Comparison of the Developed Coarse Flake of Radial Graphite with the Developed Needle Platy Graphite as the Anode Material of Lithium-ion Rechargeable Battery

T.G.T.A. Bandara[1], H.M.H.D.K. Naranpanawa[2], H.P.T.S. Hewathilake[1], H.W.M.A.C. Wijayasinghe[2] and N.W.B. Balasooriya[3]

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

Sri Lankan Vein Graphite (SLVG) has been successfully tried for anode material application in rechargeable Lithium Ion Battery (LIB). As by previous studies, among the four-vein graphite morphologies, Needle Platy Graphite (NPG) has the highest purity while the Coarse Flakes of Radial (CFR) is having the lowest, in their raw forms. Hence, the study was to compare the performances of acid digested NPG and CFR in LIB anode application. 10g of all samples (<53 μm) were treated by acid digestion method. Material characterization was carried out with ASTM C-561 Carbon Content (CC), X-ray Diffraction (XRD), and Fourier Transform Infrared (FTIR) Spectroscopy. CR2032 coin cells were assembled using treated anodes and 1M LiPF6 (EC: DMC; vol.1:1) electrolyte in an argon filled glove box. Galvanostatic charge-discharge testing was performed with a battery testing system (0.2 C, 0.002-1.50 V). CC analysis has shown that the purity has successfully upgraded over 99.98% and further confirmed by XRD phase analysis. The acid digestion has introduced favorable functional groups to the surface of both NPG and CFR, which is evidenced by FTIR analysis. Furthermore, XRD analysis has proved that the applied treatment does not adversely affect the graphite crystallinity. Treated NPG has shown the 378 mAh/g of stable capacity throughout the 50 cycles with Columbic efficiency over 99%. However, in CFR, the discharge capacity for the first cycle was 50 mAh/g and it increased up to around 300 mA h/g till the 5th cycle. Even after that, the capacity fluctuated in the range of 250-300 mAh/g throughout the rest of the 45 cycles. Notably, SEI layer formation was appeared around 0.7V and 1.13V for NPG and CFR, respectively. Normally, solvent co-intercalation, humidity contaminates or graphite exfoliation may appear around 1.45V. Therefore, contamination, solvent co-intercalation, or exfoliation may interrupt the cell permeances of CFR while NPG is facilitated by favorable SEI layer formation.

Keywords: Coarse flakes of radial graphite, Needle platy graphite, Anode, Lithium-ion battery