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Evgenii Beletskii received his Ph.D. in Electrochemistry from St. Petersburg State University, Russia. The work was devoted to the lithium-ion batteries protection against thermal runaway by means of intrinsically conductive polymers.

Today he is active in: 1) plasma solution synthesis of transition metal oxides, electrically conductive polymers, and carbon materials for batteries and fuel cells 2) modifying conductive polymers for lithium-ion battery protection 3) organic electrode materials for batteries.

Recycling of Anode and Cathode Materials of Lithium-ion Batteries via Simple Plasma Solution Treatment

Abstract

Lithium-ion batteries are essential for various applications, but their recycling poses challenges. This study presents two novel approaches for recycling cathode and anode materials.

The first approach focuses on graphite recycling using low-cost plasma solution treatment. This treatment regenerates graphite with improved capacitive properties and cycling stability. The recycled graphite exhibits a capacity of 392 mAh/g after 500 cycles, exceeding the theoretical capacity due to graphene oxide formation.

The second approach utilizes an electrical discharge in a liquid for direct recycling of cathode materials. This plasma treatment purifies the cathode material, removing conductive additives and binders, and reducing lithium content. The processed cathode material exhibits enhanced power characteristics and cycling stability. It delivers a capacity of 90 mAh/g at 0.1C and 50 mAh/g at 3C, with over 90% capacity retention after 500 cycles at 0.25C.

Both approaches offer promising solutions for sustainable and cost-effective recycling of lithium-ion battery components. The low-cost plasma solution treatment for graphite recycling addresses environmental concerns and economic viability, while the direct recycling technique using electrical discharge in a liquid provides a novel method for restoring the electrochemical activity of cathode materials.