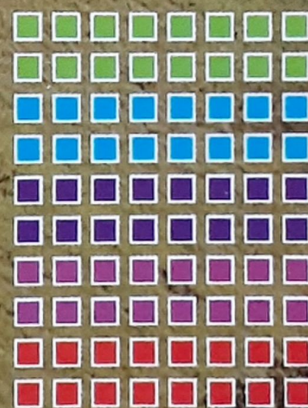




University of Peradeniya  
Postgraduate Institute of Science  
(PGIS)

# Proceedings

## PGIS Research Congress 2020



Volume 7



## ENHANCING PERFORMANCE OF RECHARGEABLE LITHIUM-ION BATTERIES BY ALKALI ROASTING AND ACID LEACHING OF VEIN GRAPHITE

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Global consumption of natural graphite has increased by using graphite in various novel industrial applications, such as nanotechnology, batteries and fuel cells. Sri Lanka is the leading producer of vein graphite with its high crystallinity and high purity. Recently, Sri Lankan natural vein graphite has been developed as battery grade graphite suitable for the anode application of the rechargeable Lithium Ion Battery (LIB). The present study aims to find the optimum NaOH concentration and the suitable method to purify the vein graphite to develop it into highly purified battery-grade graphite. To achieve this, raw graphite and HCl acid leached purified graphite were treated with different concentrations of NaOH, roasted under air, and acid leached with H<sub>2</sub>SO<sub>4</sub> followed by vacuum filtering and drying. Analysis of carbon content of the purified graphite samples revealed that the Carbon percentage in Alkali Roasted Raw Graphite (AR-RG) and Alkali Roasted HCl acid leached Purified Graphite (AR-PG) samples can be increased over 99.1% and 99.9%, respectively and best results given by 25.0 vol.% NaOH concentration. X-ray diffraction analysis revealed that the crystal structure still remained unchanged while the minor phases of impurities such as pyrite, chalcopyrite, and calcite were significantly removed by the purification processes. However, some traces of pyrite and chalcopyrite impurities have been detected in the AR-RG samples. Therefore, AR-PG process could enhance the purity to a higher level than the AR-RG method even though 25.0 vol. % NaOH concentration had shown higher purity level than the other concentrations. Fourier transform infrared spectroscopy analysis has not shown any additional peak for newly attached group other than the raw form. Therefore, the alkali roasting and acid leaching processes can be considered as effective purification methods. The LIB coin cells assembled with these developed vein graphite anode materials showed promising electrochemical performances. Galvanostatic charge-discharge study of the LIB coin cells assembled with the above materials revealed that the cycling behavior considerably improved with no obvious reversible capacity fading after purification. Hence, LIB coin cells assembled with battery-grade vein graphite developed by the AR-PG process showed more electrochemical performances than those developed by the AR-RG method and 25.0 vol. % NaOH sample gave the best electrochemical performances. Therefore, concentration of 25.0 vol. % NaOH can be considered as the optimum NaOH concentration for purification and the alkali roasted HCl acid purified method can be introduced as more favoured purification method for the development of anode materials for the LIB.

Financial assistance from General Treasury under a Cabinet paper of the Government of Sri Lanka (Grant No. 17/1907/16/038) is acknowledged.

**Keywords:** Acid Leaching, Alkali Roasting, Lithium Ion Battery, Vein Graphite