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School of Earth Sciences and Environmental Engineering Professor Jaeyoung Lee's research team produces butanol, an eco-friendly automobile fuel from the greenhouse gas carbon dioxide

□ GIST (Gwangju Institute of Science and Technology) School of Earth Sciences and Environmental Engineering Professor Jaeyoung Lee's research team developed a technology that efficiently produces eco-friendly butanol that can be used as fuel for automobiles through the process of recycling carbon dioxide *.

* recycling carbon dioxide: This is a technology that converts carbon dioxide electrochemically to produce and reuse high-value-added organic compounds.

◦ The research team used an electrochemical catalyst in which phosphorus (P) is introduced into copper (Cu) * metal to control the carbon monoxide adsorbed species (*CO), which is the step of determining the reaction rate in the process of converting carbon dioxide into butanol ** with an improved production efficiency increasing by 70 times.

* copper (Cu): Traditionally, it has been mainly used for reduction reactions that convert carbon dioxide into various organic compounds.

** butanol (C4H9OH): As a transportation energy that can replace gasoline, it can achieve high fuel efficiency due to its high energy density. Butanol is not only a material that is used in paint, ink, and bonds, but it can also be used as a cleaning agent for semiconductors and precision machines. It is also used in food, soap, and cosmetics.

- With climate change as the biggest issue facing humanity in the 21st century, securing high value-added organic compounds that can only be produced through petrochemical processes while reducing greenhouse gas carbon dioxide, which is the main culprit of global warming, is indispensable for entering a carbon-neutral society. The conversion process of increasing the number of carbon from carbon dioxide (CO_2) to two and three is not highly responsive and efficient, requiring additional separation and enrichment processes near the end of the process.

  - Recently, there were first reports of producing butanol through electrochemical carbon dioxide conversion using copper catalysts, but the conversion efficiency of C2 and C3 organic compounds such as ethylene, ethanol, and propanol was 10 to 50% similar to the previous research results of this research team. In particular, the Faraday conversion efficiency for butanol is 0.056%, which is a very difficult level to confirm.

  - The research team confirmed the production efficiency of butanol from carbon dioxide (3.868%), which is 70 times higher than before, by improving the reaction path by increasing the pro-oxygenity of the surface through a copper phosphor (CuP_2) catalyst.

- These figures are significant in that they are derived using electrode catalysts with an area about 10 times larger than the previous one.

- Professor Jaeyoung Lee said, "Until now, carbon dioxide, known as a cause of global warming, could be used as a high value-added eco-friendly resource. In the future, it is expected that butanol, which is a future hydrogen energy, can be mass-produced and used in eco-friendly internal combustion engine vehicles through large-area electrode catalysts and process improvements."

- The study by Professor Jaeyoung Lee's team was conducted with the support of GIST GRI and was published online on May 11, 2021, in *ACS Energy Letters*, a world-renowned journal in chemical technology.

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