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Office of Technology Management

SPRAY PYROLYSIS FOR THE PRODUCTION OF LI+ ION BATTERY CATHODES

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T-013647

Background

Material morphology and composition are critical for production of Li+ ion battery cathodes, and there is a need for improved synthesis methods that yield high quality materials through cost effective, green, scalable processes. Further, there is often a need to dope materials during synthesis to enhance material performance.

Technology Summary

Slurry Spray Pyrolysis (SSP): High quality cathode material with a cost-effective, scalable process

Spray pyrolysis is an established synthesis process that can reduce processing time by up to a factor of 10 compared with the commonly employed co-precipitation methods. While traditional spray pyrolysis provides excellent control of chemistry, the material density is low. The Slurry Spray Pyrolysis (SSP) process created by Professor Axelbaum's lab produces very high-quality cathode materials while preserving the 10-fold improvement in production time. The process has been demonstrated for $Li(Mn_{1/3}Ni_{1/3}Co_{1/3})O_2$ cathode chemistry and is extendible to Nickel-rich formulations.

Controlled doping to improve electrochemical performance

Trace elemental doping via spray pyrolysis allows for high uniformity of dopant, unmatched by other synthesis methods. Doping has been used to control voltage fade in NMC cathode materials. Doping with a low-cost alkali, alkali earth, or aluminum ions improves stability of these cathode materials and provides excellent capacity retention.

Further improvements to the spray pyrolysis (LT-FSP)

The SSP process can be employed in a novel flame process involving the use of renewable fuels in a way that the gas temperature can be controlled. High quality materials are obtained at high production rates and at temperatures sufficiently low that temperature-sensitive materials can be produced.

Stage of Development

Cathode materials produced through a green, industry-scalable processes demonstrate good morphology, density and composition. High electrochemical performance has been verified in battery cell tests. Improved voltage fade characteristics with doping has also been confirmed.

Patents & Publications

US 9,748,567; US 10,490,814; US14/664,632; Slurry spray pyrolysis; Layered Li materials; Flame synthesis; Wet fuel spray flames