THE ELECTROSTATIC TANDEM ACCELERATOR OF KOBE UNIVERSITY OF MERCANTILE MARINE

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Abstract

A 1.6MV electrostatic tandem accelerator was installed in 1980-81. Proton currents up to 1500nA with an energy between 0.15 and 3.2MeV and Helium ion currents up to 1000nA with an energy between 0.15 and 4.8MeV have been produced. This machine has recently been utilized to Rutherford backscattering analysis for irradiation effects produced by pulsed light ion beams (LIB).

1. Introduction

Recently, applications of small accelerators to material research have been extensively developed. Since an electrostatic tandem accelerator "PELLETRON 5SDH" made by National Electrostatics Corporation in USA was installed in 1980-81 in our laboratory, it has been applied to the studies on material analysis: nuclear reaction analysis[1], Rutherford backscattering analysis (RBS)[2] and proton induced X-ray emission analysis[3]. In this report we give a brief description on the general performance of this accelerator and some examples of the applications recently carried out.

2. Performance of the accelerator

The main specification of our machine is given in Table-1. It was verified that this machine worked well over a wide energy range. The terminal voltage is indicated with a generating voltmeter. Energies of the ion beams were determined by means of the resonance reactions; $^{19}F(p,\alpha\gamma)^{16}O$ and $^{24}Mg(\alpha,\gamma)^{28}Si$. The terminal voltage was stable within the variations less than $\pm$1kV. Stability improvement is realized by placing an energy control slit near the end of the 7m-beam line. Figure 1 shows a schematic diagram of the accelerator.

Table-1 Specifications and the test results

Ions	Energy(MeV)	Currents(nA) specifications	Currents(nA) test values
p	.15	200	280 - 430
	1.8	1000	1050 - 1700
	3.2	1000	1000 - 1100
He^{+}	.15	75	70 - 100
	1.8	200	400 - 1000
	3.2	200	250 - 350
He^{++}	.75	50	55 - 75
	2.7	100	450 - 490
	4.8	100	250 - 300

3. Application

Several samples were irradiated with pulsed proton beams and the effect was investigated by means of RBS of 2.62MeV-^{4}He ions and proton beams. About 50ns duration pulsed proton beams were produced from ERIDATRON-II: a 5kJ-Marx generator and a coaxial PFL. For a current density below 100A/cm^2, an MID generated a 200keV proton beam, which produced a damage pattern shown in Fig.2. RBS spectra for protons are shown in Fig.3. A pinched electron diode produced 500A/cm^2 and 1kA/cm^2 over an area of several cm^2, the wave form of which are shown in Fig.4. RBS spectra for He ions are given in Figs. 5 and 6. The distinct layer of aluminum which existed before irradiation disappeared. It seems probable that the layer melted and Al became ablated by irradiation. A copper layer was formed from sputtered electrode material of the diode. In Fig.6, a copper surface layer formed on the carbon was ablated and the reminder of this layer would fuse into the carbon base. More precise irradiation will make clear these effect in future.

1) S.Yano,T.Nakajima,A.Kitamura,T.Gotoh:ISIAT'-82" June 9 (1982)
2) S.Yano,Y.Furuyama,T.Nakajima,A.Kitamura:Rev.Kobe Univ.M.M. PartII (1982)155
3) M.Michijima,H.Miyake,S.Nanjo,T.Okubo,S.Yano:Rev.Kobe Univ.M.M. P-II (1982)79

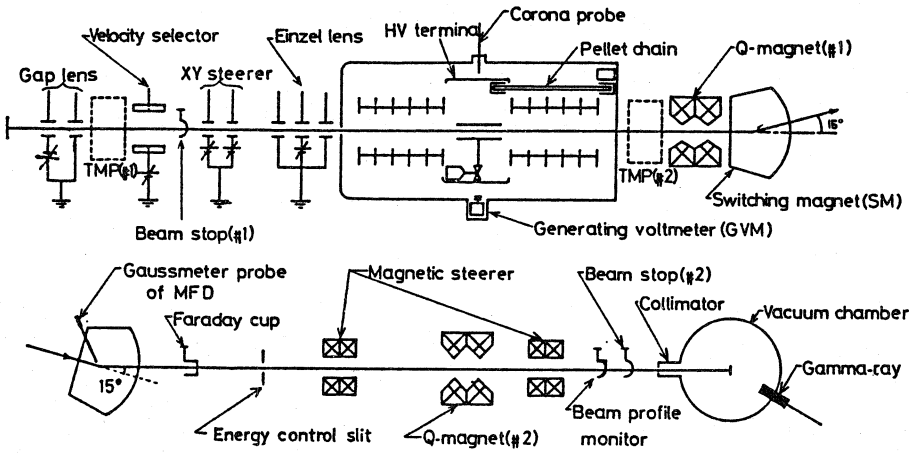

Fig.1 A schematic diagram of the accelerator and the 7m-beam line.

