FOR IMMEDIATE RELEASE

Oita University and Hitachi High-Tech Give a Joint Presentation on the Use of AI Technology to Extend the Lifespan of Polymer Electrolyte Fuel Cells

Tokyo, Japan October 10,2024 – National University Corporation OITA UNIVERSITY ("Oita University") and Hitachi High-Tech Corporation ("Hitachi High-Tech") today announced that we have started conducting research ("this research") into predicting and extending the life of electrocatalysts used in polymer electrolyte fuel cells (PEFC), utilizing Hitachi High-Tech's technology that uses AI to perform image analysis. We will be giving a joint presentation on the contents of this research at The Chemical Society of Japan Autumn Event 14th CSJ Chemistry Festa 2024, which will be held at Tower Hall, Funabori (Tokyo) from October 22 to 25, 2024.

Kinumoto Laboratory at the Faculty of Science and Technology of Oita University is involved in research initiatives using the Identical Location Field Emission-Scanning Electron Microscope (IL-FE-SEM)*1 of Oita university's proprietary technology to figure out the degradation mechanism of PEFC electrocatalysts and develop robust PEFC. This research is part of the Green Technologies for Excellence (GteX)*2 project of the Japan Science and Technology Agency (JST).
Hitachi High-Tech develops, manufactures, and sells electron microscopes, so has a wealth of expertise in the analysis of observation images, also solves problems faced by customers using informatics technologies, Materials Informatics (MI) and Process Informatics (PI)*3. Hitachi High-Tech has drawn on these strengths and combined them with AI and SEM image analysis technologies to provide support for Oita University's PEFC research and development.

Including with this research, Oita University and Hitachi High-Tech aim to continue working to accelerate efforts to develop longer-lasting PEFC going forward and contribute to solving social issues such as by achieving carbon neutrality and a decarbonized society.

*1 Identical Location Field Emission-Scanning Electron Microscope (IL-FE-SEM): It refers to the observation of a fixed-point using FE-SEM and is a technology independently developed by Oita University. Observing a fixed-point can be used effectively in research tracking and figuring out changes in physical matter.
*2 Green Technologies for Excellence (GteX): A project by JST for supporting R&D and personnel development at universities, National Research and Development Agencies and similar institutions with the aim of continually creating new technologies targeted toward achieving GX (green transformation).
*3 Materials Informatics (MI) and Process Informatics (PI): Initiatives to make materials development more efficient by using informatics techniques that leverage statistical analysis and other such methodologies. MI is often used to predict material properties or for design purposes, while PI is often used to streamline the production process.

Background

PEFC are a type of fuel cell that use polymer materials as the electrolyte*4 to generate electricity (energy) by causing chemical reactions between hydrogen and oxygen at two electrodes. Fuel cells of all kinds are increasingly used as a form of sustainable energy that can reduce CO_2 emissions and, among those, PEFC are also used in everyday applications such as vehicle and household power sources. As the achievement of carbon neutrality becomes recognized as a key issue facing society, it is predicted that PEFC will become increasingly necessary. To that end, however, PEFC in their current state need to be higher durability, with higher output, and lower in cost. This research aims to shed light on the mechanism behind the degradation of electrocatalysts, which is the utmost important issue in prolonging PEFC life, by using AI technology to analyze FE-SEM observation images and make more efficient analysis based on quantitative data possible.
*4 Electrolytes: A substance used to move ions between electrodes and facilitate an electrochemical reaction.

Overview of this Research

This research used Oita University's IL-FE-SEM technology and Hitachi High-Tech's AI-powered image analysis technology to study electrocatalyst durability and surface degradation through accelerated degradation tests in which a pulse voltage is repeatedly applied to the PEFC electrocatalysts.*5

In order to figure out the deterioration mechanism, in which there is a reduction in the electrochemical surface area (ECSA)*6 of the electrocatalytic platinum particles, Oita University is using IL-FE-SEM technology to visually inspect and analyze the platinum particles in observation images. However, although it is possible to use IL-FE-SEM technology to acquire a large volume of observation images, this has its problems in that there is a tremendous workload involved in analyzing all of the observation images due to there being hundreds of platinum particles present in each individual image. To resolve this problem, Hitachi High-Tech provided AI-driven image analysis technology to streamline the task of image analysis. Specifically, AI image analysis was used to detect*7 platinum particles present in each test. After the particles were detected in the images that had been taken, changes in the status of the particles (their disappearance, aggregation, or formation) could be tracked and the particle count automatically determined.

Going forward, the researchers will continue to work to improve particle detection accuracy and make advancements in figuring out the degradation mechanism of more efficient PEFC, as both Oita University and Hitachi High Tech will push ahead and continue to work together to develop long-lasting PEFC. They will also contribute to the cultivation of data scientists with a grounding in chemistry by working together with the students of Oita University on pushing this analysis forward.

*5 Durability testing using an accelerated degradation test (ADT). ADT rapidly evaluates fuel cell durability by applying a constant potential pulse to a sample. FE-SEM was used to image the same location on the catalyst surface to study the degradation in the cathode catalyst surface occurring over repeated tests.
*6 Electrochemical surface area: It refers to the surface area over which the reaction occurs, and it serves as an important metric when evaluating the performance of catalysts and electrode materials. The larger the electrochemical surface area, the higher the electrochemical reaction efficiency.
*7 Detected particles using semantic segmentation. Semantic segmentation assigns labels to each and every pixel in an image, enabling a precise level of detection even across wide image areas.

This research is being performed through technical collaboration with Hitachi Co., Ltd. (“Hitachi”), and the presentation at CSJ Chemistry Festa 2024 is planned to be performed jointly by Oita University, Hitachi High-Tech, and Hitachi.

- End -

Related Information

• CSJ Chemistry Festa 2024 https://festa.csj.jp/2024/index.html (Japanese only)
• The date and time of the presentation on this research: Wednesday, October 23, 1:30 PM to 3:30 PM within the Festa plan, student poster presentations*8.
• Presentation topic: “Analysis of Degradation of Pt/C Electrocatalysts for PEFC using Identical Location FE-SEM Observation and AI Image Analysis”

*8 Student poster presentations: A student poster session will be held with the objective of encouraging discussion between students and industry, academia, and government representatives.

About Hitachi High-Tech
Hitachi High-Tech, headquartered in Tokyo, Japan, is engaged in activities in a broad range of fields, including manufacture and sales of clinical analyzers, biotechnology products, radiation therapy systems, semiconductor manufacturing equipment, analytical instruments, and analysis equipment. Also, we provide high value-added solutions in industrial fields such as mobility, connected, environment and energy, etc. Through business based on our core Observation, Measurement and Analysis technologies, we will contribute to the realization of a sustainable society by solving social issues.
The company's consolidated revenues for FY2023 were approx. JPY 670.4 billion. For further information, visit https://www.hitachi-hightech.com/global/en/

About Oita University
Oita University has a Faculty of Education, Faculty of Economics, Faculty of Medicine, Faculty of Science and Technology, and Faculty of Welfare and Health Science. The university's Basic Policy state that it strives to “foster people rich in creativity, social abilities, and humanity through education and research in the humanities, the social sciences, and the natural sciences. In addition, it will actively contribute to peace and development in the world. It will play an active role in promoting human welfare and creating new culture.” This initiative is being conducted at the Faculty of Science and Technology, where research and development targeted at achieving carbon neutrality is conducted, including research into fuel cells.

Contact
Takumi Senba
Material Solution Dept.,
Supply Chain Resilience Div.,
Supply Chain Platform Business Group,
Hitachi High-Tech Corporation
Email : mi-info.aj.ml@hitachi-hightech.com/