Supply of ^{48}Ca beam from 18-GHz ECRIS using the micro-oven

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In order to enhance the intensity and stability of the ^{48}Ca beam supplied from the RIKEN 18-GHz Electron Cyclotron Resonance Ion Source (ECRIS),[1)] we have been conducting operational tests on a micro-oven using ^{40}Ca.[2)] Owing to the cost of the material in which the ^{48}Ca isotope is highly enriched (70-80%), it is very important to reduce its consumption rate. For this purpose, we adopted the so-called "hot liner"[3-5)] and studied its effect on the reduction of the consumption rate. In this study, wherein a tantalum cylinder and disk of 0.1-mm thick were installed into the ECRIS, we observed an apparent reduction of the material consumption rate by using the hot liner. Details of the results are described in Ref. 6.

The ^{48}Ca beams for a series of experiments using the micro-oven have been supplied three times until now. Each series of experiments is summarized in Table 1. The statuses of the beam supply for experiments-1, such as beam intensity and material consumption rate, are reported in Ref. 6.

Table 1. Supply of the ^{48}Ca beam using a micro-oven.

	Days	Charge	Beam course
1	Nov. to Dec. 2013	11+	GARIS, RIPS
2	Sep. to Oct. 2014	11+	GARIS, RIPS
3	Nov. to Dec. 2014	10+	BigRIPS

In the series of experiments-3, the ^{48}Ca beam produced by the present method was first supplied to the new RIBF accelerator complex. Figure 1 shows the charge distribution of the ^{48}Ca ions. The RF power fed to the ECRIS was 370 W.

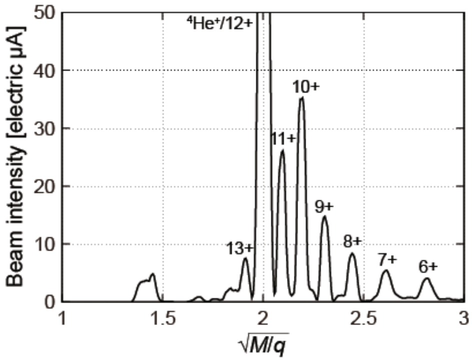

Fig. 1. Charge distribution of the ^{48}Ca ions.

The beam intensity at the exit of ECRIS and the oven current are shown in Fig. 2. The beam intensity was adjusted according to the requirements of the experiment, by changing the aperture of the slit at the exit of ECRIS. A beam intensity of ~35 electric μA with maximum slit aperture was maintained throughout the experimental duration.

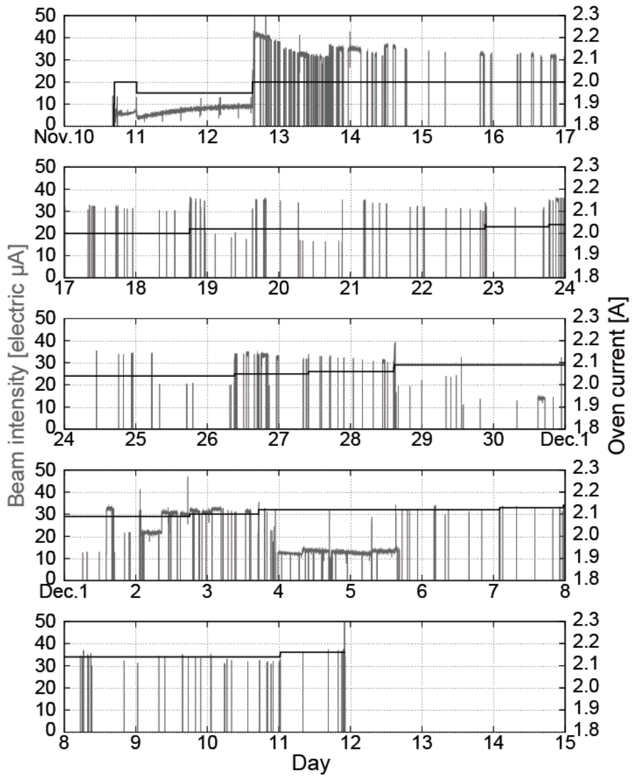

Fig. 2. Long-term supply of the ^{48}Ca beam. The beam intensity for $^{48}Ca^{10+}$ (gray) and the oven current (black) are shown.

The amounts of ^{48}Ca placed into the crucible and subsequently consumed were 299 mg and 98 mg, respectively. The consumption rate of ^{48}Ca was 0.13 mg/h. We succeeded in supplying stable and highly intense (twice as high compared to before, at the exit of ECRIS) beam with low material consumption rate (nearly one-tenth as low compared to before).

Previously, the peak intensity of the ^{48}Ca beam extracted from Superconducting Ring Cyclotron was 415 particle nA, but it was impractical to maintain the beam intensity at this level because of insufficient stability and high material consumption rate. The practical application of the micro-oven system realized long-term stable supply of the ^{48}Ca beam with an intensity of more than 400 particle nA to users.[7)]

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References

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