DIAGNOSIS OF PHOSPHORIC ACID POISONING OF PT/C CATALYSTS IN HIGH TEMPERATURE POLYMER ELETROLYTE MEMBRANE FUEL CELL

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Recently, there have been demands for development of highly efficient fuel cell as electrical power supply system for operating electronic devices of various purposes. Of them, polymer electrolyte membrane fuel cell (PEMFC) has been regarded the standard system because of high fuel efficacy and excellent durability [1]. However, in such PEMFC run at low temperature less than 80 ^{o}C, resistance against CO poisoning of catalysts was so poor that highly purified hydrogen fuel was needed.

To alleviate CO poisoning effect of catalysts, high temperature - polymer electrolyte membrane fuel cell (HT-PEMFC) working at relatively high temperature more than 100 ^{o}C is emerging as alternative of conventional PENFC. In spite of that, the HT-PEMFC has membrane issue, meaning that the well-known Nafion membrane can't be used due to deactivation by its dehydration at the high temperature range. To overcome the membrane deactivation issue, a new type of membrane consisting of Polybenzimidazole (PBI) including phosphoric acid (H_3PO_4) additive (PBI/ H_3PO_4 membrane) is developed and used. Although such developed PBI/H_3PO_4 membrane mitigates the membrane deactivation issue, H_3PO_4 additive is popped up during cell integration and operation and induces H_3PO_4 poisoning of Pt/C metal catalysts, followed by degradation in fuel cell performance [2].

In this prospect, although it is critical to find out how to minimize poisoning of Pt/C metal catalysts by the popped up H_3PO_4 additive, it is also important to search for the ways to how to quantitatively and optically diagnose degree of poisoning of the catalysts because it is difficult to quantify and optically inspect degree of poisoning just using other conventional methods. To address the problems, in this study, we suggest the new ways to examine degree of poisoning by H_3PO_4 additive of the Pt/C metal catalysts.

Based on our suggestion, we measure and calibrate the H_3PO_4 poisoning of Pt/C metal catalysts in three different ways; (i) XPS analysis, (ii) electrochemical analysis and (iii) optical analysis using UV-Vis Colorimetric method and compare the results obtained by the different approach one another. For the XPS analysis, Oxygen and phosphorus bonding peaks were measured and the degree of poisoning was calibrated, while changes in catalytic activity about oxygen and hydrogen peroxide reduction reactions of the corresponding catalysts by H_3PO_4 additive was electrochemically and optically analyzed. As a result, we propose a model to predict the degree of H_3PO_4 poisoning of Pt/C metal catalysts in a quantitative way [3,4].

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