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Frequently Asked Questions about Toshiba Fuel Cell Technology

1. **What is a Direct Methanol Fuel Cell?**

   It's like a small power generator that uses catalytic reaction. Its fuel is a mixture of Methanol water, and ambient oxygen. A Direct Methanol Fuel Cell (DMFC) is considered to provide a new energy concept for personal electronic devices such as notebook PCs or wearable electronic devices like digital audio players and headsets. Unlike batteries where users need to wait while recharging, fuel cells generate power themselves, enabling users to use the device immediately. Once these devices are commercialized, users will simply have to install a fuel cartridge and it will be ready to provide power to operate mobile products. When the device is operating on DMFC power, continuous operation is as simple as changing the methanol cartridge.

2. **When did Toshiba begin research on direct methanol fuel cells? What are some of Toshiba's notable achievements and milestones in this field?**

   Toshiba has conducted R&D on both active and passive fuel cells since the early 1990s, and has filed and obtained patents on DMFC technology. Its achievements confirm that the company remains in the forefront in developing the potential of fuel cells.

   Toshiba led the industry by demonstrating the first DMFC for portable PCs in March 2003. In June 2004, Toshiba announced a prototype of the world's smallest DMFC with energy output of 100 milliwatts (mW) that can be integrated into devices as small as digital audio players and wireless headsets for mobile phones. This new device adopts a "passive" fuel supply system which feeds methanol directly into the cell. In 2005, Guinness World Records certified this achievement. In July 2005, Toshiba exhibited a portable battery charger and cell phone jointly developed with KDDI at the Wireless Japan trade show and CEATEC Japan trade show. In October 2005, at the CEATEC Japan trade show ,Toshiba demonstrated conceptual products, such as a portable music player that carried the compact fuel cell.

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3. **What is the difference between active and passive DMFC?**

Active systems use a pump and fan to feed methanol and oxygen into a cell or cell stack, where the oxygen reacts with the methanol to produce electricity. Active systems are more complex than passive systems and are better suited for applications demanding larger power consumption. Toshiba's active fuel cell development for electronics is targeted toward the mobile computing market.

Passive DMFC have a simpler structure that requires no pump and fan. Passive and active fuel cells have different ranges of power output, requiring the devices to be integrated quite differently. Passive DMFC produces energy around 100mW to 1W and requires no pump and fan making the fuel cell size much smaller than that of the active type and suitable for use in smaller portable equipment such as cell phones, headsets and Flash-based digital audio players.

4. What products and markets are passive and active DMFC targeted for?

Generally speaking, applications that fall under the umbrella of "mobility and wearability," including Bluetooth headsets for mobile phones, Flash-based audio players, PDAs and other small handheld electronic devices which require miniaturization and consume power around 100mW to 1W, will benefit from passive DMFC. The active type will cover devices such as portable PCs, LCD televisions, and cordless small home appliances.

5. Why are these fuels cells called "direct"?

DMFCs (both active and passive) use methanol as fuel and do not change the chemical structure of methanol by subtracting hydrogen when feeding the fuel into the cell, thus sending methanol "directly" into the cell.

6. When will Toshiba commercialize fuel cells?

Toshiba is able to use the larger size, active fuel cells for laptops on a limited basis now. A realistic roll-out is subject to the regulation of methanol. Toshiba hopes to be able to commercialize DMFC for smaller devices in 2007.

7. What needs to be done to support the widespread commercialization of DMFC?

Additional development is needed to increase power output and reliability. Availability of methanol fuel cartridge in society and deregulation of methanol fuel cartridge transportation are also key issues.

8. When commercialized, will these devices be cost-competitive with battery-powered devices?

DMFC has specific advantages which are different from the prospects of rechargeable lithium batteries, so it's not easy to compare them simply with the cost of lithium batteries. Toshiba will introduce these devices at competitive prices.

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9. Where would someone charge a fuel cell?

