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Transport characteristics of porous glass membranes modified with bismuth (III) oxide

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Glassy bismuth-containing materials (GBM) are promising for the creation of optical fibers with lasing in spectral ranges that are inaccessible to traditional materials with rare-earth ions. Developments of the ISCh RAS have shown that high - silica nanoporous glass (PG) is a promising medium in which it is possible to effectively control the chemical equilibrium of luminescence centers (bismuth active centers - BACs) [1]. For directed synthesis of GBMs with controlled BACs, it is necessary to study how the colloidal-chemical properties of the pore space surface of the synthesized composites change when the initial matrices are modified. In this regard the study and comparison of the transport characteristics (counterion transport numbers, surface conductivity, streaming potential) of micro- and macroporous (MIP and MAP) glasses, as well as on microporous glass heattreated at 750°C (MIP-750), containing (or not) Bi_2O_3 in 10^{-1}-10^{-4} M KNO_3 solutions were carried out. For obtain composite materials, a part of PG matrices were impregnated in 0.5 M $Bi(NO_3)_3$ solution prepared based on 2 M HNO_3 solution; and the other part of the matrices, in 2 M HNO_3 solution for 3 days (three-stage treatment) with intermediate drying at 50 °C. After impregnation the PG samples were heat-treated to the temperature T = 650 °C, as a result of which $Bi(NO_3)_3$ decomposed in the pore space to form Bi_2O_3.

From the measured streaming potentials values for all the porous membranes under study, the values of the zeta-potentials (ζ) were calculated taking into account the electrical conductivity of the pore solution and the electrical double layer overlapping. It is shown that the efficiency coefficient (which is equal to the ratio of the specific electrical conductivities of pore and free solutions), counterion transport numbers and |ζ| values for membranes impregnated in saline or acidic solutions and heat treated are close to each other and less than for the initial matrices.

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