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SCALABLE, SOLID STATE SYNTHESIS PROCESS FOR PRODUCING NANOSTRUCTURED ELECTRODE MATERIALS

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SCALABLE, SOLID STATE SYNTHESIS PROCESS FOR PRODUCING NANOSTRUCTURED ELECTRODE MATERIALS

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Safe Li-ion batteries with high power density that can operate over a wide temperature range, including temperatures as low as -30 ^{o}C, are required for hybrid electric vehicle applications. Additionally, Li-ion batteries with improved "abuse tolerance" are desired to reduce the use of expensive electronic control systems. One approach to improve the safety and the performance of Li-ion batteries is to replace the state-of-the-art cathode (e.g., $LiCoO_2$, $LiNi_{0.8}Co_{0.15}Al_{0.05}O_2$) and carbon-based anode materials. It is now well known that electrode materials with high temperature and chemical stability are needed for HEV and other large format applications.

The major challenge that need to overcome before electorde materials with new chemistries can be commercialized in Li-ion batteries is their production cost. We developed economical single step, solid state synthesis processes for producing nanostructured electrode (cathode and anode) materials. It was observed that rate performance of cathode material both at room and low temperatures is related to processing temperature, ratio of constitutients in the raw material and the mass density of the powder. The rate performance of cathode material in half cells was a stronger function of the mass density than the electronic conductivity, and it was comparable to that of a commercial material when tested in conjunction with an improved low temperature $LiBF_4$-based electrolyte (from Army Research Laboratory) at 0^{o}C. Full cells (capacity of 9 -12 mAh) made of nanostructured cathode and anode with 1.0M $LiPF_6$ electrolyte exhibited excellent cyclability.

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