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OBTAINING OF ACTIVATED CARBON MATERIALS FOR SUPERCAPACITORS

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It is proposed ecologically pure technology for obtaining of activated carbon. On the base of activated carbon the supercapacitors were manufactured and their characteristics were determined.

Keywords: activated carbon; supercapacitor; ecologically pure materials

INTRODUCTION

Technological process of obtaining activated carbon (AC) with highly-developed surface (>1000 m^2/g) for manufacturing supercapacitors (SC) with a double electric layer is complex and often ecologically dangerous process [1,2]. Therefore search of new possibilities of obtaining AC which improve fabrication process and eliminate existing defects seems to be urgent.

In the present work the possibilities of obtaining of AC in closed volume were studied when carbonization and activating of initial material take place without inert gas as a carrier of pore generator. This allows to control effectively technological regime of obtaining AC because the mass and the heat transport are practically excluded in contrast to traditional technologies when flow of vapor and inert gas take place at the same temperature.

Thus, the aim of the present work is to obtain activated carbon with developed surface area by ecologically pure technology, to manufacture supercapacitors on its base and to determine their characteristics.

RESULTS AND DISCUSSION

As an initial material for obtaining AC ecologically pure material fruit pips (cherry, plum, cherry sweet) were used, while in majority technologies ecologically dangerous (especially at heating) organic compounds (formaldehyde, hydrocelluloze, sterol etc) are used. As a pore generator was used KOH water solution (up to 20%). Milled initial material was heated in a closed system with residual pressure less than 10^2 mm Hg at the temperature at which occur their full carbonization. Then obtained material in mixture with about 20% water solution of KOH was heated in 600 cm^3 closed container to temperature 840–880°C and keep up at this temperature during 70–80 min. In both cases heating was linear in time with the rate of 15% min and cooling was in turn-off furnace regime. In consequence of the carbonization of initial material and their activation take place. Evidently, by means of the quantity of water or KOH solution one can easily control the vapor pressure and in this way the influence on the process of the pore generation and their pore sizes. The value of the specific developed surface and the pore sizes were estimated from the specific capacity of the active materials. The general developed surface was about 1000 m^2/g. The pore sizes were of several microns. The process is easily controlled at the temperature regime also.

Thus, KOH water solution electrolyte was used in this investigation. The capacitance characteristics were measured on the setup of the firm "Maccor". The SC working voltage was 1.0 V; the electrode mass was 1.0 g.

Figure 1 shows experimental dependence of the SC capacitance in the body with the "2525" typesize, formed on the base of obtained material, at temperature of activation (The mark "2525" means that the diameter of the

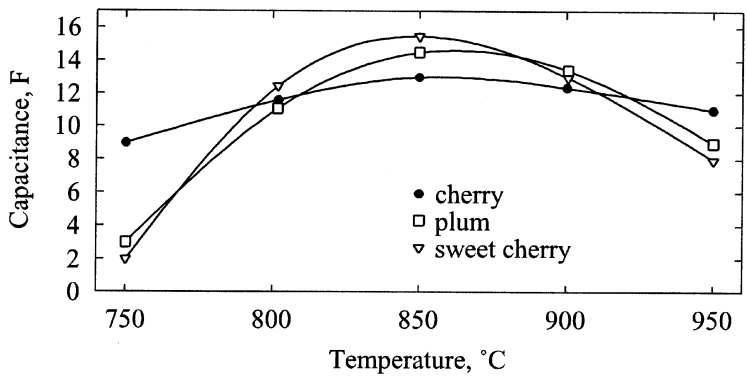

FIGURE 1 Dependence of the SC capacitance on the activation temperature of AC from which electrodes are formed.

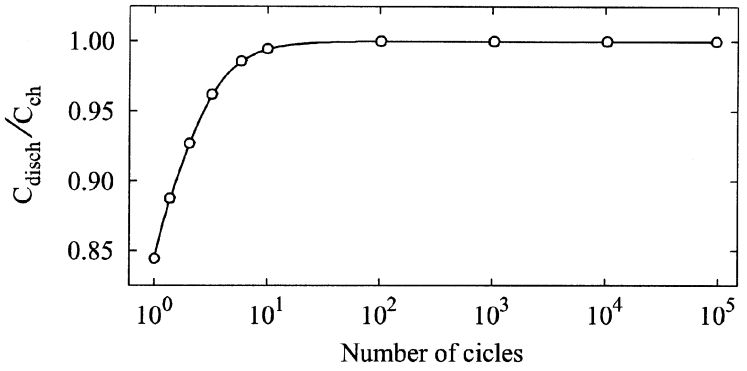

FIGURE 2 The Coulomb efficiency of SC from obtained AC in the body with the "2525" typesize.

all body is 25 mm and its height is 2.5 mm). As it is seen from Figure 1 optimal temperature for activation of preliminary carbonized initial material changes from 840 to 880°C under other identical conditions. The internal resistance at mentioned temperatures is in the range from 0.08 to 0.1 Ω. Achieved parameters of SC are not worse than analogous ones formed on the base of AC from sterolvinilbenzol copolymer [3].

Figure 2 shows the Coulomb efficiency of SC formed on the base of obtained AC. As it is seen from Figure 2 it is already after some cycles the Coulomb efficiency was stable at level 1 and was constant up to investigated 10^5 cycles. This confirms the Faraday reactions in investigated SC are absent what is intrinsic to the ideal polarized electrods. Therefore the

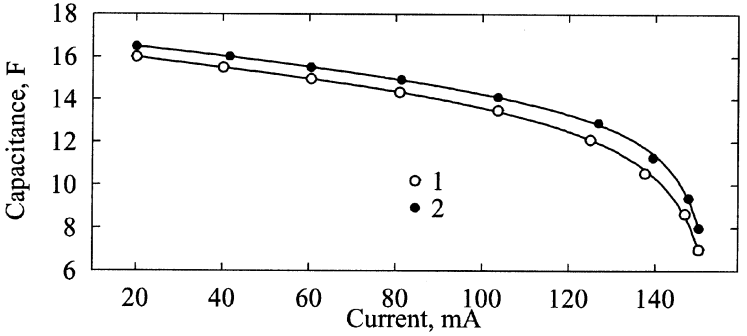

FIGURE 3 The dependence of the SC capacitance in the body with the "2525" typesize on the discharge current. 1- SC on the base of obtained AC, 2- SC on the base of AC obtained from sterolvinilbenzole copolymer.

electrodes on the base of obtained AC are practically ideal polarized ones. Moreover, it is found that the typical charge-discharge curves at the change current 0.05 A and at the discharge current 0.02 A are normal. This indicates that investigated capacitors are near classic ones.

The dependencies of obtained SC on the discharge current (Fig. 3) were also studied. Small differences in these dependencies in comparison with SC formed on the base of AC from stirolvinilbenzole copolymer were found.

Thus, the process of AC manufacturing is simplified, and is more controlled and ecologically secure. At the same time the operational characteristics of SC formed on its base is not worse than analogous obtained on the base of ecologically dangerous materials.

RESUME

We proposed and realized a new technology for obtaining activated carbon. This technology uses ecologically pure materials. All technological process is also ecology secure and occurs in a closed volume without any inert gas. We obtained activated carbon with developed surface area 900–1000 m^2/g and manufactured supercapacitors on its base. Their capacitances in the body with the "2525" typesize are about 10–15 F and the internal resistances lie within the limits 0.06–0.09 Ω.

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