Reformed Methanol Micro Fuel Cells and Safety

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The IEC Reformer Product Safety Task Group

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Major Messages

- Reformed Methanol Fuel Cells (RMFCs) generate high power density and can directly run devices like laptops.
- RMFCs use a revolutionary small micro reformer attached to the fuel cell stack to convert methanol to hydrogen just before the fuel enters the stack.
- The amount of hydrogen in the system is very small (about 2 cc at any moment).
- The technology has been developed to be inherently safe.
- RMFCs use the same type of cartridge as DMFCs.
- The IEC and UL have drafted product safety standards that provide for safe operation of RMFCs.

Presentation Overview

1. The benefits of RMFCs
2. How RMFCs work
3. RMFC safety
4. Standards group activities

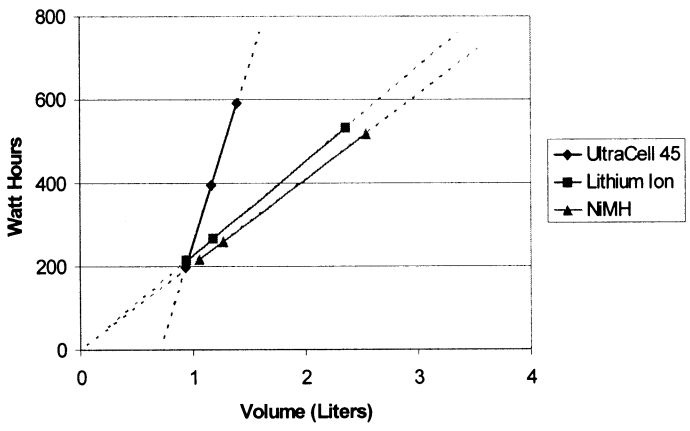
Why RMFCs?

Reformed methanol fuel cells offer:

- High enough power to run high power devices like laptop computers directly
- Instant "recharging" with easy to distribute methanol cartridges
- Lighter weights, higher energy densities
- Longer run times, more time away from the electrical outlet

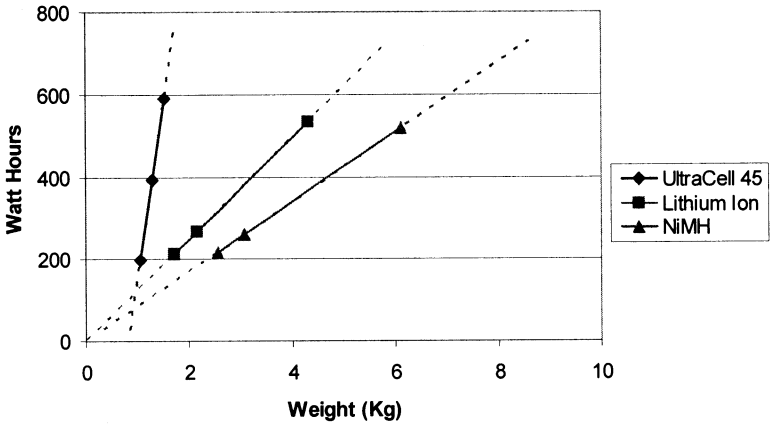
Why RMFCs?

RMFCs are also much smaller than batteries when long runtimes are needed:



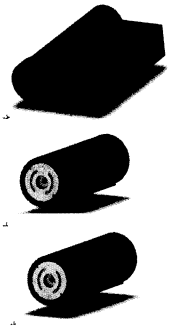
Why RMFCs?

RMFCs are much lighter than batteries when long runtimes are needed:



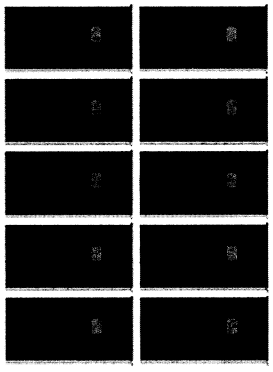
Why RMFCs?

A great example of this is the military radio – where RMFCs can save 70% of the battery weight carried by the soldier:



UltraCell XX90

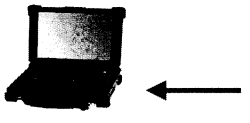
72 hour mission weight = 2.5 kg



Lithium-Ion

72 hour mission weight = 9 kg

RMFCs will be commercialized in several applications in the '06-'07 timeframe.



