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UV IRRADIATION OF TRACK MEMBRANES AS A METHOD FOR OBTAINING THE NECESSARY VALUE OF BRITTLENESS FOR GOOD FRACTURES OF SAMPLES FOR SEM OBSERVATIONS

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Synthesis of nano- and microstructures of materials inside the pores of specific template-track membranes can be used to obtain nano- and microwires or nano- and microtubes [1]. It is important for these applications to know the inner geometry of the pores like sizes, shape and surface morphology [2,3]. Scanning electron microscopy technique (SEM) was used for this kind of membrane characterisation. The proper preparation of samples for SEM observations is very important in order to prevent destruction of the structure of membrane during the fracture preparation. The breaking membranes samples at the liquid nitrogen temperature (77 K) did not allow us to obtain undistorted cross-section. The use of other methods of sample preparation as electron, gamma rays or UV irradiation allows us to make them more brittle [4-6]. The preliminary results of tensile measurements of membranes after UV irradiation are presented here.

Poly(ethylene terephthalate) (PET) membrane 10 μm thick with pore diameter 1.0 μm were prepared at the Joint Institute for Nuclear Research (Dubna, Russia) using the standard procedure [3]. Then, the samples were irradiated with UV light with energy flux 2.8 W/cm^2 during different periods of time. The tensile measurements of the initial and irradiated materials were carried out using a tensile machine Instron 5565 (Instron Co., England) in the Institute of Nuclear Chemistry and Technology. Membranes surface and fracture observations were made using SEMs: JSM 840 (Jeol, Japan), DSM 942 (Zeiss, Germany) and LEO 1530 GEMINI (Zeiss, Germany) with low accelerating.

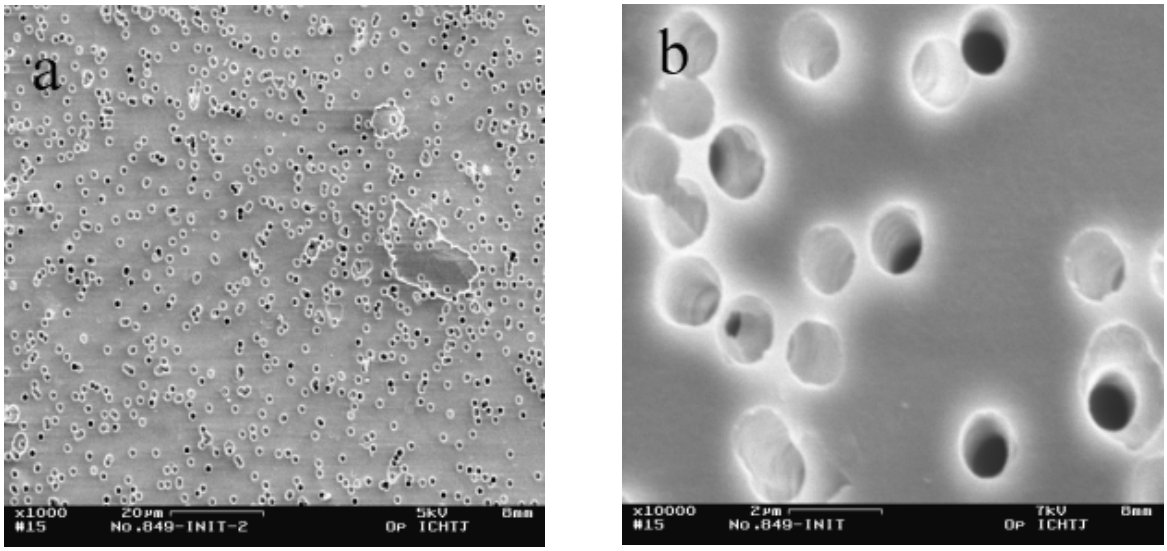

Fig.1. Surface morphology of PET investigated membrane: a) x1000 magnification and b) x10 000 magnification.

