PROTON CONDUCTIVE MEMBRANES BASED ON ACRYLIC MONOMERS AND SOL-GEL SYSTEM FOR ELECTROCHEMICAL APPLICATION

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Recently fuel cells are considered as a promising and eco-friendly technology for generating clean and efficient power, what is one of the sustainable development goals. For production of solid polyelectrolyte membrane – the main element of fuel cell – different proton conductive materials are tested. At present the only commercially successful solid polyelectrolyte membrane for fuel cell technology is DuPont's Nafion (perfluorosulfonic acid ionomer) due to its high operating characteristics. However, Nafion-type membranes have some drawbacks, therefore, the researchers develop the alternative ion conductive materials, in particular, functional polymer and organic/inorganic materials have gained much attention.

In the present study we report the synthesis and characterization of the proton conductive membranes based on cross-linked poly(acrylates) as well as poly(acrylate)/SiO_2. The silica network was provided by the addition of the sol-gel precursors 3-methacryloxypropyl trimethoxysilane (MAPTMS) and tetraethoxysilane (TEOS). The poly(acrylate) membranes were prepared from acrylonitrile (AN) – 55 wt %, acrylic acid (AA) – 25 wt %, sodium 4-vinylbenzenesulfonate (NaSS) – 20 wt % and a cross-linker ethylene glycol dimethacrylate (EGDMA) – *via* UV-induced polymerization. To obtain the poly(acrylate)/SiO_2 membranes the sol-gel precursors were added to the monomer mixture during polymerization (3–10 wt %).

Morphology of prepared membranes was investigated by SEM (Fig. 1). The resulting images indicate that the samples are in the cross section are uniform and dense, without cracks, therefore we conclude that silica is located throughout the cross-section of the membrane. Darker regions in Fig. 1, may represent localized hydrophilic ions clusters containing protons, while the lighter parts represent hydrophobic regions of the membrane.

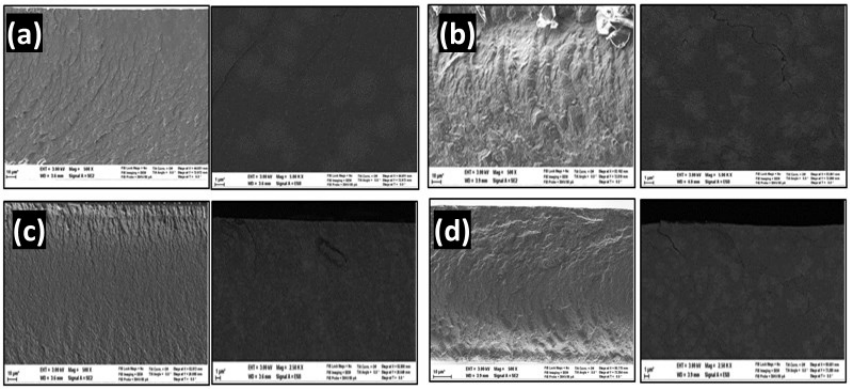

Fig. 1. SEM images of poly(acrylate) and b), c), d) poly(acrylate)/SiO_2 membranes

The proton conductivities is an important characteristic of the membrane during its operating in fuel cell. The measured values of proton conductivity of the acrylate membranes are $(1.17–2.85)\times10^{-3}$ Sm/cm. The values of proton conductivity of the poly(acrylate)/SiO_2 membranes gradually increase with increase of the inorganic component content (from 2.1±0.1 Sm/cm till 2.9±0.1 Sm/cm).