ELECTRODE MATERIALS FOR LITHIUM-IONS ACCUMULATORS

Tibor Jirák
Doctoral Degree Programme (1), FEEC BUT
E-mail: xjirak02@stud.feec.vutbr.cz

Supervised by: Jiří Vondrák
E-mail: vondrakj@iic.cas.cz

ABSTRACT

This article deals with electrode materials for positive electrodes lithium-ions accumulators. Afterwards acquired results were investigated.

1. INTRODUCTION

This article is aimed on preparing and measuring the positive electrode materials base on $LiCoO_2$ with the excess of lithium. Electrode materials with $LiCoO_2$ is one of the most commonly used materials because it promises interesting and useful results.

Lithium-ions accumulators embody very good characteristics for specific energy, lifecycle, system reliability and proportions of batteries. Lithium-ions accumulators are assembled from two electrodes intercalation type (negative, positive) and chemical reaction proceeds insertion and subduction lithium ions from structure of electrodes.

Objective of this work was obtaining positive electrode materials with good results in specific capacity lithium-ions accumulators and in time and quality of discharging curve.

2. EXPERIMENTAL

Mode of production positive electrodes is divided into two steps. Firstly is prepared active mass and afterwards it is composed with admixtures.

Active mass $Li_{1,2}CoO_2$ was result of solid / state reaction lithium nitrate $LiNO_3$ and cobalt nitrate $Co(NO_3)_2$*$6H_2O$. The active mass was dried at 90° C and 120° C for 2 hours and the mixtures were annealed at 400° C and 600° C for 2 hours and 800° C for 6 hours. Purity of all used base materials was 99 %.

Positive electrode materials were mixture of $Li_{1,2}CoO_2$ (20% excess of lithium), Chezacarb A (carbon black, Chemopetrol Litvinov Inc., Czech Republic), exfoliated graphite (Bochemia Bohumin Inc., Czech Republic) and PTFE (Dyneon TF 5035). The final mixtures were pressed on nickel mesh. Afterwards the positive electrodes (nickel mesh plus electrode materials) were dried at 150° C for 1 hour and were inserted consequently in air-proof vase.

Final prepared positive electrode materials are presented in a following table.

Electrode materials – percents relation
75% $Li_{1,2}CoO_2$, 10% Chezacarb A, 10% exfoliated graphite, 5% PTFE
85% $Li_{1,2}CoO_2$, 10% Chezacarb A, 5% PTFE
85% $Li_{1,2}CoO_2$, 5% Chezacarb A, 5% exfoliated graphite, 5% PTFE

Table 1: Positive electrode materials.

2.1. MEASURING METHOD

The electrochemical properties were investigated by the use of a three / electrode cell containing working electrode (final positive electrode), lithium counterelectrode and lithium reference electrode. The electrodes were sinked into electrolyte consisted of lithium perchlorate ($LiClO_4$, purity 99%) in mixture of ethylene carbonate and diethyl carbonate (EC-DEC, purity 99%).The electrode materials were charged to +4,2 V potentiostatically (cca 2 hours) and then discharged galvanostatically down to the cell voltage +3 V. Discharging current was set up 45 mA/g active mass and the measuring cycle was repeated three times, then the measuring process was stopped.

The achieved results were recorded via Autolab PGSTAT 30 connected to PC with software GPES.

3. RESULTS AND DISCUSSION

Aim of this work was acquiring good values specific capacity, utilisation of active mass and quality progression discharging curve. Results are presented thereunder via tables and graphs.

Scan	(Q-)/(Q+)	X_C	C_m
	[%]	[%]	[C/g]
1	0,79	52,64	390,19
2	0,86	46,14	342,00
3	0,86	40,23	298,20

Table 2: 75% $Li_{1,2}CoO_2$, 10% Chezacarb A, 10% exfoliated graphite, 5% PTFE.

Scan	(Q-)/(Q+)	X_C	C_m
	[%]	[%]	[C/g]
1	0,79	48,98	411,47
2	0,82	42,65	358,30
3	0,81	35,50	298,20

Table 3: 85% $Li_{1,2}CoO_2$, 10% Chezacarb A, 5% PTFE.

