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Section of Public Relations	Dongsun Cho Section Chief 062-715-2061	Nayeong Lee Senior Administrator 062-715-2062
Contact Person for this Article	Professor Jaeyoung Lee School of Earth Sciences and Environmental Engineering 062-715-2579	
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Professor Jaeyoung Lee's research team reaches the highest output of eco-friendly liquid fuel cells through the development of electrode catalysts

- Korean researchers have succeeded in developing electrode catalysts to secure the highest level of performance for formate liquid fuel cells produced from carbon dioxide.

- GIST (Gwangju Institute of Science and Technology) School of Earth Sciences and Environmental Engineering Professor Jaeyoung Lee's research team developed an anode electrode catalyst for use in alkaline formate fuel cells.

  - The research team performance of fuel cells by introducing boron into palladium metal in a formate fuel cell and used it as an electrochemical catalyst to improve the formate oxidation kinetics of the catalyst.

    * Palladium (Pd): In the electrochemical field, it has traditionally been mainly used for oxidation and reduction reactions of organic compounds and has excellent oxidation performance along with platinum (Pt) as an oxidation electrode catalyst. In particular, for formate oxidation, the oxidation performance of Pd greatly exceeds that of Pt, and research on the development of Pd-based electrode catalysts is being conducted.

- Formate can be produced directly in large quantities through the electrochemical reduction process of carbon dioxide, enabling the implementation of carbon neutral fuel cell systems that has higher current and power density output compared to other fuels.

- Liquid fuel cell systems can be used for electronic devices such as laptops, smartphones, drones, and small-scale transportation power such as kickboards. Currently, liquid fuel cells that generate electricity through oxidation of organic compounds such as methanol, ethanol, formic acid, and formate have been discontinued due to limited output.

  - Recently, research has been ongoing to improve the performance of alkaline liquid fuel cells with palladium catalysts. Although formate oxidation does not produce carbon monoxide intermediates, research is still needed to solve the barriers to performance improvement.

  - In particular, it is important to control the desorption reaction of hydrogen adsorbed species, which is the stage of determining the reaction rate of the reaction mechanism. The research team found that the formate oxidation reaction was improved by more than 50% by incorporating boron (B) into the palladium grid to weaken the adsorbent strength of hydrogen through effective electronic structural improvement between palladium and boron.

- Professor Jaeyoung Lee said, "The world's best performance of fuel cells was secured by developing a catalyst using the oxidation properties of formate, an eco-friendly fuel that can be mass-produced from carbon dioxide. This is expected to make a significant contribution to the development of next-generation energy conversion technology through follow-up research."

- This research conducted by Professor Jaeyoung Lee's research team with the support of the GIST Research Institute (GRI) and was published online on April 5, 2021, in *ACS Catalysis*, a world-renowned chemistry journal.