Department of Materials Science and Engineering Seminar Series 2024

Welding Encapsulated Silicon Anodes via Modified Spark Plasma Sintering

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Date and time: 15th November 2024 (Friday) 3:00PM - 5:00PM

Venue: E5-02-32

Abstract

Silicon (Si) has long been one of the most prominent anode materials in high-performance lithium-ion battery (LIB) development due to its high Li storage capacity. However, the persistent issue of ineffective or weak interfaces within the Si anode consistently restricts its structural stability. Heren, a modified spark plasma sintering (SPS) technique is employed to establish a robust interface within the Si anode. This includes the establishment of C-C interlayer bonding within the protective carbon shell, and the formation of Si-C chemical bonding at the interface between Si and carbon. These efforts culminate in the fabrication of quasi-yolk-shell-structured Si. Notably, the established C-C interlayer bonding provides high mechanical strength, allowing for effective accommodation of Si expansion under large stresses. The assembled Si-C chemical bonding at the interface between Si and carbon shells ensures stable electron and ion transport even during Si pulverization, thereby preserving the structural integrity of the Si anode. Additionally, this quasi-yolk-shell structure offers sufficient interstitial space for Si expansion while preventing direct contact with the electrolyte, thereby stabilizing the solid electrolyte interface during cycling. These features collectively ensure the stability of internal interfaces and the integrity of the structure. Moreover, the fabrication process is suitable for low-cost micron-sized Si, ensuring high convenience and scalability for large-scale industrial LIB anode material applications.

Biography

Lai Wenhui received his Bachelor's degree from Fuzhou University in 2015 and Master's degree from Tsinghua University in 2018. He is currently a Ph.D. candidate under the supervision of Prof. Barbaros Özyilmaz. His research focuses on advanced energy storage materials and technologies for supercapacitor, Li-ion battery, and Zn-ion battery applications.

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