The development of the ion source and target for BRISOL

B. Tang , B. Cui, X. Ma, L. Chen, R. Ma, Y. Ma, Q. Huang*

China Institute of Atomic Energy, Beijing, China ,102413

The construction of BRISOL was completed. A surface ion source had been developed and the first radioactive beams ($^{37}K^+$, $^{38}K^+$, $^{42}K^+$) were produced by bombarding a CaO target with a 100MeV proton beam from the cyclotron. A FEBIAD ion source with MgO target are successful used to the first physics experiments, including the decay study of ^{20}Na with the energy of 110keV and the elastic scattering study of ^{21}Na and ^{22}Na beams with ^{40}Ca, post-accelerated by a 13MV tandem. The refractory carbide targets such as SiC, LaC_2 and UC_2 are also developing for more radioactive ion beams. The first online test of SiC target has been completed recently, and radioactivity beams of $^{25}Al^+$, $^{26}Al^+$, and $^{28}Al^+$ were produced. The details of the development of BRISOL facility and the online experimental results will be presented.

1 Introduction

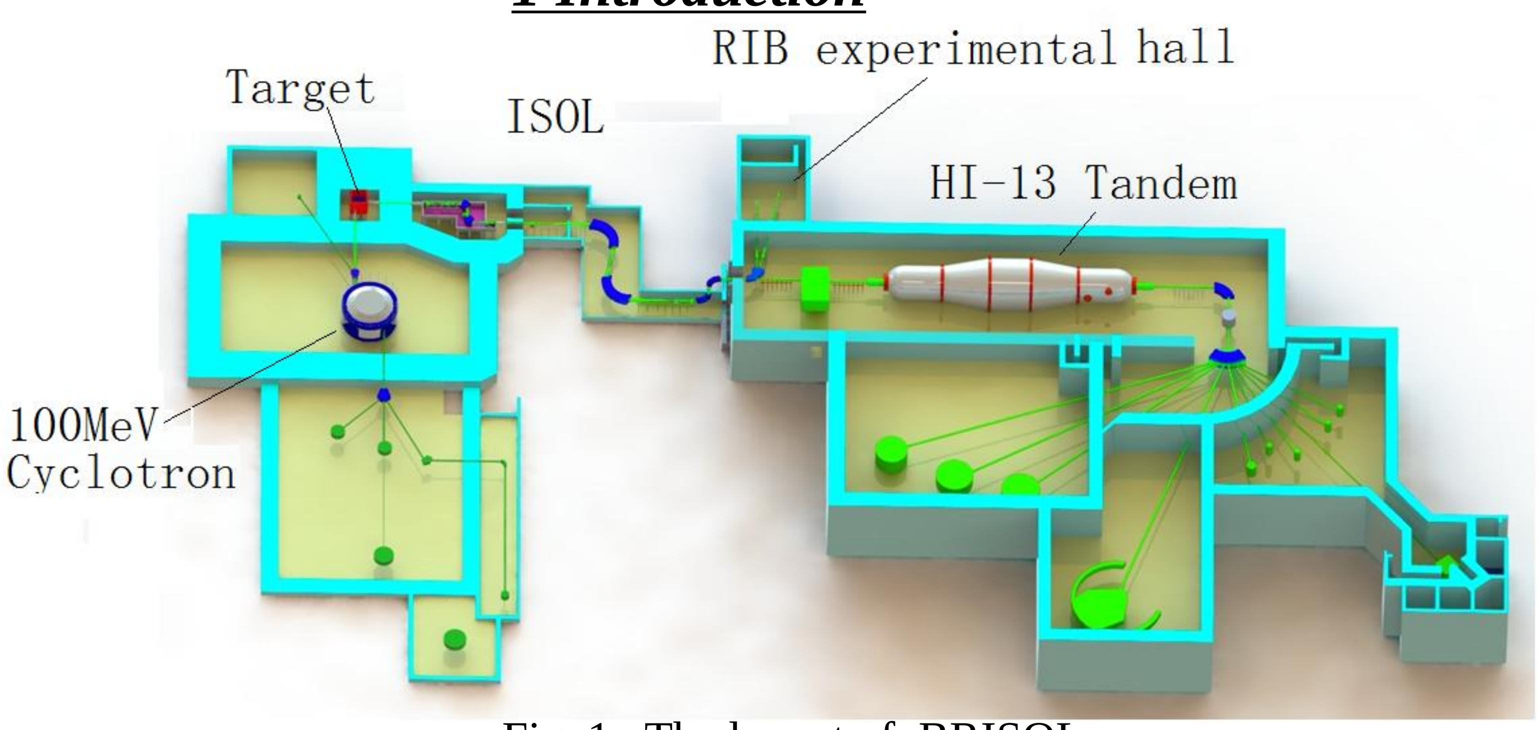


Fig. 1 The layout of BRISOL

The Beijing Radioactive ion beam facility Isotope Separator On-Line（BRISOL）is a radioactive ion beam facility based on a 100MeV cyclotron providing 200μA proton beam bombarding the thick target to producing radioactive nuclei, which is transferred into ion source to producing radioactive ion beam.

