A Study on Degradation of Membrane Electrode Assembly by Operating Conditions of FCV

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In generally, degradation of membrane & electrode assembly (MEA) according to driving conditions of fuel cell electric vehicle focused on analyzing the state of catalyst, membrane, gas diffusion layer before and after durability evaluation. At present, the exact mechanism for degradation of membrane electrode assembly (MEA) according to driving conditions of a fuel cell vehicle does not hold and the mechanism were approximately the level that analogize the whole out of a part.

In case of the degradation of MEA by operating modes, it was shown on three sources; (1) the loss of apparent catalytic activity according to the time (ηa), (2) conductivity loss by decreasing ion conductivity per the time, (3) the loss of rate of mass transfer according to the time. In other words, the equation about degradation of MEA can be seen that the basic form can be created by analyzing the polarization according to time.

In this study, the 10 driving modes were devised by cell voltage behavior according to driving conditions of fuel cell vehicle. The operating modes were basically designed by high current, middle current and low current. Also, these modes were considered about the most commonly used driving power and time variation in accordance with the current change. The result of analyzing the MEA degradation by current/voltage variation was as below.

The activation overpotential shows a tendency to be rapidly decreased in early state and decrease or increase gradually without reference to operating conditions. The ohmic overpotential tends to decrease in proportion to the time. OCV (Open Circuit Voltage) shows the result of decreasing rapidly in high current mode than low current mode. In this paper, we conducted an analysis of the equation for degradation of MEA according to the time, current/voltage variation.

In conclusions, the system of fuel cell vehicle must be operated in high current range in order to prevent degradation of the MEA in similar load change condition. It is considered to be occurred in oxidation of electrode catalyst under high voltage condition.

Fig 1. Performance according to current in each mode