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GRAPHENE INTEGRATION IN LITHIUM-ION BATTERIES FOR SMALL SATELLITES: ENHANCING EFFICIENCY AND DURABILITY

Abstract

The quest for enhancing the efficiency and longevity of lithium-ion batteries (LIBs) in small satellites has led to exploring novel materials and technologies. This research presents a groundbreaking approach to integrating graphene, a material known for its exceptional properties, into LIBs, specifically targeting small satellite applications. The focus is on creating a coating layer of graphene on the lithium-ion battery to mitigate the heat accumulation that results from increased entropy, which is a critical issue in the dense and compact hardware environments of small satellites. The conventional graphite mesh used in the anode of LIBs is prone to heat build-up, thereby affecting the battery's performance and durability.

To address this challenge, we have developed graphene nanoplatelets (GNPs) using synthetic graphite transformed from thermal coal. This process involved thermal treatment in an atmospheric furnace under an argon and nitrogen inert gas environment, resulting in multicrystalline graphite. Subsequently, this graphite underwent electrochemical exfoliation using an innovative automated electrolytic cell designed for mass production of graphene. This novel method ensures the production of high-quality graphene suitable for enhancing LIBs.

The produced GNPs were then applied as a coating layer on the anode of a conventional lithium-ion battery, specifically testing with an iPhone 10 battery model. The incorporation of graphene as a heat sink within the battery coating demonstrated significant improvements in heat management, confirming the potential of graphene to act as an effective thermal conductor. The integration of graphene in LIBs for small satellite applications not only addresses the critical issue of heat accumulation but also paves the way for more efficient and durable power storage solutions. The enhanced thermal management capabilities of graphene-coated LIBs contribute to the overall reliability and longevity of small satellites, ensuring sustained performance in the harsh and variable thermal environment of space. This research highlights the potential of graphene in revolutionizing battery technology for space applications, offering a promising avenue for future advancements in small satellite power systems.

In conclusion, the application of graphene in lithium-ion batteries represents a significant leap forward in addressing the unique challenges faced by small satellites. The improved thermal management and durability of graphene-integrated LIBs hold the promise of enhancing the operational efficiency and lifespan of small satellites, contributing to the advancement of satellite technology and space exploration.