BATTERIES WITH $RbAg_4I_5$ FOR PACEMAKER

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Abstract. A wide diversity of batteries is utilized such as implanted medical devices (pacemaker) and external devices for monitoring of bodily functions. In this paper are presented the main characteristics of $Ag/RbAg_4I_5/RbI_3$ cell. The electrochemical behavior of the batteries with $RbAg_4I_5$ solid electrolyte was studied by performance curves in two discharge regimes.

Key words: pacemaker, solid electrolytes, $RbAg_4I_5$, silver-iodine battery.

INTRODUCTION

The medical devices powered by electrochemical power sources play a vital role in the treatment of diseases and the well being of patients. The advances in battery technology, electronics and medical knowledge have produced a wide variety of sophisticated implantable devices to treat ailments ranging from irregular heartbeat to pain and epilepsy. Also a great diversity of battery powered external devices is used to administer drugs, treat ailments and monitor bodily functions.

Generally, for the safety of patients, it is used the solid state batteries which have a number of very desirable features such as absence of any possible liquid leakage or gassing and the possibility of operation over a wide temperature range. The batteries with $RbAg_4I_5$ solid electrolyte are part from these galvanic cells [3, 4].

MATERIALS AND METHOD

With $RbAg_4I_5$ solid electrolyte prepared by our method [1, 2] and structurally characterized by X-ray diffraction we realized two types (I- and II-type) of $Ag/RbAg_4I_5/RbI_3$ button cells.

Received March 2003;
in final form, March 2004.

The cathodes for both types of batteries were performed from a mixture of RbI_3 (87.30%), graphite (6.75%) and $RbAg_4I_5$ (5.95%), which was pressed.

The anode for the I-type cell was an amalgamated silver disk of 0.02 mm thickness. In the case of II-type cell the anode was made from a mixture of Ag powder (88.00%), graphite (8.00%) and $RbAg_4I_5$ (12.00%), which was pressed.

Pressing of their components (anode, solid electrolyte and cathode) assembled the cells at 1700 kgf/cm^2 for 20 minutes. The weight of obtained batteries was found in range 0.9 – 1.1 g.

RESULTS AND DISCUSSION

The values of e.m.f. for I-type cells were situated in the range 590 – 600 mV and for II-type were 650 – 660 mV. Probably this variation appears because of better connection between anode and solid electrolyte in the case of II-type batteries.

The electrochemical behavior of $RbAg_4I_5$ solid state cells was investigated by performance curves under constant load and galvanostatic regime.

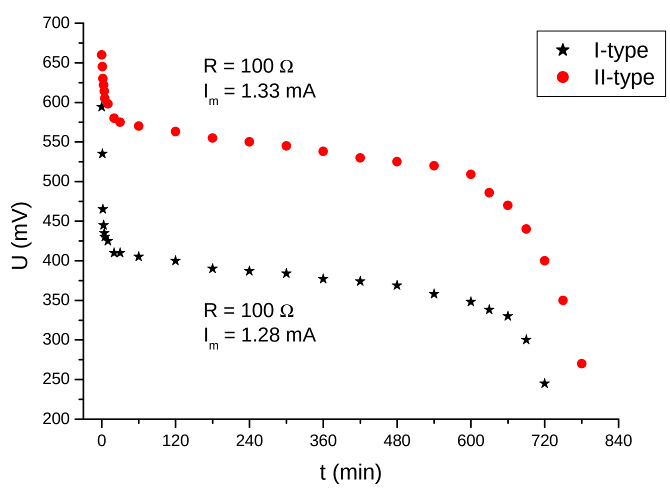

Fig. 1. Discharge curves of I-type and II-type cells under R = 100 Ω.

From Fig. 1, where are showed the discharge curves of I-type and II-type cells under constant resistance (R = 100 Ω), it can see that the II-type cell has higher characteristics than the I-type battery. Thus the discharge plateau of II-type was situated in the domain 525–575 mV, whereas for I-type in range 350–400 mV.

Also, the average discharge intensity was of 1.33 mA for II-type and 1.28 mA for I-type cell.

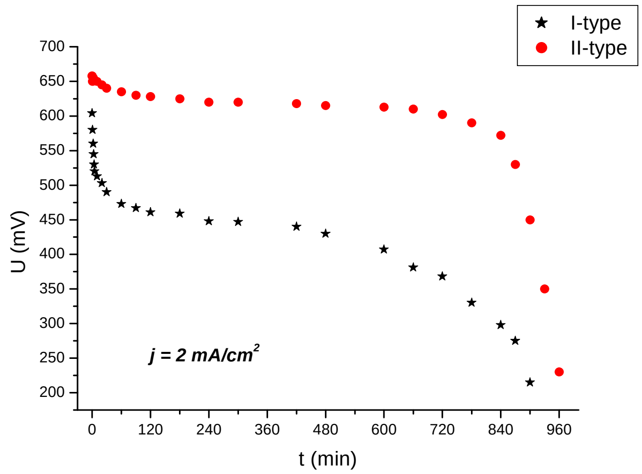

Fig. 2. Discharge curves of cells at j = 2 mA/cm^2.