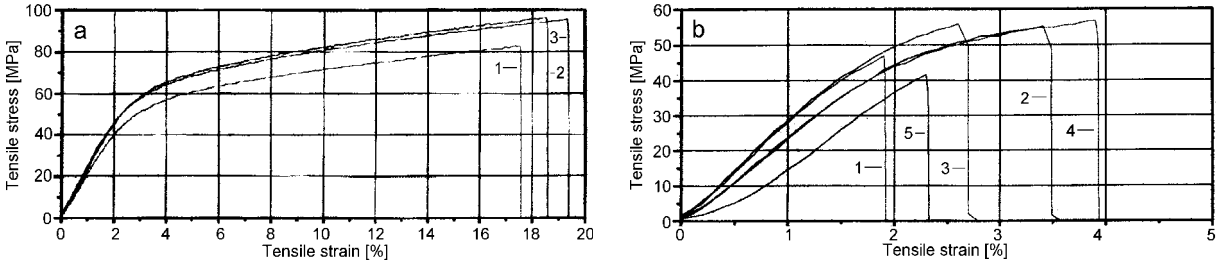

Fig.2. Samples of tensile measurements results of PET membrane: a) initial and b) after 52 h UV irradiation.

The samples were fixed using a conductive glue and then coated with a thin layer of gold to reduce the charging which takes place during SEM observations [4].

Figure 1 presents the surface morphology of the investigated membrane. Average pore diameter measured by the use of SEM was 1.14 ± 0.20 μm. In the majority of cases they have a round shape. Multiple pores can be seen.

Figure 2 presents the results of tensile measurements for initial material (three samples signed 1-3) and for irradiated material (five samples signed 1-5). According to these diagrams we can determine the main parameters of material tensile properties: strain at brake [%], tensile stress [MPa] for each sample and average values for the investigated material.

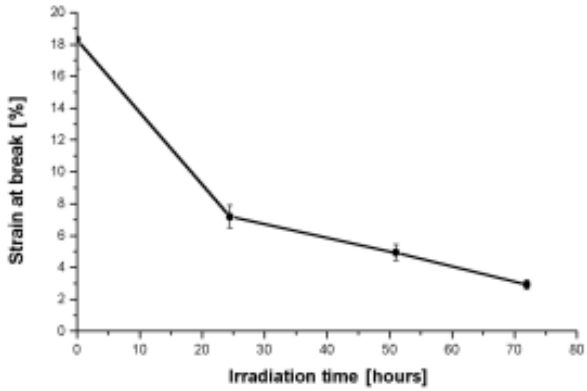

Fig.3. The strain at break of PET membrane – results of the tensile measurements *vs*. the UV irradiation time.

The dependence of the UV irradiation dose on the strain at brake is presented in Fig.3. The strength of the membrane decreases with increasing irradiation time, *i.e*. with increasing dose. This means that the investigated material became significantly more brittle. The degradation of PET was provoked by absorbed UV light with wavelengths in the range of 310-320 nm. In the case when the time of UV irradiation increases up to 90 h under the same conditions, the membrane breaks without distortion of its channel structure and we obtain the cleavage without elastic deformations.

Figure 4 illustrates the cross-section of a PET membrane with asymmetric pores subjected to

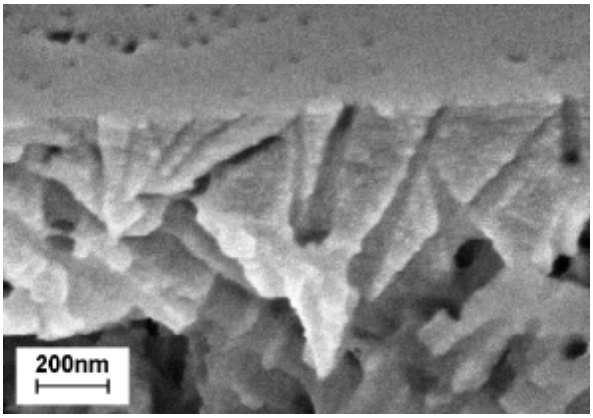

Fig.4. The fractures of PET asymmetric membrane after 90 h UV irradiation.

oxidative photodegradation under the UV irradiation in air during 90 h. The structure of selecting the layer near the membrane surface as well as the shape and sizes of channels are clearly seen. In the bulk of membrane, the high porosity can be seen at the same time. We can say that this membrane has a good productivity, dirt capacity and selectivity.

In conclusion, we can find the dose of UV irradiation that ensures the fracture without elastic deformation. In the case when the time of UV irradiation increases up to 90 h, the PET membrane breaks without distortion of its channel structure.

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