Method of Preparing a Composite Cathode Active Material for Rechargeable Electrochemical Cell

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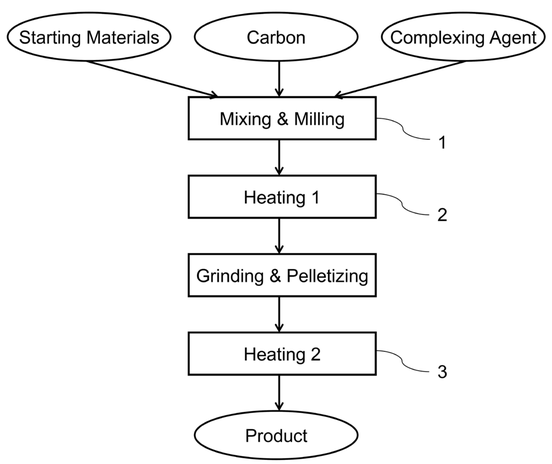
Technology Overview

This is a process for the preparation of $LiFePO_4$/C composite cathode materials with enhanced conductivity when compared to those made using the conventional techniques.

- The new method includes two carbon sources to increase the conductivity of the composite cathode
- The method is easy and simple to practice and adaptable to mass production

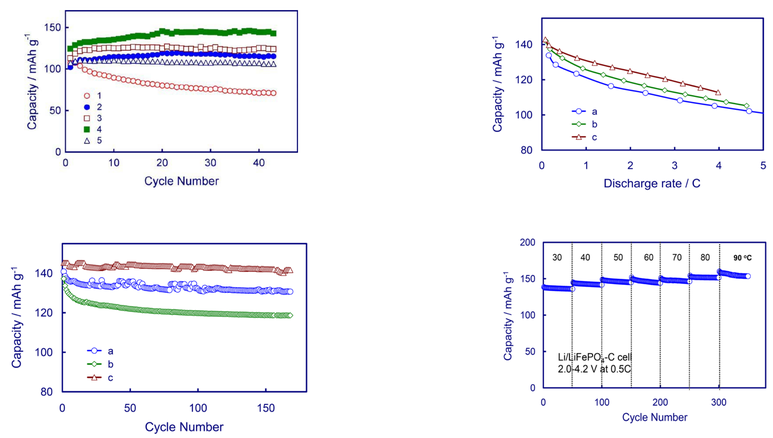


Schematic diagram of preparation process

Technology Differentiation

- Increase power capability of the Li-ion batteries
- Extend cycle life of the Li-ion batteries

Characteristics of $LiFePO_4$/C Composite Cathode Produced by this Invention



Technology Advantages

- Ionic conductivity $LiFePO_4$/C comparable to the more expensive $LiCoO_2$ cathode material
- At room temperature, $LiFePO_4$/C achieves stable capacities of 159 mAh/g at 0.02C and 145 mAh/g at 0.2C
- Cells tested with $LiFePO_4$/C cathodes exhibited much more stable capacity with increasing cycle number than the $LiFePO_4$ control cell (as seen above in upper right hand graph)
- Does not add cost while increasing the performance of the composite cathode materials
- Does not change the existing production line

Technology Agreements

Patent License Agreements (PLAs) and Cooperative Research and Development Agreements (CRADAs) are sought

A collaboration between the inventor team and the commercialization partner can speed the development to the market, which is most readily be done through a PLA or a CRADA

This technology is currently TRL 5, and it has been issued a patent (US Patent 7,824,802)

Proof of Concept

- Demonstrated the preparation of $LiFePO_4$/C composite cathode in lab scale (10-50 g per lot)
- Tested the $LiFePO_4$/C composite cathode in coin cells
- The process has been reduced to practice - Li, Fe, P source materials are mixed with carbon and an organic compound and heat the mixture at 250ºC to 300ºC to form product precursor; the precursor is reheated at 780ºC to 820ºC to get the final product with all heating procedures carried out in an inert atmosphere (a N_2 flow)
- Currently TRL-5 level - Fully functioning laboratory scale prototypes featuring cathodes created using SEDD process

Technology Applications

Commercial:

- Hybrid electric vehicles (HEV), plug-in hybrid electric vehicles (PHEV), power tools, and other high energy density applications
- Portable electronic devices , such as laptop computers, camcorder, GPS
- About $ 11 billion worldwide Li-ion market in 2010

Military:

- Soldier power for a longer life rechargeable Li-ion batteries, e.g., BA-2590
- Military hybrid electric vehicle applications to reduce fuel consumption and reduce the need for dangerous logistical refueling operations
- Military electronics

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