

Sodium Transition Metal Oxide Electroactive Compounds

Technology #17101

Applications

Sodium transition metal oxide electroactive compounds (NaTMO₂) can be used as cathode material in a variety of sodium ion batteries.

Problem Addressed

Layered sodium metal oxides have attracted considerable interest as cathodes for Na-ion batteries because they are easily synthesized and show the capability to intercalate Na ions reversibly. Currently known compounds show either good cyclability, as in the case of Na(Fe_{0.5}Co_{0.5})O₂ (FC), or high initial discharge capacity, as in the case of Na(Ni_{0.5}Mn_{0.5})O₂ (NM), but not both.

Technology

This invention combines FC and NM into Na(Mn_wFe_xCo_yNi_z)O₂ (MFCN), where the stoichiometric values of w, x, y, and z are variable. Various types of MFCN powder are obtained by sintering the pressed pellet from ball-milled mixture of stoichiometric amounts of Mn₂O₃, Fe₂O₃, Co₃O₄, NiO, and Na₂CoO₃ powder at 800°C in air. These powders can be formed into electrodes for use in an electrochemical device. Discharge capacity and cyclability of MFCN electrodes were compared to those for FC and NM. MFCN exhibited better cyclability than FC and NM, falling from 180 mAhg⁻¹ to 160 mAhg⁻¹ after 20 cycles at a charge/discharge rate of C/10. In contrast, FC fell from 160 mAhg⁻¹ to 145 mAhg⁻¹ and NM fell from 140 mAhg⁻¹ to 125 mAhg⁻¹. While crystal distortion was observed during Na de-intercalation for NM and FC, no distortion was observed in MFCN. As a result, MFCN has a much smoother electrochemical profile than NM or FC. The optimal amount of Iron (Fe) for efficient charging and discharging was found to be one third of the overall metal content. This amount of Fe is high enough to impart flexibility to the crystal lattice and low enough to stop unwanted Fe migration due to Fe interaction with Na ions.

Applications

- Better cyclability and discharge capacity than FC or NM electrodes
- No crystal distortion during discharge
- Low Na diffusion barrier compared to FC and NM electrodes

Categories For This Invention:

Energy

Energy Storage

Batteries

Other (Batteries)

Intellectual Property:

Sodium transition metal oxide electroactive compounds

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