Incorporation of TiO$_2$ into the PtPd/C Catalyst Layer for Improvement ORR Activity and Water Management

Nutthaphak Kitiphatpiboon$^1$, Mali Hunsom$^{1,2,*}$

$^1$ Fuels Research Center, Department of Chemical Technology, Faculty of Science, Chulalongkorn University, 254 Phayathai Road, Bangkok 10330, Thailand.
$^2$ Center of Excellence on Petrochemical and Materials Technology (PETRO-MAT), Chulalongkorn University, 254 Phayathai Road, Bangkok 10330, Thailand

*E-mail: mali.h@chula.ac.th

doi: 10.20964/110402741

Received: 4 January 2016 / Accepted: 29 January 2016 / Published: 1 March 2016

Titanium dioxide (TiO$_2$) samples prepared by different thermal treatments were incorporated in the cathode catalyst layer of a polymer electrolyte membrane or proton exchange membrane (PEM) fuel cell. Increasing the TiO$_2$ treatment temperature (500–800 °C for 3 h) resulted in an increased rutile phase content and crystal size, but decreased textural properties of the obtained TiO$_2$. Incorporation of TiO$_2$ prepared at the appropriate temperature in the carbon-supported PtPd catalyst (PtPd/C) layer positively affected the catalyst dispersion, electrochemical surface area and electrical conductivity of catalyst layer, but did not affect the electron pathway of the oxygen reduction reaction (ORR) of PtPd/C catalysts. Overall, the PtPd/C catalyst with TiO$_2$ calcined at 800 °C (T$^{800}$-PtPd/C) exhibited the highest ORR activity (~486 mA/cm$^2$ at 0.6 V) both in an acid solution and in a PEM fuel cell under a H$_2$/O$_2$ environment at atmospheric pressure compared to those for the Pt/C, PtPd/C and the other TiO$_2$-PtPd/C catalysts.

**Keywords:** TiO$_2$, PtPd/C catalyst; ORR activity; PEM fuel cell

© 2016 The Authors. Published by ESG (www.electrochemsci.org). This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license (http://creativecommons.org/licenses/by/4.0/).