Excess Energy and Nuclear Products

Registration of High-Energy Products in High Current Density Glow Discharge

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Abstract

The experimental results of the High-Energy Products registration are presented in this paper. In our previous experiments with glow discharges in deuterium [1,2,3] excessive heat release, neutron, gamma and charged particle emission have been observed. Results of research high-voltage (up to a few tens kV) and high current (up to hundreds A) pulses of a nanosecond duration are submitted. Amplitude spectra of a voltage of pulses for the discharge in H_2, D_2, Ar are received. Results of measurement electronic and x-ray emission cathode samples after switch off of a discharge current in the area from 2 keV up to 1 MeV are indicated.

1. Introduction

In previous experiments with glow discharges in deuterium [1,2,3] neutron, gamma and charged particle emission have been observed. We modified the experimental facilities. The purpose of experiments was determination of possible gears of conversion low energy ions of discharge in high energy.

2. Methods

A glow discharge device (continuous flow calorimeter) [3] filled with deuterium, hydrogen or inert gases was used. Cathodes were made of Pd, Zr, Nb, Mo and other materials. The typical gas pressure in the chamber was 2-10 Torr, the discharge voltage 300-800 V and the discharge current 5-100 mA. A schematic diagram of the experimental device is given in Fig. 1.

Electric probe measurements

Electric probe measurements were conducted to study high voltage pulses of a short duration which are generated in the discharge area. The consisted of Mo cylinder placed in quartz tube with one end open, the probe was placed at 1 mm from the cathode. The spacing between anode and cathode was 2-5 mm.

Leading edge was 35-40 ns and independent of the sort of gas (H_2,D_2,Xe,Ar) (Fig.2). The spectrum of probe voltage pulses consists of pronounced lines (Fig.3). The line character of the probe voltage spectrum indicates that electrons have fixed energies and can be conversion electrons.

Registration of fast electrons

We used x-ray film RT-1V (SVEMA) with various degrading screens to register x-rays and fast electrons. The films were exposed during run-times of 4000-15000 s. The film exposure was analyzed using a densitometer. In our experiments the film exposure can be caused by gamma, x-ray or fast electron emission The

results are still preliminary and the contribution of each specific component is not evaluated yet, but the results of the probe measurements (see below) indicate presence of electrons.The x-ray films were placed out side the vacuum chamber.
The registration beta of activity samples after experiment.
Beta the activity (or x-ray) was made with the help Si-Li detector, cooled by a to liquid nitrogen. Si-Li detector had a crystal by thickness 5 mm. There was a opportunity to register fast electrons up to 4 MeV. Emission is registered from samples after experiment in the field of 1 -1000 keV (Fig.5.). The activity Pd samples is higher after Ar discharge, than after D2 discharge.

The spot film exposure can be caused by electron beams. Energy of the beams depends upon the cathode material and the working gas. The beams pass through 5 mm quartz in the case of palladium cathode and registreted (Fig. 4) bay multiplication effect in plastic. Such beams can consist of electrons with energies ranging from hundreds of keV to units of MeV.

The exposure spots are clear and non diffused in spite of long-term exposure (up to 15000 s). This indicates that quite intensive beams are emitted within short-term intervals.

Discussion

Judging by the time dependence of probe and cathode voltages and cathode current, the registered pulses are generated by the spontaneous release of bunches of 0.01-0.23 MeV electrons. It is estimated that there are 10^8-10^{11} electrons in a bunch. The line character of the probe voltage spectrum indicates that electrons have fixed energies and can be conversion electrons. Made experiments show, that there is a gear of transformation low energy ions of the discharge in high energy metastable of levels in solid.

References

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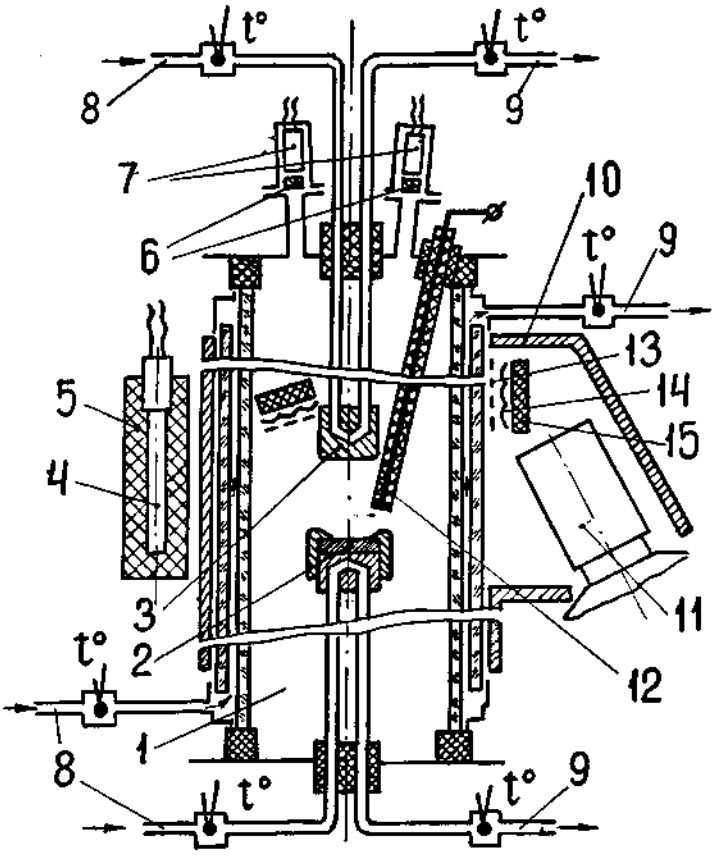

