

# POLYMER MEMBRANE SEPARATORS FOR FUEL CELLS

US Patents 7,816,482; 7,888,397; 8,809,483; 8,110,636; 7,301,002; 10,053,535; 10,370,483; 9,534,097; 9,580,541  
SD# 10987; 11085; 11210; 12299; 12549; 12691.1; 13741; 7565.1

Technology Readiness Level: 2/3

Concept Demonstrated Analytically or Experimentally

**Versatile polymer membrane separator technologies with improved long-term stability, performance in high temperatures, and suitability for acidic and alkaline environments**

Fuel cells are hailed as clean, quiet, and efficient technologies with great promise for electric vehicle applications. To date, water-based acidic polymer electrolyte membrane fuel cells (PEMFCs) have been widely studied in vehicle applications, but due to their inability to perform in high temperature operation and use of platinum, a costly precious metal, PEMFCs face persistent limitations in cost and performance. Alternatively, alkaline membrane fuel cells (AMFCs) have garnered interest for fuel cell vehicles due to their ability to leverage inexpensive, nonprecious metal catalysts; however, their chemical stability under operating conditions still requires enhancement to compete with industry standard alternatives.

Sandia researchers have developed versatile membrane technologies with improved long-term stability and performance in high temperatures. With chemical optimization, these membranes, polymers, and ionomers are suitable for acidic or alkaline environments. These innovative materials are built upon an inexpensive poly(phenylene) backbone with ionic conductivities, chemical stabilities, and alkaline durability that are superior to commercially available AMFCs. Together, they present a more efficient, cheaper alternative to industry standard fuel cell membranes and have the potential to greatly reduce fuel cell manufacturing costs and performance.



## TECHNICAL BENEFITS

- Operates in alkaline and acidic environments with chemical and thermal stability
- Decreased crossover improves fuel cell efficiency and power output
- Maintains operation performance across a wide temperature range
- Reduced manufacturing cost compared to perfluorinated sulfonic acid polymers

## INDUSTRIES & APPLICATIONS

- Automotive and stationary power systems
- Fuel cells- compatible with AEMs, AFCs, AMFCs, PEMFCs, and DMFCs
- Chloro-alkali process
- Electrolysis
- Water purification
- Flow batteries

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