Title: Sulphur/functionalized graphene composite as cathode for improved performance and life cycle of lithium-sulphur batteries.

Author Name: M. Manimehalai, P. Saranya, T. Theivasanthi, Subash C.B. Gopinath

Abstract: Over the past years, significant advantages have been introduced to upgrade the performance of lithium-sulfur battery (Li-S) batteries since their prototype in the 1960s. Due to high theoretical energy density and cost efficiency, Li-S batteries have obtained great attention and have made great progress in the last few years. In this work, we developed the sulfur-attached few-layer graphene composite (S/FLG), sulfur-attached functionalized few-layer graphene using acetic acid (S/FLG-COOH) and sulfur-attached functionalized few-layer graphene using strong acid H_2SO_4 and HNO_3 (S/FLG-OH) as a cathode material with high sulfur loading. The material's structure is confirmed through XRD. The surface morphology is confirmed through SEM and elemental composition has been obtained through EDAX. The functional groups are confirmed through FTIR. The defect level and number of layers are confirmed through Raman characterization with an excitation laser wavelength of 532 nm. The electrochemical performance of three cathodes is also identified through EIS, CV, and GCD characterization. Meanwhile, highly developed defects and edges found in the functionalization of few-layer graphene using the strong acid (H_2SO_4 and HNO_3) which consists of a hydroxyl functional group (FLG-OH) serve as polysulfide reservoirs to mitigate the shuttle effect. Among these cathodes, S/FLG-OH shows a high specific capacitance of 157.4 F g^{-1} and when applied as a cathode host on a coin cell it obtained a voltage of about 2.6 V. Well-performed S/FLG-OH cathode was used to fabricate the Coin Cell. The fabricated Coin Cell with S/FLG-OH as the cathode shows a stable potential over 50 cycles.

Keyword: Lithium-Sulfur Battery, Coin Cell, Sulfur, Composite, Functionalization.

DOI: [10.1016/j.cej.2024.154349](https://doi.org/10.1016/j.cej.2024.154349)