

**【Grant-in-Aid for Scientific Research(S)】
Science and Engineering (Engineering II)**



Title of Project : Fuel Cell Electrocatalysts with Extended Durability

Kazunari Sasaki
(Kyushu University, Faculty of Engineering, Professor)

Research Area : Engineering

Keyword : Fuel cell materials

【Purpose and Background of the Research】

Fuel Cell, one of the most important solid state electrochemical devices and systems, is considered as a promising environmentally-compatible clean energy technology. Electrocatalysts are important materials determining the performance of polymer electrolyte fuel cells (PEFC). In order to ensure durability under practical operational conditions, sufficient stability is required during start-up, shut-down, idling, and voltage fluctuation associated with severe voltage changes. Pt electrocatalysts supported on carbon-based materials suffer from carbon corrosion especially on the cathode side. In order to ensure sufficient life time up to 10 or 20 years for fuel cell vehicles, break-through in electrocatalyst research is desired without using conventional carbon-based materials.

Our research group has succeeded to demonstrate an extended durability of alternative electrocatalysts using conductive oxides as catalyst support materials, up to 60,000 voltage cycles corresponding to the life time of fuel cell vehicles [1, 2]. In this project, fuel cells with the carbon-free electrocatalysts will be prepared and characterized under practical operational conditions in order to establish scientific materials design principles for these important electrochemical devices based on solid state electrochemistry, chemical thermodynamics, catalysis, materials process engineering, and mechanical engineering.

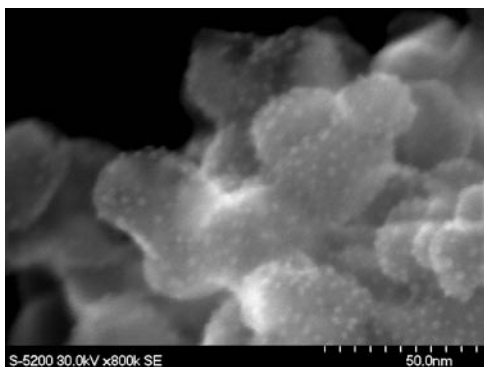


Figure: Scanning electron microscope micrograph of Pt/SnO₂ electrocatalysts.

【Research Methods】

Comprehensive research approach will be made on following research topics: (1) stability and dissolution kinetics in strongly-acidic environment, (2) electrocatalyst development with alternative support materials, (3) defect chemistry at catalyst/support interfaces, (4) device fabrication and characterization, (5) application to other related electrochemical devices. These research activities are carried out in collaboration with team members of the fuel cell research division of the World Premier International Research Center Initiative Program (WPI).

【Expected Research Achievements and Scientific Significance】

This research is of significance not only for fuel cell technologies but also for various electrochemical devices. Oxide catalyst support materials are important in the metal/semiconductor structure. Materials design principles established can contribute to realize an energy-efficient low-carbon society [3].

【Publications Relevant to the Project】

- 1) K. Sasaki, F. Takasaki, Z. Noda, S. Hayashi, Y. Shiratori, K. Ito, "Alternative Electrocatalyst Support Materials for Polymer Electrolyte Fuel Cells.", *ECS Transactions*, **33** [1] 473-482(2010).
- 2) A. Masao, Z. Noda, F. Takasaki, K. Ito and K. Sasaki, "Carbon-Free Pt Electrocatalysts Supported on SnO₂ for Polymer Electrolyte Fuel Cells", *Electrochem. Solid-State Lett.*, **12** [9] B119-B122 (2009).
- 3) K. Sasaki, "Hydrogen Energy: Current Status and Future Perspectives", *J. Japan Soc. Mech. Eng.*, **114** [4] 265-267 (2011).

【Term of Project】 FY2011-2015

【Budget Allocation】 166,000 Thousand Yen

【Homepage Address and Other Contact Information】

<http://www.mech.kyushu-u.ac.jp/~hup/sasaki@mech.kyushu-u.ac.jp>