Chapter 3

Amorphous SiO2/C as Anode for Lithium Ion Battery

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ABSTRACT

*One of the main problems with graphite anodes in LIBs is the limited charge/discharge rate, especially for the lithization process. In recent years, in order to solve the above-mentioned problems, more and more attention has been paid to the practical use of silicon oxide-based anode materials in LIBs, due to its large amount in the earth's crust, low discharge potential, and high initial irreversible and reversible capacity of 1961 mA*h*g-1. The study explores a novel approach to producing high-purity SiO_2 from rice husk (RH) and enhancing its electrochemical performance by incorporating a carbon coating, aiming to develop an advanced anode material for lithium-ion batteries (LIBs). The methodology involved a multi-step process: initially, RH was subjected to hydrochloric acid pre-treatment to remove impurities, followed by calcination to yield SiO_2. Pure SiO_2 was further processed with sodium hydroxide and hydrochloric acid to achieve high purity. To improve the electrochemical properties, SiO_2 was coated with carbon derived from sucrose.*

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I. INTRODUCTION

Energy can be stored in various forms such as heat, mechanical energy, chemical energy, electrical or magnetic energy (Mitali et al., 2022). However, not all forms of energy storage are technically feasible (Garche et al., 2010).

Renewable energy sources hold great promise for fulfilling future energy requirements and supporting the shift towards cleaner energy solutions. However, the practical use of this generated electricity hinges on its effective storage, which is crucial for continuous availability (Krivik & Bac, 2013). An effective energy storage system (ESS) is fundamental for both commercial and residential applications within the power grid. Consequently, advancing ESS technology is vital to address increasing energy demands and manage the intermittent nature of renewable energy sources (Ravi & Aziz, 2022). Batteries have been a staple in ESS for more than two centuries and remain widely utilized. Other prevalent energy storage technologies today include solid oxide fuel cells (SOFCs), electrochemical capacitors (ECs), superconducting magnetic energy storage (SMES), flywheels, and electrostatic capacitors (dielectric capacitors) (Sarfraz et al., 2022; Wang et al., 2016).

Some energy storage systems are used for commercial purposes. They are well proven in terms of cost, availability and reliability (Zhang et al., 2018; Zhu et al., 2022). Today, hydraulic accumulators and auxiliary accumulators, including supercapacitors and pseudocapacitors, are used to store energy in electric networks (Leon-Quiroga et al., 2020; Nzisabira et al., 2009; Şahin et al., 2022).

Electricity for vehicle propulsion is usually stored in rechargeable batteries or generated on board from fuel cells. The use of flywheels and capacitors for the integration of vehicles powered by internal combustion engines is under consideration (Lemian et al., 2022). However, significant efforts are currently being made to develop electrochemical energy sources for use in hybrid and pure electric vehicles (Verma et al., 2021).

The energy storage method is chosen depending on the available input energy, the expected storage time and the suitable form in which the energy is stored. Energy storage methods can be distinguished by power, stored energy, and typical usage time and self-discharge (Chakraborty et al., 2022).

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