Evaluation of Catalytic Activity of Fuel Cell Catalysts by Rotating Disk Electrode (RDE)

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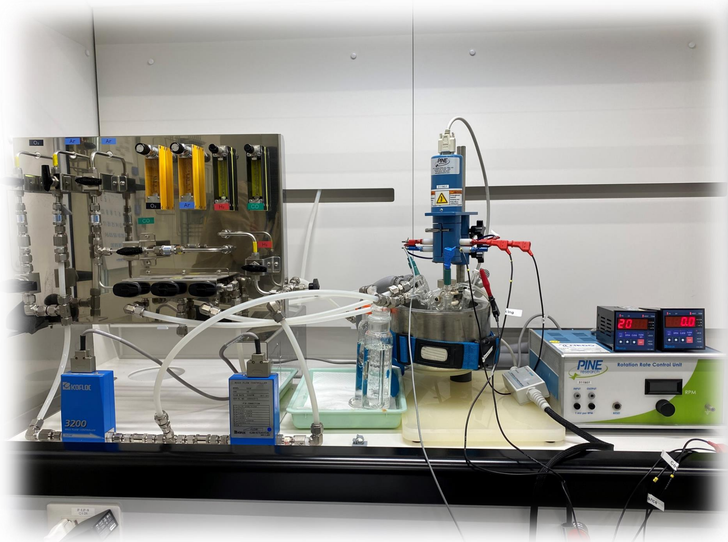
Research Background

Rotating Disk Electrode (RDE) is a NEDO technique used for evaluation of catalytic activity of fuel cell catalysts. In particular, it is used to determine:

- **The electrochemical active surface area (ECSA)**
- **The oxygen reduction reaction (ORR)**
- **The hydrogen oxidation reaction (HOR)**



Potentiostat (Autolab PGSTAT128N). Electrode rotating device (PINE AFMSRCE)

Experimental work

Ink preparation

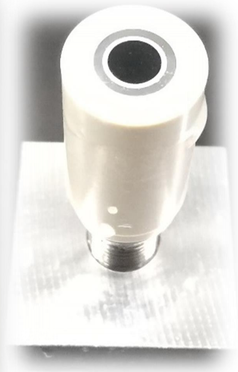
Ultrasonic homogenizer. (Mitsui Electric Seiki UX-300) Used for dispersion of catalytic inks.

Electrode polishing

Electrode surface after polishing

Desktop Automatic Polishing Machine (Marteau Diamond Wrap Ace ML-162A). The bottom surface of the electrode is polished smoothly.

Film cast on GC electrode

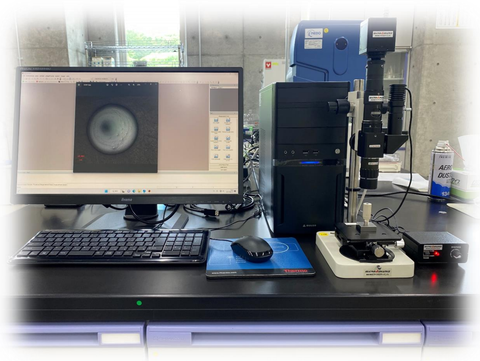


used for H_2O_2 detection

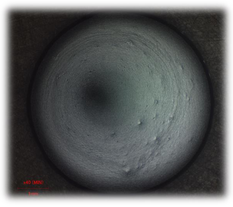
Electrode rotating device. (PINE AFMSRCE), used for rotational drying of the catalyst layer by centrifugal force. Suppresses the coffee ring effect.

Examples of Evaluation Protocols and Analysis Techniques

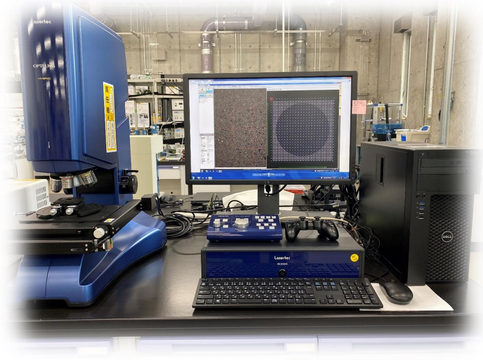
- **Cyclic Voltammetry (CV)**
- **Linear sweep voltammetry (LSV)**
- **Mass activity**



Micro digital Scope (Micro Advance AS-M1100), used to observe the cast film of the catalyst layer and its distribution.



