

Manganese Oxide Composite Electrodes for Lithium Batteries (ANL04-076)

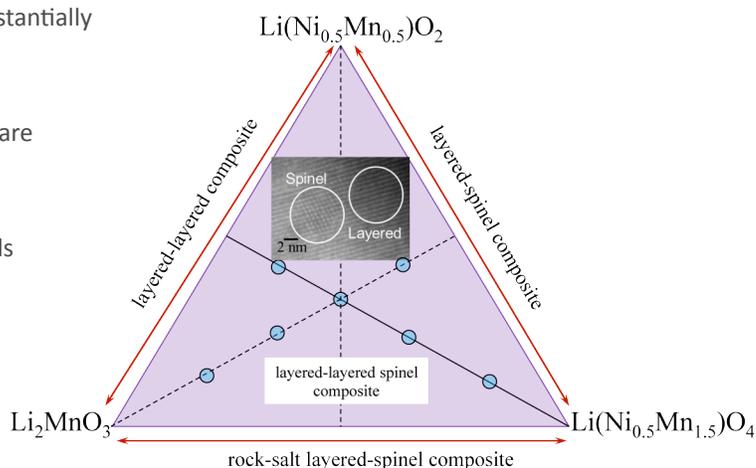
Improved spinel-containing “layered-layered” lithium metal oxide electrodes have higher voltage, increased stability, and contain less expensive manganese (Mn) for use in rechargeable lithium cells and batteries. The addition of the spinel component to the “layered-layered” class of cathode materials represents a new strategy that minimizes voltage fade while maximizing capacity and rate.

The Invention

A family of “layered-layered-spinel” materials with high-rate and stable voltage that are composed of lithium manganese nickel oxides have been discovered and are used to replace high-energy multi-component “layered-layered” type or single-phase high-rate spinel-type structures for non-aqueous lithium cells and batteries. The composition of matter in this patent defines an activated electrode for a non-aqueous electrochemical cell with a precursor of lithium metal oxides with the core formula $(x[z\text{Li}_2\text{MnO}_3 \cdot (1-z)\text{LiMO}_2] \cdot (1-x)\text{LiNi}_{0.5}\text{Mn}_{1.5}\text{O}_4$ (5 V spinel)) and other spinel or layered variations (viz. $\text{LiM}'_2\text{O}_4$; $\text{M}' = \text{Mn, Ni, Co, Li}$; and layered LiMO_2 (viz. $\text{M} = \text{Mn, Ni, Co, etc.}$) thereof, whereby the components in the precursor electrode are chemically integrated or physically blended together.

Benefits

- ▶ These new material compositions provide substantially higher capacities than state-of-the-art layered lithium/cobalt/nickel/oxide materials.
- ▶ Due to the spinel component, these cathodes are endowed with high power where they can be charged and discharged rapidly.
- ▶ The multi-component nature of these materials can be optimized in the phase space in the figure according to the manufacturer’s needs.
- ▶ Manganese is less expensive to use and more chemically benign than cobalt or nickel. Either low-cost elements and/or other elements may be doped into the structure to provide better performance, at a lower cost, as needed.



A representative phase space defining the precursor electrode of the present invention.

Applications and Industries

Electrodes used in batteries for:

- ▶ Electric and plug-in hybrid electric vehicles,
- ▶ Portable electronic devices,
- ▶ Medical devices, and
- ▶ Space, aeronautical, and defense-related devices.

Developmental Stage

The phase space in the figure and other spinel-containing compositions are under patent coverage, and are ready for commercialization.

Availability

Available for licensing

Patent Information

US Patents 7,635,536; 7,303,840; 7,790,308; 8,080,340

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