SEMINAR SERIES

International Institute for Carbon-Neutral Energy Research
Kyushu University

Title **Molecular catalysis of the electrochemical and photochemical reduction of CO_2 with earth abundant metal complexes in aprotic solvent and in pure water**

Speaker Prof. Marc Robert
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Date & Time Friday, January 15, 2016 4:30 p.m.

Place I²CNER Hall, Ito campus, Kyushu University

Abstract

Recent attention aroused by the reduction of carbon dioxide has as main objective the production of useful products – the "solar fuels" – in which solar energy would be stored. One route to this goal consists in first converting sunlight energy into electricity then used to reduce CO_2 electrochemically. Conversion of carbon dioxide into carbon monoxide is thus a key-step through the classical dihydrogen-reductive Fischer-Tropsch chemistry. We will describe our work in this field using various iron tetraphenylporphyrin derivatives, that prove to be remarkable catalysts of the reduction of CO_2 to CO when generated electrochemical at the Fe(0) oxidation state, both in terms of selectivity, durability, overpotential and turnover frequency in DMF-water mixtures. Benchmarking with other catalysts, through catalytic Tafel plots, shows that they are the most efficient homogeneous molecular catalysts of the CO_2-to-CO conversion at present. We have also been able to catalyze CO_2 reduction with visible light as a source for energy, a noticeable output for a system that combines an abundant metal (iron) based catalyst, a cheap organic sensitizer and visible photons.

Extending these results, we recently discovered that it was possible, with a water-soluble Fe porphyrin, to catalyze the electrochemical conversion of carbon dioxide into carbon monoxide in pure water as well as to transfer catalytic activity to solid surfaces by grafting of the molecular catalysts. New results involving an iron based catalyst able to cleanly transform CO_2 into formic acid with high yield will be presented. A further step has been achieved with the successful splitting of CO_2 into CO + O_2 within an efficient, low cell voltage electrolyzer in pH neutral water.

About the Speaker

Prof. Marc Robert is a young group leader of a world class electrochemistry laboratory with years of experience in the electroactivation of CO_2 using metal-organic complexes as electrocatalysts. His interests include electrochemical, photochemical and theoretical approaches of electron transfer reactions, in particular dissociative electron transfers and proton-coupled electron transfer processes in both catalysis for energy (CO_2, O_2 and proton reduction) and biochemistry. He has published 93 papers in high-impact journals international journals, including 33 JACS, 6 PNAS, 2 Angewandte, 4 Acc. Chem. Res., 2 Chem. Rev. and 1 Science (*h*-index 34), and delivered over 135 seminars and conferences. He holds 3 international patents.

Host: Professor Ken Sakai

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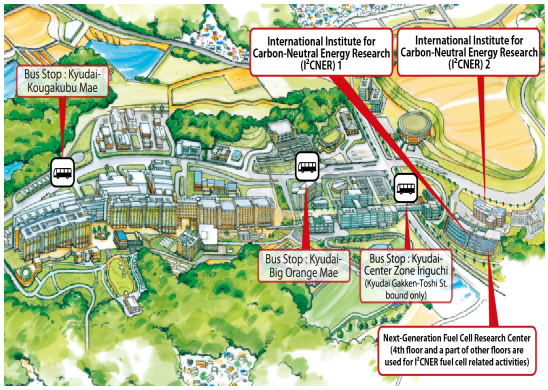

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