ELECTROLYTIC OXIDES OF TRANSITION METALS IN THE ANODES OF LITHIUM RECHARGEABLE BATTERIES

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A number of Me oxides (Me=V, Mo, Ni, Co) has been synthesized by the authors using the electrolysis of water solutions and tested in the thin-layer cathodes of lithium rechargeable batteries for their miniaturization [1-4]. Recently, transition metal oxides have attracted an attention due to their electrochemical possibilities as anode materials, which mechanism of electrochemical transformation is different from that of the traditional reversible intercalation of lithium ions [5].

In the work the electrolytic (e) oxides of Mo, Ni, Co have been tested for the anodes of lithium-ion rechargeable batteries. Oxide materials have been produced as the compact deposits on a stainless steel and as a fine-dispersed powder. They were cycled in ballast-free and composite electrodes in the voltage range 1.8-0.1V with a lithium counter-electrode. E-oxides were tested in the liquid electrolyte comprising PC, DME, 1M $LiClO_4$ and polymer chlorinated PVC, 0.5M $LiClO_4$, PC.

Synthesis of e-Mo-oxide anode material is different from the synthesis used for cathodes [2] by low temperature of ammonium-molybdate electrolyte and that of electrolysis product drying (18-20˚C). Oxygen-deficit compositions of molybdenum trioxide (e-MoO_{3-x}) are the end synthesis products. At the first cycle a discharge capacity of these compositions reaches 700-1000 mAh/g. On the 50^{th} cycle reversible discharge capacity is near 200 mAh/g. Average discharge voltage is 0.5V.

Starting discharge capacity of e-NiO synthesized by the cathode reduction of the water solution of nickel nitrate followed by anode treatment and annealing of the produced deposit at 300˚C [3] can reach 1400 mAh/g. After the second cycle it decreases and stabilizes on the level of 500 mAh/g in composite and at 200 mAh/g in ballast-free thin-layer electrodes.

On the data of X-ray diffraction analysis, e-Co-oxide corresponding to the composition of Co_3O_4 [4], similar to electrolytic Ni- and Mo-oxides at the first cycle has a high discharge capacity (850 mAh/g) in the ballast-free electrodes. Reversible discharge capacity decreases in them up to 180-200 mAh/g.

Structure parameters, thermal properties, Li^+ transport properties, surface morphology of synthesized e-oxides have been investigated and will be presented.

The great difference between starting and reversible discharge capacities is the common problematic property of the synthesized electrolytic oxides for their realization in lithium-ion batteries.

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