift velocity is negligible at the center of the vessel. Two tungsten filaments attached to current feedthroughs located on the end plate generate primary electrons. Since these high energy electrons are confined by the cusp magnetic field of the end plate, the negative ions are not destroyed by the collisional detachment reaction in the measurement region.

The holder of a cylindrical Langmuir probe is installed perpendicularly to the laser beam. The tip of the L-shaped probe, which is made of a tungsten wire, is 10 mm in length and 0.35 mm in diameter. It is movable from 0 to 15 mm in the radial direction r from the laser irradiated region by using a micrometric screw.

When all the H^- ions are destroyed in the irradiated region of the laser beam, it is possible to determine the H^- density n_-, the following equation is used[1];

$$\frac{n_-}{n_e} = \frac{\Delta I}{I_{dc}}, \qquad (1)$$

where I_{dc} is corresponding to the electron saturation current, and ΔI is the difference between I_{dc} and the maximum value of the electron current. The electron density varies from 10^{10} cm^{-3} to 10^{11} cm^{-3} and the electron temperature from 3 to 0.5 eV with the n_-/n_e ratio less than 2 %, when the hydrogen gas pressure varies from 0.4 to 18 mTorr.

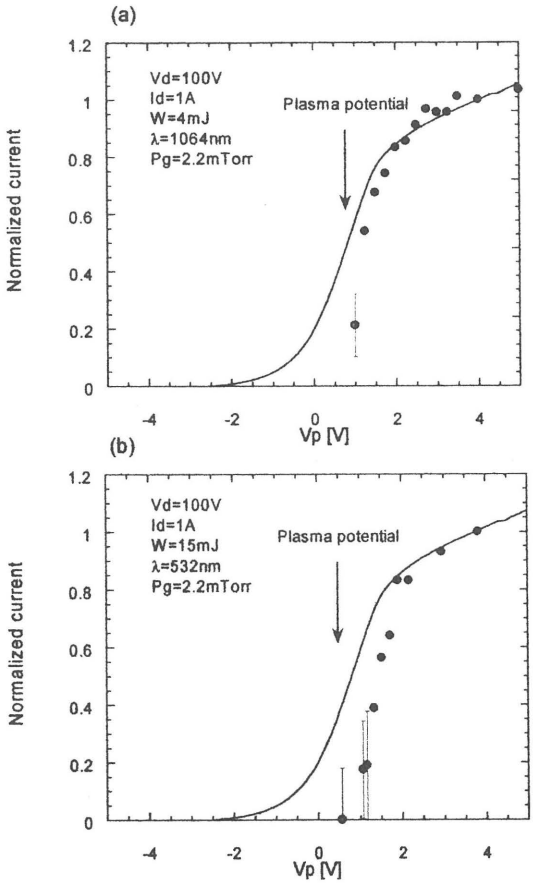

Fig. 1. Dependence of the probe current I_{dc} (line) and photodetachment current ΔI (closed circle) on the probe potential V_p.(a)λ=1064nm, (b)λ=532nm.

In order to know the influence of photodetached electron energy on photon energy, the ΔI - V_p characteristics are investigated in Fig. 1. It is found that there is no dependence of the energies of photodetached electrons on the photon energies. The effective temperature of photodetached electrons T_{eff} is close, within 40%, to that of background electrons. As a result the H^- density and the H^- drift velocity are not affected by photon energies.

Reference

1) M. Bacal, G. W. Hamilton, A. M. Bruneteau, and H. J. Doucet, Rev. Sci. Instrum. 50, 719(1979).