metallic structure was manufactured by means of the investment casting with the use of replicas technique for the designed pattern. The thermal behavior of PCM was tested with the DSC and TGA analysis.

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Synthesis and study of transport and mechanical properties of hybrid nanocomposites membranes for using in fuel cells and sensors

It is well-known that American cation-exchange perfluorinated membrane Nafion-117® (DuPont de Nemours) and its Russian analogueMF-4SC (LTD Plastpolymer) are among the most widely used asseparators in various devices like fuel cells, electrolyzers, electrodialyzers, sensors and investigated ion-exchange materials [1]. Surface and spatial modification of polymer ion-exchange membranes byincorporation of different inorganic dopants allows to change their characteristics, in particular, stability and structural properties as well as ion and molecular transport [2]. Polyaniline [3], nanoparticles of noble metals [4], oxides of zirconium [5] and silicon [6], carbon and halloysite nanotubes (HNT) [7, 8] and other materials that can transform transport properties of the membranes in the preferred direction are frequently used as such dopants. This poses the priority problem of a reliable characterization of the newly created hybrid nanocomposites membranes. Here we propose an approach to solve this problem for single- and bi-layer hybrid membranes, based on a theoretical examination of the electrodiffusion transport and our own experimental data. As dopants, halloysite nanotubes and platinum nanoparticles were used. HNT of 2% by weight were added to whole membrane or one of the membrane layers during synthesis by casting method. Halloysite clay is a natural tubule material formed by rolled kaolin sheets. Halloysite is alumosilicate which is chemically identical to kaolin but typically contains minor amount (less than 1 wt%) of ironions. Prior to synthesis, nanoparticles of platinum were deposited on the external surface of halloysite nanotubes [9]. A similar attempt to membrane characterization was made in our recent work [10] for the surface-modified MF-4SC membranes in low-temperature plasma. Thus, halloysite nanotubes are used not only as a container for the delivery of metallic nanoparticles inside the membrane matrix, but also as a hydrophilic object, which increases the moisture content of the membrane. This suggests that under the operating conditions of the fuel cell the crossover through the modified membranes will be lower. So, ion-exchange membranes with enhanced water uptake are interesting for fuel cells applications because make it possible to improve the properties of fuel cells. It was shown alsothat introduction of halloysite in perfluorinated matrix MF-4SC reduces both maximum power of the membrane-electrode block of FC and the range of operating current densities, while the subsequent addition ofplatinum compensates for the negative effect of halloysite adding: the maximum specific power becomes higher than for the original (pure)membrane by 5%, the operating current density range increases.

We experimentally established and theoretically described the phenomena of asymmetry of diffusion permeability and asymmetry of current-voltage curve for bi-layer nanocomposites when changing membrane orientation towards the electrolyte concentration gradient or direction of external electric field applied. These phenomena are very promising in developing of membrane sensors and diodes. Our novel approach to characterization of membrane nanocomposites allows predicting transport properties of bi-layer structures basing on knowledge of transport properties of single-layer membranes. We examined also mechanical properties of single-layer membranes (Young's modulus, stress at the rupture) and found best percentage of dopants in view of optimal combination of mechanical and transport properties of hybrid materials.

This makes it possible to predict the effective use of hybrid membranes based on MF-4SC and halloysite nanotubes with platinum nanoparticles, not only as separating diaphragms in fuel cells and electromembrane devices, but also as promising catalytic systems as well as membrane sensors and diodes.

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Shock refraction and focusing upon interaction with cylindrical cloud of equilibrium dust

Shock propagation through dusty gas takes place in wide array of problems, including such important topics as coal mine explosion safety and shock-impulse methods of powder coating. The key role is played by interaction of with local clouds of suspended particles. An interaction of a shock with cylindrical cloud of low-concentration quartz dust is studied in the present work. A model of equilibrium dust-gas mixture based on Euler's equations [1] is used. Refraction and focusing processes of the incident shock are described. Two qualitatively different interaction patterns – internal and internal – depending on dust concentration in the cloud are found. A dependence of peak shock focusing point and focusing intensity on dust volume concentration in range from 0.01% to 0.15% is determined. With dust concentration increase, focusing point approaches the cloud edge and shifts into the cloud, while shock focusing intensity rises non-monotonically.

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