

## Future Vehicles Powered by Fuel Cells

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### ○ Fuel Cell

In response to the public's call for the reduction of greenhouse gas emissions, many efforts have been undertaken in various fields to develop and commercialize fuel cells. A kind of power generator, fuel cells use hydrogen and oxygen to generate electricity, with water as byproduct. In thermal power generation, a process to convert thermal energy to mechanical energy is required to generate electricity. By contrast, fuel cells, which directly generate electricity using chemical reactions, can achieve a higher efficiency, and hence are thought to be effective in reducing CO<sub>2</sub> and other harmful emissions (NO<sub>x</sub> and SO<sub>x</sub>). Another advantage of fuel cells is that hydrogen, used as fuel, can be obtained via various methods, including the treatment of fossil fuels (such as natural gas and petroleum) and biomass\*, and the electrolysis of water.

Fuel cells are classified by the electrolyte to be used. Table 1 shows the types and features of fuel cells. We think that fuel cells of the solid, high molecular type are suitable for vehicle use, because they are small and light, and have a relatively low operating temperature.

### ○ Vehicle Using Fuel Cells

In comparison to automobiles and other means of transportation, trains are regarded as a means of transportation that is friendlier to the environment, and this feature can be enhanced through the use of fuel cells. Fig. 1 shows the design of the main circuit of a train car using fuel cells. The energy storage device absorbs regenerative energy at braking, to use it for acceleration.

Considering the amount of energy necessary for operation, we think that fuel cells are better suited to be used for streetcars and LRVs running in urban areas. Nowadays, streetcars are being revalued as a solution to chronic urban traffic jams and emission-induced pollution. Also, public interest is rising on low-floor vehicles designed for handicapped passengers. LRVs powered by fuel cells will no longer need overhead wiring; in addition to being friendly to the environment, they are therefore advantageous in reducing electrical equipment, and mitigating the bad effects on urban scenery. Accordingly, hopes are high of the realization of fuel cell-powered low-floor LRVs as a future means of urban transportation.

### ○ Future Tasks

At present, many tasks remain to be fulfilled concerning the life and price of fuel cells, the infrastructure related to hydrogen, the mounting position and method for fuel cells, and vehicle weight. Also, studies must be made on the simultaneous use of other energy-saving equipment (including batteries and capacitors), which is thought to become necessary in view of the use of regenerative electricity and the averaging of load on fuel cells. We believe that these many tasks can be fulfilled, given the fact that fuel cells and energy storage equipment are being developed at various locations and at a rapid pace. To realize a future urban transportation, we will find solutions to the tasks one by one, e.g. by devising a method for mounting new equipment on a low-floor LRV, within the small space available; and reducing vehicle weight even further.

#### \* Biomass

“Biomass” is a word coined by synthesizing “bio” and “mass,” and refers to biological resources. Regarding biomass, studies are under way e.g. on power generation using garbage, and the production of ethanol from sugar cane for vehicle use.