Direct Dimethyl Ether Fuel Cell Experimental Study

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A direct-fed liquid fuel cell is ideal for portable applications due to high energy density fuel storage and lack of humidification, reforming, and cooling subsystems. Although direct liquid methanol fuel cells (DMFCs) are becoming more developed and are indeed promising for portable applications, major drawbacks that remain include the use of parasitic fluid pumps, methanol crossover oxidation reaction at the cathode, and mild toxicity of methanol vapor. Several alternative fuels have been proposed that alleviate various drawbacks associated with either hydrogen or methanol, but few have been thoroughly studied to date.

Dimethyl Ether is a promising fuel alternative for several reasons. Like methanol, DME lacks a carbon-carbon bond, enabling nearly complete oxidization in low-temperature PEM fuel cells. One major advantage of DME use is that it can be stored in high-density liquid phase at modest pressures of around 5 atm, and delivered as a gas-phase fuel in a pumpless operation. Therefore, the use of DME can potentially combine the advantages of easy fuel delivery of pressurized hydrogen, and the high energy density storage of liquid fuel. In addition, DME is less toxic than methanol and used as a common aerosol propellant

Although DME has great potential for portable applications, it has yet to be studied thoroughly. Muller et al. [1] have shown performance similar to a direct methanol fuel cell operating at relatively high anode and cathode pressure and temperature, but little data are available at more modest operating conditions. In this experimental investigation, the performance characteristics of a 50 cm^2 direct DME fuel cell are determined as a function of operating conditions typical of portable applications. In addition, chemical analysis of the cathode effluent is taken to verify that no crossover DME oxidation reaction takes place.

The detailed data taken from this investigation should help determine if DME is a suitable alternative to methanol for portable applications.

[1] J.T. Muller, P. M. Urban, and W. F. Holderich, "Electro-oxidation of Dimethyl Ether in a Polymer-Electrolyte-Membrane Fuel Cell," *J. Electrochem. Soc.* 147, 4058 (2001)