

2005 Fuel Cell Membrane Emerging Technology Innovation of the Year Award

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AWARD DESCRIPTION

The Frost & Sullivan Award for Emerging Technology Innovation of the Year is presented to the company that has demonstrated technological superiority within its industry. This Award recognizes the ability of the company to successfully develop and introduce new technologies, formulate a well-designed product family, and make significant product performance contributions to the industry.

RESEARCH METHODOLOGY

To choose the recipient of this Award, the analyst team tracks emerging and existing technologies, as well as R&D developments. This is accomplished through interviews with major market participants and extensive secondary research. Also considered are elements such as product launches, customer acceptance, penetration rates, and time to market. Finally, competitors are compared and ranked for relative position. Frost & Sullivan then presents the award to the company that received the number one industry rank.

MEASUREMENT CRITERIA

In addition to the methodology described above, specific criteria are used to determine the final competitor rankings in this industry. The award recipient has excelled based on one or more of the following criteria:

- Technology innovation contrasted against competitors
- R&D expenditures
- New product/process introduction
- Price premium
- First to market
- Adoption rate
- Penetration rate



AWARD RECIPIENT: POLYFUEL, INC.

The 2005 Emerging Technology of the Year Award is presented to PolyFuel, Inc. for developing a breakthrough fuel cell membrane technology for use in portable and vehicular applications. PolyFuel manufactures hydrocarbon membranes that specifically provide fuel cell developers and manufacturers with the most ideal membrane performance features in addition to providing increased manufacturing flexibility. PolyFuel's ability to research and develop a membrane that can replace fluorocarbon membranes used in many fuel cell designs allows the company to provide a better option for increased performance and durability, in addition to lower cost, size, and weight. These key system features highlight PolyFuel's hydrocarbon membranes as the up and coming emerging technology in the fuel cell industry.

Fuel Cell Market

Fuel cells are essentially refillable batteries, with the energy produced to run devices derived from a fuel source such as hydrogen or methanol. Fuel cells have developed over the years to provide an alternative to traditional recharge-

able batteries. Today's portable devices are literally over-stretching the energy density and run time limits of conventional batteries. With increased demands on power output and reliability, the need for a more efficient power source exists. As additional features are being implemented on existing device technologies, such as digital camera features on cell phones and gaming options, the demand for power will not only increase, but the device itself will require an alternative power source to operate efficiently.

Fuel cells are likely to be the solution to the demand for increased power. This technology can directly convert the chemical energy in a fuel, such as methanol or hydrogen, into usable electricity. The system creates energy, but does not store it like a conventional battery. This process produces little or no harmful emissions and the by-product is water vapor and trace carbon dioxide. Fuel cells have the potential to deliver more energy per volume weight than conventional batteries. The research and development into micro fuel cells has begun to attract more attention, as portable devices continue to be constrained due to lack of power.

Fuel Cell Technology

Fuel cells require several components to operate, most notably

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the fuel itself and the membrane. This membrane attracts oxygen atoms and hydrogen protons and forces them through, where they combine with the returning electrons to form a water molecule. At present, fuel cell membranes are based on perfluorinated material. This material has been sufficient, but is not durable, is expensive to manufacture, has a limited operating temperature range, and requires extensive system features to regulate humidity and cooling. Due to these impedances, fluorocarbon membranes are not ideal for use in portable and automotive applications, even though they have been developed for the past 15 years. However, nearly all R&D and manufacturing activity for fuel cells has been designed and built around fluorocarbon membranes.

PolyFuel's Hydrocarbon Technology

PolyFuel has developed the hydrocarbon membrane, which is constructed of hydrocarbon molecules converted into polymers. By making the material self-assemble into structural and conductive blocks, PolyFuel has successfully engineered a membrane that is stronger and allows hydrogen protons to flow more freely to the cathode side of the cell, allowing for the following advantages:

- Smaller system size (approximately one third of a fluorocarbon membrane)
- Lighter system weight (approximately one third of a fluorocarbon membrane)
- Lower system cost (approximately one third of a fluorocarbon membrane)
- Longer run time (approximately one third of a fluorocarbon membrane)
- More robust designs
- Enables freezable systems

Manufacturing Breakthrough

The fuel cell manufacturing process remains a key challenge to the commercialization of portable and automotive fuel cells. High costs of materials and intricate designs have plagued the industry. PolyFuel's hydrocarbon membrane was developed using advanced surface modification techniques. In addition, PolyFuel's membrane is comparable in behavior to the fluorocarbon polymer during fuel cell manufacturing but

still retains the desirable features of PolyFuel's hydrocarbon polymer in fuel cell applications.

Conclusion

PolyFuel has demonstrated true technology innovation in the fuel cell industry. From inventing its innovative hydrocarbon chemistry to offering the portable and automotive fuel cell industry an alternative membrane that provides many key features to enhance today's fuel cell designs, PolyFuel has demonstrated technological superiority within its industry. The company's membrane is engineered from the molecular level, and can provide the following engineering advantages:

- Rapid prototyping capabilities
- Extensive fuel cell testing infrastructure
- Leading catalyst application expertise
- Continuous roll-to-roll membrane fabrication
- Extensive hydrocarbon polymer chemistry expertise
- Deep system understanding

By developing the hydrocarbon membrane as an alternative to provide many beneficial improvements and features for portable and vehicular fuel cells, PolyFuel is a worthy recipient of the 2005 Frost & Sullivan Emerging Technology of the Year Award for the fuel cell industry.

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