

SAFE AND EFFICIENT HYDROGEN FUEL CELLS

Fuel cells have gained a lot of attention as a next-generation power source, and their performance is expected to improve even further. Amid the development competition underway in various countries, a fuel cell charger using a solid hydrogen source for smartphones developed by Kyoto-based Rohm Co. and partners has achieved a groundbreaking compact size. Takashi Sasaki reports.

“E ven though they are all called ‘cells,’ a hydrogen fuel cell’s functions are based on fundamentally different principles from those employed by the dry cells and storage cells that store electricity. It might be easier to think of them as a small power generator that uses hydrogen for its energy source.”

So says Akira Kamisawa, director of the Research and Development Headquarters at Rohm Co., a semiconductor manufacturer in Kyoto. When water is electrolyzed, it generates hydrogen and oxygen. Simply put, hydrogen fuel cells are a way to draw electricity from hydrogen in a completely reversed chemical reaction process.

The solid hydrogen source fuel cell was announced in September 2012 out of the joint development efforts of Rohm Co., Kyoto University, and Aquafairy Corporation, another fuel cell venture headquartered in Kyoto. This USB-compatible smartphone recharger is only 86 mm long, 52 mm wide, and 19 mm thick, and fits comfortably in your palm. It weighs only 73 g, including the built-in hydrogen generator cartridge. It’s so compact you’ll hardly notice it if you carry it in your pocket or bag.

Since most conventionally developed hy-

drogen fuel cells store hydrogen in a cylinder, their drawbacks were that they were big, heavy, and hard to handle. In contrast, instead of hydrogen cylinders, the solid hydrogen source fuel cell uses sheet-type solid calcium hydride placed in an attached cartridge that was developed using proprietary technologies. If you compare fuel cells for smartphones, this groundbreaking compact fuel cell is only about a third of the size and weight of conventional models.

Kamisawa explains the development work thus:

“When calcium hydride is combined with water, hydrogen and calcium hydroxide are



USB-compatible solid fuel type hydrogen fuel cell for recharging smartphones (left)

BOTH PHOTOS COURTESY OF ROHM CO., LTD.



A small sample piece of calcium hydride solidified in sheet form

generated. Calcium hydroxide, or so-called lime hydrate, is a safe substance used as a food-coagulating agent and to neutralize acidified rivers and soil. It had been impossible to use calcium hydride with fuel cells, because calcium hydride powder reacts strongly with water and instantaneously generates hydrogen. However, we developed a solid hydrogen source by coating it with resin to a sheet form, and let it react a thousand times lower than usual, thereby enabling hydrogen to be generated safely and stably. All the other technologies that were crucial to its commercial development were unique technologies created here in Kyoto, including the compact unit for efficiently drawing electricity from hydrogen and the semiconductor technology for stably supplying electricity.”

The solid hydride source sheet placed in the attached cartridge is 38 mm long, 38 mm wide, and only 2 mm thick. By adding water (several cc), it generates about 4.5 liters of hydrogen, enabling 5 Whr of electricity to be supplied, which is enough to fully recharge a smartphone. Only a minute amount of heat is generated during operation, and the amount of water vapor created when the hydrogen and oxygen in the air are bonded is

only about as much as that in a baby’s exhaled air. Hydrogen is often associated with dangerous situations, but anyone can use this product safely. Unlike dry cells, whose performance gradually declines due to the voltage difference inside, the laminated aluminum-wrapped calcium hydride is capable of maintaining its initial energy for twenty years. Furthermore, it is believed that volume production will keep the price at a level similar to the lithium-ion batteries used for digital cameras and other equipment.

By varying the size of the attached cartridge and the reaction time, Rohm Co. and partners have developed various other types of hydrogen fuel cells in addition to this extremely-compact type for smartphones. These include a large-output type with a rated output of 200 W for use as an outdoor power source and during times of disasters, and a large-capacity type capable of generating 400 Whr of power and supplying electricity to seismometers and other equipment over the long term. Including those three kinds of fuel cells, they are conducting a market survey in order to generate their business model in the spring. While the fuel cell for smartphones is a disposable type where the cartridge must be replaced each time, the large-output types can be turned on and off just like a gasoline-fueled power generator. These convenient features have caused various institutes and business organizations around the world to focus on these new hydrogen fuel cells made in Kyoto as a clean power source that doesn’t emit noise or harmful substances. 

Takashi Sasaki is a freelance writer.