Journal of Power Sources, 26 (1989) 369 - 371

ULTRA-THIN MANGANESE DIOXIDE–LITHIUM BATTERY FOR MULTIFUNCTIONAL IC CARDS (EXTENDED ABSTRACTS)

SHINTARO SUZUKI*, YOSHIAKI ASAMI, HIROHITO TERAOKA and SUEKICHI INOMATA

Research and Development Division, Toshiba Battery Co., Ltd., Shinagawa-Ku, Tokyo (Japan)

1. Introduction

Recently several multifunctional IC (integrated circuit) cards have appeared such as the VISA super smart card developed by Toshiba. VISA super smart card, which is the same size as an ordinary credit card, combines a microprocessor, memory, keyboard with buttons and liquid crystal display for credit, checking, and saving accounts.

This card can work off-line as a completely self-contained unit and can store data about customer transactions, update account balances, convert currency, and have many other unique applications.

These multifunctional IC cards have power source batteries for supplying power to the integrated circuit.

The basic requirements for these batteries are:

(i) thickness less than 0.76 mm;

(ii) high discharge capacity;

(iii) long term reliability.

The batteries are required to have a thickness of 0.5 mm - 0.3 mm, since the multifunctional IC cards must have the same thickness as conventional magnetic stripe cards and have many components such as IC chips, keyboard and liquid crystal displays.

We have developed an ultra-thin manganese dioxide–lithium battery (MnO_2/Li) for multifunctional IC cards. The thinnest type of these batteries is 0.3 mm in thickness.

In this paper, we report on the design and characteristics of the battery.

2. Structure

Figure 1 shows a cross sectional view of an ultra-thin MnO_2/Li battery. The external appearance of this battery is rectangular. Table 1 gives the components of the 0.5 mm-type of ultra-thin MnO_2/Li battery developed for

*Author to whom correspondence should be addressed.

0378-7753/89/$3.50

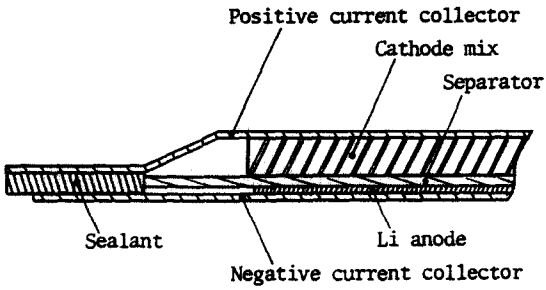

Fig. 1. Cross sectional view of ultra-thin MnO_2/Li battery.

TABLE 1

Components of 0.5 mm type ultra-thin MnO_2/Li battery for multifunctional IC cards

Parts	Materials	Thickness
Positive current collector	Stainless steel	0.02 mm
Cathode mix	MnO_2, graphite, PTFE	0.25
Separator	Nonwoven poly(propylene)	0.10
Anode	Li	0.09
Negative current collector	Stainless steel	0.02
Electrolyte	1 M $LiClO_4$/PC	
Battery		0.48 mm

multifunctional IC cards. The positive and negative current collecters also act as external sheathing.

The stainless steel plates, 0.02 mm in thickness, are used for current collectors because a stainless steel plate is mechanically strong compared with other materials.

Non-woven fabric poly(propylene) 0.1 mm in thickness was used for the separator to prevent shorting problems during discharge. The cathode mix is coated on the positive current collector plate by the same method as that reported previously [1], because, by the conventional powder press method, it is too difficult to make a cathode mix for an ultra-thin battery of less than 0.5 mm in thickness.

3. Characteristics

Figure 2 shows the relationship between the discharge capacity density and the thickness of coin type and ultra-thin type batteries. The coin type batteries are known as a comparably thin type battery. The capacity density of coin type batteries is more than 130 mA h ml^{-1}. The capacity density of an ultra-thin MnO_2/Li battery, reported previously [1], is very low, as shown

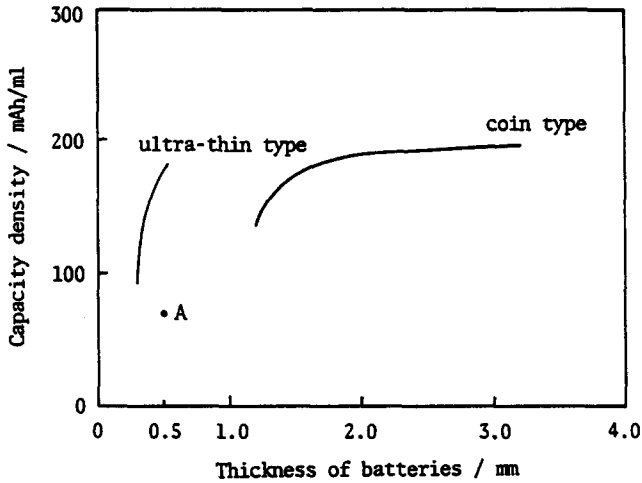

Fig. 2. Relationship between capacity density and thickness of MnO_2/Li batteries. A: ultra-thin type reported previously [1].

by point A, whereas the capacity density of the new 0.5 mm type ultra-thin MnO_2/Li battery for multifunctional IC cards has achieved the same level as that of coin type batteries. However the thinner the ultra-thin MnO_2/Li battery, the lower the capacity density. This can be explained by the increase in the volume ratio of battery container to cathode and anode and by the optimum capacity balance of the ratio of cathode and anode. A further reason is the discharge efficiency drop of the MnO_2 cathode. This problem will be reported in detail.

Reference

1 S. Suzuki *et al.*, *3rd MnO_2 Int. Symp., Austria, 1985.*