

The water ventilation method to prevent flooding in outlet of polymer electrolyte fuel cell stack

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of PEMFC stack. It is valuable solution to prevent water flooding in outlet of PEMFC stack.

Introduction

Polymer electrolyte membrane fuel cells (PEMFCs) stack and hydrogen tank combined system can be used to automobile energy sources instead of gasoline engine. There are several critical issues in PEMFC system to be commercialization. Representatively, effective water management is an important condition to achieve stable performance. The sufficient water in membrane is necessary for proton conductivity. Otherwise, excess water in electrode, gas diffusion layer (GDL) and flow field of bipolar plate hinders fuel supply especially in oxygen electrode. Supplied water control is managed with humidifier by temperature control. Generally, relative humidity (RH) of fuel is calculated by temperature difference between water in the humidifier and cell. RH 100% is best condition for easy control and for less ohmic overpotential in membrane. On the other hand, It is easy to occur water flooding at fuel input pass (flow line, gas diffusion pores and electrode reaction area). One of solution of this problem is to make limited RH. Even though low RH make increased membrane ohmic resistance, it is considerable for preventing water flooding. In the some other literatures, to improve water discharge ability in electrode and GDL become a main topic.

In our previous study, we investigated PTFE effect on the GDL of PEMFC. Basically, PTFE was considered widely to make higher hydrophobicity in electrode, GDL and flow field. It is related to obtain gas reaction area by effective water discharge from the electrode to flow field. However, The clogged up with liquid water in the outlet of stack is not much considered even though this phenomenon make critical problems in PEMFC stack. The water flooding problem in output line and stock fuel supply is more severe according to increased current density, cell size and cell number in the PEMFC stack because produced and excess water in each single cell is collected all in outlet pipe line. And then, flooding in the exit line of stack makes stop fuel supply and hard condition to water discharge because total fuel line is closed by liquid water. High amount of this liquid water should be removed quickly.

In this study, we find out detecting method of water flooding by using thermocouple in exit line of PEMFC stack. The produced and condensed water in exit line make temperature drop during fuel cell operation. At this time, we expect to solve water flooding to use line water ventilation by using Automatic electric valve. This real time control method also should be contribute to prevent water flooding in the cell reaction side and to supply sufficient fuel in each cell.

Basically, the voltage drop on the constant current test is related with insufficient fuel due to produced water blocking. In the test result, we can confirm that this real time control method is effective to make better condition