LITHIUM BATTERIES

Ing. Pavel NEČESAL, Doctoral Degree Programme (3)
Dept. of Electrical and Electronic Technology, FEEC, BUT
E-mail: pavel.necesal@centrum.cz

Supervised by: Dr. Jiří Vondrák

ABSTRACT

The materials based on lithium – cobalt oxides were prepared by low-temperature deposition. The number of portable computational and communicational devices increases rapidly in the multimedia age, and the need for miniaturised energy sources becomes a necessity. An ideal battery should be inexpensive, compact, lightweight, and infinitely rechargeable. For general consumer use it has to fulfil safety and reliability standards. In this point the development of Li batteries has not met the requirements of the market and safety yet.

1 INTRODUCTION

Today's market, more than before, request such power supply, that would answer very exacting and sometimes antagonistic requirements (output versus size, service life and reliability versus price etc ..).

Early eightieth´s years there was more intensive interest in more efficient current power supply with a long life and a low percentage self-discharge, that are determination for use in microelectronics, medicine, military and other region.With it relates searching a new type galvanic primary and secondary cell. For area microelectronics be to seek cells with a long service life during a small output. This requirements nowadays the best fulfil lithium or lithium - cobalt batteries.

These very efficient electrochemical current source with in comparison with common conventional source, for example Leclancheovymi or alkaline, define double voltage (3 - 3,4 V), multiple higher specific energy (till 500 Wh/kg), flat discharge curve, a long service life at stocking (10 years) and it all also at extreme temperatures. One of the major feature of lithium battery is also low ratio self-discharge, under 1 % yearly. That is why lithium cells are already producing in million amounts yearly.

For majority applications be to seek, so that cells offer resistance shocks, reliably work in the range of common outside temperature in haphazard position and don´t lose yours capacity. These are the main reasons why the liquid electrolyte are replacement gel polymer electrolytes, which thanks it´s viscosity better correspond with this exacting requirements.

2 ANALYSIS

2.1 COMPOSITION OF ELECTRODES

In practical parts of my work I investigated composition of positive electrodes for lithium cells. These electrodes are realized by striking due masses, that has to be totally exsiccation on nickel-coated net. The materials kept up piles due to PTFE (teflon emulsion). Further the net with drifted material is pressed. Materials extract on net by this way are dry, because using teflon emulsion for better joinder material nesting contains waters. This way made electrodes with by various conditions components I measured on computer controlled potenciostat (AUTOLAB) and analysed optimum composition for positive electrode of lithium cell. Appreciation consists in comparison available energy and capacities from explored electrodes. This work is connected on already aged research in the area of lithium batteries which is transactioned on our institute. Used materials for spot sample are presentation with the following table.

N. of material	**$LiCoO_2$**	**Carbon black**	**Graphite CR5**
	Weight [%]	**Weight. [%]**	**Weight. [%]**
1	20	50	30
2	50	20	30
3	80	15	5

Tab. 1: *Composition of positive electrode*

- As negative electrode is used metal lithium.
- As electrolyte is used 0,5 M solution of $LiClO_4$ in propylene carbonate.

2.2 COMPARISON OF MEASUREMENT AND WORK OUT DATA VALUES

These samples for positive electrodes were investigated by cyclic voltametri (discharge and repeatedly charging these articles) on computer controlled potenciostat AUTOLAB. Samples was investigate in voltage extent from 1,8 V till 4 V. Values of usable capacities and energy for spot sample was obtained by reckonings, that are summary with the following table.

No. of material	**$LiCoO_2$**	**Carbon black**	**Graphite CR5**	**Obtained capacity**	**Obtained energy**
	Weight [%]	**Weight [%]**	**Weight [%]**	**[%]**	**[$Wh.Kg^{-1}$]**
1	20	50	30	**24,51**	**125**
2	50	20	30	**6,02**	**25**
3	80	15	5	**4,02**	**20**

