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ABSTRACTS

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DEVELOPMENT OF ANODE MATERIAL FOR RECHARGEABLE SODIUM ION BATTERY USING MODIFIED VEIN GRAPHITE OF SRI LANKA

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Vein graphite is considered the most valuable and highest quality form of natural graphite. Sri Lanka is renowned for its highly crystalline vein graphite with high natural purity and extensive mineralization amid the countries possessing natural vein graphite resources. Sri Lankan vein graphite (SLVG) with its distinguished properties, should be able to play a vital role in high–tech industrial applications. Graphite has already been used as a feasible electrode material for the extensively used rechargeable Li-ion batteries. However, the application is limited by the fact that Li is a rare element. As an alternative, rechargeable Na-ion batteries (NIB) have recently drawn significant attention. However, Na^+ being rather larger than Li^+, expansion of interlayer spacing of graphite is essential to use it for the anode of NIB s. This study aims to obtain expanded graphite with sufficient increase in interlayer spacing for better sodium ion intercalation. For that, Sri Lankan vein graphite from deep underground mines was collected and visually inspected to identify the different morphological varieties. Small chips of Needle Platy Graphite (NPG) variety, which possesses high carbon content, were crushed and particle size fraction below 53 μm was separated by mechanical sieving. The powder sample was subjected to purification via acid leaching. The purified graphite was then treated with chromium trioxide and hydrochloric acid to prepare Graphite Intercalation Compound (GIC). The resultant GIC was characterized by X-ray Diffractometry (XRD) and Scanning Electron Microscopy (SEM). The XRD of GIC shows the expansion of interlayer spacing of GIC (4.02 Å) compared to that of raw graphite (3.35 Å). Moreover, the SEM images of GIC exhibited an expanded, accordion like structure in contrast to the platy structure of raw graphite. The SIB assembled with the electrode fabricated from synthesized GIC showed an initial discharge capacity of 215.9 mA h g^{-1} and a low reversible capacity of 26.9 mA h g^{-1} vs Na/Na^+ during the first cycle. However, this is a considerable achievement as the previous studies with raw graphite showed a poor capacity of only 13 mA h g^{-1} vs Na/Na^+. Although GIC had a better interlayer spacing, the expected reversible capacity is very low and that could be because the remaining chromium trioxide molecules within the graphitic layers could have blocked the passage of Na^+ movement within the layers. The capacity of this battery could be increased by partial removal of CrO_3. Altogether, the current study shows that the modification of graphite through the investigated method could result in an increased interlayer spacing with improved reversible capacity.

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