

## Catalyst Property of High Performance PEMFC MEA under Low Humidification Conditions

J. O. Park, Y. H. Lee, J. S. Ha, S. Hong, J.-H. Kim

Samsung Institute of Technology,  
Samsung Electronics, Ltd.,  
Mt. 14-1, Nongseo-Dong Giheung-Gu Yongin-Si  
Gyeonggi-Do, Korea 449-712

To develop PEMFC system for vehicle application, it is desired to have a stack that can operate at the temperature higher than the current operation temperature of 80 °C. When PEMFC operates at 80 °C in vehicles, the capacity of current cooling system in vehicle such as automobile is not sufficient to maintain the operation temperature of 80 °C. Thus, larger cooling system becomes necessary, and it is difficult to design compact fuel cell vehicles. By increasing the operation temperature to 120 °C, the PEMFC can be applied to automobile without significant changes in the capacity of current cooling system. To keep the PEMFC operable at ambient or small applied pressure at such temperature, the relative humidity (RH) needs to be kept under 40%. At such low RH environment, it is essential that water content in the MEA is maintained during operation to achieve the desired cell performance. Various approaches have been attempted to maximize water content in the MEA at low RH operation conditions (1, 2). In the current study, catalyst supports with various surface area, surface concentration of oxygen and pore structure were used to analyze parameters that are critical to performance of MEAs under low humidification conditions.

Table 1 shows the properties of catalysts and catalyst layer that were used to prepare MEA A, B and C. The three catalysts had different carbon supports which varied in surface area, pore structure and surface concentration of oxygen. The MEAs prepared with the three catalysts showed differences in the dependence of active Pt areas on RH when they were evaluated in the RH of 40% and 20%. Figure 1 shows the I-V curves of the three MEAs which were evaluated at 120 °C under low humidification conditions of 40 % and 20 % RH. The MEAs had the same Pt loading, and the highest cell voltage values were measured from different MEAs depending on the current density region and RH conditions. At low current density region, the catalysts with high surface area showed the highest cell voltage. When the current density was over 0.2 A/cm<sup>2</sup>, other properties of catalyst supports such as surface concentration of oxygen and pore structure seem to affect the cell voltage. In the presentation, the dependence of cell voltage of MEAs which operate under low humidification conditions on the properties of catalyst support and catalyst composition will be discussed. The MEA performance will be analyzed to separate the kinetic, ohmic and mass transfer resistances within the MEA. The results will be analyzed to investigate the role of pore structure, surface area and surface concentration of oxygen of catalyst supports on the current-voltage responses of MEAs. The optimum catalyst support material and the design of catalyst layer which are suitable for facilitating transport of oxygen as well as maintaining water within the MEA will be proposed.

## References

1. H. Liang, L. Zheng and S. Liao, *International Journal of Hydrogen Energy*, **37**, 12860 (2012).
2. T. Kitahara, H. Nakajima and K. Mori, *Journal of Power Sources*, **199**, 29 (2012).

MEA type	Catalyst		MEA	
	BET surface area (m <sup>2</sup> )	O/C surface concentration ratio	Pt area (cm <sup>2</sup> /cm <sup>2</sup> active area)	
A	180	0.073	23	25
B	350	0.052	82	68
C	350	0.071	120	48

Table 1 Catalyst property (surface area and oxygen/carbon surface concentration ratio) and active Pt area in MEA at 20% and 40% RH, Pt loading : 0.39 mg/cm<sup>2</sup>.

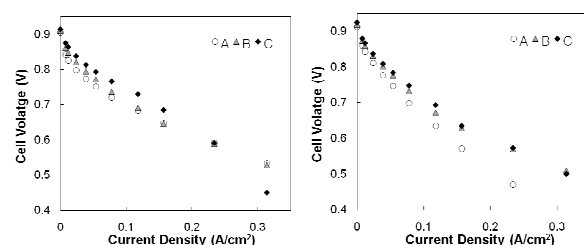


Figure 1 I-V characteristics of MEA A, B and C, 120 °C, ambient pressure, Pt loading : 0.39 mg/cm<sup>2</sup>, left : 40% RH, right : 20% RH.