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EVALUATION OF LITHIUM CELL MATERIALS: TRANSIENT RESPONSE TO HEAT AND D.C. PULSE (EXTENDED ABSTRACT)

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Summary

Various components of a commercially available lithium cell have been evaluated in respect of changes in characteristics due to oxidation and chemical changes which might occur on their exposure to air. The cell was disassembled and the components were tested for variations in response to short heat and d.c. pulses. The decay of the signal measured in response to short pulses of 0.2 - 1 s was measured. A simple thermocouple (copper/constantan) was used to measure the response to a 100 W heat pulse, while parallel copper electrodes were used to monitor the response to a 5.3 V d.c. pulse for 0.2 s. The results show a dependence of the measured response (temperature in the case of the heat pulse or open cell voltage, OCV, in the case of the response to the d.c. pulse) on the condition of the parts of the lithium test cell. The proposed technique might be of potential interest for quality control applications as well as for production processes. The prediction of cell characteristics might be possible by using the proposed method for the evaluation of cell components. However, more work is recommended before the application of such a system as a standard technique for use in industry.

Introduction

Lithium cell active materials degrade rapidly on exposure to air due to various chemical reactions with oxygen. Once the cell is disassembled or its active materials are exposed to air, its electrical and thermal characteristics change. The objective of this work was to monitor the transient changes of various components in a commercial Li cell. A novel and simple technique was used for the evaluation.

Experimental

A commercially available 3 V MnO_2/Li flat button type (CR2025) cell was selected for this study. The cell was disassembled and its components

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(negative electrode, anode; positive electrode, cathode; cathode can; separator) were tested for their transient thermal and electrical characteristics. The experimental set-up used to test the parts included a thermocouple, a resistor to generate the heat pulse, copper electrodes, and a high impedance mV chart recorder to record the response signals to the heat pulse (temperature decay) and the d.c. pulse (open cell voltage, OCV, decay). More details are available elsewhere [1 - 3]. Once the cell was opened, the transient responses of the cell parts to heat and d.c. pulses were measured. The duration of the heat pulse (100 W) was 1 s in all the experiments. The resistor used for the heat pulse generation was 1 Ω. A d.c. pulse of 5.3 V for 0.2 s was used. The pulse was applied using parallel copper electrodes (electrode separation 1 mm) that contacted the Li cell separator (wetted by the Li cell electrolyte). The measurements of the responses to heat or d.c. pulses were repeated for periods of up to 2 days.

Results

Response to heat pulse

Figure 1 shows the response to heat pulses of cell components exposed to air for periods of up to 2 days at ambient temperature. There is a significant change in the transient heat transfer, in response to the same heat pulse, between freshly exposed cell parts and those exposed to air for longer periods at ambient temperature. Active materials show the major change in pulse response.

Response to d.c. pulse

The results of open cell voltage (OCV) decay in parallel copper electrodes contacting the Li cell separator are shown in Fig. 2. The largest difference in the measured response to the d.c. or the heat pulse was noticed in the cathode (MnO_2) layer after one day's exposure to air when compared with the MnO_2 from a newly opened cell. The details concerning MnO_2/Li cell components and chemistry have been discussed in a recent report [4].

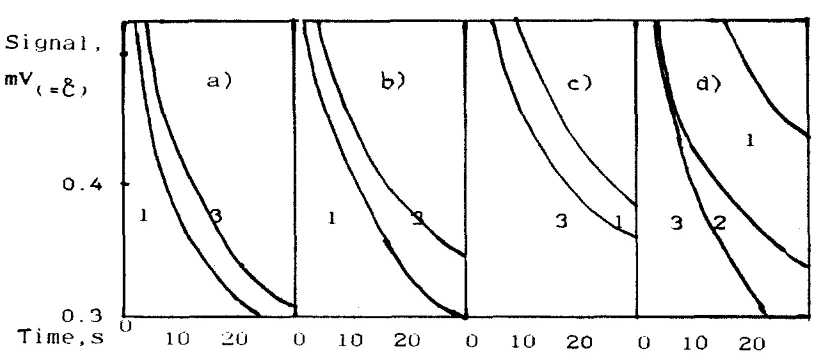

Fig. 1. Response to heat pulse (1 s 100 W) of Li cell materials: (a) anode; (b) cathode; (c) separator; (e) seal. Materials exposed to air for: 1, 1 min; 2, 6 h; 3, 24 h.

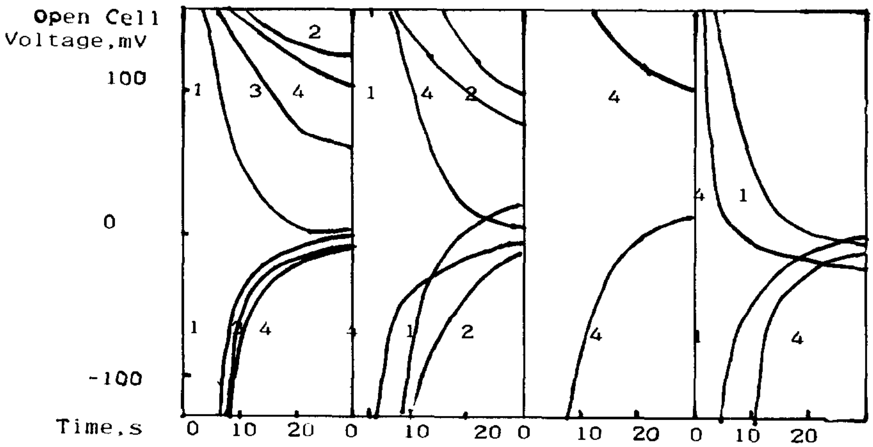

Fig. 2. Response to d.c. pulse (0.2 s 5.3 V) of Li cell (CR2025) (a) anode; (b) cathode; (c) separator; (d) seal. Materials exposed to air for: 1, 1 min; 2, 6 h; 3, 24 h; 4, 48 h.

Conclusions

The proposed accelerated testing technique is useful where following the progress of the reaction of Li cell materials with air. The responses to heat and d.c. pulses are dependent on the changes in the test materials.

References

1 M. I. Ismail, *J. Power Sources, 20* (1987) 81 - 85.
2 M. I. Ismail, *J. Power Sources, 20* (1987) 75 - 79.
3 M. I. Ismail, M. R. Reda, T. Al-Sahhaf and J. Al-Hajji, *3rd Int. Meeting on Li Cells, Kyoto, Japan, May 27 - 30, 1986*, pp. 134 - 137.
4 H. Ikeda, N. Furukawa and M. Hara, *3rd Int. Meeting on Li Batteries, Kyoto, Japan, May 27 - 30, 1986*, pp. 28 - 35.6.