Efficient Fuel Cell Membrane Design (#4995)

A hybrid fuel cell that offers superior conductivity with a low carbon-monoxide poisoning risk

Murat Unlu and Paul A. Kohl from the School of Chemical and Biomolecular Engineering at Georgia Techhave developed a hybrid fuel cell that offers superior conductivity with a low carbon-monoxide poisoning risk. The fuel cell encompasses a stack of acidic and alkaline fuel cell membranes. This is achieved by sandwiching a conductive cation exchange membrane between two catalyst-coated anion exchange membranes. This structure creates two ionic junctions where the membranes join one another.

Georgia Tech's innovation provides many advantages over traditional PEM or AEM designs. Ion movements in this acidic-alkaline configuration are different from those in acidic PEMs, allowing for faster fuel oxidation and oxygen reduction as well as increased output voltage. The metallic catalyst in alkaline conditions can be nickel or silver rather than the prohibitively expensive platinum required for acidic conditions. Carbon-monoxide oxidation is less likely to occur in an alkaline environment, so the risk of carbon-monoxide poisoning is significantly reduced. Georgia Tech's hybrid fuel cells also offer improved water management compared to traditional AEM or PEM cells and can operate at lower relative humidity.

Benefits/Advantages

- **Cheaper:** Silver or nickel may be used as catalysts rather than platinum.
- **Faster**: The hybrid cell design offers faster oxidation of fuels, such as methanol or ethanol.
- **Less toxic**: Carbon monoxide is less likely to form in alkaline conditions.

Potential Commercial Applications

- Electric vehicle batteries
- Distributed power sources
- Industrial equipment and machinery

Background/Context for This Invention

This technology was developed to meet the significant demand for cost-efficient fuel cells with high ionic conductivity and resistance to carbon-monoxide poisoning. Fuel cells are being developed for use in various applications, including distributed power generation systems and automotive engines. Proton exchange membrane (PEM) fuel cells offer excellent energy output, but their widespread use is prevented by the high cost of noble-metal catalysts and perfluorinated membranes, risk of carbon-monoxide poisoning, and limited lifetime due to membrane and electrode degradation. Anion exchange membranes (AEM) are being considered as a viable alternative to PEMs because they can use less costly catalysts and

are resistant to carbon-monoxide poisoning. However, AEMs are less conductive than PEMs and their performance is very dependent on humidity.

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More Information

Publications

For more information about this technology, please visit:
https://licensing.research.gatech.edu/technology/efficient-fuel-cell-membrane-design

Images:

The automated sequential delivery of multiple fluids. A varying number of delay gates imprinted in the branches are shown in the figure.

COVID-19 and flu saliva test on paper: (A) The automatic sequential delivery of multiple reagents required for virus test; (B) Water pouring into the device triggers the virus assay, allowing the presence of SARS-CoV-2 and influenza A & B viruses to be visually identified by the color changes in the corresponding detection spot