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INVESTIGATION OF PROTON CONDUCTIVITY OF THE ORGANIC-INORGANIC MEMBRANES FOR FUEL CELLS

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Proton conductivity of the organic-inorganic membranes on the basis of acrylic monomers and sol-gel precursors 3-methacryloxypropyl trimethoxysilane and tetraethoxysilane was investigated.

Keywords: *organic-inorganic membrane, proton conductivity, fuel cell.*

ДОСЛІДЖЕННЯ ПРОТОННОЇ ПРОВІДНОСТІ ОРГАНО-НЕОРГАНІЧНИХ МЕМБРАН ДЛЯ ПАЛИВНИХ ЕЛЕМЕНТІВ

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Досліджено протонну провідність органо-неорганічних мембран на основі акрилових мономерів та золь-гель прекурсорів 3-метакрилоксипропіл-триметоксисилану та тетраетоксисилану.

Ключові слова: *органо-неорганічна мембрана, протонна провідність, паливний елемент.*

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Proton conductive membranes are the key elements of fuel cells, which are considered at present as effective and clean energy sources [1]. The critical requirement for membrane materials is proton conductivity.

Proton conductive membranes were synthesized *via* UV-initiated free radical copolymerization of acrylic monomer mixture (acrylonitrile (AN), acrylic acid (AA), 2-acrylamido-2-methylpropane sulfonic acid (AMPS) and *N,N'*-methylene-*bis*-acrylamide (MBA) as a cross-linker) with simultaneous sol-gel process of the added sol-gel system based on tetraethoxysilane and 3-methacryloxypropyltrimethoxysilane taking place *in situ*. 2.2-dimethoxy-1.2-diphenylethane-1-on (DMPA) was used as photoinitiator [2]. The ratio between the components of the feed composition was as follows: AN : AA : AMPS : MBA : DMPA = 60 : 10 : 30 : 3 : 2 wt %. The content of the added sol-gel system was 50 wt %.

The four-point-probe method was used for the proton conductivity measurement in a temperature- and humidity-controlled chamber (FuMaTech GmbH, Germany). The proton conductivity of the membrane was calculated by the following formula:

$$\sigma = \frac{l}{w \times d \times R},$$

where *l* is the distance between electrodes (1 cm), *R* is the measured resistance, *w* is the width and *d* is the thickness of the sample.

Fig. shows the results of the membrane proton conductivity measurements at different relative humidity (RH). The synthesized membranes demonstrated high level of proton conductivity – $6.2 \cdot 10^{-2}$ - $1.1 \cdot 10^{-2}$ mS cm^{-1}, since hybrid organic-inorganic membranes are facilely constructed to efficient pathways for continuous transfer of protons provided by $–SO_3H$ groups of AMPS. As one can see from Fig. 1, the values of the membrane proton conductivity sufficiently depend on RH.

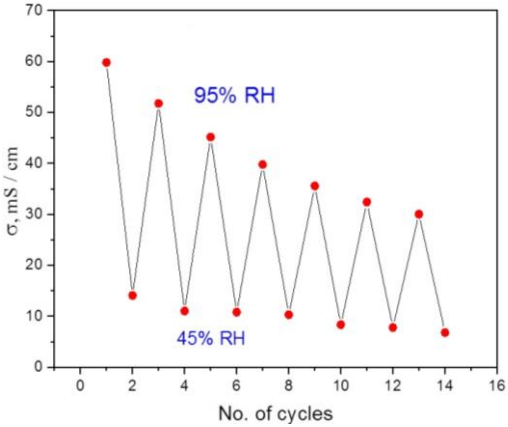

Fig. Proton conductivity of the membrane, equilibrium time 2 hours

Hence, the synthesized cross-linked polyacrylic/silica membranes possess reasonably good proton conductivity, so, they are promising candidates for further investigations with the goal to obtain non-fluorinated inexpensive proton conductive membranes for fuel cells.

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