The Next Generation Large Capacity Battery Fuel Cells Technology and their Prospects

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Abstract: Fuel cells is proved that potential energy is greater than the existing power generation. In this paper, we describe a principle of fuel cell which is used for next generation portable battery and brief characteristic of direct methanol fuel cells (DMFCs) that used for portable appliances by miniaturization of polymer electrolyte fuel cell. Lastly we describe about research investment for fuel cells.

Keywords: Fuel Cell, Reforming, DMFC, Fullerene, Micro reactor

1. INTRODUCE

Research on secondary batteries that used in portable battery is prevail. Especially, a great deal of research is taking place on fuel cell instead of lithium battery. Because environmental pollution occurrence factor of fuel cell is less than general fossil fuels, life time of appliances is overlong, the companies which produce portable appliances is interested to fuel cells.

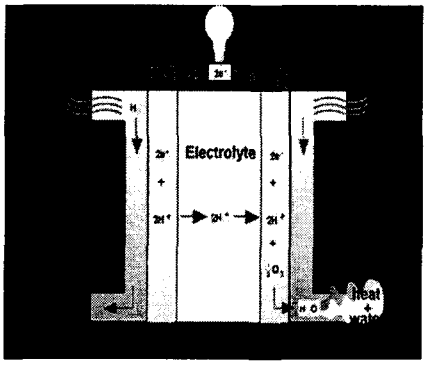

Fig. 1. Principle of fuel cell operation

2. PRINCIPLE OF FUEL CELL

Fuel cells are devices that get electrical energy electricity and chemically reacting oxygen and hydrogen or any other fuel. If electrolyze water, although oxygen and hydrogen happen from electrode, fuel cells are that make electricity and water from hydrogen and oxygen that use inverse electrolysis reaction of water. Fuel cells can produce electricity as long as hydrogen and oxygen are supplied differently with general chemical cells (e.g., dry battery, stationary battery, etc.).

Because of these principles, fuel cells are fundamentally different battery which store and discharge electricity. In conclusion, fuel cell has same structure as a power generator.

3. TYPES OF FUEL CELLS

Fuel cells two electrodes—an anode and cathode—are separated by an electrolyte. At the hydrogen electrode (anode), hydrogen ions and electrons are formed. Ions migrate through the electrolyte to oxygen electrode (cathode) while electrons move through an external circuit to a load and return to the cathode. Thus, by forcing the electrons to take an external path, low temperature direct energy conversion is achieved. Oxygen can get easily in air. But hydrogen does not exist as natural resources. For this reason, there are much that have gotten and use hydrogen in natural gas including hydrogen, LP gas, petroleum, alcohol and etc.. These operation refers to reforming.

Gasoline is most profitable from the hydrogen occurrence amount and infra but need exclusion sulfur of gasoline and reforming is difficult fault.

Methanol is easy to reform, but it has much energy damages and needs remodeling of supply infra. Infra of natural gas and LP gas is equipped only to gasoline, but reforming is difficult than methanol. Usually, it is using natural gas because it can use pipeline of city gas by fuel cell in development equipment Also, it is methanol that handling of fuel is easy by liquidity fuel cell that is used on a vehicle. If miniaturization of gasoline reformer is gone, it may use gasoline taking the place of methanol. There are five different types of fuel cell technologies: Alkaline Fuel Cell (AFC), Phosphoric Acid Fuel (PAFC), Polymer Electrolyte Fuel Cell (PEFC), Molten Carbonate Fuel Cell (MCFC) and Solid Oxide Fuel Cell (SOFC). The following classification is based on the type of electrolyte used in the fuel cell. Especially, phosphoric acid fuels (PAFCs) have been developed to the first stages of commercialization. Molten

Table 1. Fuel cell types and characteristics

	AFC	PEMFC	DMFC	PAFC	MCFC	SOFC
Electrolyte	aqueous potassium hydroxide (30~40%)	sulphonated organic polymer (hydrated during opration)	sulphonated organic polymer (hydrated during opration)	phosphoric acid	molten lithium/sodium/ potassium carbonate	yttriastabilised zirconia
Operating temp., ℃	60~90	70~100	90	150~220	600~700	650~1000
Charge carrier	OH^-	H^+	H^+	H^+	CO_3^{2-}	O^{2-}
Anode	nickel (Ni) or precious metal	platinum (Pt)	platinum-ruthenium (Pt,Ru)	platinum (Pt)	nickel/chromium	nickel/yttriastabilised zirconia
Cathode	*nickel (Ni) or lithiated NiO*	*platinum (Pt)*	*platinum-ruthenium (Pt,Ru)*	*platinum (Pt)*	*Nickel oxide (NiO)*	strontium (Sr) doped lanthanum manganite
Co-generation heat	none	low quality	none	acceptable for many applications	high	high
Electrical efficiency, %	60	40~45	30~35	40~45	50~60	50~60
Fuel sources	H_2 Removal of CO_2 from both gas steams necessary	H_2 Reformate with less than 10 ppm CO	water/methanol solution	H_2 reformate	H_2,CO natural gas	H_2,CO, natural gas

carbonate fuel cells (MCFCs) is expected as a housing development. Polymer electrolyte fuel cells (PEFCs) and solid oxide fuel cells (SOFCs) are promising because it can solve problems of evaporation and corrosion of liquid electrolyte. In the solid oxide fuel cells (SOFCs), operating temperature is high, it can be used as co-generation system. The reason why polymer electrolyte fuel cells (PEFCs) are most suitable to household and vehicles that operating temperature is normal.

4. PORTABLE APPLIANCES TYPE FUEL CELL

Polymer electrolyte fuel cells (PEFCs) are attracted to portable appliances (e.g., notebook, PDA and portable phone.) power supply. Because, miniaturization is easy. It can use methanol, ethanol and butane as the fuel, but consider treatment easy, stability, expense so use methanol. There are reforming and direct methanol method to get hydrogen in methanol. As reforming method spoke in front, it is way to take out hydrogen in fuel including hydrogen. There are necessary reaction temperature which very high, and miniaturize to reformer. In this reason direct methanol method will be used to portable appliances fuel cell.

Direct methanol fuel cells (DMFCs) are unnecessary of reforming hydrogen from another fuel, there are working directly from methanol. However, sometimes, methanol does not react and penetrates an electrolyte membrane. There is referred to crossover problem, and there are output less than reforming method in efficiency aspect. Therefore, there need electrolyte membrane of suitable good quality in methanol.

There is the Dupont's the Nafion on DMFC's electrolyte membrane that used widely present. However, ion-exchange resin is the Nafion's material that is very expensive and there is no countermeasure for crossover. Therefore, there are groping electrolyte membrane to take a place of fluorine. It is fullerene type electrolyte membrane that it announces in SONY that is receiving the latest footlights by next generation electrolyte membrane. SONY is experimenting using pure hydrogen by fuel, so it is unknown quantity that it can use methanol.

5. FUEL CELL THAT USE REFORMER

Reformer is called micro reactor and it can be manufactured to silicone wafer. Micro reactor generates hydrogen that act enough portable appliances in 280℃, after evaporated at 120℃ in a laboratory.

When use methanol to fuel, compare with lithium-ion electric cell take life about quadruple by weight of half. Namely, portable PC weights decrease and continuous control action is possible during 20 hours. Also, it can take a performance from sextuple to octuple in uses alcohol that energy is high.

6. CONCLUSIONS

Fuel cell have many advantages and much potential energy than traditional power generation technologies form through basis research that consist worldwide during last 30 years. As early as possible, we must participate regularly to fuel cell which secure future source of energy and prevent environmental pollution. Also, many investments should be achieved.

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