Recovery and upcycling of spent graphite into high-performance Graphene oxide and conductive ink

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Abstract:

The rapid expansion of technology has driven extensive use of Li-ion batteries (LIBs) in consumer electronics and electric vehicles (EVs). Given their limited lifespan, there is an urgent need for effective recycling and a circular economy to mitigate the serious environmental impact and resource depletion associated with their disposal. While recycling efforts typically prioritize high-value cathode metals, graphite—comprising up to 22% of battery weight—is often overlooked. This research presents a comprehensive framework for the recovery and upcycling of spent graphite into high-performance functional materials. The work describes an innovative route for the selective recovery of graphite from spent Li-ion batteries and its subsequent conversion into graphene oxide (GO) and conductive ink. An improved Hummer's method was applied for the preparation of graphene oxide from the recovered graphite powder. The preparation of the conductive ink involved the dispersion of ultra-fine graphite particles within a biocompatible or polymer-based binder system. The functional materials were characterized for structural and physiochemical properties through X-ray powder diffraction (XRD), Fourier transform infrared spectroscopy (FT-IR), Raman spectroscopy, and Field emission scanning electron microscopy (FESEM). The as-prepared GO was used as a photocatalyst for the degradation of dyes and the desalination of water. The resulting conductive ink is suitable for applications in printed electronics, RC circuits, and disposable electrochemical sensors.

References

[1] Anandita Dey, AnkurJyoti Kalita, Hiramoni Khatun and Utpal Sarma, Eng. Proc., 87 (2025), 1-6

[2] Anoop S Kumar, K. Ramaswamy, Dhvani B Purohit, Priyadarshini Bais, K Venkatesham, Neha Mohiuddin, S Rajesh Kumar, R Ratheesh, and Ajay Kaushal*, Bull. Mater. Sci. 48 (2025), 1-8

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