Development and Demonstration of Direct Methanol Fuel Cells for Consumer Electronics Applications

Shimshon Gottesfeld

MTI Microfuel Cells
Albany, NY

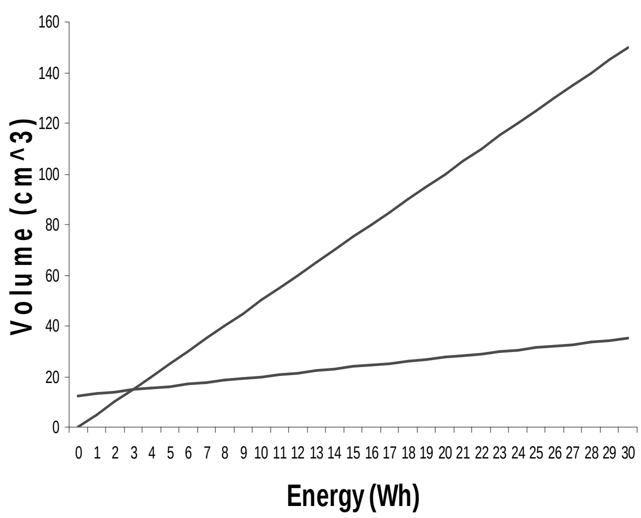
A number of major OEMs and battery suppliers for the consumer electronics industry, have recently described interest in fuel cell based power sources. One reason for this broad interest seems to be the need in the consumer electronics industry for a breakthrough in power source technology that would enable to significantly exceed the energy density of advanced batteries. This translates into advanced power sources of energy density significantly exceeding 0.3Wh/cm^3, providing at the same time the power output levels required for the full dynamic range of a given device. Such power sources would allow well extended use per recharge (or, rather, per refuel), for cell phones, laptop computers and digital cameras.

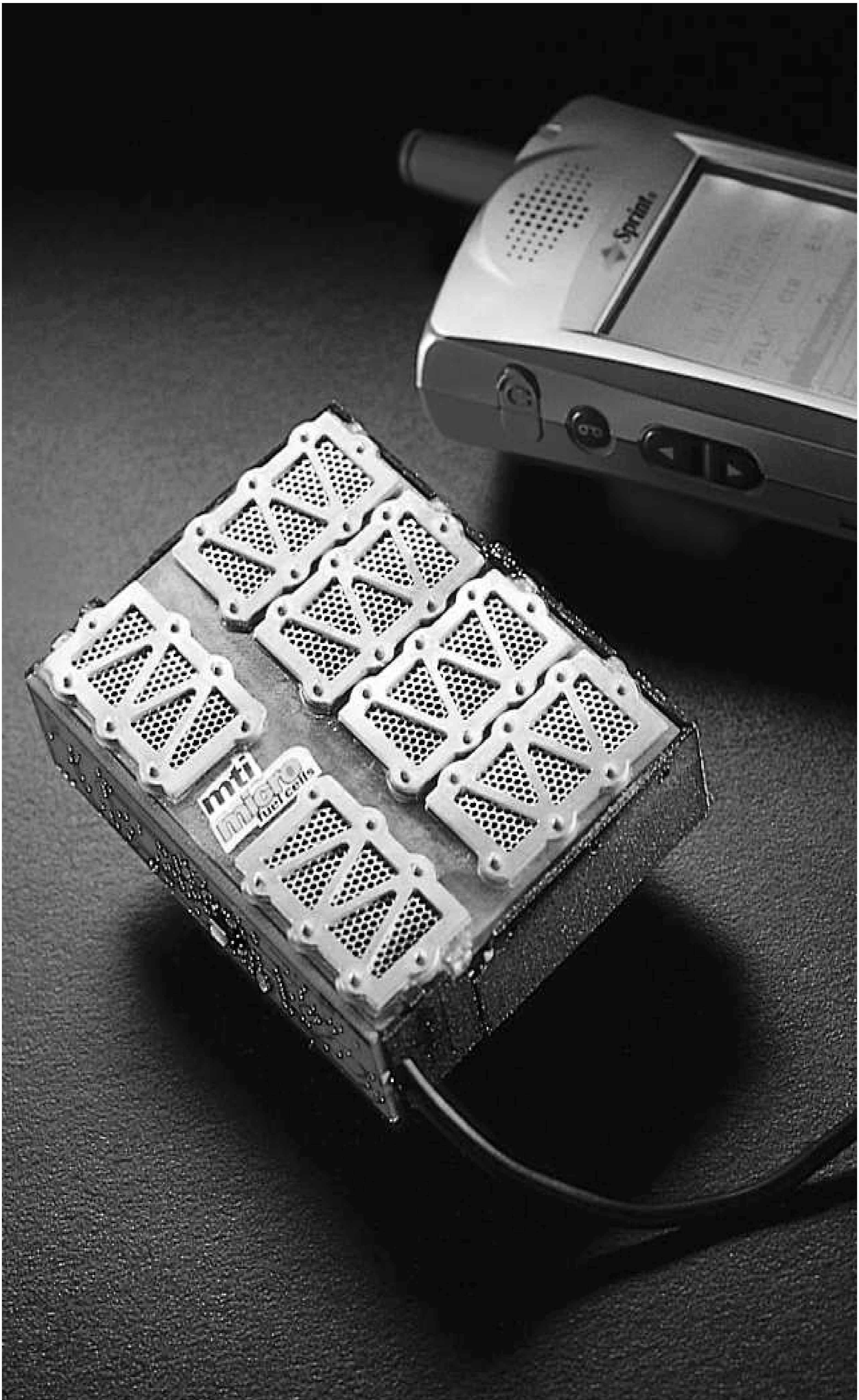
Rising interest in fuel cells as the potential answer for such power needs, has been supported by recent advancements in micro fuel cell technology, significantly so in the technology of air breathing direct methanol fuel cells (DMFC) which are the subject of technology and product development efforts at MTI Microfuel Cells ,among others. Repeated recent demonstrations of areal power densities of 40-60 mW per cm^2 of membrane area in air breathing DMFCs operating at ambient (external) temperature, have shown that volume power density around 100 mW/cm^3 is achievable in such cells under the relevant operation conditions. And once such level of power density has been established, thereby limiting the volume occupied by the fuel cell, the fundamental advantage of a fuel cell based power source, i.e., the high energy density of the fuel, gives it the clear energy density advantage. In the case of direct methanol fuel cells, the energy density of the liquid methanol fuel is 6 Wh/g, or 5Wh/cm^3. Figure 1 gives , for some range of required energy contents, the volume of a 1W power source comprising a DMFC stack of 100 mW/cm^3 and methanol fuel (lower line) together with the corresponding volume of a Li ion battery (upper line). The DMFC stack power density determines the intercept (10 cm^3) for the DMFC line, whereas the energy conversion efficiency, assumed here to be 30% (relatively high but not unrealistic), determines the slope of the DMFC line. From figure 1, a 1W;30Wh DMFC system of 30 cc, is projected to be 5 times smaller than a Li battery of energy density 0.2Wh/cc. (This calculation neglects any "BOP" volume in the DMFC system, which could lower the DMFC advantage to x3-x4 for this specific case). Obviously, the longer the use time (overall energy content) required at some given power, the stronger is the projected relative advantage of the DMFC.

Figure 1: Volumes of 1W power sources: DMFC + MeOH (projected, lower line) and Li ion battery (present technology, upper line), as function of energy content

Technology features and potential applications of such portable, "micro"-DMFCs, will be discussed, highlighting

Figure 1

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