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Activated Carbon Based Supercapacitors

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In this paper we present investigations of nanoporous carbon materials from organic raw materials of vegetable nature appropriate to be used as an electrode component in supercapacitors with an aqueous electrolyte. For such materials the principal energy – capacity characteristics are determined. Some types of supercapacitors based on the obtained materials are developed and their parameters are investigated.

Keywords: Vegetable raw material, Supercapacitor, Electrode, Capacity.

PACS numbers: 81.05.U – , 81.07.De

In this work, we have studied the main performance characteristics of disk-shaped non-polar electric double-layer capacitor (EDLC) with electrodes made of activated nanoporous carbon material. Raw material: banana peel. Carbonization was carried out at low vacuum (8-10 Pa) at a temperature of 700 °C for 1 hour. Activation: $T \approx 800$ ° C; $t = 40$ min.; $P = 8$-10 Pa in the KOH.

The experimental samples of supercapacitors (SC): the case of typesize "2325", nickel mesh lamel electrodes extruded at 50 atm/sm² without additives and binder material. Electrolyte: 30% water solution KOH. Two coats of asbestos paper for chemical power sources "Bahyt-48" thickness 48-52 microns was used as separator. The mass of the active material on each electrode 0.16 g.

Charge-discharge curves at the current 0.005 A are shown in Fig. 1. Calculated specific capacity of the material is 126.3 F/g.

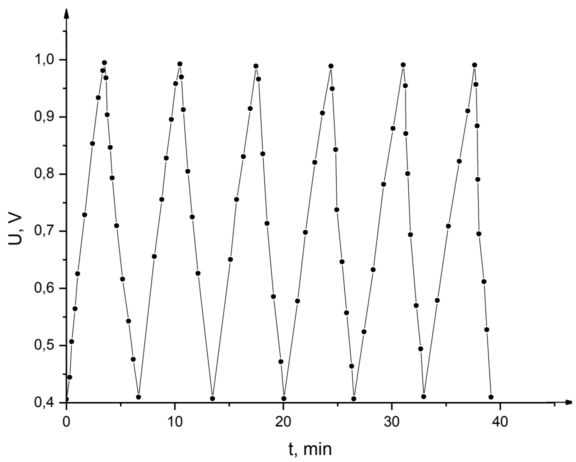

Fig. 1 –Charge-discharge curves at the current 0.005 A

In Fig. 2 shows voltammograms of experimental samples at different speeds scans. The linearity of SC voltage change on time (in 0-0,9 B) and absence in voltammogram any peaks and half-waves indicates that this electrochemical cell has the characteristics of a classical capacitor and electrode material does not contain impurities.

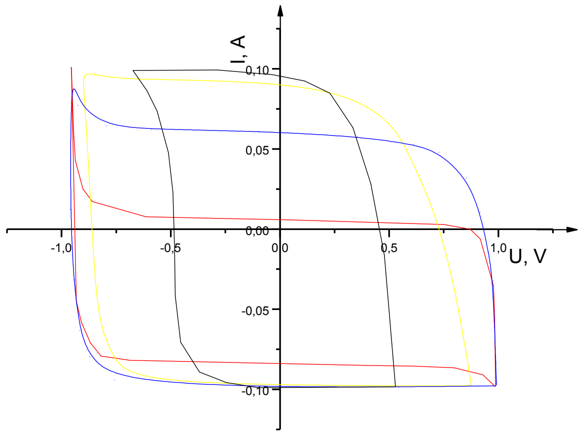

Fig. 2 – Voltammograms of experimental samples at different speeds scans:
- __ - scanning speed 50 mV/s;
- __ - scanning speed 20 mV/s;
- __ - scanning speed 10 mV/s;
- __ - scanning speed 5 mV/s.

Mode $I_{charge\text{-}discharge}$ = const is used very rarely in practice. The most widely used the mode of the charge-U = const and discharge-R_l = const. In Fig. 3 shows the discharge curves of prototypes for different values of R_H. It was established that the course of the discharge voltage curve described by (1.1):

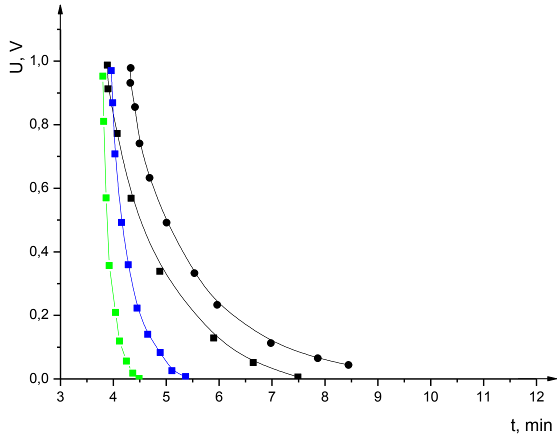

Fig. 3 – The discharge curves of prototypes for different values of R_l.
__ - 10 Ohm; __ -20 Ohm;
■ – 50 Ohm; ● – 70 Ohm.

$$U(t) = U(0)\exp\{-[\frac{t}{C(R_{\text{н}} - r_i)}]\}, \qquad (1.1)$$

$U(t)$ – discharge voltage value at time;
C – capacity of the investigated SC;
R_l – magnitude of the external load;
r_i – internal resistance SC.

It is also found that the Coulomb efficiency was stable at the level close to unity and was constant up to investigated 10^5 cycles.

It is concluded that this method of carbon obtained from organic materials can be successfully used as an electrode component in SC.

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