2 The FEBIAD ion source for BRISOL

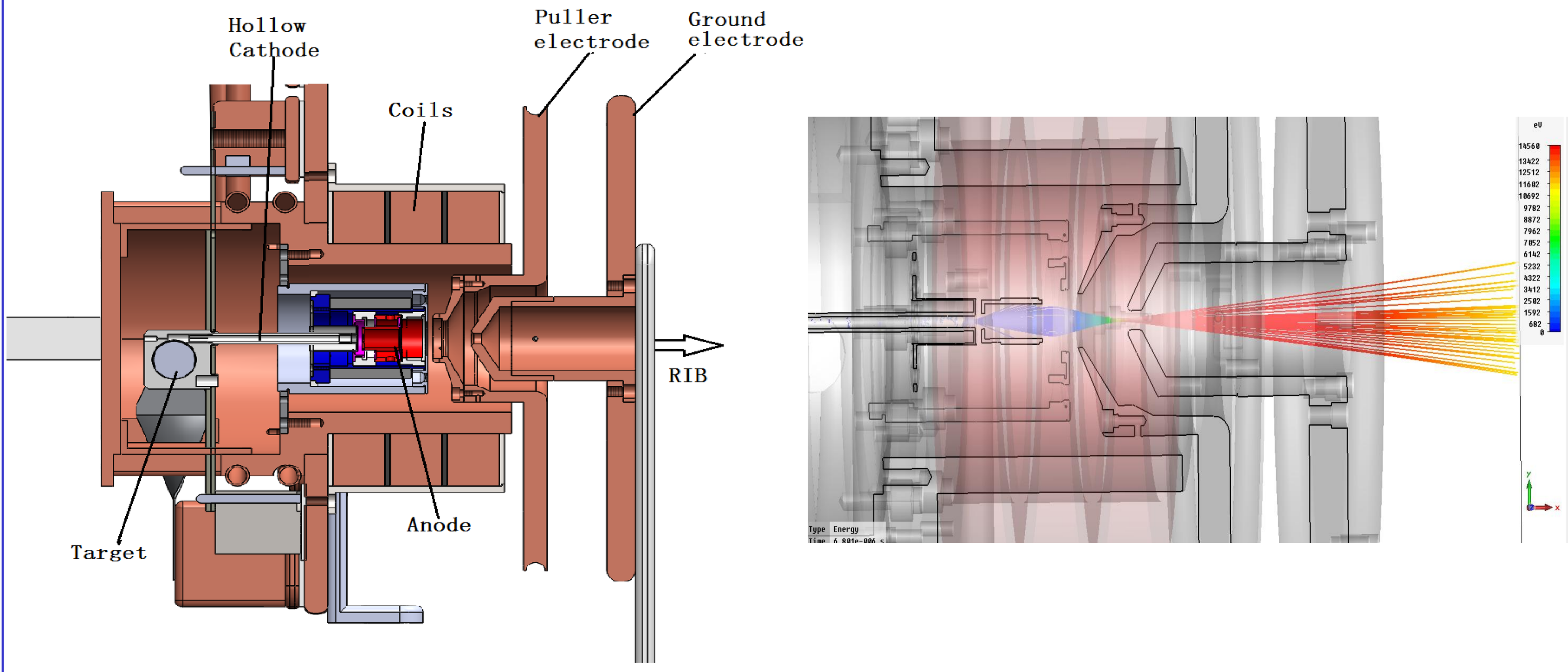
