Palmyrah kernel shell derived hard carbon as an anode material for secondary sodium-ion batteries

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Abstract

Rechargeable lithium-ion batteries (LIBs) are the most essential inventions that have driven the development of electronic devices over the decades. Scientists are currently working hard to develop rechargeable sodium-ion batteries (SIBs) to replace expensive LIBs. One of the most difficult challenges in developing SIBs is selecting the most appropriate anode material for Na^+ intercalation. Hard carbon as an anode material for SIBs has sparked a lot of interest in recent years. Biomass waste is one of the most exciting, readily available, and cost-effective sources of hard carbon (HC). In this study, biomass waste from Palmyrah kernel shells were studied as potential precursors for the preparation of HC employing a pyrolysis approach followed by acid washing, which helps to eliminate inorganic impurities. Palmyrah kernel shells are impregnated with phosphoric acid (H_3PO_4) and pyrolyzed at 1100 ℃ after washing away the acid with deionized water to prepare the HC material. In this research study, Scanning Electron Microscopy (SEM) was used to analyze the carbon morphology of the HC, and Fourier-transform infrared spectroscopy (FTIR) was used to analyze the functional groups contained in the HC. According to recorded SEM images, the derived HC has a fibrous structure with high porosity and large cavities, as well as an irregular structure that is more conducive to Na^+ intercalation through the inter-atomic layers in HC. Furthermore, the prominent band at 1733 cm^{-1} in the FTIR spectrum indicates the presence of C=O stretching frequency caused by the hemicellulose carboxyl functional groups in the HC.

Keywords: Hard Carbon; Electrode materials; Palmyrah kernel shells; Sodium-ion batteries

Acknowledgement: This research was supported by the Accelerating Higher Education Expansion and Development (AHEAD) operation of the Ministry of Higher Education funded by the World Bank (DOR Project # 62 and ELTA-ELSE Faculty Development Project, Faculty of Science, University of Jaffna).