

# HIGH CURRENT PULSED ION INDUCTOR ACCELERATOR FOR DESTRUCTION OF RADIOACTIVE WASTERS

S.A. Korenev, I.V. Puzynin, V.N. Samoilov, A.N. Sissakian.

*Joint Institute for Nuclear Research,  
141980, Dubna, Moscow region, Russia*

**Abstract.** The project of high current pulsed linear ion this report. Accelerator consists of ion injector, system of separation on the charge and kinetic energy of ions, inductor inductor accelerator for applications is considered in the accelerating system, system of out put ion beam to air. Ion source with explosive ion emission uses as injector of accelerator, which can produce all kind of ions. System of separation includes pulsed magnetic system. Inductor accelerating structure including the inductors on the basis amorphous iron with inside magnetic elements for transport of pulsed high current ion beams.

## INTRODUCTION

The high current ion beams are used for surface modification of different materials. The requests of many technologies consist in the increasing of kinetic energy of ion beam. The destruction of radioactive wasters presents large interest and in this case is necessary increasing of kinetic energy by ion beams. The linear inductor ion accelerator can be used. The research linear inductor ion accelerators [1,2] allow to design these machines. However, two tasks ( injector and window for out put ion beam from vacuum chamber to air) is limited progress in the this field.

The project of linear ion inductor accelerator for different application is considered in the this report. The new type of injector on the basis of ion source with explosive ion emission and new construction of windows for out put ion beams is suggested in the proposal.

## THE GENERAL STRUCTURE OF ACCELERATOR

The general block-diagram of linear ion inductor accelerator is given in Fig.1. Accelerator consists of ion injector, separation system, linear inductor accelerating system, system of out put ion beams from vacuum chamber to air.

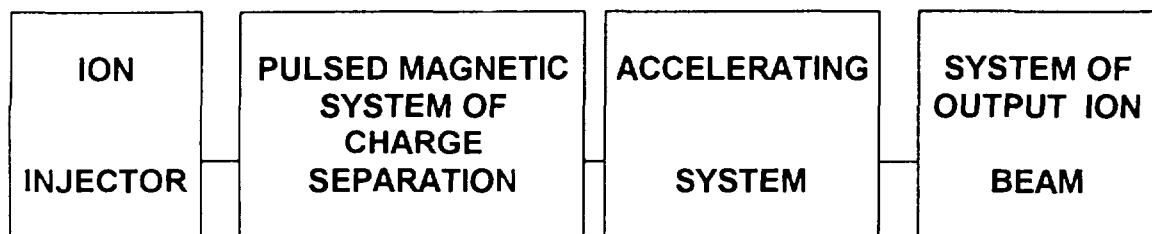


Fig.1. The general block-diagram of ion inductor accelerator

The ion injector on the basis of ion source with explosive ion emission allows to production of different kind of ion beams. Pulsed magnetic separation system separates ion beams on the charge and kinetic energy. The properties of explosive ion emission lead to separation of ion beams on these parameters. For supply pulsed magnetic will be use pulsed high current generator on the basis of LC- line with tyatron commutator. Inductor accelerating system on the basis of amorphous iron allows to receive stored energy for accelerating ion beams and gradient of electrical field 20 kV/cm [2]. The system for out put ion beam from vacuum chamber has Ti or Be foils with special coatings.

The main parameters of linear inductor accelerator for application has got next parameters:

- kinetic energy 20 - 50 MeV;
- pulsed beam current 1 - 200 A;
- pulse beam duration 100 nsec;
- repetition 5 - 50 Hz;
- kind of ion beams: all conducting materials
- length 50 - 75 m.

### ION INJECTOR

A detailed discussion of pulsed explosive emission is reviewed in detail in refs. [3] only the main principles are considered here. A plasma (emitter of ions) is formed on the surface of the anode ( on the plasma initiator) and then to extract ions from by applying a single positive voltage pulse. The main mechanism for maintaining the anode plasma is follows. Initially there ia a condition of auto-emission from the heating by ion current of points, micro-heterogeneities on the surface of anode, and electron emission from cathode. The atoms in the vapor are ionized and form an anode plasma which is the emitter of ions so that an ion beam can be extraction from this plasma, and the effects promote the formation of a stable vacuum discharge.

For operation of a planar ion source on the bases of explosive ion emission, the intensity of the electric field  $E$  in the diode must exceed the threshold  $E$  needed for forming the anode plasma:

$$E = KU/d > 10^7 \text{ V/cm}, \quad (1)$$

where:  $U$  is the voltage applied to the diode,  $K$  is the amplification factor of the electrical field on the initiator determining its geometry, and  $d$  is the distance between anode and cathode.

For supply of ion source we are used pulsed high voltage generator by Arkad'ev-Marx type with next parameters:

- voltage 300 - 700 kV;
- pulse duration 300 - 500 nsec;
- repetition 1-5 Hz;
- stored energy 10 - 50 J.

Also as a high voltage generator can be used inductor accelerating section.

Ion source consists of vacuum chamber, high voltage insulator, anode electrode with initiator of anode plasma, extractor electrode and beam current measurement system on the basis of current transformer ( Rogovsky transformer), see Fig.2.