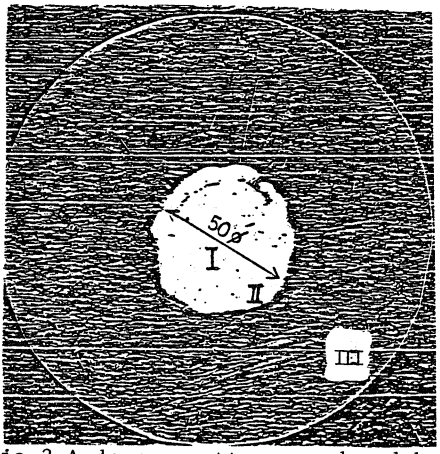

Fig.2 A damage pattern produced by a 200keV-100A/cm^2 proton beam.

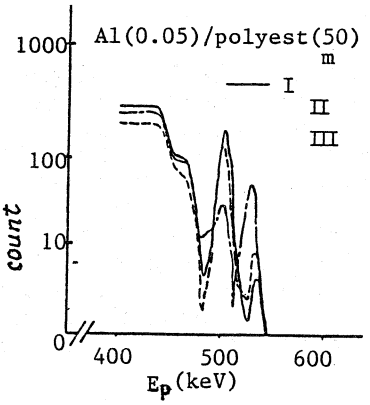

Fig.3 RBS spectra for protons incident on Al/Polyester films. I, II, III correspond to the parts shown in Fig.2.

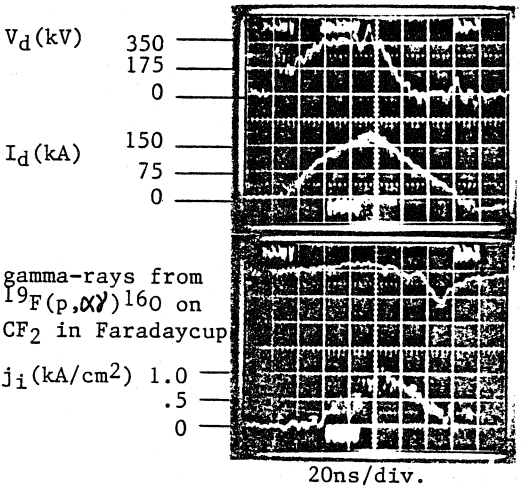

Fig.4 Parameters of the pinched electron beam generation. V_d:diode voltage, I_d: diode current, j_i:proton current, γ-ray: produced by impact of protons on CF_2target.

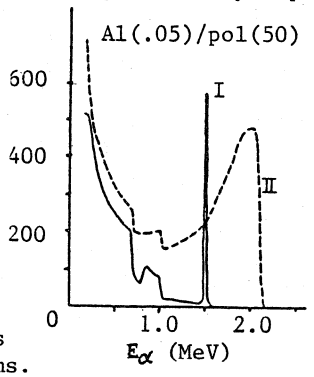

Fig.5 RBS spectra for He-ions incident on Al/PE film;I:before and II: after irradiation.

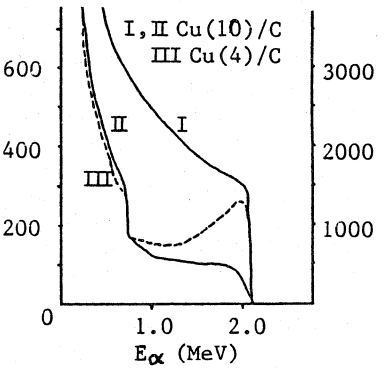

Fig.6 RBS spectra for He-ions incident on Cu/C, I: before, II :after irradiation, and Cu/C 4 m/2mm III after irradiation.