WedM03

Further improvement of RIKEN 28GHz SC-ECRIS for production of intense U beam

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This spring, we successfully produced more than 200euA of U^{35+} even though we used the lower injected RF power (28+18GHz) and the magnetic field strength lower than the ordinary High-B mode operation for 28GHz. Although the sputtering method gives lower beam intensity and higher consumption rate, we could dramatically reduce the consumption rate of metal U from ~8.6 to ~2.8mg/h with sputtering method to produce intense beam of U^{35+} (~150euA), which is almost same or even lower than the oven method. Based on these results, we successfully produced stable intense beam of U^{35+} ion in RIBF experiment for long term (more than one month) with low material consumption this year. To obtain these results, we systematically studied the effect of main parameters (magnetic field, gas pressure etc) on the beam intensity for various heavy ions (Ar~U) with 18 and 28GHz. In these studies, we observed that the beam intensity is strongly dependent on the main parameters. For examples, we observed that the beam intensity was saturated at B_{inj}>1.5B_{ext} and B_r>1.1B_{ext} for U^{35+} ions in a wide range of B_{ext}. Optimum value of B_{min} for maximizing the beam intensity was dependent on the microwave frequency and the gas pressure. We found that the optimum value of B_r to maximize the beam intensity is strongly dependent on B_{min} in a certain condition. We also observed the limitation of sputtering method at higher RF power.

In this contribution, we present how to optimize the ion source performance, how to minimize the consumption rate and the analysis of the long-term production of intense U ion beams. We present the effect of the magnetic field distribution on the beam intensity for various heavy ions and its mechanism in detail. We also discuss the optimum structure for higher frequency based on these results.