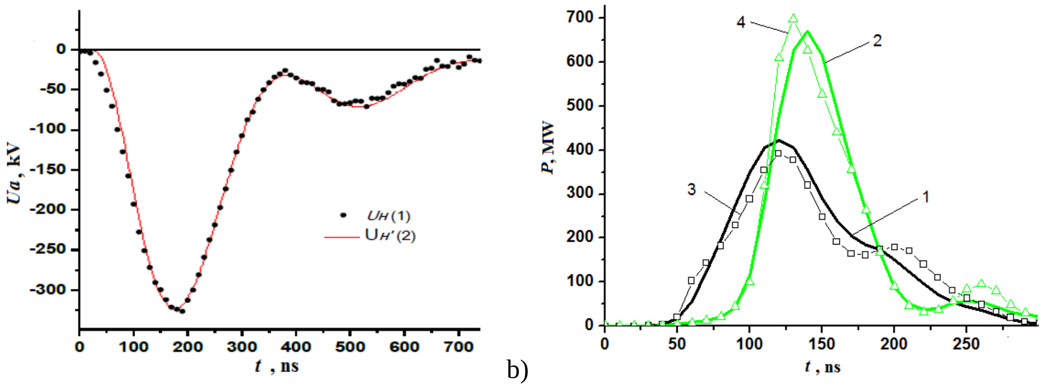
capacities of the high-voltage insulator structure were evaluated by Elcut simulation environment with the using of the finite element method for electric field computation. The computational model of the vacuum electron diode was created. Model is based on the analysis of the experimental curves of the diode impedance for the previously constructed model of the generator [2]. Matching of both models of the generator and the diode allowed simulating of the whole «ASTRA» accelerator. Verification of the accelerator model was carried out by comparing the simulation results and the results obtained experimentally (Fig. 1).



a) b)

Figure 1 a). Comparison of real (1) and simulated (2) voltage pulses. b). Real (1,2) and simulated (3,4) power pulses in the diode of the accelerator.

The amplitude and the shape of the voltage pulses obtained experimentally and by modelling agree satisfactorily (Fig. 1a). It is found that in determining the power (Fig. 2b) and the value of the energy released in the diode, the error introduced by the model does not exceed 7%.

REFERENCES

1. Egorov I., Esipov V., Remnev G., et. al., A high-repetition rate pulsed electron accelerator // Proceedings of the 2012 IEEE International Power Modulator and High Voltage Conference. – San Diego, 2012, – pp. 716-719.
2. Egorov I. S. Note: Numerical simulation and experimental validation of accelerating voltage formation for a pulsed electron accelerator // Review of Scientific Instruments. – 2014. – Vol. 85. – Iss. 6. – P 066112.

THE RESERCH OF INFLUENCE OF PLASMA IMMERSION ION IMPLANTATION OF TITANIUM ON HYDROGEN SORPTION OF Zr-2,5% Nb

A.N. Sutygina, E.B. Kashkarov, N.N. Nikitenkov
National Research Tomsk Polytechnic University,
Russia, Tomsk, Lenina ave., 30, 634050
E-mail: sutygina2013@mail.ru

Zirconium and its alloys are important constructional materials of light-water nuclear reactors. Under the influence of radiation, radiolysis of water occurs and hydrogen is released, which leads to hydrogen embrittlement. One of the ways of the zirconium alloys protection from hydrogen embrittlement is an ion surface modification. The influence of the plasma immersion ion implantation (PIII) of titanium into Zr-2,5% Nb alloy on its hydrogen sorption is studied in this report.

The samples size: diameter – 30 mm, thick – 1 mm. The surfaces of the samples were polished. The roughness of the samples is 0,567 µm. The titanium implantation into Zr-2,5% Nb was carried out at the installation «Raduga-Spectrum» [1]. The implantation time was 15 min. Samples were pre-cleared in argon plasma at 0,06 Pa pressure during

3 min. The implantation conditions: the arc current I = 70 A, the bias voltage U= 1,5 kV, frequency of impulses – 100 kHz, the pressure – 0,02 Pa. The part of the samples was implanted with a plasma filter, other part without the filter. The samples were saturated with hydrogen on the installation «Gas Reaction Controller» by the Siverst method at 400^0C during 120 min. The hydrogen pressure was 1,95 atm. The glow discharge spectrometer «GD-PROFILER 2» was used for the study of the elements distribution in the modified layer.

The sorption results are shown in table 1. From this table it follows that the sorption rate of hydrogen decreases after implantation of titanium in Zr-2,5%Nb. The using of the plasma filter reduces the sorption rate of hydrogen. This may be linked with the large number of microdroplets in plasma when titanium was implanted without the filter that reduces the homogeneity of the modified layer.

Table 1. The rate of hydrogen sorption in Zr-2,5% Nb

Samples	**Rate of sorption ×10-4 cm^3 H$_2$/(sec.·cm^2)**	
Zr+Ti with the plasma filter	0,73	
Zr+Ti without the plasma filter	2,1	3,9 (t>4000 sec.)
Zr	6,8	

The depth distribution of the elements shows that the depth of the modified with the filter is ~250 nm, without the filter is ~300 nm. Also the hydrogen concentration in Zr-2,5%Nb after hydrogenation is lower for the sample with the filter than for the sample without the filter. The obtained modified layer with the filter prevents the penetration of hydrogen.

Conclusion. PIII of titanium in Zr-2,5%Nb reduces the rate of hydrogen sorption. The barrier layer is formed during the implantation of titanium with a filter which prevents the penetration of hydrogen into the sample.

REFERENCES

1. Le Z., Krasnov D.N. Investigation of hydrogen influence on the titanium nitride coatings by vacuum arc deposition // XII International Conference of Students and Young Scientists «Prospects of Fundamental Sciences Development». – Tomsk, 2014 – V.1 – P. 125–127.

CHANGING OF TRACK MEMBRANES CONTACT WETTING ANGLE AFTER LOW-TEMPERATURE ATMOSPHERIC PLASMA TREATMENT

E. O. Filippova, V.F. Pichugin
National Research Tomsk Polytechnic University,
Russia, Tomsk, Lenin str., 30, 634050
E-mail: katerinabosix@mail.ru

There are a lot of polymer’s materials with low surface energy and surface wettability. One of these materials is polyethylene terephthalate (PET), which is widely used in medicine [1]. Plasma-induced modifying the polymer’s surface is the perspective and modern method of modifying the polymer’s surface. This method allows changing of the surface morphology and as a result its wettability [2, 3].

This article shows results of plasma-induced modifying the PET track membrane surface, changing of its morphology and wettability. The purpose of research is to study the hydrophilic changes of the track membranes surface properties after exposure to low temperature atmospheric plasma.

Experiments were conducted using a track membrane “TOMTREK” based on PET with pores diameters 0.4 μm and $5 \cdot 10^6$ pores / cm^2 density. The pores are formed by irradiating the polymer PET 40Ar +8 ions with energy 41.5 MeV. After irradiation, the membrane was chemically treated in the alkaline solution. The surface had been