The most popular thought is through existing retail channels. There are also some who believe "fueling stations" will be the answer. Proposals that the cartridges could be delivered directly from the original equipment manufacturer have also been discussed. The delivery method of methanol cartridges is not fixed, and could use any combination of these ideas. Toshiba is working with the appropriate organizations and regulatory bodies to ensure a timely market adoption.

10. There are several sources of fuel under consideration for fuel cells. Why is Toshiba concentrating its research on methanol fuel cells? What are the advantages of methanol as a fuel source?

There are two reasonable choices for power source of portable devices, Hydrogen or Methanol. Hydrogen requires complicated storage and would take much more space for small devices. Liquid methanol is more practical for small devices, in terms of storage and energy density as fuel.

11. How long can a fuel cell operate?

The length of time a fuel cell can operate varies with the size of the fuel tank or cartridge and the power requirements of the mobile electronics device. A few examples from Toshiba prototypes, however, provide a glimpse of the long-life of DMFC compared to today's rechargeable batteries. March 2003 saw Toshiba's announcement of the world's first prototype of a small form factor DMFC that attached directly to a computer, in this case Toshiba's Libretto mini-notebook PC. With a 50cc methanol cartridge the PC runs for five hours, and a 100cc cartridge pushes that time to 10 hours.

Toshiba's prototype passive DMFC announced in June 2004 can power a Flash-based audio player for as long as 20 hours on a single 2cc charge of highly concentrated methanol.

12. Is DMFC considered safe?

When used normally and when taking the necessary safety measures into account, the risk is very limited. If abused or misused, there is a possibility of combustion as methanol is a flammable liquid. Compared to batteries, Toshiba expects better safety results since the energy is not stored in the fuel cell. Batteries on the other hand hold readily available energy inside whichunder abnormal performance conditions such as external shorts, overcharge, or overload may become a safety concern.

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13. Do you think methanol will be allowed on airplanes and other secured modes of transportation?

There are deregulation issues underway that require time and due process. However, deregulation is now being discussed at the U.N. and the other international standards committees, with the objective of securing safe transportation for methanol.

In November 2005, the International Civil Aviation Organization (ICAO) drafted conditions that will allow the transportation and use of methanol fuel cells and methanol fuel cartridges on board passenger airliners from 2007 in response to a proposal by the US Fuel Cell Council.

14. Will future mobile devices use both a fuel cell and a battery?

It's possible, as hybrid solutions are quite promising. The final application for a hybrid may depend on the original equipment design, subsequent system level trade-offs and the end user requirements.

15. Are there organizations addressing issues of standardization and compatibility in fuel cells?

The International Electrotechnical Commission (IEC), the multi-national organization that defines industrial standards for electronic devices, consumer products and communications equipment, has established three working groups within its TC105 fuel cell technical committee. The micro fuel cell working groups to consider industrial standards are so called WG 8, 9, and 10. These Working Groups are tasked with providing customers and manufacturers with standards for Safety (at WG8), Performance (at WG9), and Interchangeability (at WG10). As for compatibility, by establishing WG10, the IEC has brought together a team of experts on micro fuel cells that will focus on setting common guidelines on specifications for micro fuel cell power units and their fuel cartridges by 2007. A recognized industrial standard for micro fuel cells will provide users of micro fuel cells with easier access to standardized fuel cartridges designed to fit any type of electronic device and produced by manufacturers around the world. Dr. Fumio Ueno, Technology Executive of Display Devices and Components Control Center, Toshiba Corporation, was appointed to chair WG10 on July 30, 2004.

16. What are the environmental benefits for transferring over to fuel cells as a source of energy?

Unlike generators that are powered by engines, fuel cells do not emit any harmful materials such as nitrogen oxides or sulfur oxides. And since the electricity is generated by a scientific process, fuel cells do not vibrate or make noise.

In addition, one fuel cell cartridge can be reused over-and-over again, whereas batteries need to be replaced.

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