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PRESS RELEASE（2011/9/6）

Molecular Catalysis in a Fuel Cell
(demonstrated 1/25 performance of fuel cell with platinum catalyst)

OUTLINE

Kyushu University (President Setsuo Arikawa) has successfully "developed fuel cells that use molecular catalysts for electrodes". When using the molecular catalyst for a cathode, the performance was 1/25 of fuel cells using a traditional platinum catalyst. A summary of the research results will be released in the online version of *Angewandte Chemie International Edition*.

This research was conducted by Professor Seiji Ogo of Kyushu University and his research group on the Ito campus of Kyushu University and at Fukuoka Industry–Academia Symphonicity as part of research by Kyushu University's "Carbon-Neutral Energy Research Institute (I^2CNER, Director Petros SOFRONIS)", one of six research institutes that comprise the World Premier International Research Center Initiative (WPI Program) established by the Ministry of Education, Culture, Sports and Science and Technology, the Global COE Program (Program Leader Nobuo KIMIZUKA), "Science for Future Molecular Systems", and the Basic Research Programs CREST Type, "Development of the foundation for Nano-Interface Technology (Supervisor Seiji SHINKAI)" from Japan Science and Technology Agency.

PRESS RELEASE

The press briefing will be held as follows;

Time & Date:	1:30 pm – (approx. 30 minutes), September 7th, 2011 (Thursday)
Venue:	Meeting Room, Big Orange, Ito Campus, Kyushu University (744 Motooka, Nishi-ku, Fukuoka)
Speaker:	Seiji Ogo, Professor Department of Chemistry and Biochemistry Graduate School of Engineering Kyushu University

After briefing, the development site of the molecular fuel cells located at Fukuoka Industry–Academia Symphonicity (203-1 Motooka, Nishi-ku, Fukuoka) will be introduced to those who are interested. (approx. 30 minutes)

■ BACKGROUND

Traditionally, a platinum unit and alloy have been used as electrode catalysts for fuel cells. However, platinum is both expensive and exhaustible, and difficult to control its catalytic power. Therefore, the development of an electrode catalyst, which is inexpensive and easy to control the catalytic power, has been a desired goal.

Professor Seiji Ogo of Kyushu University and his research group have already succeeded in "A Dinuclear Ni(μ-H)Ru Complex Derived from H_2" (Note 1, press release 2007/04/25) and "Extraction of Electrons from H_2 with a $Ni^{I}Ru^{I}$ Catalyst ("Ogo Catalyst", Fig. 1)" that extracts electrons from hydrogen in water, at normal temperature and under ordinary pressure (Note 2, press release issued on August 9, 2008). The Ogo Catalyst is the world's first molecular catalyst that severs hydrogen via heterolytic cleavage and extracts electrons. Because of this achievement, it is expected that fuel cells will be developed by using Ogo Catalyst as an electrode catalyst.

■ CONTENT

Recently, the research group lead by Professor Seiji Ogo of Kyushu University succeeded in developing the basic technology for fuel cells with a nickel-ruthenium molecular catalyst (Ogo Catalyst, Fig. 1) as an electrode catalyst. When compared to a traditional fuel cell that uses a platinum catalyst for both the cathode and anode (Note 3), the use of the Ogo Catalyst showed a performance of 1/25 when used for cathode, 1/100 for anode and 1/600 for both anode and cathode (Fig. 2).

■ EFFECT

Because this newly-developed fuel cell uses molecules as an electrode catalyst, it is easy to visualize the mechanism of the chemical reaction within a cell using analytical equipment in a laboratory environment (Fig. 3). Based on the observed reaction mechanism, it makes it possible to promptly develop various molecular catalysts with different properties, and a breakthrough for fuel cell's capabilities is expected. Also, the basic concept of fuel cells using the developed molecular catalyst can be applied to future technologies in various areas.

■ FUTURE DEVELOPMENT

Continuing efforts will be made to improve the molecular catalyst (Ogo Catalyst) and develop "molecular fuel cells" with the same ability as platinum fuel cells.

