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## **Professor Chanho Pak's research team develops alloys catalysts that improves fuel cell performance of hydrogen electric vehicles**

- GIST (Gwangju Institute of Science and Technology, President Kiseon Kim) School of Integrated Technology Professor Chanho Pak's research team developed a multifunctional non-platinum catalyst with similar activity to platinum under acidic conditions, greatly improving the durability against the reverse voltage phenomenon\* of the cathode for a hydrogen electric vehicle fuel cell.

\* reverse voltage phenomenon: In normal operation, the voltage of the anode of the fuel cell must be higher, but when the hydrogen fuel is insufficient, the voltage of both electrodes is reversed as the voltage of the cathode increases.

- The iridium-ruthenium alloy catalyst developed by this research team is expected to replace platinum in the fuel cell cathode in the future by significantly improving the durability of the cathode while showing the same performance as platinum when applied to the fuel cell cathode.
- Existing hydrogen fuel cells, which mainly use platinum as a cathode catalyst for hydrogen oxidation reactions are not only scarce and expensive but also overflow water and supply of reactive gases in fuel cells, which acted as a stumbling block to catalyst stability.
  - In particular, when the reverse voltage phenomenon of the cathode occurs due to hydrogen deficiency, corrosion of the carbon carrier proceeds due to the high voltage, which greatly reduces the stability of the catalyst. Therefore, research

is being actively conducted to improve durability of reverse voltage phenomena by adding oxygen-producing catalysts to fuel cell cathode.

- By optimizing the iridium-ruthenium alloy ratio, the research team developed excellent catalysts for both hydrogen oxidation and oxygen-producing reactions, replacing platinum catalysts in fuel cell cathode. In addition, in the situation where hydrogen fuel was insufficient, excellent oxygen generation and carbon corrosion were suppressed to improve the reverse voltage durability of the negative electrode.
  - The fuel cell produced by this research team implemented similar performance to commercial platinum catalysts, and it was confirmed that it lasted more than 7 hours, which is 175 times more than the platinum catalyst cathode, which lasted less than 10 minutes in the cathode reverse voltage durability evaluation using hydrogen deficiency phenomenon.
- Professor Chanho Pak said, "This research achievement has the greatest significance in that the iridium-ruthenium alloy catalyst was synthesized in an acidic condition to ensure performance and durability of the negative electrode in a fuel cell. It is hoped that this solution to the oxidation problem of the iridium-ruthenium catalyst will be applied to a commercial vehicle for hydrogen that requires high durability."
- This research was led by GIST Professor Chanho Pak and conducted by integrated student Seung Woo Lee, master's students Bongho Lee and Chaekyung Baik, and Dr. Tae-Yang Kim with support from the Korea Institute of Energy Technology Evaluation and Planning, the Ministry of Trade, Industry & Energy, and the GIST Research Institute and was published on June 21, 2020, in the *Journal of Materials Science & Technology*, a prestigious international journal.

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