New binder with 72 times higher electrical conductivity enhances battery performance

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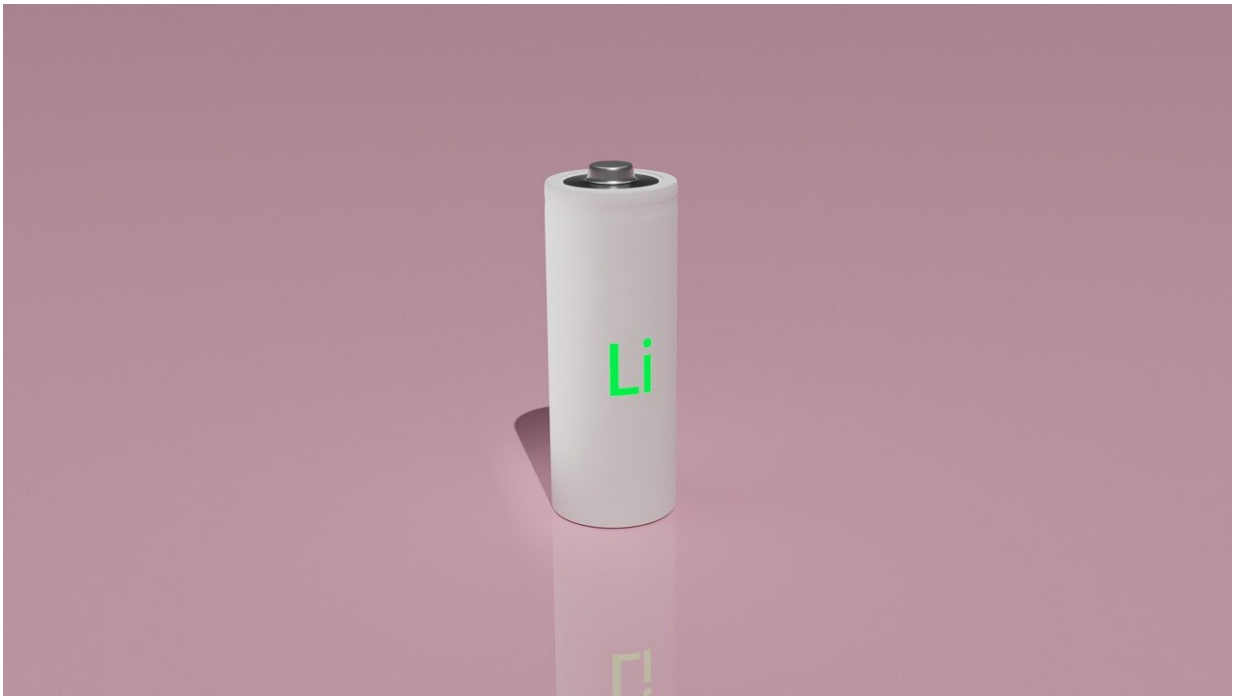

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A research team, jointly led by Professor Seok Ju Kang and Professor Hyun-Wook Lee in the School of Energy and Chemical Engineering at UNIST, has successfully developed a novel binder technology that promises to revolutionize battery performance. By combining PEDOT:PSS and polyethylene glycol (PEG) polymers, the research team has achieved a binder with an impressive 72 times higher electrical

conductivity, opening up new possibilities for high-performance lithium-ion batteries.

The research is published in the journal *Energy Storage Materials*.

According to the research team, this breakthrough in binder technology holds tremendous potential for advancing battery performance and enabling the development of high-energy density lithium-ion batteries.

Traditionally, binders have served as adhesives between electrodes and conductive materials in batteries. However, their relatively low electrical conductivity has limited their effectiveness. This breakthrough research introduces a high-conductive polymer binder that eliminates the need for additional conductive materials, thus enhancing the energy density of batteries.

"By developing high-electrical conductivity polymer binders using commercially available polymers, we can significantly enhance the performance of silicon cathode-based secondary batteries," said Professor Kang. "The developed binder mixture demonstrated approximately 72 times higher electrical conductivity than previous binders."

In addition to its exceptional electrical conductivity, the newly developed binder exhibits remarkable mechanical properties. It effectively accommodates the expansion and contraction of the battery volume, overcoming the typical challenges associated with silicon cathodes. Notably, even after 100 charging and discharging cycles, the battery maintained 75% of its initial capacity, highlighting the binder's high performance and stability.

"Our research team has achieved a silicon cathode with high energy density by improving electrical conductivity and mechanical properties

through effective phase change of PEDOT:PSS," said Nyung Joo Kong, the first author of the study.

"The real-time lithium storage experiments using the developed polymer binders further confirmed their high stability, positioning them as a significant advancement in silicon cathode research," noted Professor Lee.

More information: Nyung Joo Kong et al, Promoting homogeneous lithiation of silicon anodes via the application of bifunctional PEDOT:PSS/PEG composite binders, *Energy Storage Materials* (2023). DOI: 10.1016/j.ensm.2023.103074

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