ANALYSIS OF HYBRID POWER SOURCES ON DIRECT METHANOL FUEL CELL AND BATTERIES FOR PORTABLE APPLICATIONS

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Fuel cells are able to provide the essentially high efficiency and low emission demanded by present power sources. This study was carried out to develop direct methanol fuel cell(DMFC)/battery hybrid power sources used in portable applications. For a hybrid power system, DMFC was applied for the main power source at average load and the battery was applied for auxiliary power at overload.

For this experiment, we manufactured a 40 W DMFC stack with an external manifold. To use the DMFC as a portable power source, its voltage and current characteristics were measured(Fig 1).

In the experiment, we examined the load-sharing characteristics of the system by measuring the voltage and the current of the fuel cell, battery and load under changing current conditions. We interpreted the dynamic performance characteristics of the fuel cell and battery under a sudden load change, and investigated the load-sharing pattern, and predicted the basic specs required for a portable power system.

Understanding the load-sharing characteristics of the hybrid fuel cell and battery power system is the most important core technology, of which the ultimate goal is to control the fuel used. To understand the dynamic characteristics of the fuel cell power system, we examined how much power is shared by the battery and the fuel cell under an instantaneous load change.

The Ni–Cd battery the discharge characteristic of a fuel cell and battery hybrid system is shown in Fig. 2.

Fig. 3 shows the constantly pulsed load characteristics of a hybrid DMFC and Ni–Cd, Ni–MH battery hybrid power source.

When the load shows a sharp decline, the fuel cell raises its output voltage sharply and reduces the output current fast. The battery also shows a voltage rise and a reduction of output current. In this case, also, the transient characteristic appears because a fuel cell drops its output current sharply. This transient characteristic of the output current of the fuel cell does not get stabilized soon, requiring a setting time of longer than 1 min.

This experiment showed following results:

• If the load power increase constantly, the output ratio of the battery was higher than that of the fuel cell

• To use the battery for an auxilious power source, needs a booster of output voltage control

• The fuel cell and the battery showed similar follow-up characteristics of load

• The transient characteristic of the output current of the fuel cell requires a setting time of longer than 1 min, and frequent and sharp changes in load may damage the fuel cell

• The load-sharing ratio of the fuel cell in the fuel cell/battery hybrid power system was 2 and 1 when the load current was lower than 10 A and higher than 20 A, respectively

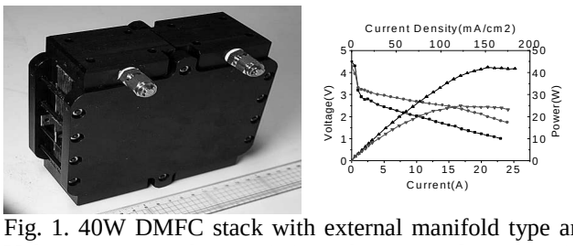

Fig. 1. 40W DMFC stack with external manifold type and Voltage-current characteristics change under changing temperature

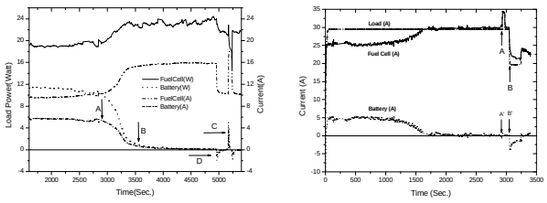

Fig. 2. Battery discharge characteristic of a fuel cell and battery hybrid system (DMFC and Ni–Cd battery, (a)in case of lack of booster, (b) in case of booster).

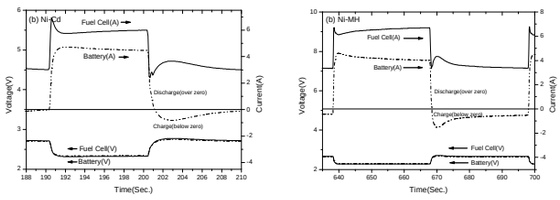

Fig. 3. Typical transient current response on the application of a voltage interrupt ((a)Ni–Cd 2.4 V, 5 Ah and (b)Ni–MH 2.4 V, 2 Ah).

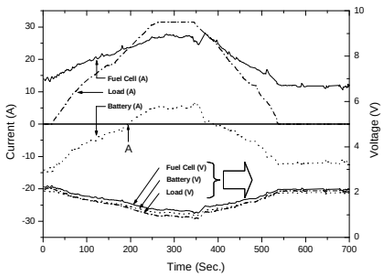

Fig. 4. Dynamic characteristic when load increase or decrease.

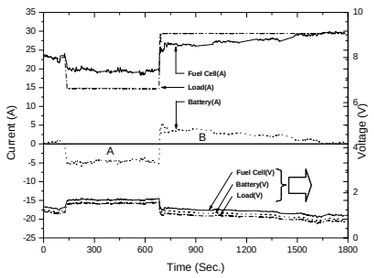

Fig. 5. Battery charging and discharging characteristic of a fuel cell and battery hybrid sources