LITHIUM BATTERIES WITH V_2O_5 CATHODIC DEPOLARISANT

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Introduction

In recent years, a great attention has been given to the several vanadium oxides witch have been proposed as positive electrode materials for use in secondary lithium batteries. Thus, V_2O_5 may be regarded as one of the most promising candidates for cathodic depolarisants, because of its electrochemical behaviour and physical properties, attractive energetic characteristics combined with a good rechargeability [1-4].
In the present work, the lithium intercalation process into V_2O_5 has been studied by cyclic voltammetry and charge-discharge curves.

Experimental

We have prepared V_2O_5 by thermal decomposition of ammonium metavanadate at 500^0C in argon atmosphere and characterized by X-ray diffractometry. The electrodes were obtained by pressing V_2O_5 – powder as active material, graphite as electronic conductor and Teflon as binder.

The voltammetrical measurements were done in a three-electrode glass cell at room temperature. The cyclic voltammograms were recorded in 1M $LiClO_4$ solution in propylene carbonate-dimethyl ethan (PC:DME) mixture (1:1 volumic ratio) as electrolyte, at slow rate (1mV/min).

The electrochemical behaviour of V_2O_5 electrodes has been investigated by charge-discharge curves in galvanostatic regime, at room temperature, using Li/ V_2O_5 button cells. These batteries were discharged at the current density of 1mA/cm^2, whereas the charge curves were performed at 0.5mA/cm^2, because the oxidation process unfolds slower [5, 6].

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Results and Discussion

The cyclic voltammograms for electrode containing 64.5%V_2O_5, 29% graphite and 6.5% Teflon are showed in figure 1. It can be observed two cathodic peaks (at 3.192 V vs. Li and 3.390V vs. Li), corresponded at lithium ion insertion in crystalline lattice of V_2O_5 and two anodic peaks (at 3.258V vs. Li and 3.446V vs. Li) corresponded to the oxidation of V_2O_5,too. Also, it can be remarked one small anodic peak at 3.194V vs.Li, witch corresponded to the oxidation of intercalation compound $Li_x V_2O_5$.

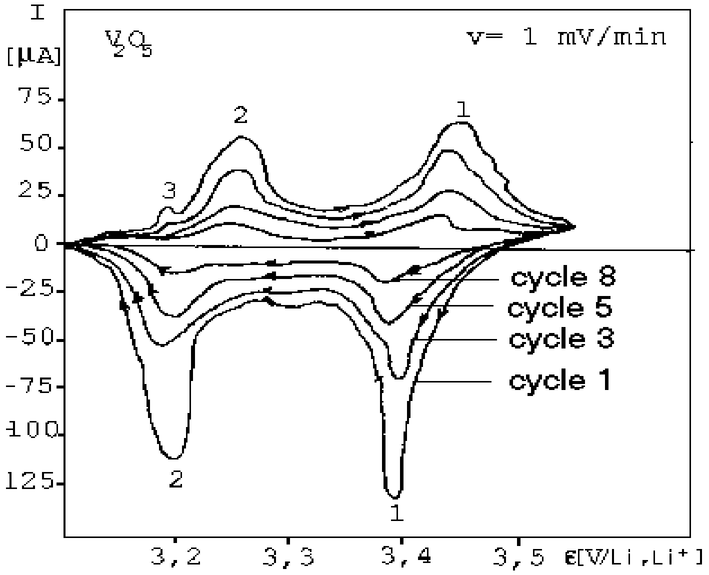

Fig. 1 *Cyclic voltammograms of V_2O_5 electrodes.*

It was observed one cathodic peak about of 0.75 V vs. Li accordingly to lithium ion insertion in graphite. The cathodic and anodic peaks correspond to the two main plateaus of the charge-discharge curves (see Fig. 2).

