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## Electrochemical performance of thermally oxidized graphite as the anode material in Lithium-ion rechargeable batteries

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**Background:** The development of natural graphite for the anode application in rechargeable Lithium-Ion Batteries (LIB) has brought about excellent cycle capability with increased power and energy densities. The thermal oxidation method is a low cost and single-step solid-gas phase reaction technique used for graphite modification.

**Objectives:** Investigating an effective, simple and low cost method to improve the electrochemical performance in the graphite electrode.

**Methods:** In the present study, Purified Natural Vein Graphite (PNVG) was thermally oxidized under air at 550 °C. The thermally oxidized (TO) graphite were then investigated by X-ray diffraction, scanning electron microscopy, Raman microscopy, BET surface area and Fourier Transform Infrared spectroscopy. Electrochemical characterization was performed with CR 2032 coin cells assembled with the anode fabricated with TO graphite/LiPF<sub>6</sub>/Li cell configuration.

**Results:** The results revealed that the TO graphite has a better crystalline structure, higher surface area and improved surface functionalization than the PNVG. The initial discharge capacity of the TO anode is 375 mA h g<sup>-1</sup>. Compared to PNVG, high discharge capacity is observed for TO. After 50 cycles, the Coulombic efficiency of TO improved from 84% to 99.9%. Electrochemical impedance analysis revealed smooth diffusion and lithiation-delithiation of Li-ions during charging and recharging while showing five transition stages of intercalation of Li-ions into the graphite. During phase transition stages I and III, a continuous drop in voltage was observed while other II, IV and V stages show voltage plateaus, indicating that these transitions may occur via two-phase electrochemical reactions.

**Conclusion:** Surfaces of PNVG have modified during oxidation hence improving graphite structure for higher Lithium-ion intercalation. Simultaneously, it has also improved the reversible capacity and cycling behavior of PNVG, considerably. As a result, it can be concluded that these considerable modifications in graphite surfaces have caused the enhancement of the electrochemical performance of the TO graphite anode.

**Keywords:** Graphite, Thermal oxidation, Electrochemical performance, Li-ion rechargeable battery

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