**INTRODUCTION**

Contemporary negative hydrogen (H⁻) ion sources are operated with cesium ovens, and some part of the H⁺ ion current extracted from the source is believed produced at the surface of the biased plasma electrode. The principle mechanism of the H⁺ ion current production can be due to the reflection of atomic hydrogen, but this hypothesis has not been directly confirmed in the actual ion source operating condition yet. An atomic hydrogen source is attached to a multicusp type H⁺ ion source to see the effect upon the extracted negative ion current. The atomic beam source produces hydrogen beams of low temperature atoms by capacitively exciting a plasma in a pyrex tube. The influence of low temperature atomic hydrogen injection to the plasma grid on H⁺ production has been investigated.

**EXPERIMENTAL DETAILS**

[Diagram of experimental setup]

**RESULTS**

[Graphs showing results with and without cesium]

**SUMMARY**

Under a cesium-free condition, CCP injection to the negative ion source enhanced the H⁺ production rate considerably. The increase of H⁺ could be caused by volume production because the surface production process should not work in a non-cesiated situation. As the microwave atomic source emits not only atoms but also electrons and positive ions due to its magnetic field-free structure, electrons and excited molecules enhance H⁺ volume production. While the CCP injection to the negative ion source is a useful way in the cesium-free condition, CCP injection to the cesiated source showed an opposite effect of cesium-free condition. These results indicate the H⁺ quantity generated in volume production by plasma from CCP is less than the quantity of H⁺ distraction by atoms, positive ions, and fast electrons from CCP. Experimental results imply the atomic temperature of CCP is insufficient to realize the surface production since the threshold energy is believed to be 0.75 eV: $\Phi_{TH} - E_L$. 

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