Tab. 2: *Comparison of obtained capacity and energy*

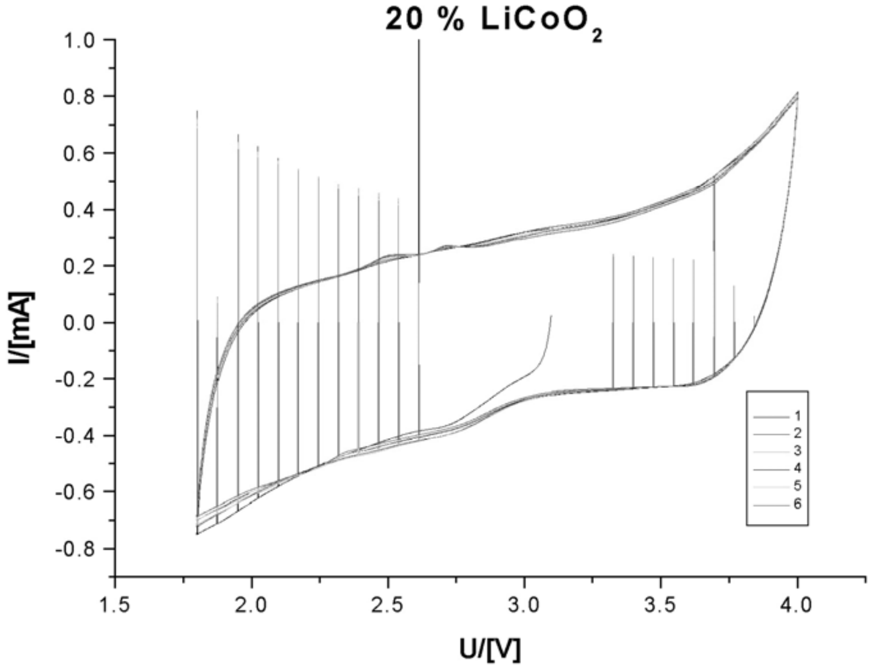

Fig. 1: *Voltammetric curves for 1st sample*

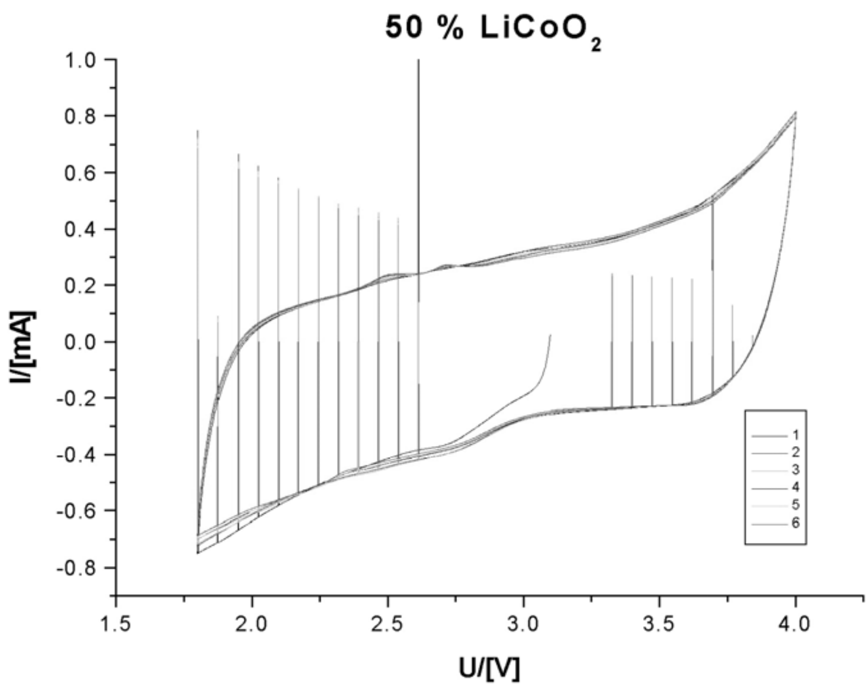

Fig. 2: *Voltammetric curves for2nd sample*

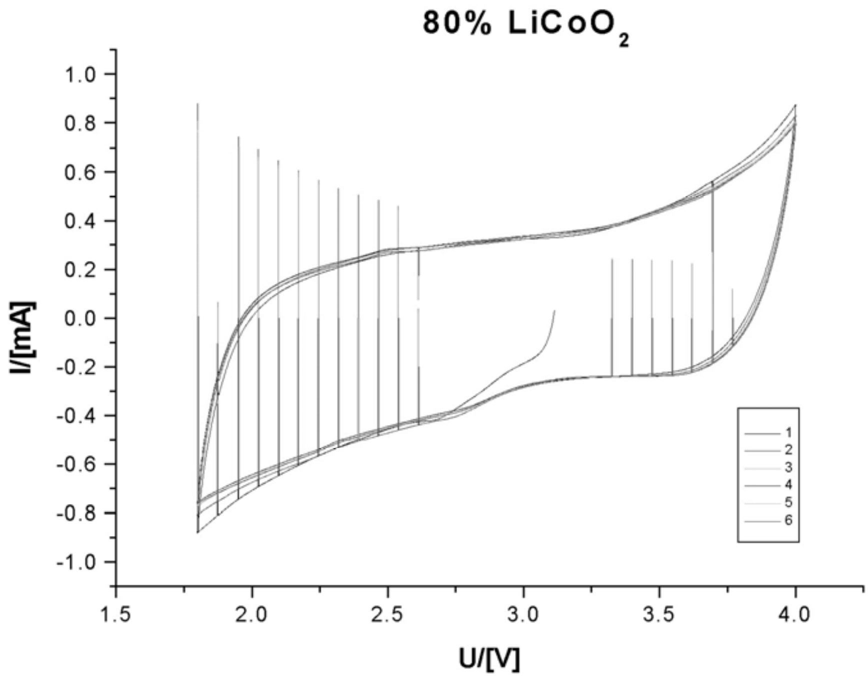

Fig. 3: *Voltammetric curves for 3rd sample*

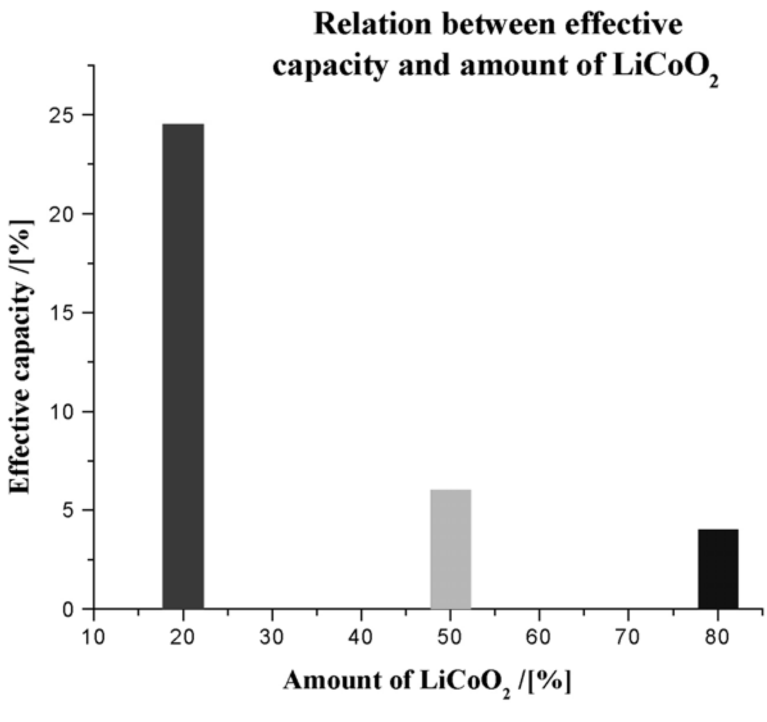

Fig. 4: *Effective capacity*

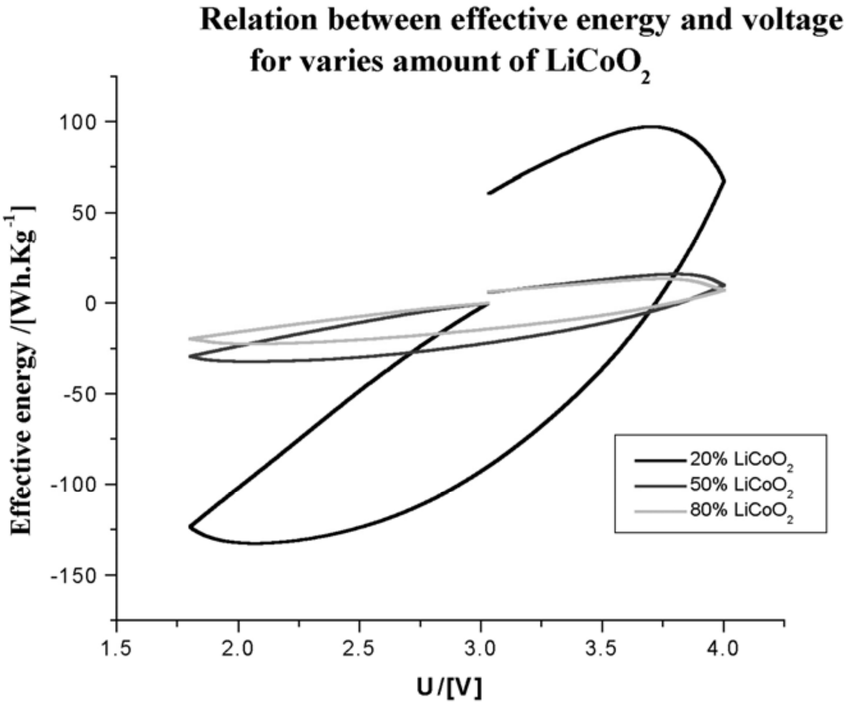

Fig. 5: *Effective energy*

3 DISCUSSION

The biggest available capacity was obtained from sample No. 1 with 20 % amount of $LiCoO_2$ and it is 21,51 %. The best energy efficiency shows again sample No. 1 with 20 % mount of CoO_2 and it is 125 $Wh.Kg^{-1}$.The best parameters for practical use has sample No. 1 with 20 % amount of $LiCoO_2$, since provides the best capacity and offers the biggest output power of all surveyed samples.

ACKNOWLEDGMENTS

This work was supported by Grand Agency of Czech Academy of Sciences (grant No, 4032002) and by the Ministry of Education of Czech Republic (No. CEZ J 22/98:2622 00010).

REFERENCES

[1] Vondrák, J.: Habilitační práce, Ústav elektrotechnologie VUT, Brno 1999

[2] Jakubec, J: Chemické listy – interkalační látky a jejich chemické a elektrochemické vlastnosti;1985

[3] Pistoia, G.: Lithium batteries. New materials, developments and perspectives, Industrial, Chemistry Library, The Netherlands 1994

[4] Fischer, O.: Vybrané kapitoly z fyzikální chemie, rektorát UJEP, Brno 1988