§4. Improvement of H^- Extraction by Adjustment of Plasma Potential in a H^- Source

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Improvement of negative ion sources has been required to obtain more heating power for ITER and future nuclear fusion devices. To develop higher efficiency sources, we have two ways, namely, improved H^- density, and enhancement in extraction probability of H- from ion source plasmas. We have been studying the latter approach with both experimental and numerical approaches. Through our previous reports, we know that potential structure near a plasma electrode in an ion source plays an essential factor for H^- extraction physics[1]. In this study, our aim is to improvement H^- extraction probability by controlling the potential structure at the beam extraction region in an ion source.

In this fiscal year, we introduced a second filament system at an extraction region in an ion source, shown in Fig.1. It supplies additional electrons to change potential structure. Figure2 shows a relation between electric input power into the second filament and plasma potential measured by a Langmuir probe. The discharge voltage was fixed at 70.0V with discharge current of 0.5A, and beam extraction voltage of 0kV. When the input power is 30W, we can confirm the change of the plasma potential due to increment of electron density. The potential change was 0.4V as the maximum decrease. According to photo-detachment measurement in our previous study, this potential drop is enough to change H^- transport, because H^- kinetic energy is below 0.1eV[2].

Next, H^- beam current is measured with and without the electron emission. It makes beam current decrease from 3.4mA to 0.9mA. To measure how much decrease of H^- extraction probability is caused by the potential change, we carried out the measurement of the extraction probability by two kinds of laser photodetachment. However, it was difficult to estimate the H^- extraction probability due to low signal to noise ratio of the photodetachment signals, when the second filament is used. We confirmed a tendency that second filament unstabilized the ion source gas pressure. It is considered that the rise of filament temperature made undesirable gas emission. Accordingly, it enhanced the noise onto photodetachment signals. As the next step, we will measure H^- extraction probability again, after improvement of second filament system and a gas line to reduce the noise. And, an aperture will be introduced in front of the second filament to localize additional electron injection region along the plasma electrode surface. Thus, we expect that potential structure can be controlled for local region near the extraction hole.

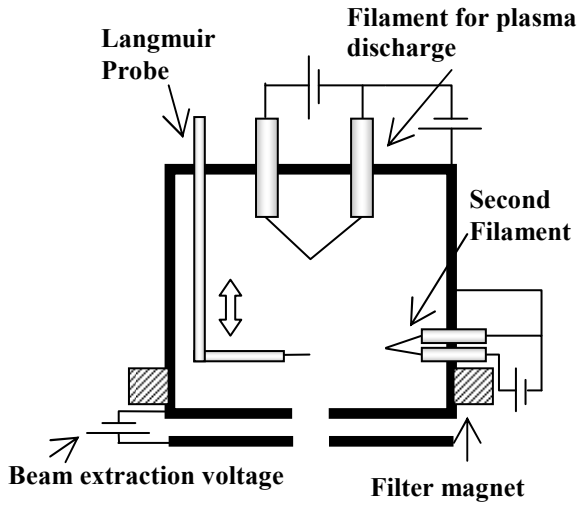

Fig. 1. Experimental apparatus

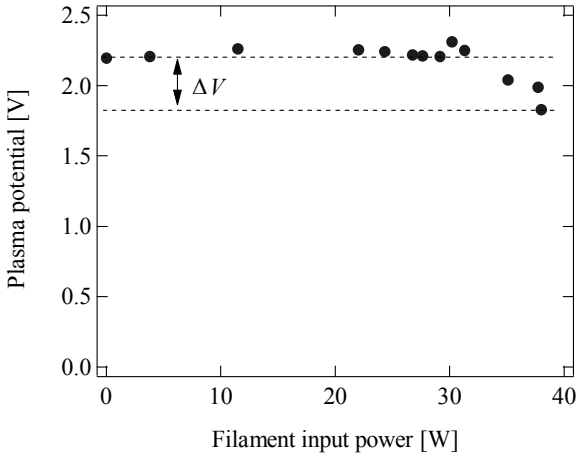

Fig. 2. Dependence of plasma potential on second filament input power.

1) Y. Matsumoto, M. Nishiura, M. Sasao, H. Yamaoka, K. Shinto and M. Wada , Rev. Sci. Instrum. **79** 02B909(2008)
2) Y.Matsumoto, M.Nishiura, M.Sasao, H.Yamaoka, K. Shinto and M. Wada , Rev. Sci. Instrum. **81**, 02B701(2010)