Analysis of the dependence of the structural parameters of membranes based on NOA and anode current on the parameters of the production process

M.S. Batalova[1*], B.E. Alpysbayeva[2], N.E. Korobova[3]
[1]*al-Farabi Kazakh National University, Almaty, Kazakhstan*
[2]*Laboratory engineering profile of al-Farabi Kazakh National University, Almaty, Kazakhstan*
[3]*Institute of Nano-Micro System Technique, National Research University of Electronic Technology (MIET), Moscow, Russia*
E-mail: batmal@yandex.kz

Among the porous membranes, PAOA-based membranes, formed by the method of electrochemical anodizing of aluminum foil, are of the greatest interest. Membranes obtained by electrochemical anodization are highly ordered structures with parallel vertical pores [1]. The unique porous structure, the parameters (diameter, length and distance between adjacent pores) of which can be varied during the synthesis process allows the use of films of porous aluminum oxide as inorganic membranes, templating material for the synthesis of nanowires or nanotubes with a controlled diameter and high geometric anisotropy, as well as 2D photonic crystals and biosensors [2,3].

Aluminum foil (99.999%) with a thickness of 0.5 mm was used as the starting material for the synthesis of films of porous aluminum oxide. Oxide layer formed on the foil surface was removed by electrochemical polishing of aluminum in a mixture of 40g CrO_3 + 210 ml H_3PO_4 (concentrated acid) + 45 ml H_2O at a temperature of 80°C. The membranes based on porous alumina were obtained by a two-stage anodizing process in 0.4 M oxalic acid at a temperature of 4–19 ° C.

With an increase in the magnitude of the voltage, the thickness of the porous film, which grows in the same time, increases; the growth rate of the film grows sublinearly. With increasing voltage value, the initial value of the anode current also increases. The anode current in the anodization process gradually decreases, which, as already noted, indicates the beginning of pore formation and further stabilization of the anode current occurs when the pores grow deep into the oxide film. According to the data obtained on the dependence of the anode current on the time of the anodization process, it can be concluded that the maximum current value at room temperature is higher than at low temperature, and this can be traced for all voltage values.

References

[1] W. Lee, R. Ji, U.G. Sele, K. Nielsch, “Fast fabrication of long-range ordered porous alumina membranes by hard anodization”, Nature materials. 2006. V. 5 P. 741 – 747.
[2] S. Shingubara, “Fabrication of nanomaterials using porous alumina templates”, Journal of Nanoparticle Research. vol. 5, 2003, pp. 17–30.
[3] R.E. Gyurcsányi, “Chemically-modified nanopores for sensing”, *TrAC Trends Anal. Chem.* 2008, *27*, 627–639.