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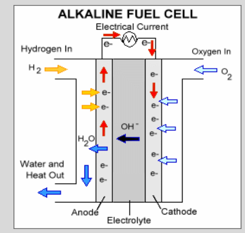
Sandia National Laboratories

Polymeric Ion-Exchange Membranes for Fuel Cell and Battery Applications

Increasing performances and lifetimes of electrochemical devices with durable, highly-conductive ionomers



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The stability and conductivity of the Sandia membranes enable the development of fuel cells and batteries.

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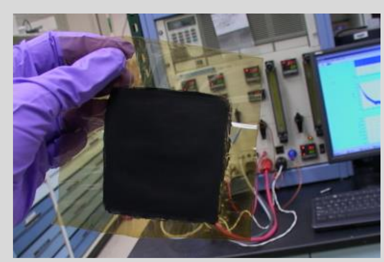
Problem Statement:

A wide range of electrochemical devices such as fuel cells, electrolysis cells, and batteries require a separator to prevent contact of the electrodes while still allowing the passage of ionic species to complete the circuit. The separator material must be stable at elevated temperatures and pH extremes and also possess enough elasticity and mechanical strength to facilitate film processing and cell fabrication. In addition, control of water swelling in these materials is often a critical parameter.

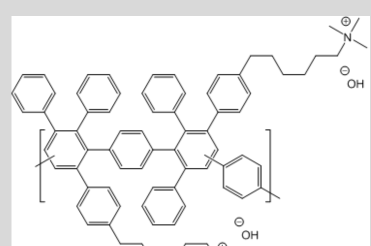
Approach:

In recent years, Sandia has patented the synthesis of a series of ion-exchange membranes based on a poly(phenylene) backbone with either pendant sulfonic acid groups or pendant trimethyl ammonium groups (see structure of TMAC6PP in bottom right figure). These polymers are very stable because the backbone is entirely aromatic and the cationic groups are shielded from attack. The Sandia membranes show chemical stability at higher pH and temperature conditions than those reported by any other group and they have hydroxide ion conductivities comparable to the highest reported values. In addition to their use in membranes, the polymers are soluble in alcohols and thus can be used as ionomeric binders in fuel cell electrodes. The Sandia membranes are also suitable for use as separators in batteries and electrolysis cells.



Impact:

Sandia’s hydrocarbon-based membranes are substantially less costly to produce than currently marketed fluorinated membranes sold by DuPont, 3M, and others. In addition, the anion-exchange membrane market lacks a product that is durable enough to function in an electrochemical cell at high pH.



TMAC6PP

U.S. DEPARTMENT OF ENERGY NNSA National Nuclear Security Administration

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