Fig.1. Experimental device: 1-vacuum chamber, 2-cathode, 3-anode, 4-He3 neutron detector, 5-moderator, 6-windows with attenuating foils, 7-Si-Au detectors, 8-, 9-Be window 10-lead shielding, 11-Ge-Li detector, 12-probe 13-x-ray film, 14- attenuating foils, 15- multiplicater

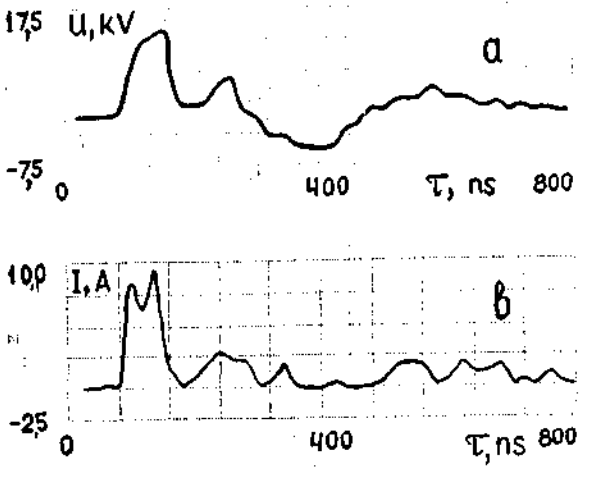

Fig. 2.Oscillogram of probe voltage and current in the cathode circuit. (Pd, D_2).

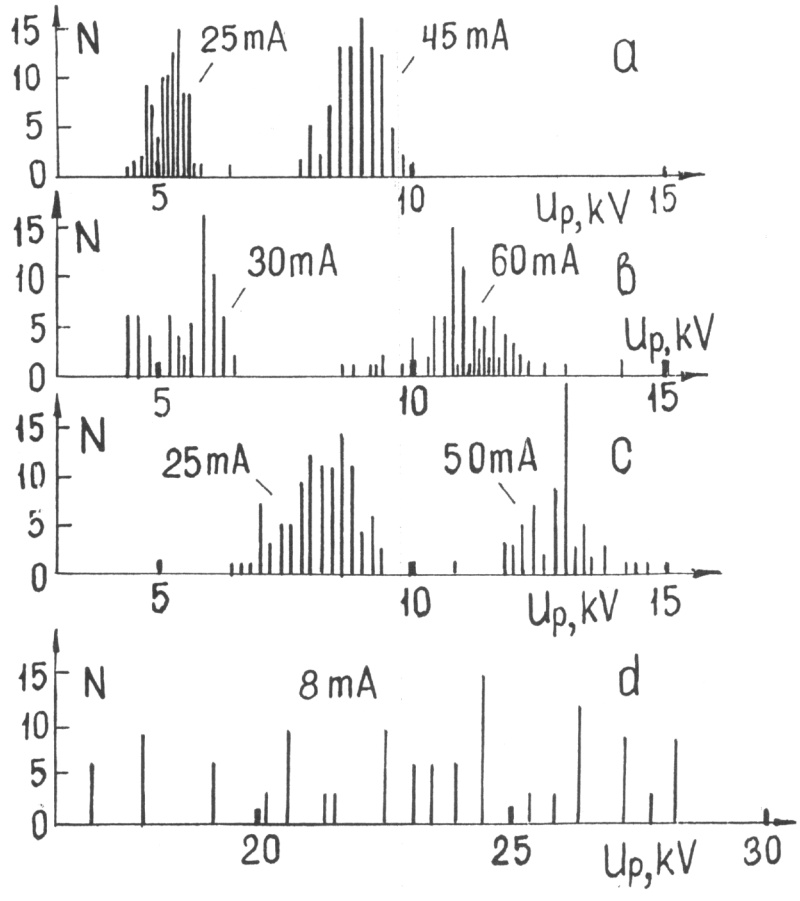

Fig.3. The spectrum of probe voltage pulses; a- Pd-Ar, b- Pd-D2, c- Pd-H2, d- Pd-D2, high loading D/Pd

