

CATION-EXCHANGE MEMBRANES DOPED WITH SILICA AND ZIRCONIA WITH FUNCTIONALIZED SURFACE

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Cation-exchange membranes are widely used for fuel cells applications, sensor devices, and water purification. Doping membranes with inorganic oxides in some cases results in increase in the ion transport selectivity and the conductivity of the obtained materials. The functionalization of the oxide surface with acidic groups allows to achieve an additional improvement of transport properties. In this work, we studied the transport properties of composite materials based on cation-exchange homogeneous membranes MF-4SC and heterogeneous membranes like membrane foil (MFC) doped with zirconia or silica with a surface modified by phosphate- or sulfo-groups.

In the homogeneous MF-4SC membranes, the introduction of sulfonated zirconia (silica) leads to an increase in the conductivity and selectivity of the transfer processes (for some samples more than 1.5 times as compared with the initial membrane). The efficiency of heterogeneous membranes modification is usually low. At the same time, it seems interesting to modify the thin heterogeneous MFC membranes developed by Mega (Czech Republic). It has been shown that they are characterized by significantly higher doping degree compared to homogeneous ones. For hybrid membranes modified with zirconia, a significant decrease in the rate of cationic transfer is observed. The use of oxides modified with phosphate- or sulfo-groups results in the conductivity improvement by 10–25% in some cases and decrease in the numbers of anion transfer by more than 7 times. A decrease in the gas permeability of the modified samples down to 20% was shown. Differences in the water uptake, conductivity, and interdiffusion coefficients of the obtained hybrid membranes are discussed using the model of limited elasticity of the membrane pores. The participation of the dopant surface containing acidic groups in transfer processes is shown.

The obtained results suggest that the proposed modification method is promising for improving the transport properties of heterogeneous cation-exchange membranes.