## §8. Negative Ion Measurement for the Simulated Gas Divertor Experiment in High Heat Flux Sheet Plasma

Kawamura, K., Takayama, K. (Res. Inst. Sci. Tec., Tokai Univ.), Tonegawa, A. (Dept. Phys. Sci., Tokai Univ.), Watanabe, T.

The target divertor requirs based on the redistribution of heat load at a surface based on radiation and collisions with neutral particles. It is important to play a rule of the negative ion in the process of the molecular activated recombination involving vibrationally excited hydrogen molecule to reduce the energy of the heat flux of the plasma in front of the target.

To investigate the influences of the negative ion on the detached plasma, we have measured the characteristics of the negative ion on the gas target divertor in a high heat flux magnetized sheet plasma device[1]. The produced sheet plasma has two regions of the hot plasma (7-8eV) in the center region and the cold plasma (1eV) in the outer region. The formation of detached He plasma has been carried out at the contact of hydrogen gas $H_2$.

The electron temperature $T_e$ and electron density $N_e$ were measured by rapid scanning Langmuir probe. Heat flux onto the target plate W was measured with the calorimetric method. A cylindrical probe made of tungsten (φ 0.4 x 2 cm) is used to measure the spatial profiles of the negative ion density of hydrogen atom by a probe-assisted laser photodetachment method(see Fig.1). The Q-switch YAG laser was driven at a pulse repetition rate of 10 Hz. The maximum powers of fundamental (1064 nm) radiation was 65 mJ. The laser width was about 10 ns and the diameter of a laser beam was 3 mm. When the laser beam is injected into the plasma, electrons are detached from negative ions. The detached electrons are collected by the cylindrical probe aligned along the laser beam. The probe is biased at +35 V with respect to the chamber of the earth potential. The probe circuit is used to measure the pulse current by the photodetached electrons and the ordinary electron saturation current by the bulk electrons simultaneously. The currents of the detached electrons are recorded by a digital oscilloscope. The signals are averaged more than 2048 times to reduce the noises. The negative ion density is determined from the photodetached electron current, and the electron saturation current. The spatial profiles of the negative ions is measured to move the cylindrical probe with the Laser beam.

Fig.2 shows that W, $H^-$, Ne, and Te are plotted against the contact $H_2$ gas flow ratio $Q_{H2}$. The value of $N_e$ and W rapidlly decreases with incresing $Q_{H2}$, indicating that the detached plasma was produced The value of $H^-$ is the peak value of the radial profiles of the negative ions. The negative ion of hydrogen atoms are localized in the cold electron (1eV) of the surrounding the sheet plasma. The value of $H^-$ gradually decreases when $H_2$ gas contacts to the main plasma. These observations indicate the negative ion is produced by the dissociated attachment between vibrationally excited hydrogen molecule and the cold electron(1eV) around the detached plasma .

[1]A.Tonegawa, K.Kawamura at al., J.Advanced Science, Vol.11, No.4(1999)232.

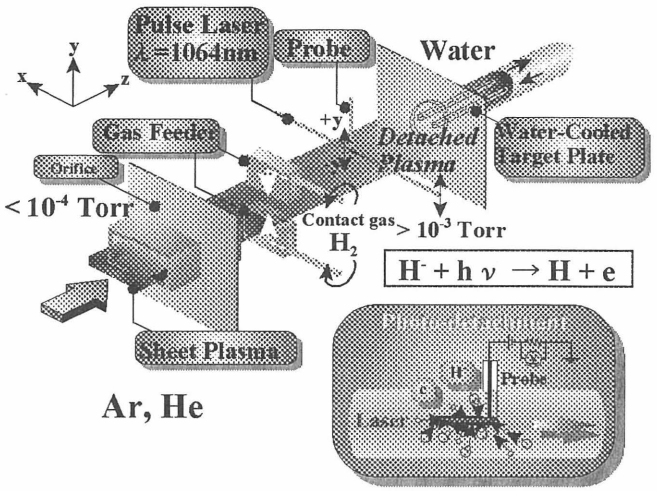


**FIG. 1** Measurement system of Laser photo-detachment in Gas-Divertor.

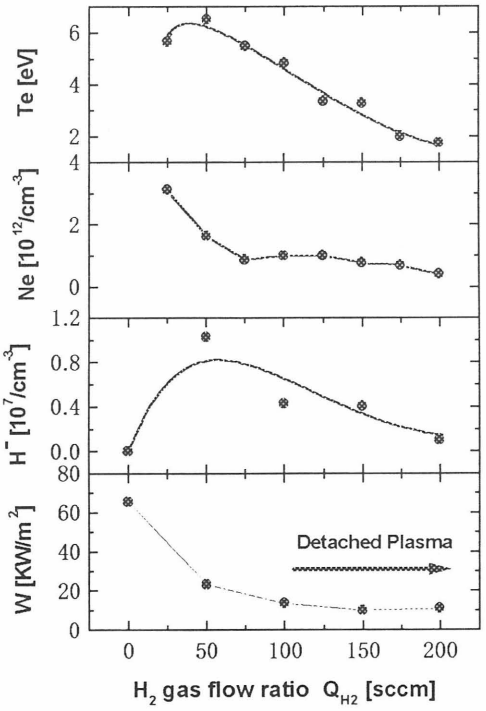


**FIG.2** The heat flux onto the target W, negative ion density $H^-$, electron temperatrure Te, and the electron density $N_e$ were plotted against the contact $H_2$ gas flow ratio $Q_{H2}$