Materials, Properties, and Lifetime of Anionic Membranes and Direct Methanol Fuel Cells

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Introduction

Anionic fuel cells are of interest because they have the potential to overcome cost and performance platinum usage issues with acid fuel cells. In this study, a series of anion-conductive multiblock copoly(arylene ether sulfone)s were synthesized and compared to random copolymers in direct methanol fuel cells. The block copolymer can create a nanochannel structure for ion conduction. The corresponding random copolymers were less effective at creating conductive channels in the polymer structure. The lifetime of the polymers was evaluated by comparing their degradation in accelerated ex-situ conditions. The effect of polymer backbone and pendant ion group stability was evaluated.

Results and discussion

A series of anion conductive multiblock copolymers (mPES) with different block lengths containing quaternary ammonium groups were synthesized by the polycondensation of separately prepared OH- and F-terminated oligomers. The F-terminated oligomer at which quaternary ammonium groups were attached become an ion-conductive hydrophilic block.

The ion exchange capacities, the ion conductivities, and the relaxation times were evaluated as a function of degree of fluorination, and ion exchange capacity. The relaxation times correspond to water in the polymer membranes rather than polymer protons, confirmed by the absence of peaks belonging to the polymers and the high water content of the membranes.

Polymer lifetimes were evaluated by NMR analysis. The results show the benefit of higher ion concentration, controlled water uptake, and optimized ion channel size. The stability of the backbones materials was dependent on the polymer backbone and type of conducting ion.