

Addressing Materials and Electrocatalysis Challenges in DMFCs with Combined Engineering and Science Tools

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Abstract

This talk opens with review of recent development of direct methanol fuel cells (DMFCs) for portable electronic devices, including multi-functional handsets, laptops and more. Methanol fuel has substantial advantages for such applications, being a liquid under ambient conditions associated with relatively high theoretical energy density and with relatively high rates of anodic oxidation when considering it is a carbonaceous fuel. However, the miniaturization required for consumer electronics applications sets a high bar for DMFC technology developers. An innovative approach to DMFC system simplification, applied starting in 2003 at MTI MicroFuel Cells (Albany, NY), has contributed significantly to system miniaturization capability and is, in fact, an example for the theme of this meeting: "Physical Understanding leading to a Novel Fuel Cell Architecture"

It will be further shown that the only way to define a target performance for some micro fuel cell application, is to consider the specific *combined* demands of power output, energy conversion efficiency and use time. Once these combined demand parameters are defined, system optimization is required to achieve the minimum possible volume, or weight of the power source. Main adjustable parameter in such optimization are the cell voltage and cell temperature and the input required for the optimization includes the dependence of the polarization curve on temperature and the thermal properties of the packaged power system. An example for such optimization will be given for a 1w; 30Wh target DMFC power source.

Finally, the remaining gap between present DMFC micro-fuel performance and that required for smallest handset applications will be diagnosed. It will be shown that future, advanced electrocatalysts are probably the most important tool for closing this performance gap. Recent theory (DFT) and novel catalyst synthesis developments (shell on core) provide a basis for optimism in this regard.