Scan	(Q-)/(Q+)	X_C	C_m
	[%]	[%]	[C/g]
1	0,82	46,80	393,13
2	0,87	42,50	357,06
3	0,84	36,13	303,50

Table 4: 85% $Li_{1,2}CoO_2$, 5% Chezacarb A, 5% exfoliated graphite, 5% PTFE.

Explanation: X_C [%] – utilisation of active mass, C_m [C/g] – specific capacity

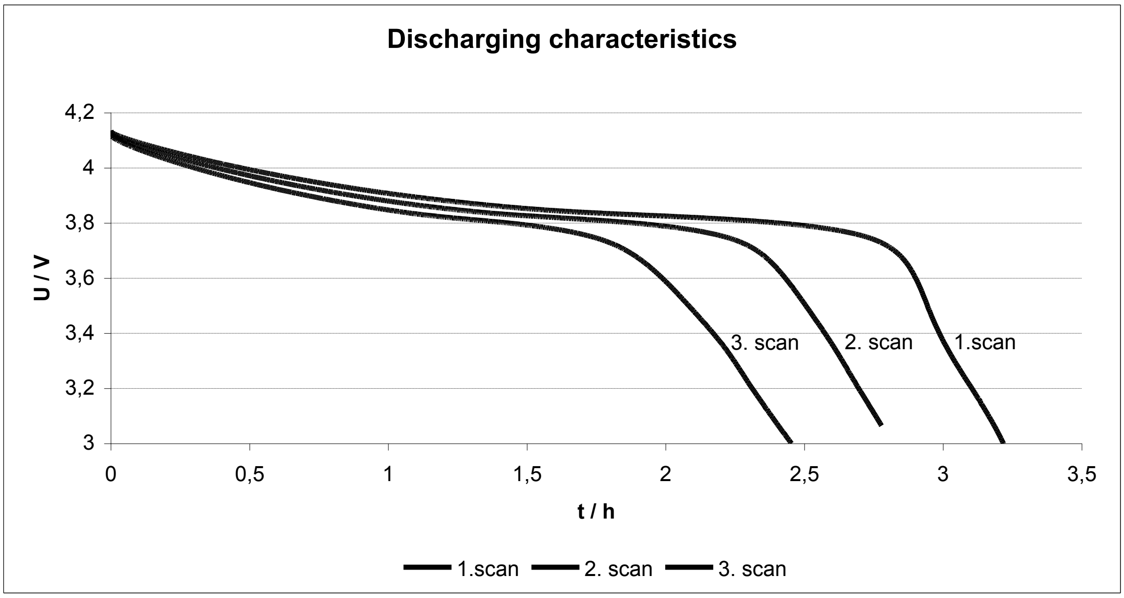

Figure 1: 75% $Li_{1,2}CoO_2$, 10% Chezacarb A, 10% exfoliated graphite, 5% PTFE.

