SYNTHESIS OF OPRGANIC/INORGANIC MATERIALS WITH PROTON-CONDUCTING AND ADSORPTION PROPERTIES

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Today, in the face of complex geopolitical challenges associated with the growing dependence of countries' economies on the supply of raw materials, qualitatively new solutions to energy and environmental problems are needed. Therefore, research aimed at creating new materials with specified functional properties is relevant for the sustainable development of societies.

Electroactive polymeric and organic/inorganic materials are used as solid electrolytes in fuel cells which become popular as alternative current sources. In the same time the materials with functional groups may be used also as adsorbents for the purification of polluted water.

The goal of our work was to develop organic/inorganic materials with proton-conducting and sorption properties for the use in fuel cells as proton-conducting membranes and in wastewater treatment processes. For the synthesis of such materials, acrylic monomers were chosen, which are commercially available and relatively inexpensive, which is important for the commercialization of technologies based on the obtained products. Most of the functional polymeric and organic/inorganic materials reported in the literature are obtained by thermal polymerization. The choice of acrylic monomers allows the use of UV technique, a fast and convenient method of polymerization. The synthesis of composite materials was carried out by UV-initiated copolymerization of a mixture of acrylic monomers: acrylonitrile (AN), acrylic acid (AA), 2-acrylamido-2-methyl-propanesulfonic acid (AMPS) using the cross-linking agent *N,N'*-methylene-bis-acrylamide (MBA) in the presence of the polymerization photoinitiator 2,2-dimethoxy-2-phenylacetophenone (IRGACURE 651). To obtain organic/inorganic material sol-gel precursors (TEOS and MAPTMS) were introduced into the monomer mixture providing the formation of inorganic network through the polymer matrix.

Proton conductivity is the main parameter used to assess the efficiency of the membranes in fuel cells. Proton conductivity of the synthesized organic/inorganic materials was measured in a fuel cell with controlled temperature and humidity. It was established that proton conductivity of the materials depends on the content of sulfonic acid. In all synthesized organic/inorganic materials, a slight increase in proton conductivity value was observed compared to purely polymeric material (from 3.65 ± 0.25 mSm/cm for polymeric material to 4.14 ± 0.29 mSm/cm for organic/inorganic composite).

The results of the study of the adsorption Co(II) ions from aqueous solutions by the synthesized organic/inorganic materials revealed sufficiently high adsorption rate. The interaction of ion-exchange groups with a metal ion occurs quite quickly, since the degree of membrane swelling is optimal for the diffusion of the metal ion into the pores of the material, the ion-exchange groups have a high affinity for metal ions. The maximum adsorption values are achieved during the first 25 - 30 min. of contact of the membrane with a solution of metal ions. After this, the process of removing Co(II) metal ions reaches an equilibrium state. The adsorption efficiency of the developed material reaches 90.2 %.

Thus, the synthesized organic/inorganic materials possess sufficiently high proton conductivity, which makes their application as membranes in fuel cells promising. At the same time, these materials demonstrated high efficiency as adsorbents of Co(II) ions in the wastewater treatment process.