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水素負イオン引き出し領域への非蒸発ゲッター材料の挿入
Insertion of Non-Evaporable Getter in the Extraction Region of a Negative Hydrogen Ion Source

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1. Introduction

The current density of negative hydrogen (H^-) ions extracted from an ion source increases by reducing the destruction of H^- ions produced in the ion source. Enhanced density of hydrogen atoms can cause smaller H^- ion current by associative detachment (AD) reaction and contribute to the higher co-extracted electron current. In principle, non-evaporable getter (NEG) materials may reduce local hydrogen atom concentration and increase the H^- ion current when they are placed near the extraction system. In this study, tantalum (Ta) wire and ribbon filaments are inserted as NEG materials into hot cathode discharges to investigate the effect of NEG on the H^- ion extraction.

2. Experimental setup

Figure 1 shows the experimental setup of the ion source. The cylindrical source chamber made of stainless steel has 150 mm diameter and 200 mm height. A DC plasma is generated between the tungsten (W) filament cathode located in the lower part of the chamber and the chamber wall anode with 80 V of discharge voltage in 0.5 Pa of hydrogen. The extraction electrode and the Faraday cup are biased at 800 V against the chamber wall ground. The Ta filaments are curved and inserted into the chamber from the central port.

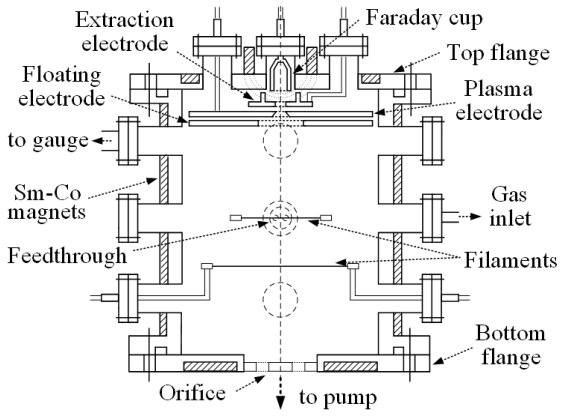

Fig. 1. Schematic diagram of the ion source.

3. Filament current characteristics

Tantalum filament current (I_f) was changed in the plasma sustained by the 1.0 A discharge current generated by a W filament. The negative ion current (I_{H^-}) was measured through sweeping the bias voltage of the plasma electrode (V_b) from 0 to 5 V for every 0.5 A of I_f. Figure 2 shows I_{H^-} against I_f of the Ta wire: 0.5 mm of diameter and 50 mm of length. The peak value for 14.5 A of the wire filament current was recorded at 1.3 V of V_b. Figure 3 shows I_{H^-} against I_f of the Ta ribbon: 3 mm of width, 0.1 mm of thick and 50 mm of length. For 29.0 A of the ribbon filament current, 1.8 V of V_b was needed to observe the peak value.

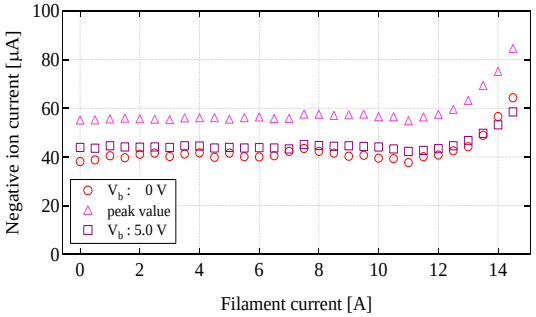

Fig. 2. Negative ion current at V_b=0 V: circle, V_b=5 V: square and at V_b giving the maximum I_{H^-} as functions of the Ta wire filament current.

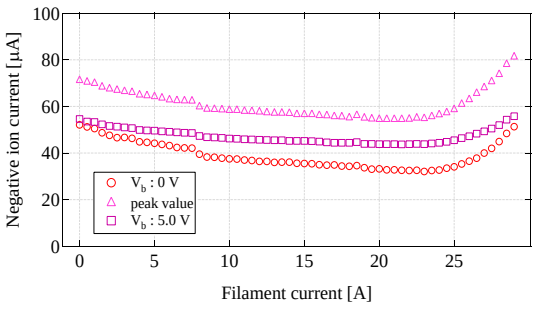

Fig. 3. Negative ion current at V_b=0 V: circle, V_b=5 V, square and at V_b giving the maximum I_{H^-} as functions of the Ta ribbon filament current.