Lithium Manganese Spinel – Well Known Material with New Properties.

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While providing relatively high energy densities, Li-ion batteries based on $LiCoO_2$ can undergo thermal run-away during rapid charge or discharge. In addition, cobalt oxide is not an environmentally friendly material. The need to replace the $LiCoO_2$ with other cathode materials is clear and pressing.

Lithium manganese oxide spinel is thermally stable and not prone to the thermal runaway reactions associated with cobalt oxide cathode materials. With growing concern over the safety of the cobalt oxide cathode designs, spinels based of LiMn2O4 are growing in popularity as cathode materials.

The goal of the presented work was to develop a low cost, high conductivity, high tap density, high electrochemical performance $LiMn^2O^4$ spinel with a new structure for Li-ion battery cathodes. The chemical MnO_2 (CMO) with high tap density (up to 2.7 g/cm^3) was used as the starting material for spinel synthesis. The presentation will include the results of work to determine the correlation between structure of the initial MnO_2 and the resulting spinel, electrochemical properties including the rate of discharge process, and data on cyclability. We analyzed the following characteristics of the initial MnO_2 and synthesized $LiMn_2O_4$: bulk density; fractional composition; structural modification (α, β, γ); crystallite dimensions; parameters of crystal lattice; manganese dioxide percentage in spinel; specific discharging capacity

Spinel synthesized using developed method has tap density: 2.6 g/cm^3. Electrodes based on this spinel, have a bulk density of 2.5 g/cm^3. and as results electrodes have a high specific discharge capacity - 280 mAh/cm^3 (electrode mass).

Conductivity of the $LiMn_2O_4$ spinel developed by authors of presentation was tested using a non-contact electromagnetic method and device. These tests showed that the new spinel has higher conductivity than $LiCoO_2$ and $LiMn_2O_4$ from other sources. Because of the higher bulk conductivity, this spinel material can also yield higher power densities than the cobalt oxides. The coating technology that was developed for cathodes based on $LiMn_2O_4$ provides a high level of discharge capacity 80 mAh/g (spinel) at a discharge rate 20C.

Other work in this area involves the development the additives to electrolyte and electrodes for increasing stability during storage and cycling of Li-ion batteries based on $LiMn_2O_4$ spinel. Special direction of researches was connected with investigation the electrochemical reaction in the system lithium manganese spinels / solid inorganic electrolyte with the structure of glass. This system is promising for solid state lithium batteries.

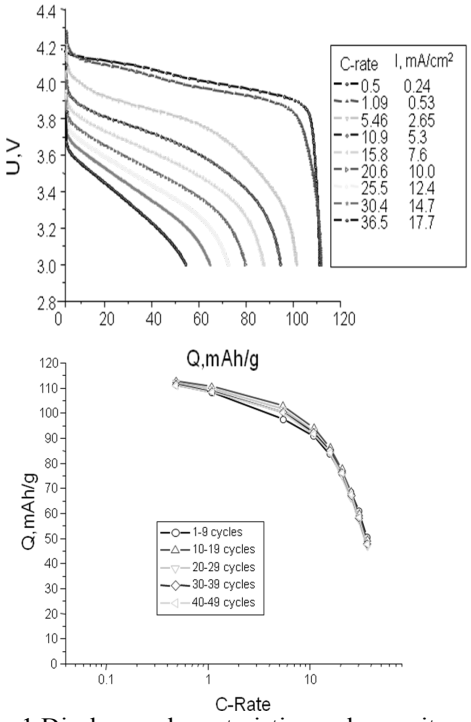

Fig. 1 Discharge characteristics and capacity as a function of current discharge C-rate for $LiMn_2O_4$ electrodes

[1] E. Shembel et al, US PA No. 12/287,396
[2] E. Shembel et al. US PA No. 12/290,068

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