PRODUCTION AND ACCELERATION OF LIGHT- AND MEDIUM- HEAVY IONS AT THE JAERI TANDEM ACCELERATOR

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Four ions of ^{10}B, ^{27}Al, ^{32}S and ^{56}Fe have been successfully accelerated by the JAERI tandem accelerator. Negatively-charged atomic and molecular ions of these elements were obtained from a negative ion sputter source by using the cesium ionization gun developed in our laboratory. As details of the ion source and the gun were already reported in the previous paper[1),2)], we do not explain them here.

Eleven sputtering cones were tested to know how much currents we can get from them, and how long they work. After this test, four cones of B, Al_2O_3, PbS and Fe_2O_3 were selected to accelerate ^{10}B, ^{27}Al, ^{32}S and ^{56}Fe ions. Results of the test are summarized in table 1. This table contains typical parameters of the ion source, negative ion currents and materials of the sputtering cones. Typical beam currents terminal voltage, beam energy, charge state and so on, are summarized in table 2. The beam currents were measured by electron-suppressed Faraday cups arranged along the beam lines. Locations of the Faraday cups are illustrated in fig.1.

Table.1 Typical Parameters of the Ion Source, Negative Ion Currents and Ion Source Materials of the Sputtering Cones.

Ion Source Material	B,	B,	Si+Al,	Al,	Al,	Al_2O_3,	PbS,	Fe,	Fe_2O_3,	Ge,	GeO_2
Abundance	10 92%	11 80%	27 100%	27 100%	27 100%	27 100%	32 95%	56 92%	56 92%	74 36%	74 36%
Beam Species & Currents(microampere)	^{10}B	^{11}B	Si+Al	Al	Al	Al	S	Fe	Fe	Ge	Ge
	1.67	0.01	3.13	0.02	0.09	0.05	24.5	0.11	0.08	0.16	0.86
	^{10}BO	^{11}BO	SiO+AlO	AlO	AlO	AlO	SO	FeO	FeO	GeO	GeO
	4.11	0.19	0.12	0.10	0.12	1.31	0.02	0.5	1.6	0.015	0.01
Extraction Voltage(KV)	23	23	23	23	23	23	23	23	23	23	23
Current(mA)	1.5	1.2	1.4	1.4	2.2	2.0	2.1	1.4	1.3	2.0	2.5
Focus(-)(KV)	13	12.8	12.9	12.7	12.8	12.6	12.8	12.8	12.8	12.9	12.9
Focus(+)(KV)	18.3	18.6	18.3	18.7	18.7	18.8	19.0	19.1	18.6	18.4	18.4
Suppression Voltage(KV)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
X-Steerer(KV)	0.17	0.17	0.39	0.14	0.25	0.15	0.39	0.20	0.16	0.64	0.34
Y-Steerer(KV)	0.32	0.3	0.3	0.3	0.55	0.42	0.28	0.31	0.3	0.81	0.33
0-Steerer(KV)	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53
Ionizer Voltage(V)	5.5	5.8	5.6	5.8	5.9	5.8	6.0	6.0	5.9	5.9	6.0
Current(A)	27	29	28	29	29	29	29	29	29	29	29
Oven Current(A)	0.19	0.16	0.20	0.18	0.22	0.19	0.18	0.19	0.19	0.22	0.23

Table 2 Beam Currents and Other Parameters of the Accelerator.

Beam Species	^{10}B	^{27}Al	^{32}S	^{56}Fe	^{12}C	^{16}O
Negative Ion Chemical Form	BO	AlO	S	FeO	C	O
Ion Source Materials	^{10}B	Al_2O_3	PbS	Fe_2O_3	C	GeO_2
Ion Source	NISS*	NISS	NISS	NISS	NISS	NISS
Terminal Voltage (MV)	16.5	16.5	16.5	16.5	15.6	17.0
Beam Energy(MEV)	72.3	126.1	181.7	178.1	93.8	119.3
Stripper	foil	foil	foil	foil	foil	foil
Charge State	4+	7+	10+	10+	5+	6+
Beam Currents, /Faraday Cup						
FC I1-1	3.68^{-6}	3.75^{-7}	9.5^{-7}	3.13^{-7}	3.3^{-6}	3.4^{-6}
FC 02-1	3.36^{-6}	3.68^{-7}	8.04^{-7}	3.55^{-7}	2.2^{-6}	2.3^{-6}
FC TH-1	6.71^{-7}	2.38^{-7}	6.95^{-7}	1.24^{-7}	3.24^{-6}	2.2^{-6}
FC 04-1	3.02^{-7}	1.26^{-7}	9.8^{-7}	1.81^{-7}	3.0^{-6}	2.2^{-6}
Target	/	/	/	/	3.0^{-6}	2.2^{-6}

* Negative Ion Sputter Source

References

1) E.Minehara, S.Abe, C.Kobayashi and S.Kikuchi.,Proc. 4th Symp. on Ion Sources and Ion Application Technology, p261(1980).
2) S.Abe, E.Minehara, C.Kobayashi and S.Kikuchi.,Proc. 6th Symp. on Ion Sources and Ion-Assisted Technology, p185(1982).

Fig.1 Faraday Cups arranged along the beam lines of the JAERI Tandem Accelerator