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## **Professor Chang Hyuck Choi's joint research team identifies key technologies for designing electrode materials for hydrogen production (Korea Research Foundation)**

- GIST (President Kiseon Kim) School of Material Science and Engineering Professor Chang Hyuck Choi, Kyungpook National University Professor Sang-II Choi, and Kangwon National University Professor Hyung-Kyu Lim's collaborative research team identified the theoretical principles behind the process of decomposing water to obtain hydrogen.
  - As opposed to fuel cells that produce water and electricity through the reaction of hydrogen and oxygen, water electrolysis produces and obtains hydrogen from water and is one of the next generations of clean energy and is actively being researched for practical applications.
- However, to get enough hydrogen to be used as an energy source, the challenge remains to improve the slow reaction rate of water electrolysis for more power consumption.
  - Although there is a lot of research to increase the activity of catalysts to assist in water decomposition, there is a difficulty in designing new catalyst materials due to the incomplete understanding of how the catalyst works in solution.
- The researchers devised a catalyst with a palladium-platinum or palladium hydride-platinum core-shell structure that wrapped palladium or palladium

hydride in a platinum atomic layer like egg yolks and whites. It was found that the performance of the catalyst was increased.

- The team devised a catalyst with a palladium-platinum or palladium hydride-platinum core-shell structure, wrapped in an atomic layer of palladium or palladium hydride, like egg yolks and whites. A thicker platinum atomic layer resulted in a higher performance of the catalyst.
  - The atomic distances of the surface platinum have been found to affect hydrogen production by coating platinum atoms precisely from single layers to five layers. The catalyst of the core shell structure is used as a new catalyst model in which the atomic distance of surface platinum is controlled, and the hydrogen production reaction is affected by the atomic distance of the platinum.
  - It was also confirmed that the internal palladium alters the electronic structure of the surface platinum and affects the hydrogen production reaction. Results showed higher response performance when palladium was used as the core than palladium hydrogen chloride.
- By providing new ideas for the design and manufacture of hydrocatalytic catalysts for the mass production of hydrogen, it is expected to invigorate high-efficiency and low-cost hydrogen mass production and related research and development.
- GIST Professor Chang Hyuck Choi said "The biggest achievement of this research is the establishment of a core development strategy for efficient hydrogen production. Based on this research, we plan to continuously research and develop high-performance hydrogen generating catalyst that will be the core of the hydrogen economy."
  - This research was supported by the National Research Foundation of Korea and the KIST Institutional Program and was published in the Journal of the American Chemical Society on October 17, 2019.

※ Title: Theoretical and Experimental Understanding of Hydrogen Evolution Reaction Kinetics in Alkaline Electrolytes with Pt-Based Core-Shell Nanocrystals