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HIGH POWER PULSED NEUTRON SOURCE FOR ELECTRONUCLEAR INSTALLATION

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Abstract. The pulsed neutron source on the basis of reaction T(d,n)He is described in the report. The urce consists of pulsed Arkad'ev-Marx generator and vacuum diode with explosive ion emission.

INTRODUCTION

The research in the field of electronuclear power generation [1] and surface modification of materials by neutron [2] has been of practical interest. The small neutron sources can be used for test experiments and investigations of surface modification of materials. The development of neutron sources on the basis of reaction T(d,n)He [3,4] allows to design new small pulsed neutron sources. The small neutron source on the basis this reaction in the vacuum diode with explosive ion emission is considered.

THE GENERAL STRUCTURE OF NEUTRON SOURCE.

The main idea of this pulsed neutron source consists in the next. The deuteron ion beams from anode plasma in the ion source with explosive ion emission irradiate tritium target and as a results of the reaction T(D,n) He we have neutron beams. The motivation of using explosive ion emission ion is increasing of neutron yield because explosive ion emission allows to have high current of ion beam.

The pulsed neutron source consists of a high voltage generator for deuterone ion beam, acceleration, vacuum diode and vacuum chamber with target unit. A chematic block -diagram of pulsed neutron source is given in Fig. 1.

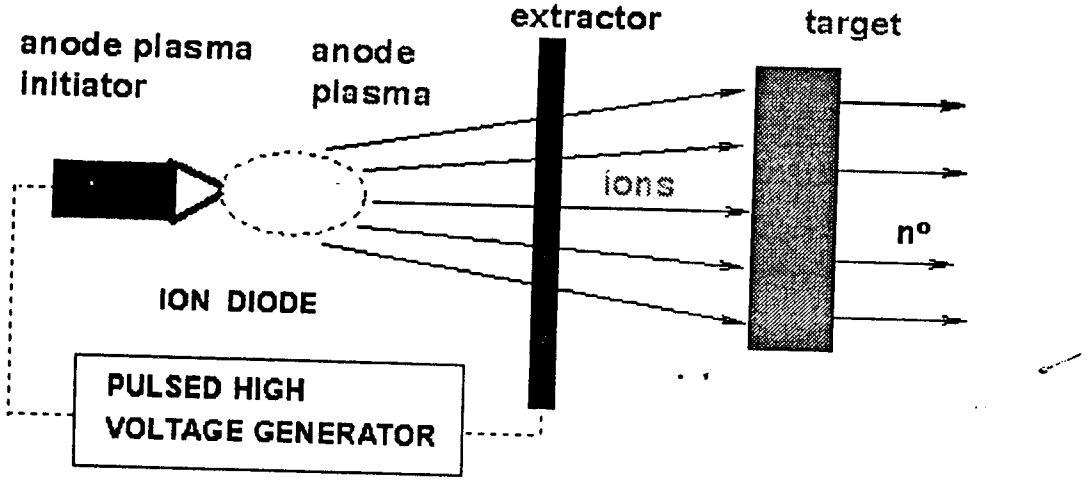

Fig.1. The general block-diagram of pulsed neutron source

The pulsed high voltage generator is a Arkad'ev-Marx generator with five capacitors steps. The polarity is set on the high voltage rectifier. The vacuum diode is very simple in design and comprises a stainless steel chamber 350 mm long and 400 mm in diameter, high voltage insulator from Capralon on which is mounted the anode plasma initiator, a cathode (extractor electrode), and various diagnostic devices for measurements of ion and neutron beams, total current (integrating Rogovski transformer and Faraday cup), and the pulsed voltage on the anode (a high resistance divider.
The deuthrone polymer initiator of anode plasma of 10 mm diameter is used for production of deuterone beams. Distance between anode and cathode is 7 mm.

MAIN PARAMETERS OF NEUTRON SOURCE.

The pulsed high voltage generator operates in the following main parameters range:

- voltage 100- 700 kV;
- pulse duration 300 - 1000 nsec;
- pulse repetition 1-5 Hz.

