# Improvement of PEMFC Activity by Control Ionomer Distribution

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Polymer electrolyte membrane fuel cells (PEMFCs) are a key power source to realize sustainable and low-carbon societies. Thus, lowering the cost of PEMFCs is a critical issue. In particular, the amount of Pt used in the catalyst layer (CL) for the oxygen reduction reaction (ORR) in the PEMFC cathode needs to be reduced to lower cost. To realize low-Pt PEMFCs, a promising strategy is improving the utilization efficiency of the Pt catalyst (i.e., mass activity).

The CL is a three-dimensional (3D) porous structure that typically consists of Pt-loaded carbon (Pt/C) and proton-conductive polymers (i.e., ionomers). In the cathode CL, the proton and electron generated in the anode CL react with the $O_2$ gas supplied from the outside of the CL to produce water. Therefore, the connectivity of both the ionomer and the pores in the 3D porous CL dominate the resistance of the proton delivery and $O_2$ diffusion, thereby affecting the PEMFC resistance. The most widely used ionomer is polyfluoroethylene-based polymers with perfluorosulfonic acid (PFSA), such as Nafion, because of their excellent proton conductivity. To control the 3D structure of the CL, including the distribution of its ionomers and pores, the dispersion compositions of the Pt/C with ionomer, referred to as “ink,” and their casting conditions for the CL preparation are highly important.

We studied an effect of alcohol content in ink to PEMFC activity and found that the lower alcohol content facilitated the ionomer adsorption on the Pt/C, realizing homogeneous distribution in CL and improving PEMFC activity. Furthermore, when the polybenzimidazole (PBI) was coated on the carbon, effect of alcohol content was minimized and even higher alcohol content ink offered high PEMFC activity, which is advantageous to establish high production rate of the CL.