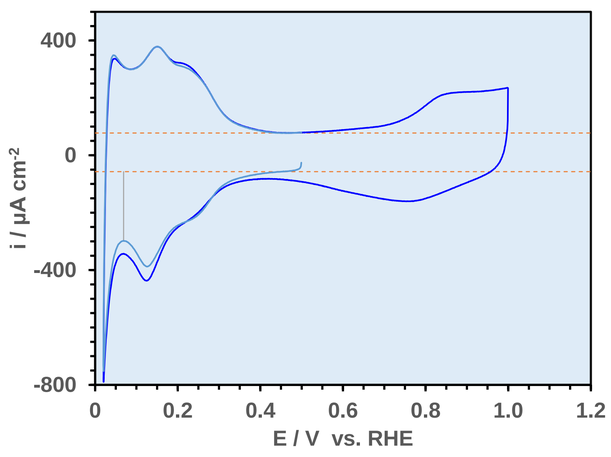
Electrode surface after film cast



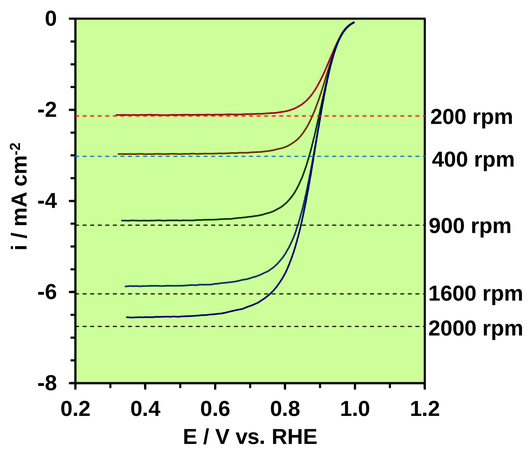
Confocal microscope (Laser tec OPTELICS HYBRID L3), a non-destructively method used to observe the shape and the thickness of the cross-section of the catalyst layer.

Results

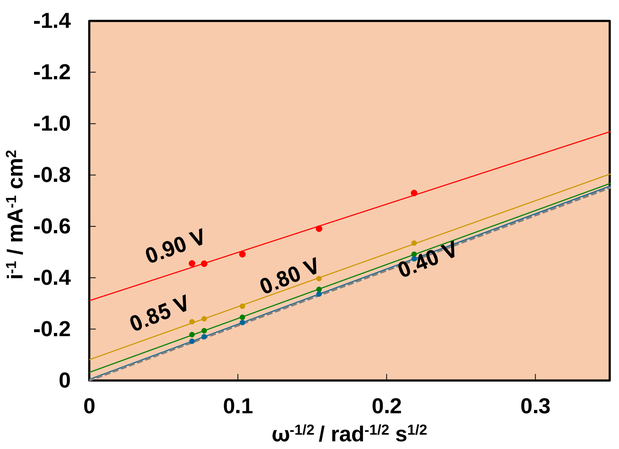
CV



LSV



Koutecky-Levich plot at 0.9V



Results	
H_{ads} Charge	208.22µC
Pt Surface Area	**0.992cm²Pt**
Roughness Factor	5.050
ECSA	**87.63m²Pt/gPt**
Double Layer Capacitance	264.679µF
Double Layer Capacitance	**1348.00µF/cm²**
Double Layer Capacitance	266.94µF/cm²Pt
Charge of H_{ads} & HER Regime	288.88µC
Charge of H_{des} & HOR Regime	247.00µC
Charge of Pt Oxidation Regime	143.04µC
Charge of Pt Reduction Regime	167.37µC

Future plans: Academia collaboration for testing new materials for commercialization targets Materials characterization for new applications

Acknowledgment: This poster is partially based on results obtained from a project commissioned by the New Energy and Industrial Technology Development Organization (NEDO).