

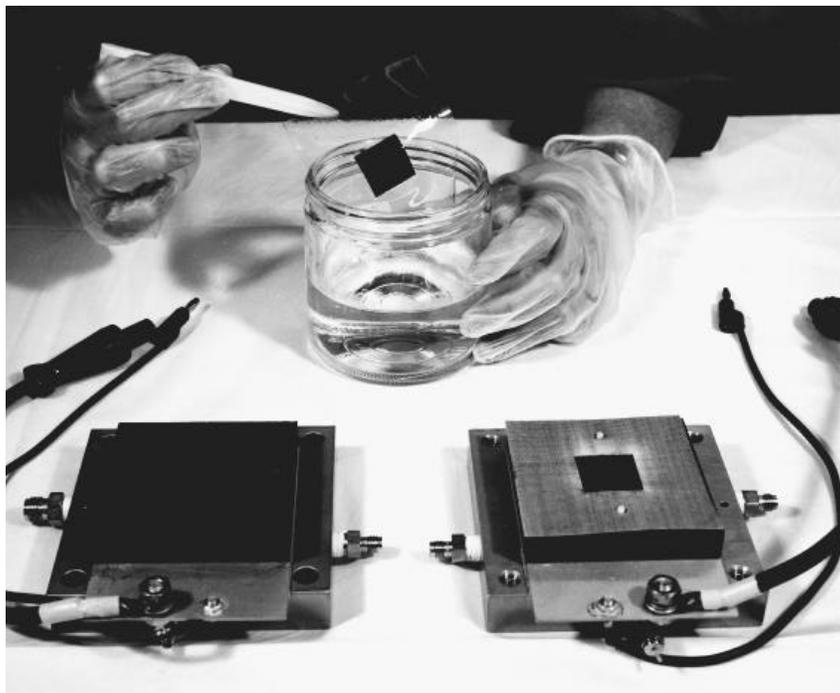
focus on . . .

Fuel Cells for Transportation

New technology leads to more efficient, cleaner vehicles

A fuel cell is an energy conversion device capable of efficiently converting the chemical energy of a fuel directly into electric energy. A simplistic picture of the fuel cell would be that of a "black box" with inlets of fuel (typically hydrogen) and oxidant (typically air) and an electric outlet of direct current. The polymer electrolyte fuel cell is a member of this family of energy devices that has received attention recently as a potential power source for the next generation vehicle. The reason for this interest is the unique combination of high energy conversion efficiency and very low emission levels that can be achieved with this power source. This combination of properties could significantly lower U.S. dependence on oil imports and ensure a cleaner environment.

A technician prepares to install a membrane electrode assembly into the fuel cell hardware. This polymeric membrane has a high ionic conductivity with thin films of catalyst bonded on both its major surfaces. These films provide the active sites for the electrocatalytic reactions of hydrogen and air, that is, the sites where chemicals are directly converted to electricity. The technology developed at Los Alamos enables extremely high catalyst use in highly robust structures, thus drastically lowering precious metal needs.



Fuel cell research focuses on challenges related to materials

Until recently, fuel cell technology was considered too expensive and too unreliable to have practical applications in the transportation industry. By reducing the cost of materials, modifying materials properties for specific applications, and identifying new materials or combinations of materials for various components, researchers at Los Alamos have significantly advanced this technology.

The polymer electrolyte fuel cell technology uses carbon, polymers, and precious metal catalysts. The heart of the cell is a polymeric membrane with high ionic (protonic) conductivity with thin films of catalyst bonded on both its major surfaces. These films provide the active sites for the electrocatalytic reactions of hydrogen and air, that is, the sites where chemicals are directly converted to electricity. Previous fuel cell technology used relatively large amounts of platinum, a very costly component, as the catalyst. Scientists have now optimized the structure and composition of this catalyst, creating a unique thin film that greatly reduces cost while maintaining high performance.

Development efforts have also successfully optimized other components, including the gas diffuser, which enables direct access of reactant gases to the thin film catalyst with no excessive transport barriers. Other R&D efforts at Los Alamos have focused on detailed characterization of the membrane material and its transport processes. The result has been optimization of membrane thickness and properties with significant improvements in power density and in longevity of the cell. Detailed fuel cell codes have been based on this experimental data.

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Los Alamos scientists pursue industrial collaborations and commercialization opportunities

Fuel cell technology advances are important to U.S. businesses, including the automotive, chemical, and power source industries. Los Alamos researchers have collaborated extensively with manufacturers to develop commercial products for fuel cell applications. The Los Alamos Industrial Partnership Office (505/665-9090) acts as a liaison between the Laboratory and industry. This office will respond to inquiries from businesses interested in pursuing information about collaborations involving the fuel cell program

A Los Alamos researcher checks the progress of a long-term test of fuel cells. Such tests have demonstrated performance and longevity appropriate for transportation applications.



Interesting facts

- Transportation accounts for over 60 percent of U.S. petroleum usage, an amount greater than total domestic production.
- Fuel cells can provide approximately twice the energy efficiency of internal combustion engines with comparable range and performance.
- Fuel cells produce much lower emissions than internal combustion engines.

Recent achievements in the Los Alamos fuel cell program

- Reduced the cost of platinum for a complete power source for a passenger car from \$30,000 to just \$300.
- Tested advanced electrode technology in single cells for periods exceeding 3,000 hours to demonstrate negligible performance losses.
- Subjected cells to numerous shut-down/start-up and freeze/thaw cycles.
- Developed effective technique to avoid catalyst deactivation in presence of trace impurities in the hydrogen fuel.
- Optimized membrane properties to achieve effective water management.