# §20. H⁻ Ion Source Using a Local Magnetic Filter in the Plasma Electrode: Type I LV Magnetic Filter H⁻ Source

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A small ion source with a single hole had been used to do basic research of H- ion source in a past experiment at Higashiyama-site - a virtual magnetic filter was proposed in the plasma electrode localized in the vicinity of each extraction hole[1]. This local filter uses pairs of small permanent magnets, adjacent to each aperture. We call this Localized Virtual Magnetic Filter of type I in the plasma electrode, i.e., a local magnetic filter H- ion source[2]. A similar magnet arrangement has been used for electron suppression, instead of filter action, in the literature.

We investigated/optimized the ion source characteristics of H- yield and the electron beam component with the local filter, especially for arrangement of the multipole magnetic field. The characteristics of the Cesium seeded H- source was also tested.

The ion source consists of a multipole plasma source which has a square cross section of 26(W) x 26(L) cm2, and a small accelerator with a single extraction hole of 4 mm in diam. All six surfaces of the plasma source are covered by multipole magnets of SmCo5. The plasma electrode over 5x12 cm2 around the beam hole has a local magnetic filter, and is isolated from the anode electrically and thermally. A magnetic geometry of 3 x 3 SmCo5 generates a Multi-Pole magnetic field. The small accelerator system uses an accelerator consisting of six electrodes. No magnets are imbedded in the extraction or 2nd, electrode.

The optimum spacing of the filter magnets became short, i.e.,10 mm, for a high discharge power plasma at a higher gas pressure, and long, i.e.,15~20 mm, for a low discharge power plasma. A maximum H- ion current density of 10 mA/cm2 is achieved with 3Pa.

When the number of Cs introductions (in Fig 1) is increased sufficiently, H- production efficiency is increased by a factor of 3~5 compared to that for pure volume production. The maximum achieved H- ion current density is 51 mA/cm2 at a filling gas pressure of 3 Pa. The ratio of Iele / IH- is 0.3 to 0.5 at a H- ion current density of 50 mA/ cm2 without applying a bias potential.

It is found from Fig.2 that the total electron component decreases with the increase of the line integrated magnetic field strength in the accelerator rather than the just the magnetic field strength. Even if the magnetic filter arrangement and/or the gap are changed, the accompanied electron behaviour tends to be understood only by the value of Gcm. The necessary value of the line-integrated magnetic field is determined mainly by the electron energy, and the geometry of the extraction systems. The value of Gcm for efficient H- production should take priority in the local filter source over the value for suppressing electrons, although H- production was optimized weakly with the magnetic field.

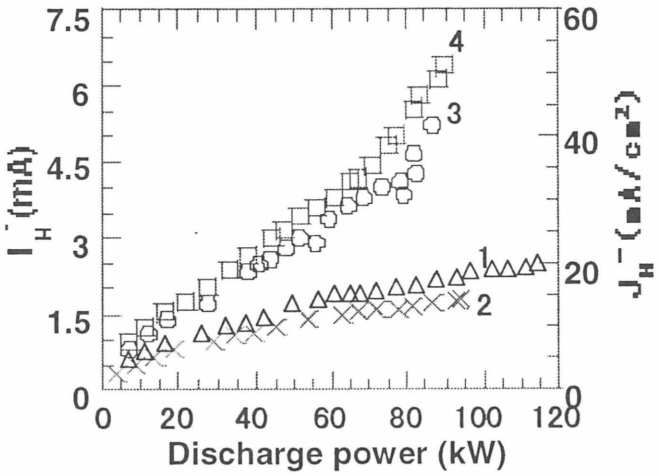


Fig.1 H- yield as a function of the discharge power with the total number (cycles) of Cs introduction as a parameter.

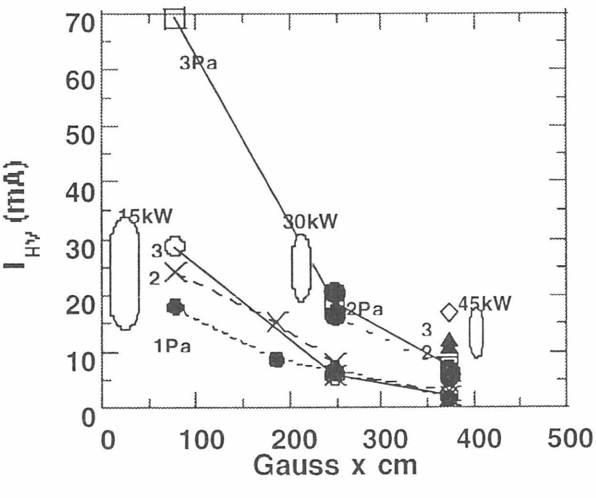


Fig.2 Dependence of HV drain current (which is composed of mostly total electron current) on the line-integrated magnetic field strength.

References,

1) Y.Oka et al., Proc. of the Domestic Meeting in the JSPS and NFR.,1990, p113.
2) Y.Oka et al., Rev.Sci.Instrum.vol.71.693(2000).