From the experimental data, corresponding to the different cycles, discharge capacities C_{disch} , charge capacities C_{ch} , utilization coefficient of active mass and efficiency of batteries have been estimated. The electrochemical characteristics of electrodes with 64.5% V_2O_5, 29% graphite and 6.5% teflon are shown in Table 1.

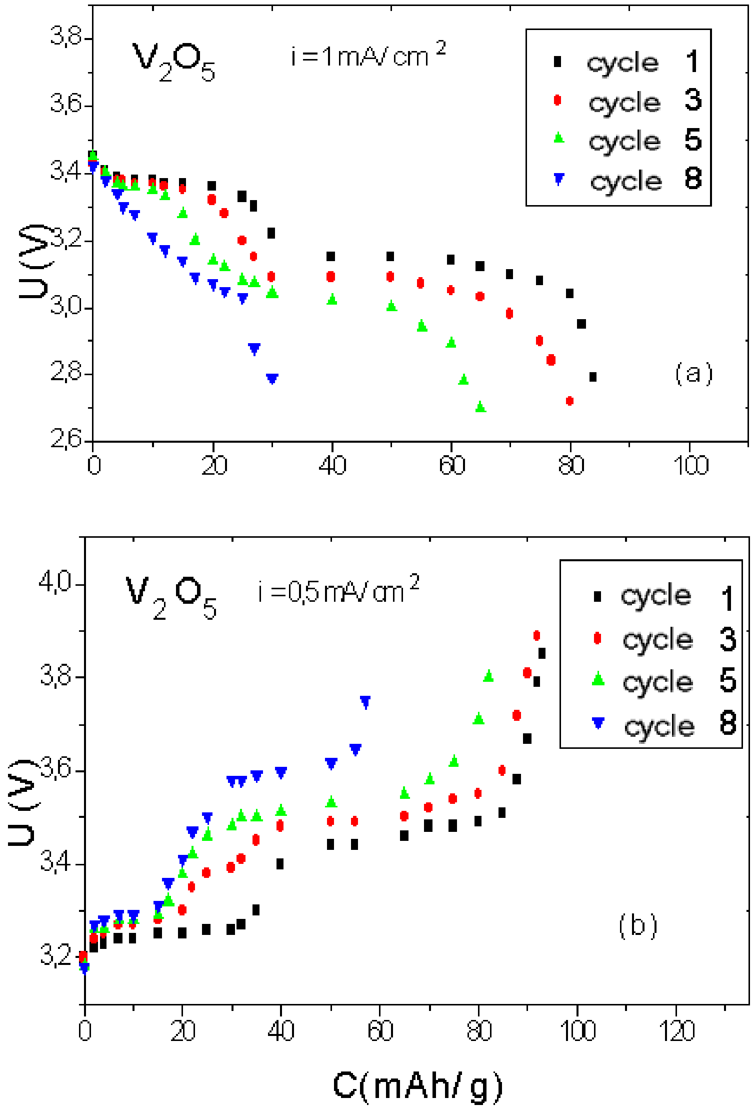

Fig. 2 *Performance curves of Li/V_2O_5 cell; (a) discharge curves and (b) charge curves.*

Table 1 *Electrochemical characteristics of V_2O_5*

Cycle	C_t [mAh/g]	t_{disch} [h]	C_{disch} [ah/g]	t_{hc} [h]	N_{CH} [ah/g]	F_r [%]	u [%]
1	94.69	20	81.24	45	91.39	88.89	85.57
3	94.69	19	77.18	44	89.37	86.63	81.50
5	94.69	15	60.93	40	81.24	77.88	64.34
8	94.69	8	32.49	30	60.93	53.23	34.31

The reversibility of the electrode processes decreases with the number of charge-discharge cycles, because the oxidation process becomes more difficult in the presence of lithium ions.

Conclusion

From the obtained results it can be establish that V_2O_5 electrodes present good electrochemical characteristics, the intercalation process taking place by diffusion of lithium ions in the crystalline lattice of active mass.

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