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Professor Kwang Sup Eom's research team develops a sodium ion battery with superior performance

☐ GIST (Gwangju Institute of Science and Technology, President Kiseon Kim) School of Materials Science and Engineering Professor Kwang Sup Eom's research team succeeded in increasing the capacity of 'sodium ion batteries' using ultra-low-cost sodium to the level of lithium secondary batteries.

☐ Lithium, the main material for the most widely used lithium-ion batteries, is a rare metal and is not suitable for ultra-large energy storage devices such as electric vehicles and smart grids due to its regional bias and price fluctuations. Therefore, research on new materials for next-generation battery materials to replace them is actively underway.

- As an alternative, studies are being conducted using commonly available sodium resources, but sodium ions are more than three times heavier than lithium ions, resulting in greater resistance to electrochemical reactions. Therefore, commercialization requires technologies that make electrodes thicker while maintaining performance.

- In general, sodium ion batteries have very low performance compared to lithium ion batteries, such as capacity, output, life span, and energy conversion efficiency, which acts as limitations for large commercialization.

☐ The research team developed a sodium ion battery using sodium vanadium fluorophosphate (Na3V2(PO4)2F3) cathode material and tin phosphide (SnPx)

anode material, which can store a lot of energy but have difficulty in commercialization due to its large resistance. Therefore, it succeeded in realizing the same performance with the same weight as the existing lithium ion battery.

- Through the solution process, the size of the sodium fluorophosphate vanadium anode was controlled to several hundred nanometers and distributed uniformly on a highly conductive graphene surface to realize an anode with little performance degradation even at a thickness 5 to 10 times higher than the electrode thickness used in previous research.

- In addition, it was found that tin phosphide material having a specific chemical composition ratio (tin:phosphorus ratio) causes a unique structural change in the charging and discharging process, resulting in a dramatic increase in output performance, lifespan, and energy conversion efficiency. The current synthesis technique was unable to control the composition ratio and implement the necessary nanostructures to improve the performance of the electrode material, but this was made possible through the new method developed this time.

□ Professor Kwang Sup Eom said, "In addition to establishing a basic battery design method and material design method in developing a new high-capacity and low-cost sodium ion battery, we have secured technology that can increase the electrode thickness, which is the most important for the commercialization batteries. It is expected that if a sodium ion battery of various types is commercialized through subsequent studies, it will be possible to reduce the dependence on the battery material overseas and secure economic feasibility."

□ This research was led by GIST's School of Materials Science and Engineering Professor Kwang Sup Eom and conducted by Ph.D. student Hayong Song with support from the GIST Research Institute (GRI) and LG Chem (Korea) and was published on June 9, 2020, in *Advanced Functional Materials*, a world-renowned journal of high-tech materials.

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