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GIST School of Earth Sciences and Environmental Engineering Professor Jaeyoung Lee's research team improves the performance and durability of platinum catalysts for hydrogen fuel cells and expects the economic feasibility of hydrogen electric vehicles

- Hydrogen fuel cells are an eco-friendly, high-efficiency energy that does not emit any pollutants other than water, and it has been spotlighted as a clean and safe future new growth engine and sustainable energy source by emitting less carbon dioxide than an electric vehicle.
 - Hydrogen fuel cells can be used not only in hydrogen electric vehicles but also in portable electronic devices such as drones and laptops. Currently, problems such as development of low-platinum and high-durability electrodes need to be solved for the expansion and distribution of hydrogen fuel cells.
- Gwangju Institute of Science and Technology (GIST, President Kiseon Kim) School of Earth Sciences and Environmental Engineering Professor Jaeyoung Lee's research team improved the performance and durability of a hydrogen fuel cell platinum catalyst by using carbon containing isolated electron pairs *.

* isolated electron pair: a pair of two electrons that are not bound to other atoms

- Platinum is currently considered the most suitable oxygen reduction catalyst, but it is quite expensive due to its limited reserves. To increase the price

competitiveness of the fuel cell, the amount of the platinum catalyst used must be reduced, and the performance and durability in the oxygen reduction reaction should also be improved.

□ The platinum catalyst developed in this study not only has superior performance compared to the existing platinum catalyst in the oxygen recovery reaction due to the bond between platinum and nitrogen atoms, but it also improved durability by minimizing the amount of platinum eluted during hydrogen fuel cell operation due to the strong interatomic bond.

- The research team synthesized nitrogen-doped carbon using the ball milling method * and used it as a catalyst for oxygen reduction reaction in a hydrogen fuel cell by using it as a carrier for platinum particles.

* ball milling method: a synthesis method in which ceramic spheres and samples are rotated at high speed to cause chemical reactions through frictional heat or to break down the sample size to a smaller size

- The researchers confirmed that the isolated electron pair containing a large amount of nitrogen-doped carbon not only serves to uniformly grow platinum particles on the carrier but also forms a bond between platinum and nitrogen atoms that accelerate the oxygen reduction reaction.

□ Professor Jaeyoung Lee said, "It is possible to improve the performance and durability of platinum metal catalysts in hydrogen fuel cells by revealing the role of the isolated electron pair of the carbon carrier in the platinum catalyst formation process and reaction mechanism. This is expected to make a great contribution to the hydrogen economy by increasing the manufacturing economics of hydrogen electric vehicles."

□ The research was led by GIST School of Earth Sciences and Environmental Engineering Professor Jaeyoung Lee (corresponding author) and conducted by Ph.D. student Kahyun Ham (first author) with support from the National Research Foundation of Korea and was published in the cover paper of the March issue of *ChemSusChem*, a world-renowned academic journal in the field of energy and chemistry.

Paper title: The Role of Lone Pair Electrons in Pt-N Interactions for the Oxygen Reduction in Polymer Exchange Membrane Fuel Cells