The batteries were discharged at three current densities: j = 2 mA/cm^2 (Fig. 2), j = 1 mA/cm^2 (Fig. 3) and j = 0.2 mA/cm^2 (Fig. 4) in galvanostatic regime.

From the discharge curves it can ascertain that at less current densities (1 mA/cm^2 and 0.2 mA/cm^2) the discharge plateaus have higher values for I-type cell, close to those of II-type cell. At the current density of 0.2 mA/cm^2 the total yielded energy was of 10.20 mWh for I-type cell and 11.89 mWh for II-type cell.

The electrochemical characteristics of $Ag/RbAg_4I_5/RbI_3$ cells are presented in Table 1. From the experimental data were calculated the mass capacities, C, the energy densities, W, and the utilization coefficients of active material (silver), u.

As can be seen from Table 1, the all calculated parameters are better for II-type cells than for I-type cells. The mass capacities and energy densities depend on the discharge regime, they are higher under galvanostatic at less current densities (0.2 mA/cm^2).

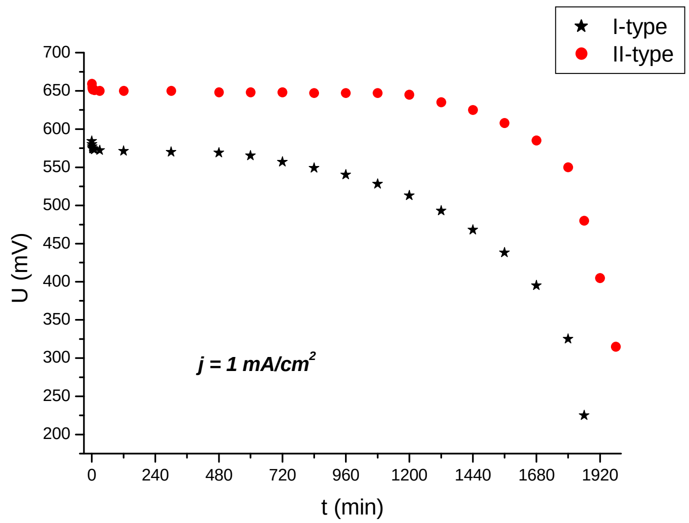

Fig. 3. Discharge curves of cells at j = 1 mA/cm^2.

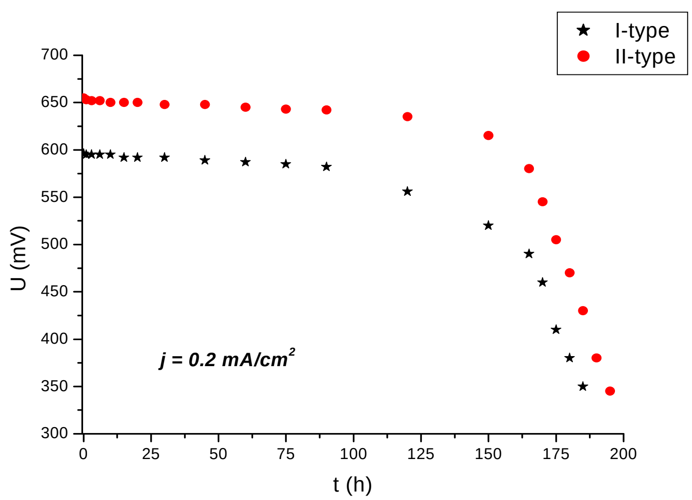

Fig. 4. Discharge curves of cells at j = 0.2 mA/cm^2.

Table 1

The electrochemical characteristics of batteries with $RbAg_4I_5$ solid electrolyte

Cell type	Mass (g)	Discharge regime	j (mA/cm^2)	C_g (Ah/kg)	W_g (Wh/kg)	u (%)
I	1.096	Load R = 100Ω	2.52	13.80	5.92	55.2
II	1.037		2.63	16.49	9.79	66.0
I	0.995	Galvanostatic	2	15.07	6.22	62.8
II	1.053			15.20	9.00	63.3
I	1.050	Galvanostatic	1	14.76	7.53	64.2
II	1.012			16.30	10.07	70.1
I	0.915	Galvanostatic	0.2	20.22	11.15	84.3
II	0.954			20.44	12.46	85.2

CONCLUSIONS

From the obtained results it can be establish that $Ag/RbAg_4I_5/RbI_3$ batteries present good electrochemical characteristics to use in medical devices such as cardiac pacemarker.

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