Rugged Computer





Soldier Power

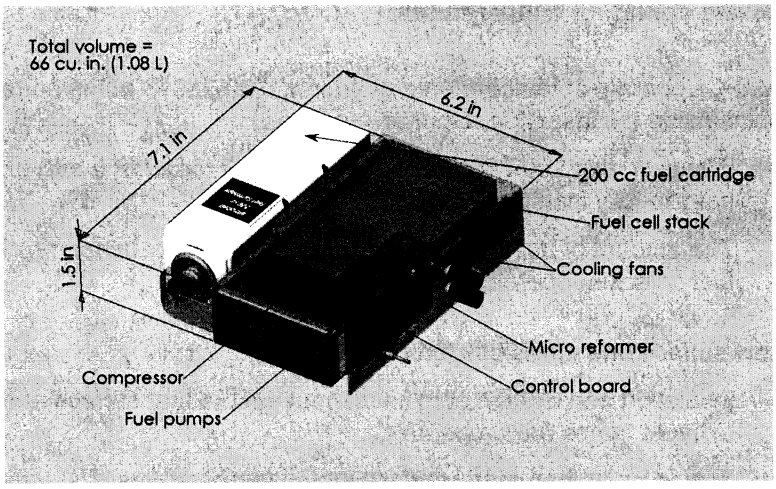


Professional Video

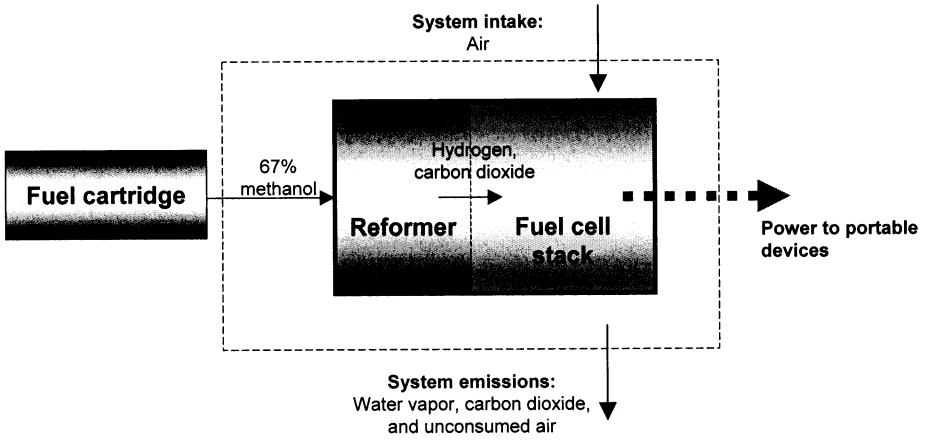


Consumer Notebooks

The UltraCell 45 Alpha



How RMFCs work



RMFC Safety Analysis

Moderate operating temperatures:

- RMFCs operate at temperatures of approx. 250-280°C at the hottest point inside the insulated reformer.
  - However, this 250-280°C zone is very small (order of a mL) and easy to fully insulate.
  - The amount of heat given off is comparable to low temperature fuel cells that operate at 60°C or less.
- Low surface and emissions temps
  - Insulation and dilution of exhaust heat ensure that surface and exhaust temps are below 45°C.
  - This is lower than many surface laptop temperatures.

RMFC Safety Analysis

Very low amounts of hydrogen inside the fuel cell:

- At any one time the maximum amount of hydrogen carried inside the micro fuel cell system under normal operation is approx. 2 cc. (Source: Casio, Motorola, UltraCell)
- This is very low energy: 2 cc of hydrogen has the energy equivalent of less than **1/20 of one drop of methanol**.

RMFC Safety Analysis

Official IEC tests for RMFC systems (TC 105, WG#8):

- *Sections 7.2.2.1 and 7.2.2.2:* Demonstration of less than 25% lower flammable limit (LFL) under all operating conditions (inside and outside unit)
- *Section 7.3.1:* Auto shutdown from abnormal temperatures
- *Section 7.3.2:* Safe operation under high reformer temperature (30°C above the normal operating temperature)
- UL standards have also been drafted for RMFCs.

Summary

- RMFCs will soon be commercialized, on target for 2006.
- The technology has been developed to be inherently safe.
- RMFCs use the same type of cartridge as DMFCs.
- The IEC and UL have drafted product safety standards that provide for safe operation of RMFCs.

Thank You

IEC RMFC product safety working group contacts

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