ARC PULSING SYSTEM OF A DUOPLASMATRON ION SOURCE

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Introduction

The duoplasmatron ion source of 4.5 MeV Dynamitron accelerator in our department is equipped with a nanosecond pulsing system of the extracting voltage and is mainly used for the experiments in pulse beem mode. Normally, even in a pulsed mode operation, the ion source arc is sustained in d.c. mode and it is heavily loaded. Such a hevy load oepration could shorten the life of ion source filament and einzel grid up to 200-500 hours by the bombardment of low energy ions on the barium oxide coating of filament and of extracted high energy ions on the grid, respectively.

In this report, we like to mention of an arc pulsing system as well as its performance which has been examined in the Laboratory to improve such a situation.

Arc Pulsing System

The block diagram of the arc pulsing system of the prototype is shown schematically in Fig. 1. The power supply of the duoplasmatron arc is of low impeadence and its maximum rating is 6 A at 250 V d.c.. As for the arc pulser, a high speed switching trasistor is employed which is driven by the signals from a switching characteristics of the system is measured with a dummy load of a 50 Ohms high frequency register, and turn out to be as follows; T_{rise} = 100nsec. and T_{fall} = 200nsec. at the peak current of 16A.

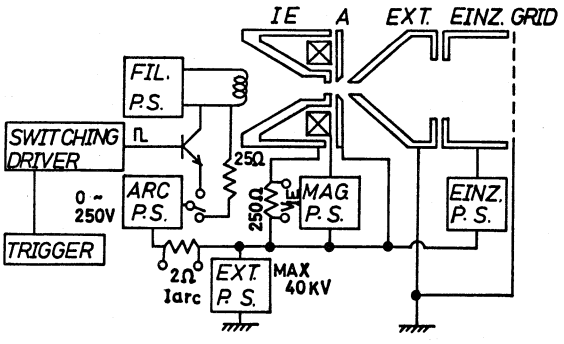

Fig.1. Schematic drawing of the ion source and the arc pulsing system

Pulsed Beam Performance

Fig. 2 shows the arc current (I_{arc}) driven in a pulsed mode of 2-μsec. width 1 kHz repetion rate, and also the voltage of the intermediate electrode (V_{IE}) in this operation. (see Fig.1) It is very obvious that the voltage drop of V_{IE} corresponds to the increase of I_{arc}. When I_{arc} is at the maximum, V_{IE} is nearly constant, and such a characteristics of arc discharge may reveal the quasi-stable production of the arc plasma. The over swinging of V_{IE} up to the positive level after the quasi-stable phase is considered probably to be due to the incoming flux of ions. The wave form of accelerated D^+ ion beam (I_{beam}) at 3MeV is shown in Fig. 3. Where I_{beam} is measured with a fast Faraday cup with the same ion source parameters as those in Fig. 2. It is observed in general that the peak current becomes to be larger and the rise- and fall time to be shorter as increasing the arc discharge voltage.

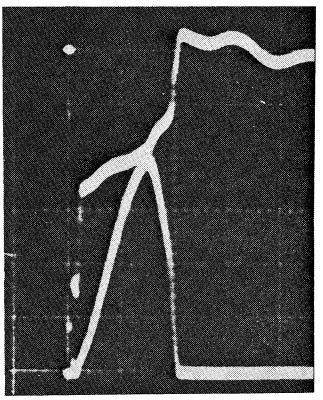

Fig.2. The arc current wave form (lower) and the intermediate electrode voltage (upper). (vert. 2v, 20v/div., respectively, horiz. 2μs/div.)

The magnet current is one of the most sensitive parameters to the wave form of I_{beam}, but it is not to the I_{arc}. Above a certain value of the magnet current, the beam pulse begins to oscillate[2] and splits into two peaked pulses with reduced peak current.

Wider arc pulsed operation has also been tested, and 5 mA or more peak current of 50-μsec. width has been obtained.

More improvements for the arc pulse characteristics and the developping a synchronization system with nanosecond pulsing system have been in progress.

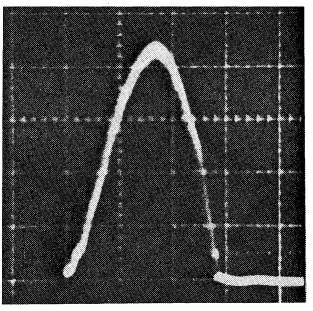

Fig.3. The D^+ ion beam wave form (vert. 400μA/div., horiz. 1μs/div.)

References

1) M.Baba et al., Ann. Report 1976, Fast Neutron Laboratory, NETU-22, p. 22. (1977)
2) K.Takagi et al., Proc.1st.this Conf.(in Japasese), Tsukuba, P. 133 (1975)