Fuel Cell Membranes That Operate at High Temperature

A thermally and mechanically stable polymer electrolyte membrane for use in fuel cells

Georgia Tech inventors have developed a thermally and mechanically stable polymer electrolyte membrane for use in fuel cells. The fuel cell PEM contains a porous support film with fibers, a layer of free acid, and a polysiloxane polymer bonded to the film and both sides of the layer of free acid. Membranes may contain single or multiple layers that are laminated before use in a fuel cell. The tri-layer PEMs have been adapted to operate at low humidity and at high temperatures with minimal loss of conductivity. A key feature is a skin layer that is molecular-level grafted phosphonic acid polysiloxane, while the central layer consists of free acid doped with heterocycle grafted polysiloxane. This design inhibits free acid leakage from the central layer due to repulsion of the same-charge carrier in the central and skin layers. The PEMs may be synthesized by sol-gel process, spraying methods, or similar methods.

Summary Bullets

- High conductivity at high temperature and low humidity
- **Mechanically stable** — PEMs do not tear or deform under normal operating conditions
- **Reduced acid leaching** — unique acid doping between layers reduces leaching, which prolongs the life of the fuel cell

Solution Advantages

- High conductivity at high temperature and low humidity
- **Mechanically stable** — PEMs do not tear or deform under normal operating conditions
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Potential Commercial Applications

- Proton exchange membrane fuel cells
- Electrochromic cells
- Capacitors

- Electrochemical devices

Background and More Information

Fuel cells are in high demand as alternative energy sources due to their lower emission and higher energy profiles. They operate by electrochemical reactions, where a positively charged electrode and a negatively charged electrode are separated by a membrane. Polymer electrolyte membranes or proton exchange membranes (PEMs) are used in many fuel cell designs; however, some are difficult and costly to synthesize, and others experience conductivity loss due high temperatures or low relative humidity. In addition, some may experience acid leaching when operated at high temperatures.

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