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Progress of High-Temperature Oven Development for 28 GHz ECR Ion Source

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At the RI-beam factory at RIKEN, uranium is the most frequent requested beams for the experiments, and there is great need for an increase in the beam intensity. U^{35+} ions extracted from a superconducting 28 GHz ECR ion source are used for the acceleration of the uranium beam. The ion source is operated continuously for 1–1.5 months keeping the beam current of U^{35+} at approximately 100 μA. Although we operate the ion source by the sputter method of metal uranium at present, we have been developing a high-temperature oven in parallel with the aim to increase and to stabilize the beam current since the beginning of 2013. Because the oven method uses UO_2, a tungsten crucible with the inside dimensions of ϕ11 mm×13.8 mm is joule-heated to a temperature higher than 2000℃ with DC current of 450–510 A. In the operation of the oven, the UO_2 blocking of the crucible's ejection hole was often observed. This cause was estimated as follows from the ANSYS calculations: the temperature of the cap of the crucible near the ejection hole was low, and the body temperature around the ejection hole may reduce due to the local heating at the rods of the crucible. To resolve the blocking problem, We modified the crucible structure slightly. After the modification, the performance of the oven was dramatically improved. So far we successfully extracted the 100 μA U^{35+} for longer than one week continuously from the 28 GHz ECR ion source by using the high-temperature oven. The beam current was almost the same as that in the operation by the sputter method at the same RF powers. The consumption rate of UO_2 was 2–3 mg/h.

References

1. J. Ohnishi et al., Rev. Sci. Instrum. 85 (2014) 02A941.