The Current-Voltage characteristic for the ion source for deuterons is shown in Fig.2.
The neutron generation target is the 2 mm thick copper-zirconium alloy substrate onto which with tritium. The results of measurement of 14 MeV neutrons yield is shown in Fig.3. These measurements are shown possibilities of using of neutron source for different applications.

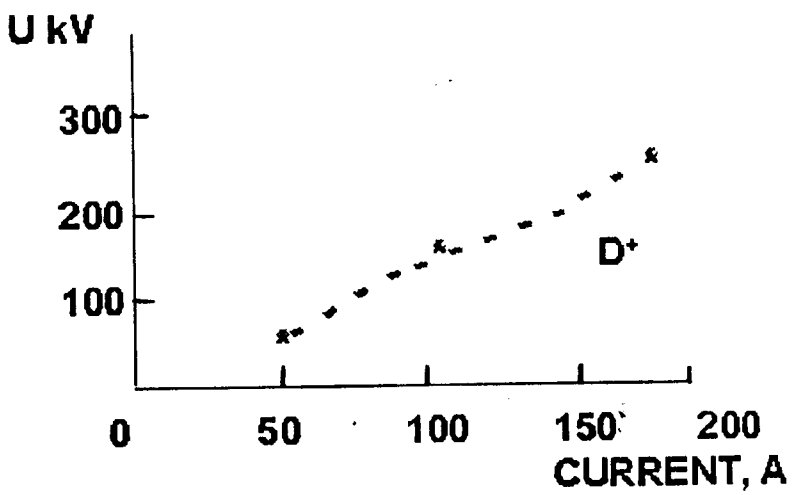

Fig.2. The Current-Voltage characteristics of ion source.

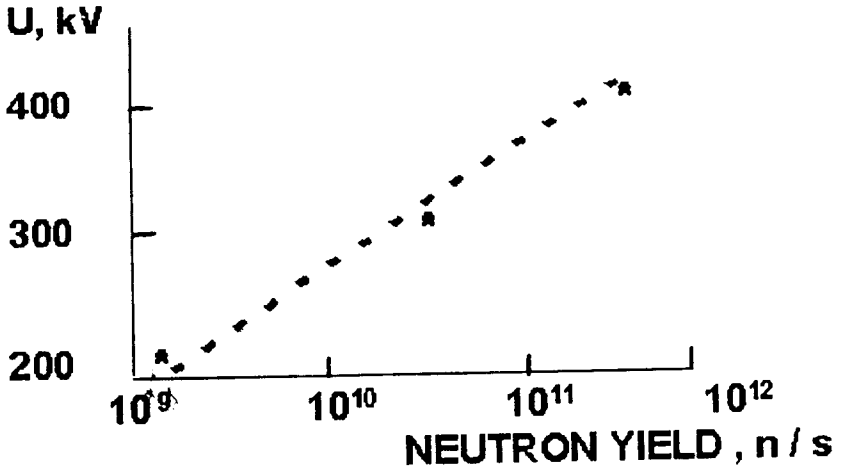

Fig.3. Neutron yield from voltage on the ion source.

EXPLOSIVE ION EMISSION

A detailed discussion of pulsed explosive emission is reviewed in detail in refs. [5,6] only the main principles are considered here. Referring to the schematics shows in Fig.1, a plasma 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.

For a planar ion source the electric filed E must exceed the threshold value needed to form anode plasma:

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

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.

The kind of ion beams can be selected from among all metals and conducting and dielectric materials [7].

DISCUSSION

The main problem of pulsed neutron sources on the basis standard reaction is ion source for production of deuteron. The using duaplasmatron, ECR type sources allow to work in continuous regimes [4] and vacuum arc [8] - in the pulsed regime. Explosive ion emission permits to production more high current ion beams and its properties are interesting for design simply neutron source. The results of measurements are shown its. The pulsed neutron source can be used in the surface modification of different materials in the combine with pulsed electron/ion source with explosive emission [9]. The future development of this kind of neutron source consists in the study of stable regimes of forming pulsed neutron beam.

CONCLUSION

1. New variant of pulsed neutron source on the basis of ion source with explosive ion emission is considered.
2. Parameters of pulsed neutron source allow to use in the different experiments.
3. The operation of this pulsed neutron source is more simple.

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