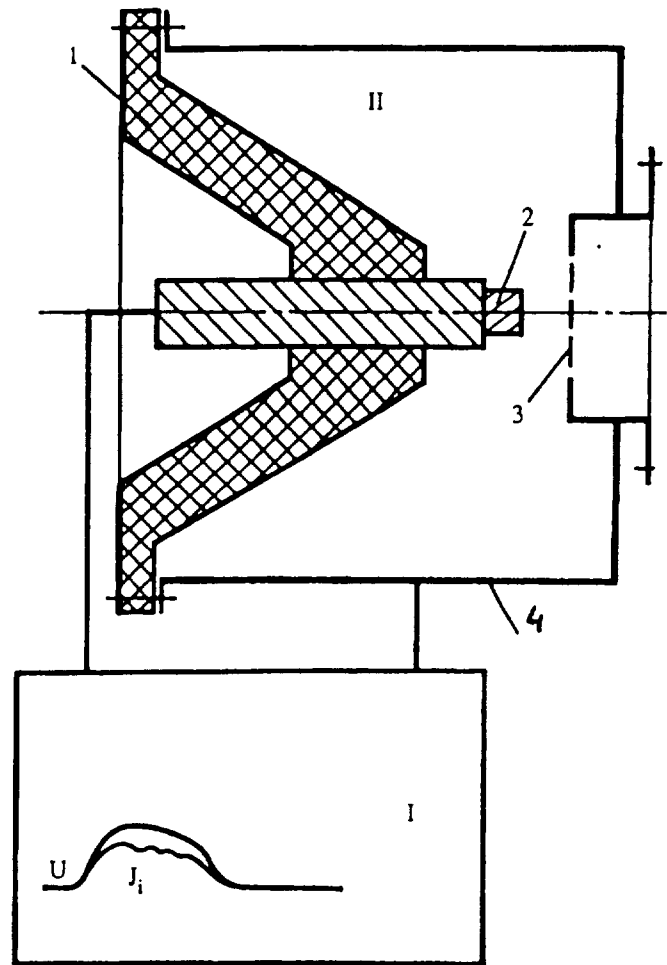


Fig.2. Block-diagram of an ion injector: I - Arkad'ev-Marx generator; II - ion source: 1 - high voltage insulator; 2 - anode plasma initiator; 3 - extractor; 4 - vacuum chamber

The kind of ion beams determine by materials of initiator of anode plasma. This ion source can be use for production of different ions of conductivity materials: metals, ceramics. For example, the emission characteristics of ion source is shown in Fig.3.

### FOIL'S WINDOW FOR OUT PUT ION BEAM

The diamond-like coatings with both sides onto Be or Ti foil allow increasing life-time to 10 times in the comparison with clean foil.

### CONCLUSION

This proposal has primary test of few units.

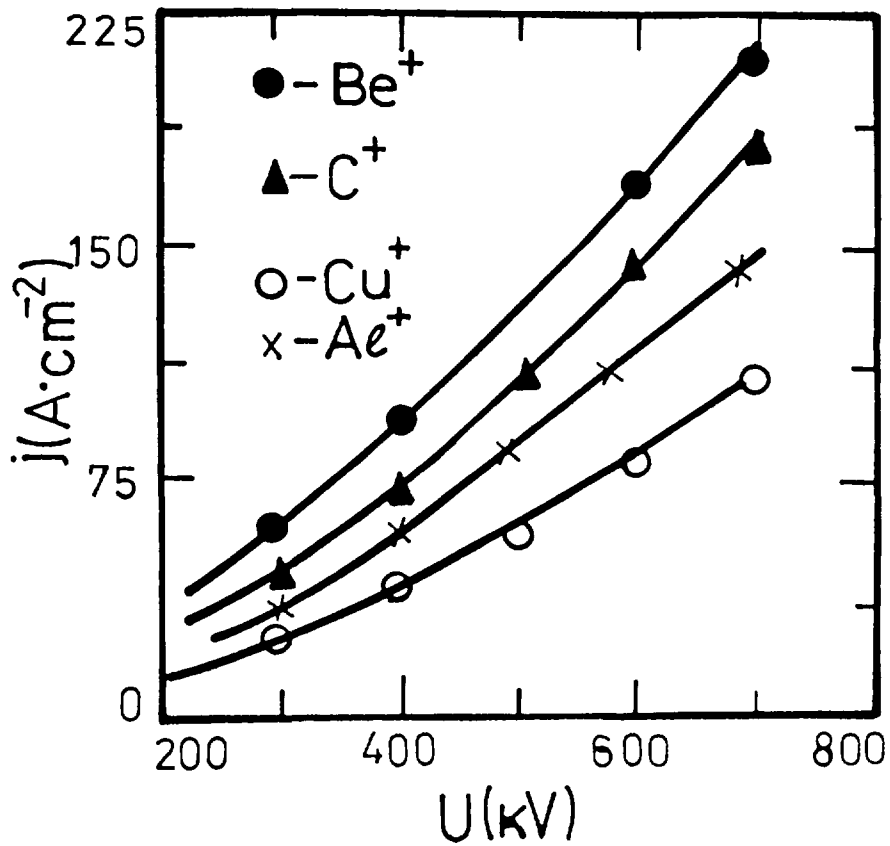


Fig.3. Emission characteristics of ion source for few kind of ion beams.

#### REFERENCE

- [1] Keefe D. Proton Accelerator Conference, Proc. (1976), pp. 127-132.
- [2] Vahrushin Yu.P., Anatsky A.I. Linear inductor accelerators. Moscow, tomizdat, (1978).
- [3].Korenev S. Nuclear Instruments and Methods in Physics Research B80/81 (1993), pp. 242 - 247.