

2

Total World Micro Fuel Cell Markets for Consumer Portable Devices

Market Overview

Overview and Definitions

The micro fuel cell (MFC) market has received a level of hype similar to that given to revolutionary or disruptive types of technology innovation in the past. This hype, however, is well warranted, considering that most people have become highly dependant on their handheld devices such as cell phones and laptop computers. In this hectic and chaotic world, consumers long for the day when they need not worry about their battery power running dangerously low, or being stuck in a situation with no means of recharging, except with traditional sources, or by having to carry bulky chargers and cords. An average business traveler consumer carries several adaptors to recharge his/her various electronic devices.

The hype in this arena is only expected to increase, as developers continue to vie for market share. As commercialization looms closer and closer, developers are becoming increasingly competitive, and new entrants are continually appearing on the marketplace radar. All major consumer electronic device manufacturers are either developing micro fuel cell technology, or are partnering with an organization that is developing the same. Many developers have working on technology under stealth mode, and have yet to enter the market.

Technology Defined

This micro fuel cell research does not include discussions on alternative cells being developed, which have similarities to fuel cells such as metal-air batteries, including zinc-air and aluminum-air chemistries. Generally, these batteries only store energy and require externally generated power to recharge and reprocess fuel components. Some existing technologies incorporate one-time use disposable battery designs. Market and technology trends could be discussed for these disposable and reusable designs.

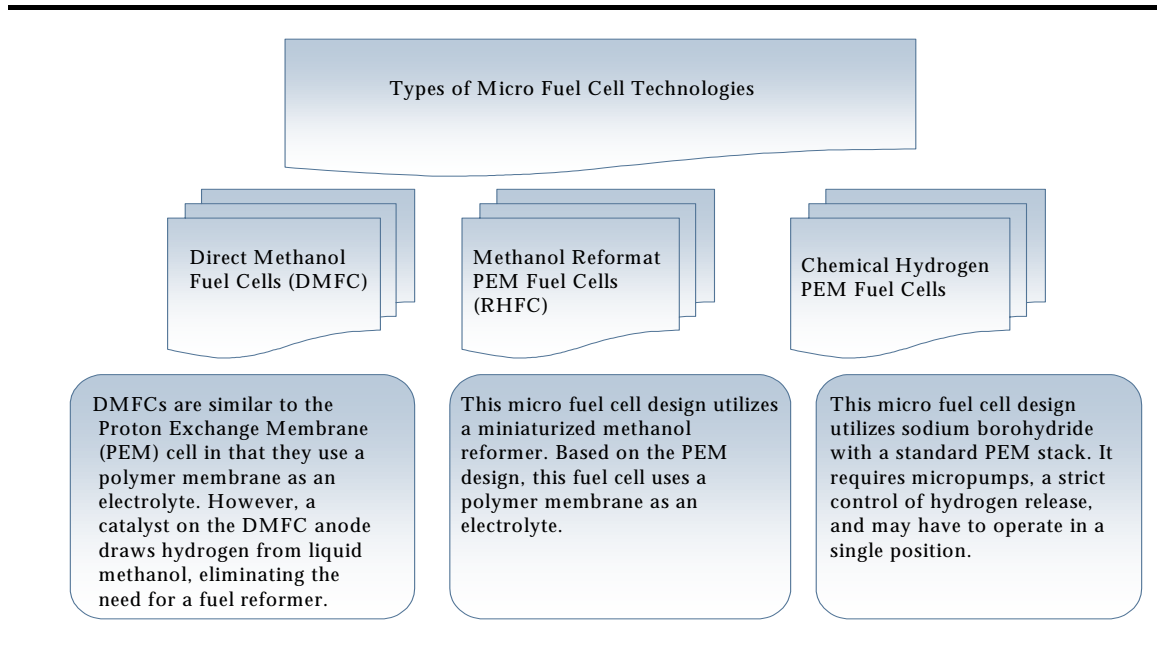
As defined by Frost & Sullivan, fuel cells generate power but not store it. They rely on a continuous fuel stream. However, these cells do not consume the power in use and do not require replacement or reprocessing of components to maintain power output. All types of fuel delivery designs for micro fuel cells are covered—replaceable cartridge to 'refuelable' or 'refillable' designs by use of a syringe or other apparatus.

This study does not cover what is known as 'portable' power fuel cells, which are utilized in small power-generation devices for backup power. Unlike micro fuel cells, portable power fuel cells can produce up to x kilowatts (kW) of energy for an application. Micro fuel cells target applications requiring up to xx watts of power, or over x,xxx watt-hour per liter (Whr/L).

Chart 2.1 outlines the key micro fuel cell technologies being developed across the globe.

Chart 2.1

Micro Fuel Cell Market for Consumer Portable Devices: Outline of Key Technologies (World), 2006



Source: Frost & Sullivan

Figure 2-1 depicts the key comparison points between traditional batteries and fuel cells.

Figure 2 - 1

Micro Fuel Cell Market for Consumer Portable Devices: Comparison of Key Benefits (World), 2006

Feature	Batteries	Fuel Cells
Discharge Curve	Flat or sloping discharge curve, depending on battery type	Flat discharge
Energy Density	Around xxx watt-hour/liter (Wh/L) (average) for lithium-ion cells. Cells vary in energy density by cell manufacturer	xxxx to xxxx Wh/L for direct methanol fuel cells (DMFCs) is expected
Cost	Approximately \$x.xx per cell on average, can vary depending on cell amperage	If the micro fuel cell design includes platinum as the catalyst, then materials are expensive. At this point in the market development, cost has not been determined. Re-fuel cartridges will likely be inexpensive, \$x.xx-x.xx per re-fuel cartridge
Consumer Usability	Current safety issues, but consumers are familiar with technology	Not familiar with technology, but developers are designing simple micro fuel cells with cartridges that would not be too difficult to use
Product Design	Some flexibility, although device designers struggle with limited energy density growth	Miniaturization remains a design challenge, much work is being done on this

Source: Frost & Sullivan

Applications Defined

This segment examines the micro fuel cell market for the following consumer portable devices:

- Notebook computers
- Personal digital assistants (PDAs)
- Cellular phones and converged/"smart" phones
- Portable audio/video devices
- Digital imaging devices
- Others, including but not limited to consumer global positioning systems (GPSs), handheld gaming devices, do-it-yourself (DIY) cordless tools, and others