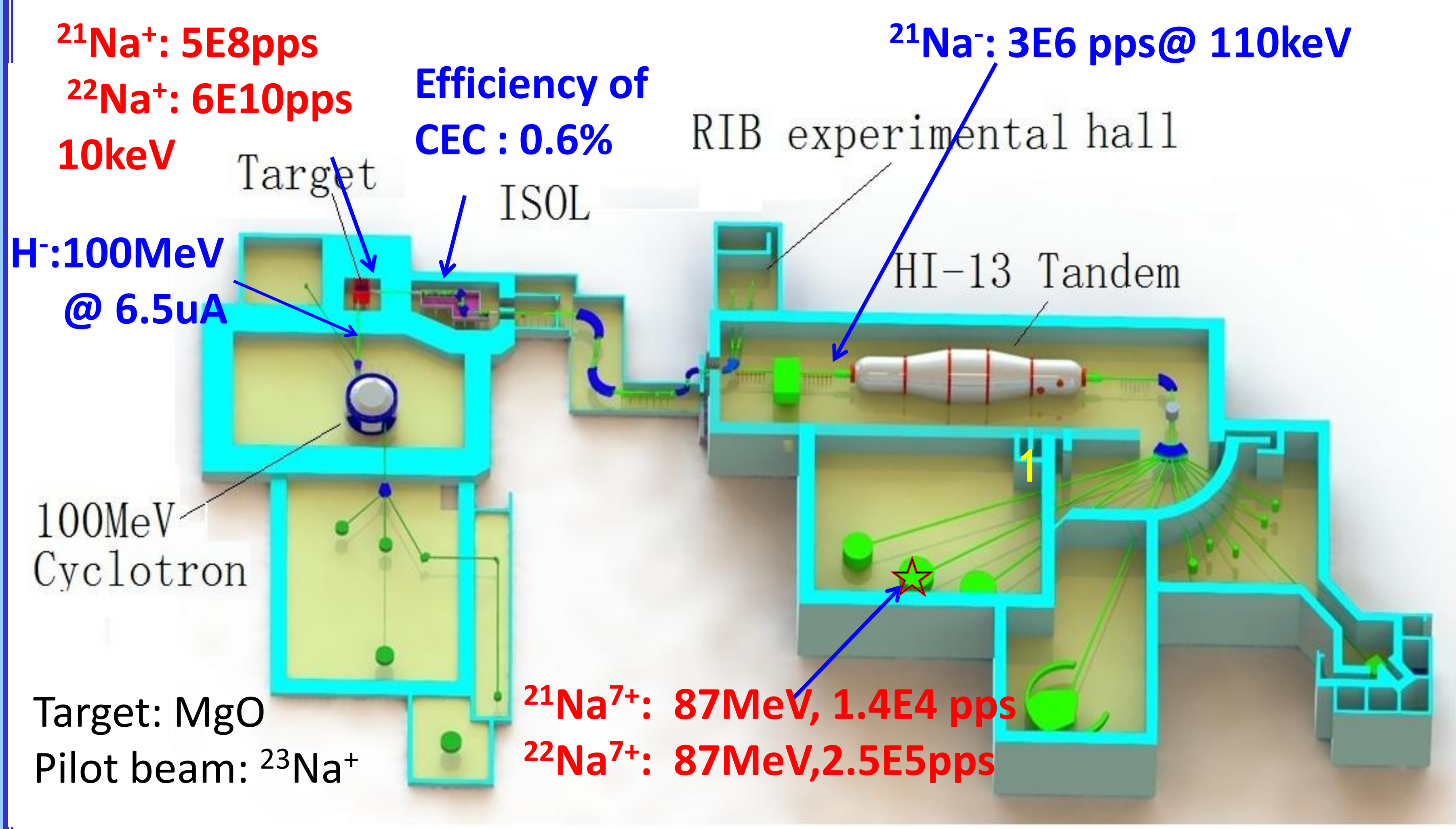


