§8. Development of a Compact Au⁻ Source for Local Electric Potential Measurement of a LHD Plasma

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The plasma potential measurement system based on a negative ion beam probe has become operational at Large Helical Device in the fiscal year 2005. The system successfully yielded signals corresponding to local plasma fluctuations. However, the present signal is not adequate to give precise information of plasma fluctuation, but more probe beam current improves the signal-to-noise ratio of the overall system. Thus, a study to enhance Au^- beam current extracted from a small plasma-sputter-type negative ion source has been started.

Two approaches have been taken to accelerate the source performance development. In one design, the size of the ion source discharge chamber has been enlarged so as to contain a larger sputtering target. The sputtering target is located at the center of the plasma confined in a multi-line-cusp magnetic field. A larger sputtering target is installed at the end wall of a smaller multi-cusp plasma source in the other design. These sources have been installed on test stands of proper extraction systems, and heavy negative ion beam currents are measured on each setup.

Total amount of beam current has increased in accordance with the size of the sputtering target.[1] However, the beam quality did not improve much, indicating a growth of beam emittance with the target size. An attempt to enhance the beam brightness is being conducted with the smaller ion source by changing the size of the sputtering target. As shown in Fig. 1, the size of the sputtering target can be made as large as entire back end plate, while the diameter can be reduced down to 2.5 cm through changing the design of a floating potential plasma shield. The results have shown that more stable operation of the ion source with smaller diameter sputtering target.

Optimization of Cs coverage on the sputtering target is another important subject to study with the test ion source. Consumption of Cs by the ion source is reduced by modulating the discharge current. Deposited Cs during the discharge-off period is removed from the target when heavy negative ion beam is extracted. Pulse waveforms of negative ion beam current with the flat top period of 200 ms have been successfully obtained as shown in Fig. 2, and more negative ion current is extracted stably with smaller Cs consumption.

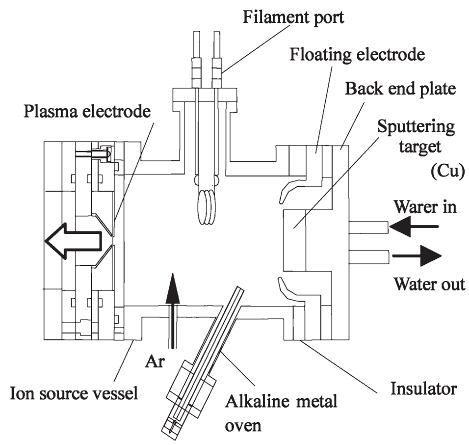

Fig. 1. Schematic illustration of an ion source used to study the dependence of beam brightness upon sputtering target size.

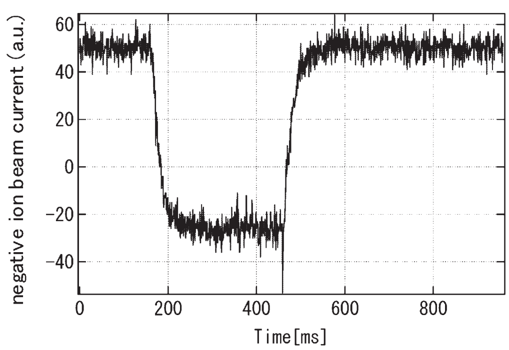

Fig. 2. An oscillograph trace showing the temporal change of heavy negative ion beam current as discharge power is modulated.

References

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