Ambient-Pressure Regeneration Of Degraded Lithium-Ion Battery Cathodes Via Eutectic Solutions

Tech ID: 30405 / UC Case 2019-263-0

BACKGROUND

Lithium-ion batteries (LIBs) are currently the dominant power sources for portable electronics and electric vehicles, both of which have rapidly growing markets. Recycling and re-use of end-of-life LIBs, to reclaim lithium and transition metal resources and eliminate pollution from disposal of waste batteries, have become urgent tasks. Great effort has been made to recycle LIB cathode materials. State-of-the-art approaches include pyrometallurgy, hydrometallurgy, and direct recycling. The pyrometallurgical approach requires high temperature smelting as well as multi-step purification and separation processes; the hydrometallurgical approach requires acid leaching and subsequent complicated precipitation steps to produce precursors for the re-synthesis of new cathode materials. Both approaches have to totally destroy the LIB cathode particles which represent a significant amount of value from their primary manufacturing process. The direct recycling approach combines physical separation to harvest the cathode materials with high-pressure relithiation to regenerate cathode materials, where the high pressure process greatly increases the cost of regeneration.

TECHNOLOGY DESCRIPTION

Researchers at UC San Diego have developed methods that pertain to energy-efficient, low-cost, and sustainable recycling and re-manufacturing of spent and degraded lithium-ion battery cathodes. The invention combines an ambient-pressure, low-temperature molten-salt reaction with a short-time thermal annealing to directly regenerate degraded cathode particles. The chemical composition and bulk crystal structures can be recovered from this regeneration process. With the successful revival of their composition and structure, the Li storage capacity, cycling stability and rate capability of the degraded cathode particles can be recovered to the original levels of the pristine materials.

APPLICATIONS

Recycling and regeneration of lithium-ion battery cathodes

ADVANTAGES

Energy-efficient, low-cost, and sustainable

STATE OF DEVELOPMENT

Laboratory demonstration

INTELLECTUAL PROPERTY INFO

Provisional patent application

RELATED MATERIALS

- Yang Shi, Minghao Zhang, Ying Shirley Meng, Zheng Chen. Ambient-Pressure Relithiation of Degraded LixNi0.5Co0.2Mn0.3O2 (0 < x < 1) via Eutectic Solutions for Direct Regeneration of Lithium-Ion Battery Cathodes. Advanced Energy Materials, Volume 9, Issue 20, May 23, 2019, 1900454 https://doi.org/10.1002/aenm.201900454 - 05/23/2019
- UC San Diego JSOE News Apr 17, 2019 Researchers improve method to recycle and renew used cathodes from lithium-ion batteries - 04/17/2019

PATENT STATUS

Patent Pending

CONTACT
University of California, San Diego
Office of Innovation and Commercialization
innovation@ucsd.edu
tel: 858.534.5815.



OTHER INFORMATION

KEYWORDS

Cathodes, eutectic solution, lithium-ion batteries, regeneration, relithiation, recycling

CATEGORIZED AS

- **Energy**
  - Storage/Battery
- **Materials & Chemicals**
  - Storage

RELATED CASES

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University of California, San Diego
Office of Innovation and Commercialization
9500 Gilman Drive, MC 0910, ,
La Jolla,CA 92093-0910

Tel: 858.534.5815
innovation@ucsd.edu
https://innovation.ucsd.edu
Fax: 858.534.7345

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