Fig. 3 The FEBIAD ion source



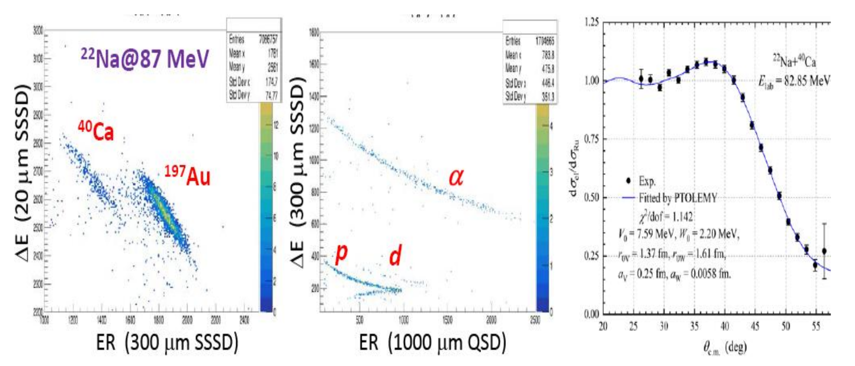
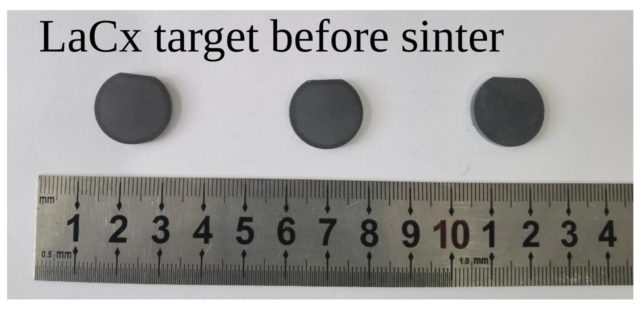
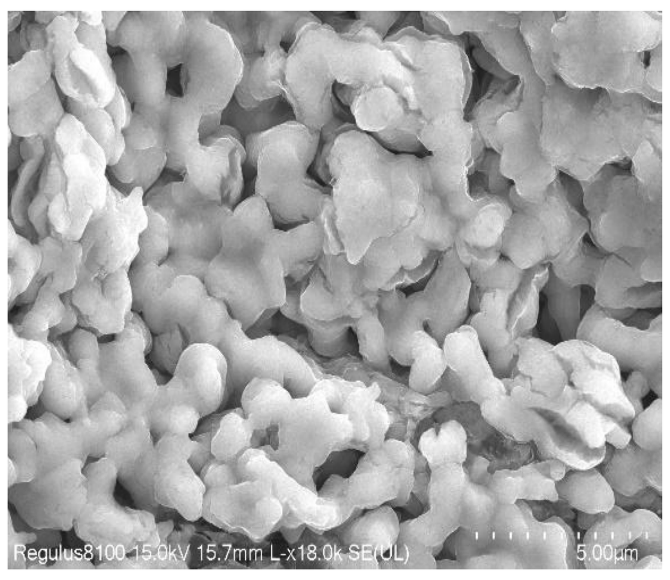


