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Professor Jaeyoung Lee's research team improves water management for hydrogen fuel cells by using graphite nanofibers

□ GIST (President Seung Hyeon Moon) – A research team led by Professor Jaeyoung Lee of the School of Earth Sciences and Environmental Engineering has successfully conducted joint research with the Korea Electric Power Research Institute (CEO Sung-hwan Bae) to improve the water management problem of hydrogen fuel cells by using graphite nanofibers.

◦ Hydrogen fuel cells are eco-friendly, highly efficient power generators that produce hydrogen oxidation reaction at the anode and oxygen reduction reaction at the cathode. The hydrogen injected into the fuel is decomposed into hydrogen ions and electrons. The disassembled electrons produce electricity through external circuits, and the hydrogen ions react with oxygen in the atmosphere through the hydrogen ion exchange membrane.

□ Water generated by the oxygen reduction reaction improves the hydrogen ion conductivity when properly contained in the proton exchange membrane, but when the generated water becomes excessive, water flooding occurs inside the electrode. This interferes with the

mass transfer of fuel and acts as a serious degradation factor for the hydrogen fuel cell.

- The researchers synthesized carbon nanofibers using electrospinning and then graphitized the carbon by heat treatment at an ultra-high temperature of 2500 °C. Subsequently, a graphite or nanofiber was mixed with a platinum/carbon catalyst to prepare a highly dispersed catalyst ink, and the electrode was constituted by spraying.

□ The hydrogen fuel cell electrodes developed by the research team played an important role in facilitating the spontaneous discharge of excess water and oxygen supply in the air compared with the conventional platinum/carbon electrode. This is due to the hydrophobic surface of graphitized carbon nanofibers in the catalytic layer and the high electrical conductivity.

□ Professor Jaeyoung Lee said, "Electrodes with improved water management by introducing graphite nanofibers have an excellent effect on improving relative durability by suppressing the corrosion of the carbon electrode. This research has made it possible to secure the durability of platinum precious metal catalysts, which is expected to contribute to improving the economic costs of manufacturing hydrogen powered vehicles."

□ This study was led by Professor Jaeyoung Lee (corresponding author) and Dr. Sun-ki Jung (first author) was supported by KEPCO and published in the *Journal of Power Sources* on August 4, 2018.

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