A PIG ION SOURCE WITH REC PERMANENT MAGNETS

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Abstract

A compact PIG ion source is designed for heavy ion beams. Its structure and performance are described.

1. Introduction

The reduction of weight and electric power consumption (heat generation) is one of the most important factors in the design of heavy-ion sources for single ended electrostatic injectors of accelerators. The present work is a part of program of the heavy-ion accelerator study at Tokyo Institute of Technology. In the preceding paper[1] we have reported the use of ferrite magnets for the PIG magnet field where a field of 1000 Gauss has been obtained to generate stable HI beams. A higher magnetic field and, therefore, a higher yield of multiple-charged positive ions are expected by using REC magnets. In the following sections we present the structure, test results and applications of the PIG designed in our lab.

2. Structure of the PIG source

Six REC-18 magnets (TDK) are used to generate a field of 2.4 k Gauss in the discharging chamber. The magnets are ring-formed and originally designed for audio speakers. Each magnet has a magnetomotive force of H = 8k Oe and a thickness of 5mm. Six magnets are stacked as shown in Fig. 1. The iron pole pieces work at the same time as the top and bottom walls of the discharging chamber, respectively. To prevent the magnetic field from running away through flanges and bolts, non-magnetic materials are chosen. The materials for the anode and the cathodes are SUS 304 and pure aluminium, respectively. The supports of anode are made of steatite rods. The upper cathode has a cavity to capture the ion beam and sputtered atoms. The lower cathode has a beam extraction hole suitable for ion optics of the Tokyo Institute of Technology 4.75 MV Van de Graaff.

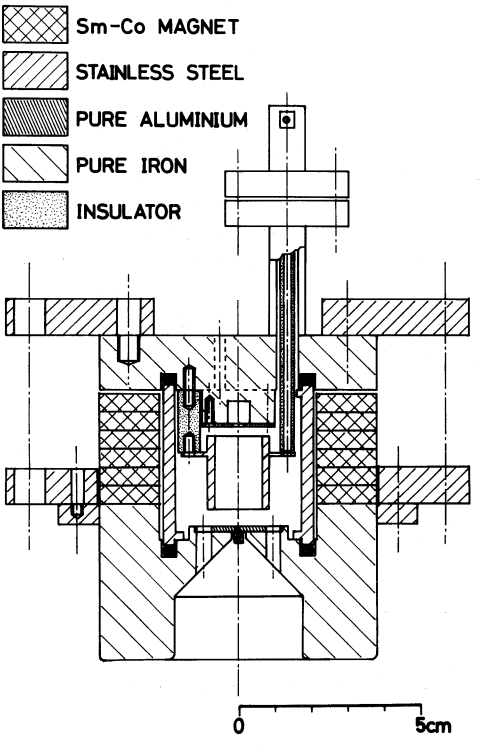

Fig. 1. Cross section of the PIG ion source

3. Results and Applications

Figure 2 shows, as a typical example, the relative yields of multipe-charged Ar ions. The absolute value is determined by the anode-discharge current as well as the extraction voltage

and the extraction geometry. Ions of Ar^{+} to Ar^{5+} are observed in the mass spectrum. The analyzing magnet has ports for the simultaneous extraction of beams with different charge states. We usually use the single-charged beam for the corona-stabilization of the accelerator.

Typical examples of applications are: 1) material testing experiments using several kinds of beams, 2) measurements of concentration profile of hydrogen by means of the $H(^{15}N,\alpha r)^{12}C$ reaction and 3) nuclear reactions using a He^{2+} beam.

References

1) E. Arai, Y. Oguri, K. Hayashi and T. Mitsunari: Proceedings of the Sixth Symposium on Ion Sources and Ion-Assisted Technology, 5, June 7-9, 1982.

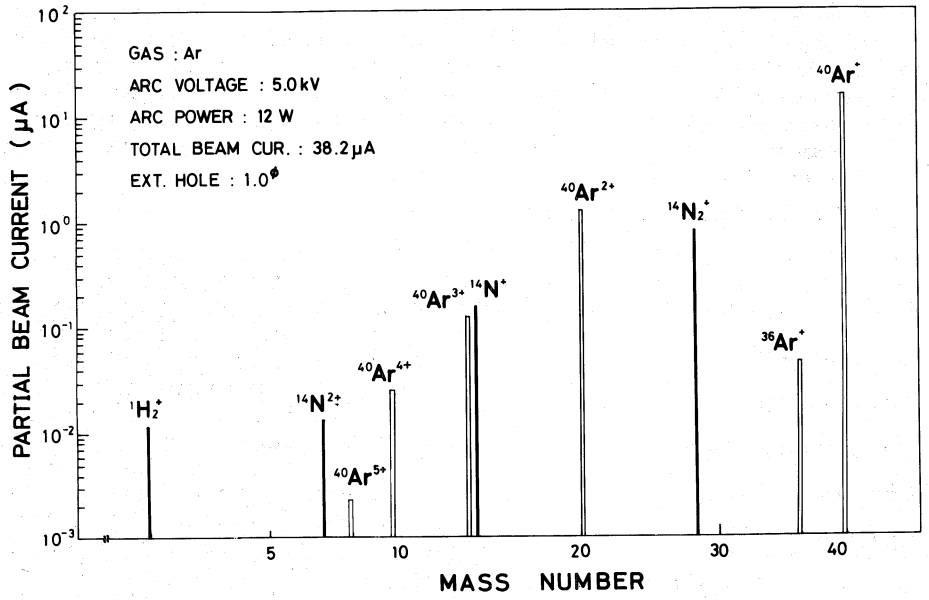

Fig. 2. Relative yield of Ar ions. The nitrogen and hydrogen ions are from the residual gas in the discharging chamber.