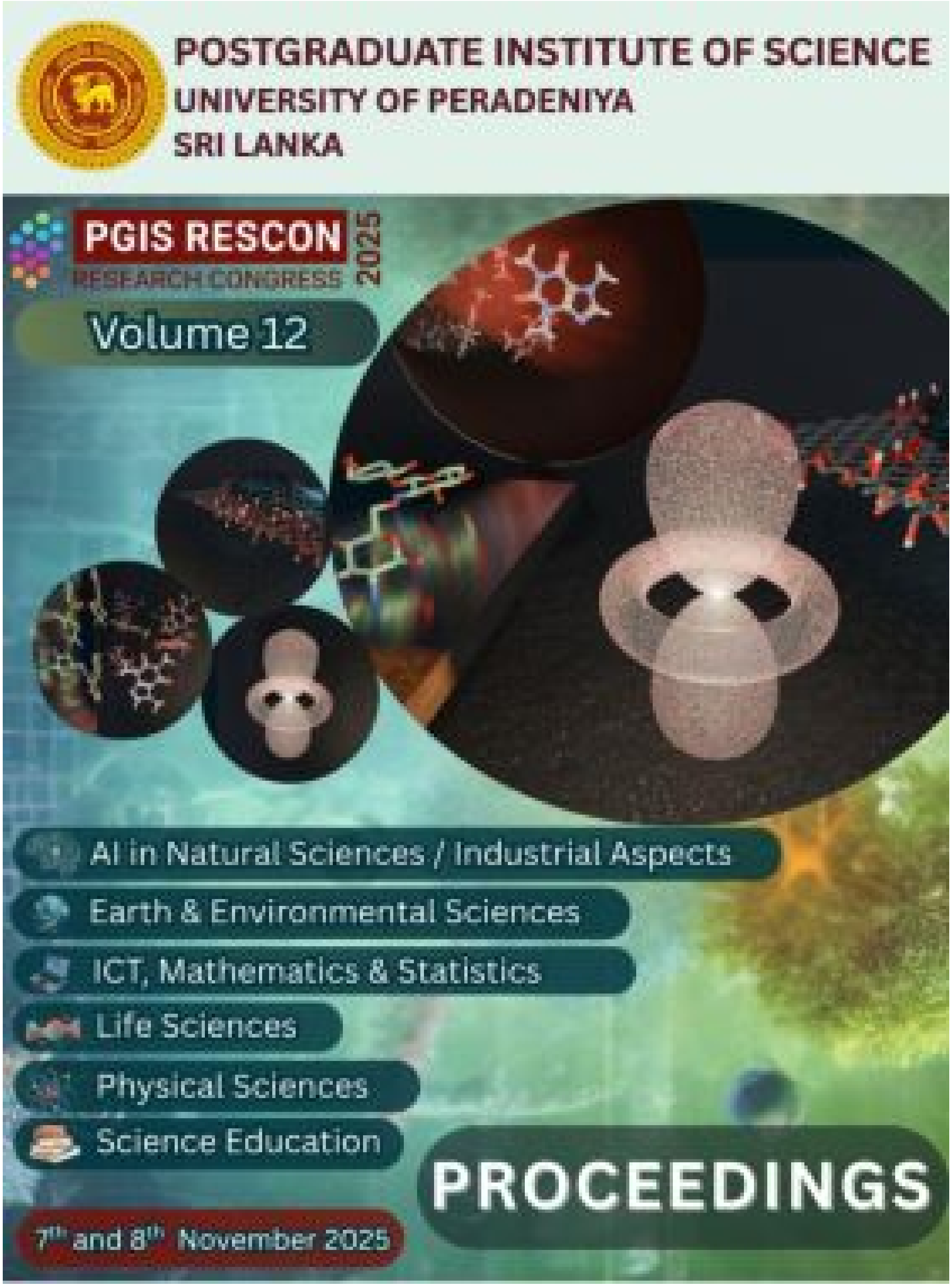
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LABORATORY-LEVEL FEASIBILITY OF MILD OXIDATION METHOD SCALE-UP FOR BATTERY-GRADE SRI LANKAN VEIN GRAPHITE

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The demand for renewable energy storage is critical for achieving sustainable development, especially in countries such as Sri Lanka. One promising approach in this regard is to value addition to local mineral resources. Sri Lankan vein graphite, known for its high purity and crystallinity, is a promising candidate for lithium-ion battery (LIB) anodes. However, surface imperfections of vein graphite can lead to excessive formation of the solid electrolyte interphase, which limits the lithium-ion intercalation. Although chemically mild oxidation using HNO_3 acid (NO method) was previously developed and optimised to improve surface properties, its scalability, reproducibility and suitability for commercial-level processing remain unexplored. This study aimed to address this research gap by evaluating the feasibility of scaling-up the NO method at the laboratory-level, emphasising the process reproducibility and in-depth analysis of material characterisation. A graphite batch purified by HCl acid leaching, scaled-up to nine times the initial sample size, was subsequently treated under the optimised conditions (50.0 mL of 69% HNO_3). The modified graphite samples were then characterised using X-ray diffractometer (XRD), Fourier transform infrared (FTIR) spectroscopy, Raman spectroscopy, scanning electron microscopy (SEM) and simultaneous thermal analysis (TGA/DTA). The results showed that the scaled-up samples retained the structural characteristics and introduced functional groups consistent with the initial laboratory sample, as indicated by FTIR and Raman spectra. XRD and SEM results revealed that the graphite structure was preserved. TGA revealed distinct decomposition patterns corresponding to surface functional groups, and DTA provided insight into the enthalpy changes during oxidation. Furthermore, replicated carbon content measurements (n = 3) confirmed the high purity of the treated graphite (99.90±0.03)%, demonstrating batch-to-batch consistency and overall reliability of the NO method at the laboratory-level. These findings confirmed that the NO method is structurally scalable and reproducible for modifying Sri Lankan vein graphite. Ongoing electrochemical studies will further evaluate its potential as an anode material in LIB. This work provides a strong foundation for future pilot-scale processing and commercialisation of Sri Lankan vein graphite for energy storage applications.

Keywords: Laboratory-level, Mild oxidation, Scale-up, Vein graphite