■ INQUIRIES

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■ PUBLICATION

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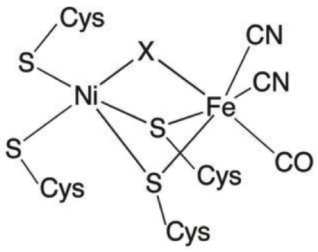
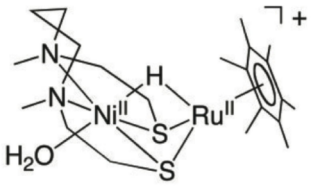
■ GLOSSARY

(Note 1)

In 2007, the research group of Prof. Seiji Ogo of Kyushu University succeeded in "A Dinuclear Ni(μ-H)Ru Complex Derived from H_2" (press release 2007/04/25).



(a) Active site structure of hydrogenase



(b) Hydrogenase model compound

(Science 2007, 316, 585-587)

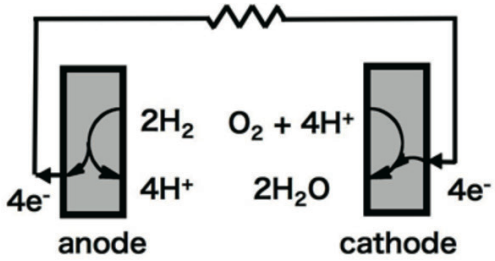
(Note 2)

In 2008, the research group of Prof. Seiji Ogo of Kyushu University succeeded in "Extraction of Electrons from H_2 with a $Ni^{I}Ru^{I}$ Catalyst (Ogo Catalyst, Fig. 1). This research showed the mechanism that extracts electrons from hydrogen in water, at normal temperature and under ordinary pressure differs substantially from a 2 (two)-electron system mechanism (1) which has been proposed for the traditional fuel cells (anode) and hydrogenase. This is a 4 (four)-electron system (2) that no one has ever imagined possible.

$$H_2 \longrightarrow H^+ + H^- \longrightarrow 2H^+ + 2e^- \qquad (1)$$

$$2H_2 \longrightarrow 2H^+ + 2H^- \longrightarrow 2H^+ + 2e^- + H_2 \qquad (2)$$

(Note 3)



Conceptual Diagram of Fuel Cell

■ SUPPORTING FIGURES

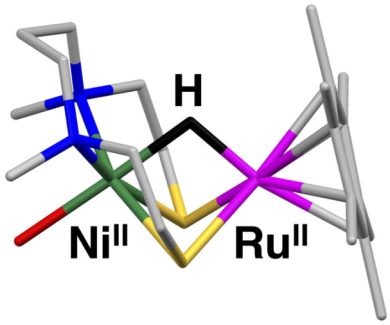


Fig. 1. Ni(μ-H)Ru molecular catalyst (Ogo Catalyst) used as electrode catalyst for fuel cell

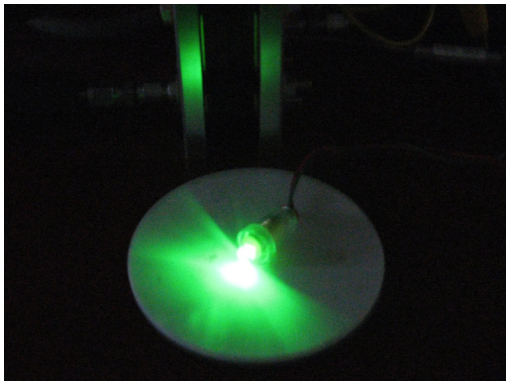


Fig. 2. Electric power generated by fuel cell with Ogo Catalyst

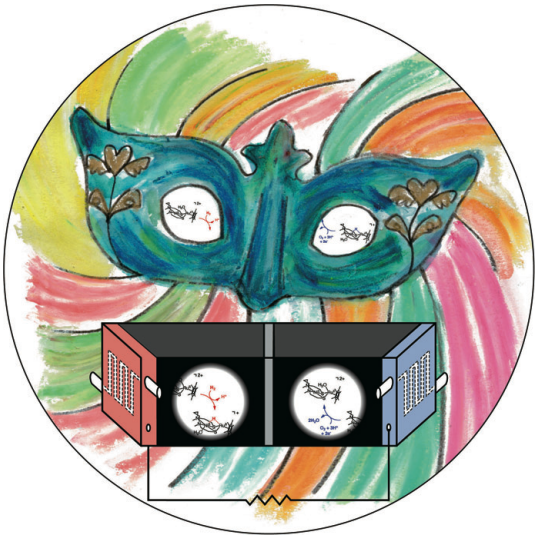


Fig. 3. Visualization of reaction mechanism (image diagram)
Selected for the cover page of "Angewandte Chemie International Edition"