Effect of Polymer Coating on Carbon Supports for Polymer Electrolyte Membrane Fuel Cells Electrocatalyst

T. Fujigaya[1, 2, 3, 4]

[1]*Department of Applied Chemistry, Graduate School of Engineering, Kyushu University, 744 Motooka, Nishi-ku, Fuku-oka 819-0395, Japan.*
[2]*International Institute for Carbon Neutral Energy Research (WPI-I2CNER), Kyushu University, Fukuoka 819-0395, Ja-pan*
[3]*JST-PRESTO, 4-1-8 Honcho, Kawaguchi, Saitama, 332-0012, Japan*
[4] *Center for Molecular Systems (CMS), Kyushu University, 744 Motooka, Nishi-ku, Fukuoka 819-0395, Japan.*
fujigaya.tsuyohiko.948@mail.cstm.kyushu-u.ac.jp

1. Introduction

Polymer electrolyte membrane fuel cell (PEMFC) is a favorable energy device in the next generation due to its cleanness and high efficiency. However, the high cost coming from high Pt usage hinders the global commercialization of PEMFCs. Many approaches have been reported to lower the amount of Pt, such as core-shell[1], alloy[2] and size reduction of Pt-NPs. However, these approaches could not decreased the amount of Pt satisfactorily. Therefore, improvement of Pt utilization efficiency is required. During this study, polybenzimidazole (PBI) (Fig. 1) is used as the surface wrapping material of the carbon black materials (CBs) to provide homogeneous distribution of Nafion and capping of the micropores of the CB surface in order to enhance the Pt utilization efficiency.

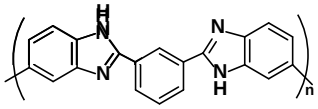

Fig.1 Chemical structure of

2. Results and discussion

The power densities of CB/Pts (dotted line) and CB/PBI/Pts (solid line) are shown in Fig.2. Improving effective Pt surface area by reducing Pt deposition into pores is a promising strategy[3]. This phenomena was observed with Vulcan, KB and AB which have different micropore density and micropore density is increasing in the order of AB/Pt < Vulcan/Pt < KB/Pt. Power density of CB/Pts was decreased in the following order; AB/Pt < Vulcan/Pt < KB/Pt, consistence with the order of increasing micropore density. Moreover, power densities of CB/PBI/Pts were higher than that of respective CB/Pts. The higher power density of CB/PBI/Pt may be due to the capping of the micropore of the CB surface by PBI which reduced inaccessible amount of Pt deposited onto the micropore of CB. And also higher power density of CB/PBI/Pt can be attributed to the reduced charge transfer resistance due to the homogeneous Nafion layer assisted by basic nature of PBI. Furthermore, power densities of CB/PBI/Pts were increasing in the order of KB/PBI/Pt < Vulcan/PBI/Pt < AB/PBI/Pt. The higher performance of AB/PBI/Pt may be due to the lower mass transfer limitation in the catalyst layer which is caused by lower pore density of AB/PBI.

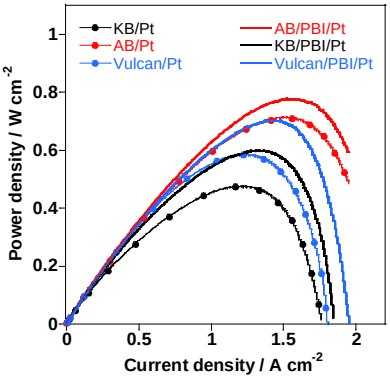

Fig. 2 Power density curves of CB/Pts (dotted line) and CB/PBI/Pts (solid line)

References

1) D. Wang *et al*., *Chem. Mater.* **24,** 2274 (2012). 2) V. R. Stamenkovic et al., *J. Am. Chem. Soc.***128**, 8813 (2006). 3) Y. C. Park et al., *J. Power Sources*, **315**,179 (2016).