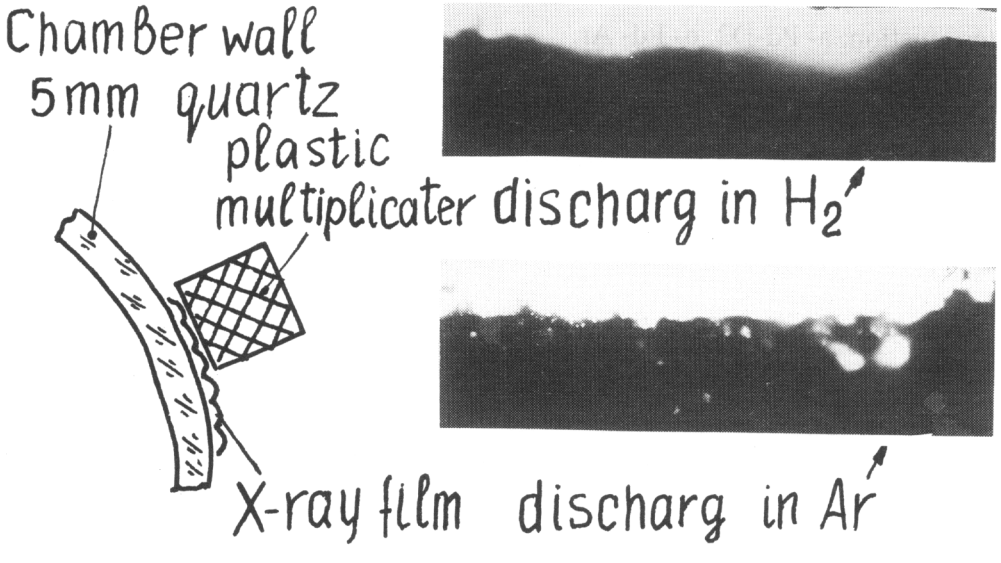

Fig.4. Schematic diagram of registration of radiation emission outside the chamber using an X-ray film and positive image of the film, Pd-cathode.

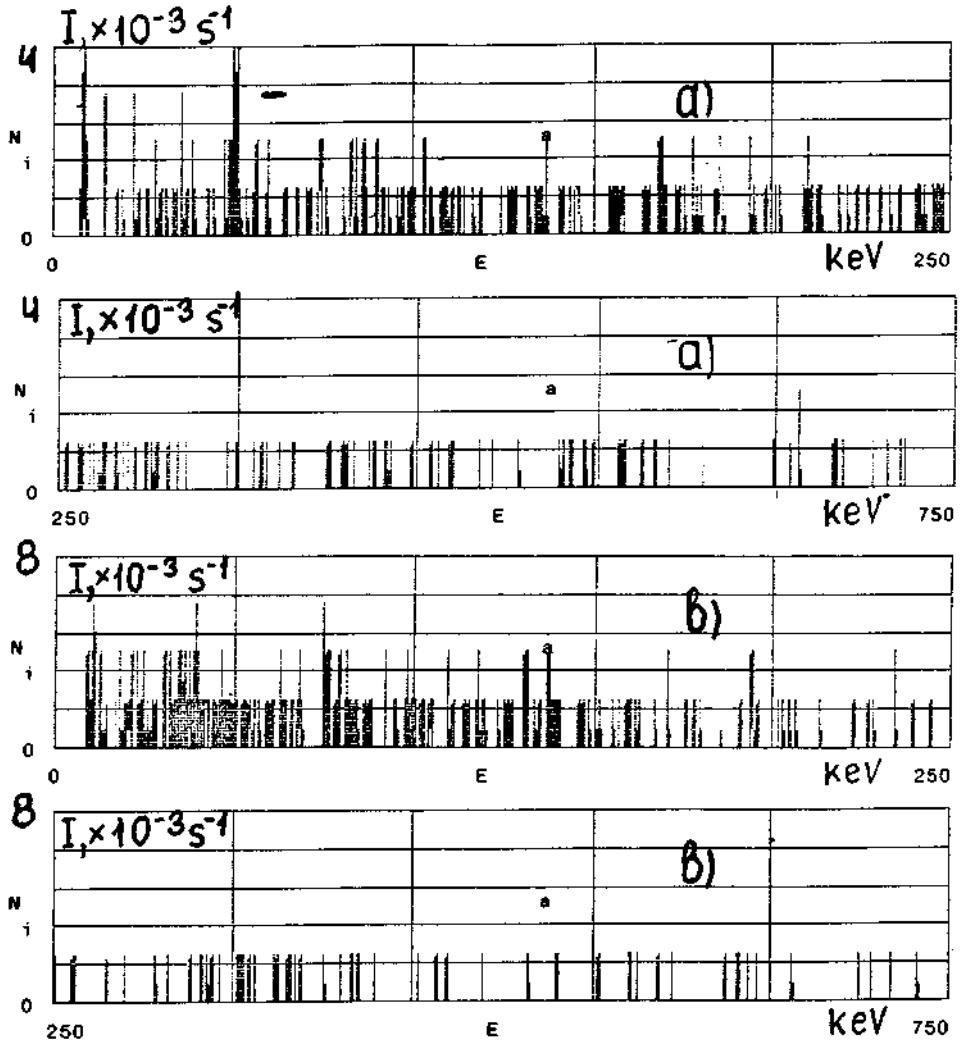

Fig.5. Background-corrected beta-spectra of cathode samples after discharge termination; a- Pd-D2, b- Pd- Ar.