Fig.4 The elastic scatting experiment of ^{21}Na+^{40}Ca and ^{22}Na+^{40}Ca

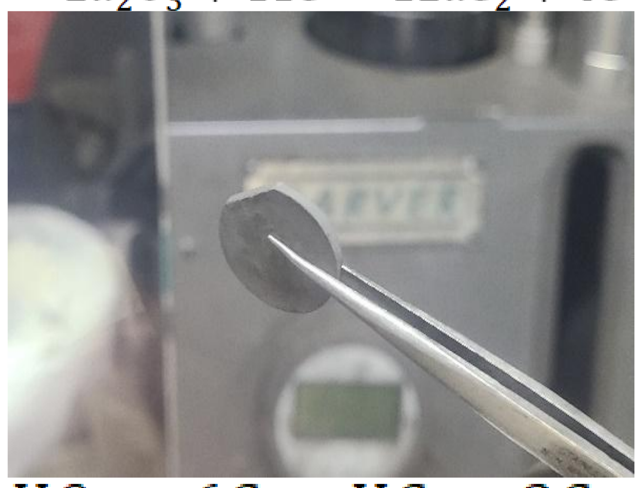
3 Carbide targets

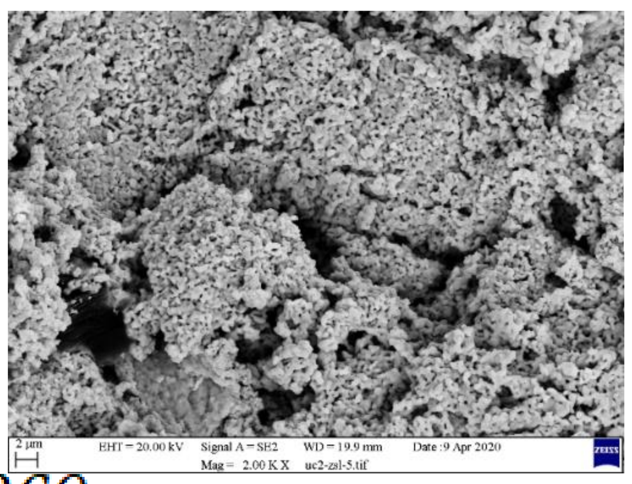




LaCx target
ρ=2.4g/cm²

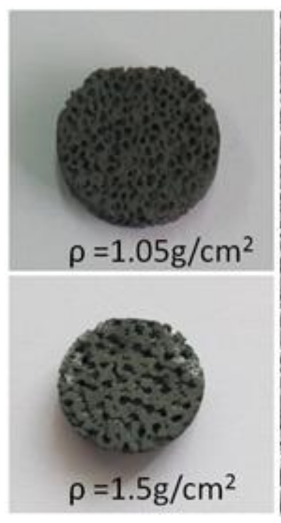
$La_2O_3 + 11C \rightarrow 2LaC_2 + 4C + 3CO$

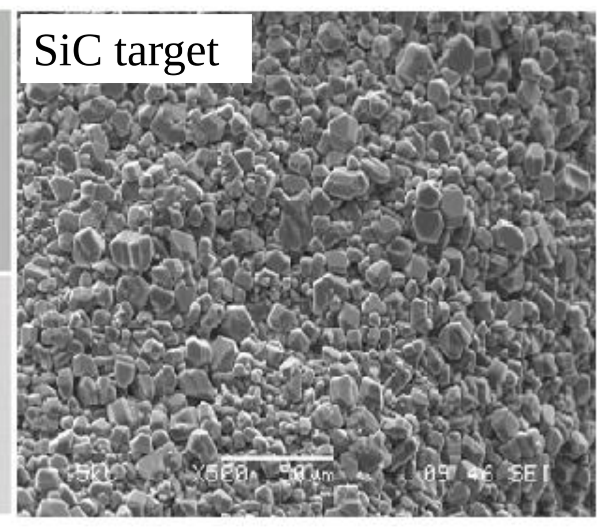




UCx target
ρ=3.6g/cm²

$UO_2 + 6C \rightarrow UC_2 + 2C + 2CO$





Heating rate	1st Dwelling	2st Dwelling	3st Dwelling	Cooling rate
2℃/min	500℃, 4h	1300℃, 24h	1600℃, 24h	2℃/min

Fig. 5 The picture and the SEM of carbide target for BRISOL

4 On-line results

Target	Beam	$T_{1/2}$	Proton/μA	Yield /pps
MgO	$^{20}Na^+$	0.448 s	8	2×10⁵
	$^{21}Na^+$	22.5 s	8	4×10^8
	$^{22}Na^+$	2.6 y	2. 6	6×10^9
	$^{24}Na^+$	14.9 h	8	5×10^7
	$^{25}Na^+$	59.1 s	8	3.7×10^7
	$^{26}Na^+$	1.07 s	6. 5	1.6×10^3
SiC	$^{20}Na^+$	0.448 s	15	2.1×10^5
	$^{21}Na^+$	22.5 s	15	1.6×10^7
	$^{22}Na^+$	2.6 y	15.5	4.4×10^9
	$^{24}Na^+$	14.9 h	15	2.3×10^8
	$^{25}Na^+$	59.1 s	15.5	2.9×10^6
	$^{26}Na^+$	1.07 s	10	1.7×10^4
	$^{23}Al^+$	0.47 s	13.5	2.2×10^2
	$^{25}Al^+$	7.183 s	15.5	7.2×10^3
	$^{26g}Al^+$	7.16×10^5 y	13.5	8.7×10^7
	$^{26m}Al^+$	6.35 s	10	1.5×10^4
	$^{28}Al^+$	2.245 min	15.5	2.7×10^4

5 Conclusion

The first RIB physical experiment accelerated by Tandem-13 was carried out, the current of $^{21}Na^+$ and $^{22}Na^+$ on target were 1.4E4pps and 2.5E5pps respectively due to the low efficiency of the charge exchange cell and the tandem .

The target of of SiC, LaCx and Ucx target were developed for more RIBs. The first on-line test of the SiC target was carried out and the aluminum isotope radioactive ion beams were generated successfully. The beam intensity of $^{26g}Al^+$ is 8.7×10^7pps, and that of $^{23}Al^+$ is 2.2×10^2pps.

* tangb364@126.com