

Silicon-Enriched Biomass-Derived Hard Carbon for High-Capacity Lithium-ion Battery Anodes



26 September 2025

Prof. Yimin CHAO

Foshan Xianhu Laboratory

Venue: N23-4018

Time: 16:30 - 17:30

Hosted by: Prof. Kwun Nam HUI

Abstract

Silica-enriched hard carbon derived from barley husks (BHs) is investigated as a high-performance anode material for lithium-ion batteries (LIBs). By systematically incorporating silica into the carbon matrix at different ratios, the resulting composite anodes exhibit a significant enhancement in specific capacity, achieving up to at C/5, far exceeding commercial graphite. The synergistic interaction between silica and carbon effectively mitigates the volume expansion of SiO_2 , ensuring improved cycling stability and rate performance. A full cell was assembled using NMC622 as the cathode, delivering an energy density of at C/10 and maintaining 89% capacity retention after 100 cycles, surpassing conventional graphite-based cells. The anode fabrication follows a straightforward, scalable approach, relying on simple carbonization and mechanical mixing without requiring complex synthesis steps, making it suitable for large-scale production. Comparative electrochemical analysis reveals that the prepared anodes outperform graphite in terms of both specific capacity and rate capability, making them a viable, sustainable alternative for next-generation LIB anodes.

Biography

Prof. Yimin CHAO is currently a Distinguished Expert at Xianhu Laboratory, where he focuses on the electrochemical properties of nanomaterials and their industrial applications. His work emphasizes creating a collaborative ecosystem that integrates production, academia, research, and application. He has extensive expertise in analyzing electrochemical phenomena, establishing structure–property relationships, and elucidating underlying mechanisms. In particular, he has made original contributions to the lithium-ion storage kinetics of nanosilicon and the development of high-capacity electrode materials. Previously, Prof. Chao was the Head of the Nanomaterials Innovation Laboratory in the School of Chemistry at the University of East Anglia (UEA). He is a Fellow of the Royal Society of Chemistry (RSC) and serves as Chair of the RSC Chemical Nanoscience and Nanotechnology Group. He is also a panel member for the UKRI Future Leaders Fellowships sift and interview panels. Prof. Chao has accumulated a broad range of experience in the synthesis of nanoscale materials, their environmental and biological impacts, and their sustainable applications. His current research themes include the functionalization and characterization of silicon quantum dots (Si-QDs) and their applications in lithium-ion batteries and thermoelectric modules. His research has been funded by multiple national and international organizations.