Title : Preparation and characterization of silicon-based anode materials derived from rice straw and chahokkien leaves for lithium-ion batteries

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ABSTRACT

Lithium-ion batteries (LIBs) are widely used in various electronic devices and electric vehicles, due to their advantageous properties such as lightweight and high energy density. However, LIBs still face safety concerns, primarily due to the use of graphite as the anode material. Graphite can lead to the formation of lithium dendrites, which may cause short circuits within the battery. Furthermore, graphite has a relatively low theoretical capacity (372 mAh g^{-1}). Hence, it is necessary to develop alternative anode materials to enhance safety and meet the current demand. Among alternative anode materials, silicon-based materials such as silicon (Si) and silicon dioxide (SiO_2) have emerged as promising candidate for anode material due to their high capacity of 4200 mAh g^{-1} (Si) and 1965 mAh g^{-1} (SiO_2) which is significantly greater than that graphite anode. The important issue of Si-based materials as anodes is their high-cost production. Therefore, this work aims to prepare Si/SiO_2 materials from biomass wastes. The biomasses in this study are chahokkien leaves and rice straw. The experimental results showed that the Si/SiO_2 composites from chahokkien leaves and rice straw exhibited the cubic Si phase and amorphous SiO_2 phase. Morphology of the Si/SiO_2 composites showed clusters of nanoparticles. Electrochemical performance of the Si/SiO_2 composites from chahokkien leaves and rice straw showed good cycle stability and good rate performance. The capacity of Si/SiO_2 from chahokkien leaves (179.07 mAh g^{-1} for 300 cycles at 100 mA g^{-1}) was higher than that of Si/SiO_2 from rice straw (104.40 mAh g^{-1} for 300 cycles at 100 mA g^{-1}). This research suggested that using biomass as a raw material source enables large-scale, energy-efficient, eco-friendly, and cost-effective synthesis of Si-based anode materials for LIBs.