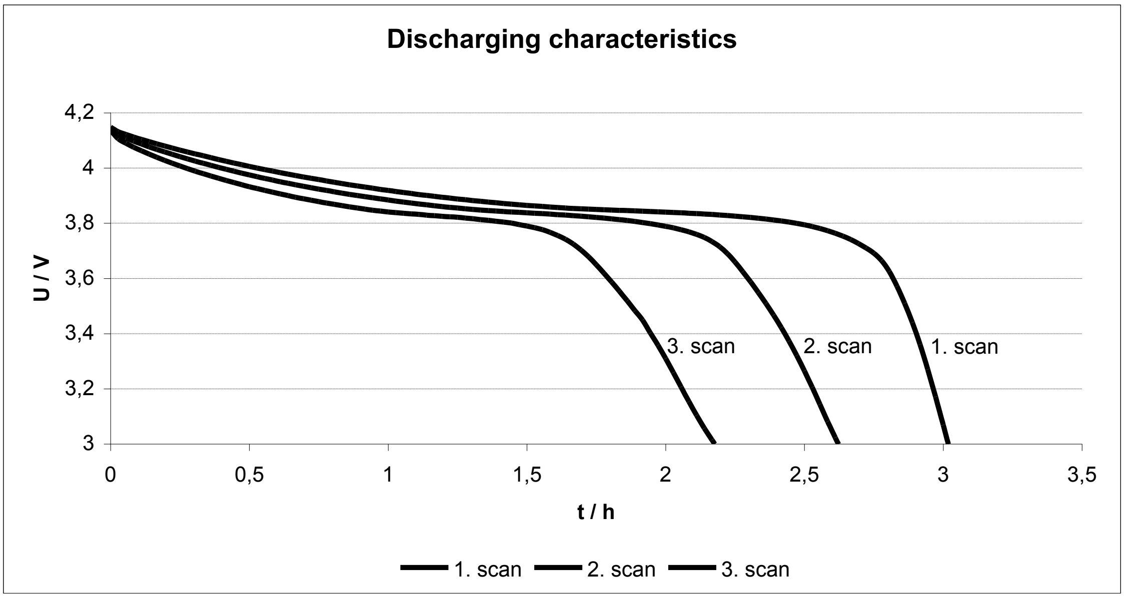

Figure 2: 85% $Li_{1,2}CoO_2$, 10% Chezacarb A, 5% PTFE

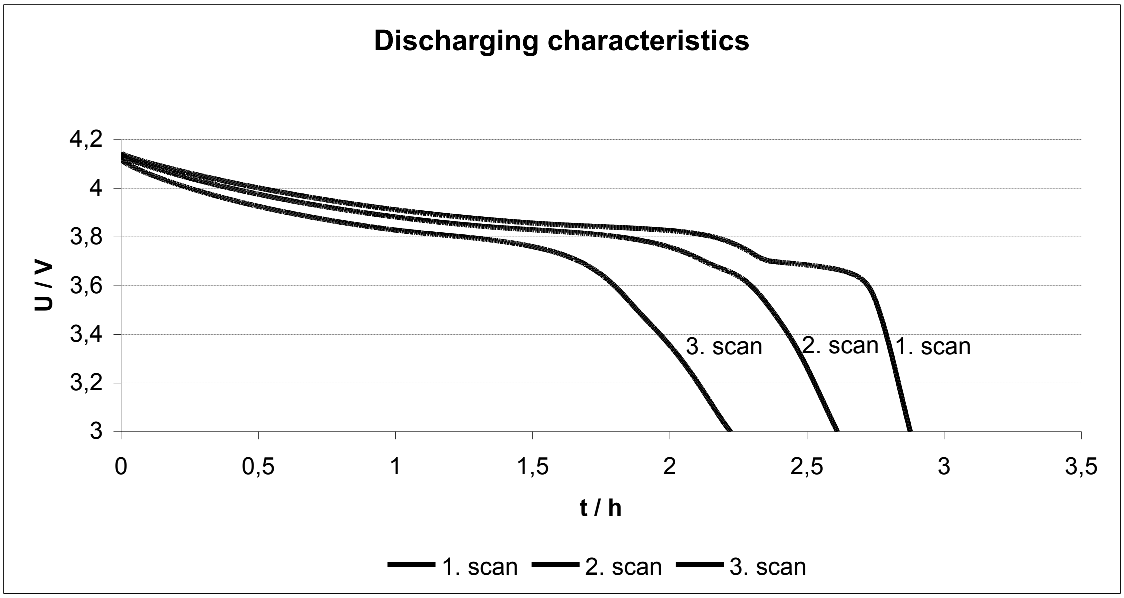

Figure 3: 85% $Li_{1,2}CoO_2$, 5% Chezacarb A, 5% exfoliated graphite, 5% PTFE

4. CONCLUSION

The best results were obtained using electrode material 75% $Li_{1,2}CoO_2$, 10% Chezacarb A, 10% exfoliated graphite, 5% PTFE. First discharging scan looked best for every electrode materials, afterwards electrode materials degraded.

Obtaining ideal measurement results depends on a quality active mass, the optimal volume of admixtures and their distribution in the electrode material (for example conductive carbon, compounding conductivity, must be balanced with the decrease of electrode capacity), prevention entering air into cell and many others factors.

ACKNOWLEDGEMENT

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