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Submitted to the Third Conference on *Thin Films and Nano Materials for Energy Conversion and Storage*, to be held in Cleveland, Ohio on September 18-19, 2003

Solid-State Thin-Film Rechargeable Lithium Batteries

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CONDENSED MATTER SCIENCES DIVISION
OAK RIDGE NATIONAL LABORATORY
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Contract No. DE-AC-05-00OR22725
with the
U.S. DEPARTMENT OF ENERGY
Oak Ridge, Tennessee

August 2003

Solid-State Thin-Film Rechargeable Lithium Batteries

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Thin film rechargeable lithium batteries investigated at Oak Ridge National Laboratory have a number of unique and attractive features. The batteries, which are 10-15 micrometers thick, are constructed by sequential deposition of the thin film battery components, typically using vacuum sputtering or evaporation methods, onto a support substrate. Ideally the substrate is an integral part of the device to be powered by the battery. For applications where the battery can be recharged at frequent intervals, the volume and mass associated with the battery power can be greatly reduced relative to other rechargeable technologies. Also, the thin film design provides for very high charge and discharge rates with good utilization of the battery capacity. All ORNL thin film batteries use a glassy lithium phosphorous oxynitride material for the electrolyte. Because this material has a high electronic resistivity and good electrochemical stability, the thin film batteries have a very low self-discharge rate and no detectible corrosion or redistribution of materials at the interfaces. The lithium intercalation electrode materials prepared by vapor deposition are very fine-grained or amorphous which we believe accounts for an enhanced mechanical stability when cycled for extended time or over an extended voltage window. Recent results will be discussed, including studies of very small area batteries for MEMS devices, lithium intercalation of crystalline $LiCoO_2$ and nanocrystalline $LiMn_2O_4$ films, redistribution of the lithium anode, and properties of the Lipon electrolyte over an expanded composition window.

This research has been supported over the years by the DOE's Division of Materials Sciences, Division of Chemical Sciences and Office of Technology Transfer.

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