

Abstract

Designing sustainable active materials for energy storage systems has become a critically important research area. Given the increasing demand for metal-ion batteries, researchers are focusing on developing alternative materials to address issues with graphite and currently available commercial anode materials.

This thesis explores the potential applications of conjugated polymers in energy storage devices. It highlights how introducing heteroatoms can increase theoretical capacity. Moreover, by creating ion channels through microstructure regulation, researchers can reduce diffusion path lengths, facilitating fast-charging applications.

Chapter 1 provides an introductory review. Chapter 2 discusses the synthesis and application of a novel donor-acceptor type conjugated network polymer, POL 202, as an active material in Li-ion secondary batteries. It emphasizes POL 202's remarkable capability to support extremely fast charge-discharge cycles, directly attributed to its structural advantages.

In Chapter 3, a triazine-bithiophene-based porous organic polymer is designed and used as a precursor material for carbons. A hierarchical N, S co-doped micro/mesoporous carbon is synthesized from a POP, POL 102, at two different temperatures, 600°C and 800°C. Physical and chemical characterizations provide insights into variations in surface area, pore volume, and defects with increasing carbonization temperatures, and their impact on electrochemical and charge storage properties.

Chapter 4 summarizes the findings and discusses the prospects for this research.

Keywords: organic polymers, nanoporous carbon, fast charging batteries, lithium-ion batteries, sodium-ion batteries