PKU 2.45GHz MICROWAVE DRIVEN H⁻ ION SOURCE PERFORMANCE STUDY*

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Abstract In a high intensity volume-produced H⁻ ion source, H⁻ ion production processes are great affected by electron temperature and gas pressure distribution within the discharge chamber. The H⁻/e ratio within an extracted H- ion beam is much depended on the electron absorption within the extraction system. At Peking University (PKU), lots of experiments were carried out for better understanding H⁻ processes and electron dump on our 2.45 GHz microwave driven Cs-free permanent magnet volume-produced H⁻ source. Detail will be presented.

EXPERIMENT SETUP

Principle volume of H⁻ source:

$$e(fast) + H_2 \rightarrow H_2^* + e + h\upsilon$$

$$e(slow) + H_2^* \rightarrow H + H^-$$

H⁻ ion source:

- The ECR region
- Filter region
- H⁻ formation region

- e-dump field: 30 Gs, 40 Gs, 55 Gs
- The operation pressure: 1.5×10^{-3} Pa ~ 8.0×10^{-3} Pa
- Extracted voltage: 50 kV
- Pulsed RF power:2800W(1ms/100Hz)

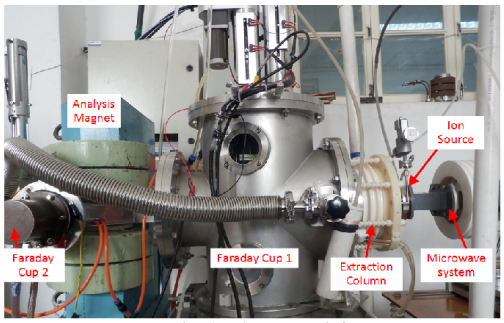

Figure 1: Ion Source Test Bench of PKU

EXPERIMENTAL RESULTS OF H⁻ ION SOURCE

Enhancing microwave power could improve the production of fast electron, the microwave power was set at 2800W.

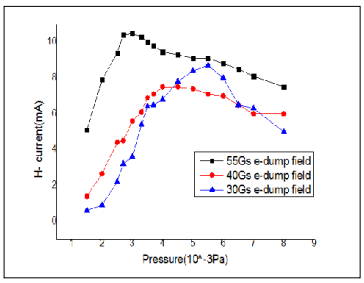

Figure 2: H- current VS operation pressure

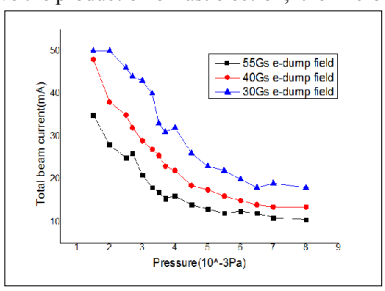

Figure 3: Total beam current of source VS operation pressure

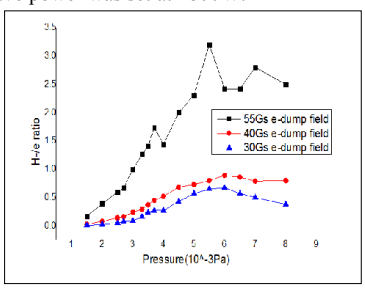

Figure 4: H-/e ratio VS operation pressure

Exist an optimum operation pressure for H⁻ beam current.

- Enhancing pressure could increase the collision possibility of fast electron with H_2.
- Increasing pressure would enhance the possibility of H atoms and molecules destroy H⁻.

From fig.3 and fig.4:

- Increasing the intensity of e-dump field could reduce total beam current and increase H⁻/e ratio.
- So, increasing the intensity of e-dump field in an appropriate range could dump electron from the extracted beam.

- Dipole magnet and the outer magnet could dump the electron on the collar.
- Decrease possibility of arcing and slow down water cooling problem.

SUMMARY

The significant influence of operation pressure and electron dump field had been found:

- There exists an optimum operation pressure for H⁻ beam current by balancing the production of H⁻ and keeping it from being destroyed.
- Increasing the intensity of e-dump field could dump electron from the extracted beam on the collar.

Performance of PKU H⁻ source was improved significantly. The negative ion source is working in pulsed/CW mode without caesium (Cs). A 14.7 mA pure H⁻ ion beam was produced by this developing source.

Parameter	Experimental value
Operation pressure	2.8×10^{-3} Pa
strength of e-dump field	55 Gs
Microwave power	2800 W
Extraction voltage	50 kV
H⁻ beam current	14.7 mA

Table 1: Experimental condition of highest H⁻ current

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