Catalytic Nanofabrication for Improved Energy Storage

Nick Whelan, Hong-Li Zhang, Jon Fold von Bulow, Teyeb Ould-Ely, and Daniel E. Morse
LifeCell Technology Inc., Santa Barbara, CA and Center for Energy Efficient Materials,
a DOE Energy Frontiers Research Center, University of California, Santa Barbara, CA 93106, USA
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ABSTRACT
• We describe a new low cost method for kinetically controlled catalytic synthesis of nanocomposite anodes, cathodes and protectants for high-power Li ion batteries (LIBs).
• Anodes are nanocomposites of Sn or Si nanocrystals catalytically grown in high yield and purity yield fine-grained nanocrystalline ceramics with strong positive thermal coefficients of resistivity (PTCR) that can be used as internal protectants against thermal runaway.
• Syntheses of the anodes, cathodes and PTCR protectant are affordably scalable.

1. HIGH-POWER NANOCOMPOSITE ANODE
- BaSrTiO$_3$ high energy density.
- Cathodes are catalytically synthesized as nanocomposites of nanocrystalline metal
- Anodes are nanocomposites of Sn or Si nanocrystals catalytically grown
- We describe a new low cost method for kinetically controlled catalytic synthesis of
- Syntheses of the anodes, cathodes and PTCR protectant are affordably scalable.

2. HIGH-POWER, HIGH VOLTAGE NANOCOMPOSITE CATHODE
- Catalytic growth of Sn nanocrystals inside the conductive and resilient matrix of dispersed multwall carbon nanotubes:
- 96% retention of original capacity after discharge at 10 C;
- >80% capacity retention at the exceptionally high rate of 20 C;
- Full recovery after complete discharge at 50C:

3. COLLABORATION WITH CERDEC, LIFECEL and QUALLION FOR BATTERY SAFETY: Internal PTCR Protection from Thermal Runaway
- Doped BaSrTiO$_3$ nanocrystalline ceramic coatings on electrodes or current collectors to provide internal PTCR protection against fire and explosion in rechargeable LIBs
- Protection results from unique Positive Thermal Coefficient of Resistance (PTCR)

4. FUEL CELLS
- Bio-inspired, vapor-diffusion catalytic synthesis of nanocrystalline Pt@Carbon Black nanocomposite.
- Unoptimized performance matches commercial, but with 30% less Pt.

5. TECH TRANSFER: SCALE-UP SYNTHESIS
- Catalytic syntheses of Anode, Cathode and PTCR Protectant are “Chemical” (not “chip”) technology; thus Readily Scalable
- Spun-out LifeCell Technology Inc. for manufacturing.

Acknowledgements
We gratefully acknowledge support from the U.S. Army Research Office and Army Research Laboratory through contract W911NF-09-D-0001 to the Institute for Collaborative Biotechnologies.

References