YSCMR 2021

Proceedings of the

Young Scientists' Conference on Multidisciplinary Research - 2021

Virtual International Conference

21st October 2021

"Multidisciplinary Research for Tomorrow's Challenges"

ISSN 2815-0260

Proceedings of the Young Scientists' Conference on Multidisciplinary Research - 2021

21st October 2021

Published by:
Young Scientists' Association (NIFS-YSA),
National Institute of Fundamental Studies,
Hanthana Road, Kandy,
Sri Lanka
www.nifs.ac.lk
Tel: +94 (0) 812 232 002
Email: ysa@nifs.ac.lk

Cover page design & Page setup

Buddhika Karunarathne, Mahesh Senarathna, Hiran Kankanamge

ISSN 2815-0260
Proceedings of the Young Scientists' Conference on Multidisciplinary Research-2021
Young Scientists' Association, National Institute of Fundamental Studies, Sri Lanka
21st October, 2021

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

Y.M.I.B. Samarakoon[1*], H.M.H.D.K. Naranpanawa[1], T.H.N.G. Amaraweera[2], N.W.B. Balasooriya[3], R.J.K.U. Ranatunga[4], H.W.M.A.C. Wijayasinghe[1]

[1]*National Center for Advanced Battery Research, National Institute of Fundamental Studies, Kandy, Sri Lanka*
[2]*Department of applied Earth Sciences, Uva Wellassa University, Badulla, Sri Lanka*
[3]*Department of Geology, University of Peradeniya, Peradeniya, Sri Lanka*
[4]*Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka*

* *indika.sa@nifs.ac.lk*

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/LiPF6/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^{-1}. 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*

Acknowledgment: The financial assistance by the general treasury under a cabinet paper of the government of Sri Lanka (no:17/1907/16/038 on 2017-08-09) is highly acknowledged.