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Silicon/Carbon Anodes for Lithium-Ion Batteries

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Lithium ion batteries are one of the most promising energy storage option for devices such as electrical vehicles etc. Silicon (Si) is a premier candidate for next-generation lithium-ion battery anodes due to its exceptional theoretical capacity of ~4200 mAh/g. However, its practical application is hindered by a ~300% volume expansion during lithiation/delithiation, which causes particle pulverization and unstable solid-electrolyte interphase (SEI) formation, leading to rapid capacity decay.

This work presents the controlled synthesis of Si/C yolk-shell nanostructures designed to accommodate this expansion within a protective conductive framework. The methodology involved the surface modification of Si nanoparticles via thermal oxidation to create a SiO2 sacrificial layer, followed by the polymerization of dopamine at varying intervals. Subsequent carbonization and selective etching of the SiO2 layer created the required internal void space.

Characterization through Transmission Electron Microscopy (TEM) and X-ray Diffraction (XRD) confirmed the successful formation of the yolk-shell architecture and the retention of silicon's crystallinity. Thermogravimetric Analysis (TGA) demonstrated that polymerization time is critical for controlling carbon content. Preliminary electrochemical testing showed that these yolk-shell materials exhibit enhanced structural stability compared to bare silicon, effectively mitigating pulverization and stabilizing capacity during cycling.

Biography:

Georgia Moysiadou(Chemist) is a Ph.D. candidate in Chemistry at the University of Patras under the foundation of a national scholarship of H.F.R.I and a researcher at the Institute of Chemical Engineering Sciences (FORTH/ICEHT). Also, she has finished a Master at AUTH titled <<Science and Technology of Electrochemical Systems>>. Her research interests are centered on the synthesis, physicochemical, morphological, and electrochemical characterization of anode electrodes for Lithium-Ion batteries. Her work has been communicated through national and international conferences. Additionally, she has participated in national research projects focused on advanced electrochemical systems and material development.