Electrophysical characteristics of an activated composite based on humic acid and microspheres

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Electrophysical properties are the main indicator of carbon materials used in electrothermal processes, as well as for the manufacture of superconducting materials, capacitors and fuel cells from them. Measurements of the electrophysical properties were carried out according to the technique [1].

In this work, the electrophysical characteristics of an activated composite based on humic acid and a microsphere (10/1) have been investigated. The porous carbon material was obtained by carbonization and activation in argon and water vapor. The study of the electrical properties (dielectric constant (ϵ), electrical resistance (R)) was carried out by measuring the electrical capacity of the samples on a serial device LCR-800 (Taiwan) at an operating frequency of 1 kHz, 5 kHz and 10 kHz continuously in dry air in a

the data obtained, the band gap (ΔE) of the samples was calculated.

The electrophysical characteristics of the obtained composite material were investigated to study the possibility of using it as electrode materials for a supercapacitor. According to the results of the study, it was found that the activated HA: microsphere = 10: 1 at all studied frequencies of 1, 5 and 10 kHz in the range of 293 - 483 K shows very high, and at 1 kHz - colossal values of the dielectric constant: $2.27 \cdot 10^7$ (1 kHz), $1.41 \cdot 10^6$ (5 kHz), $4.14 \cdot 10^5$ at 293 K, $7.20 \cdot 10^8$ (1 kHz) at 423 K, $4.0 \cdot 10^8$ (5 kHz) at 483 K and $1.27 \cdot 10^8$ (10 kHz) at 483 K. It should be noted that the dielectric constants of this relatively cheap carbon material can compete with a similar characteristic of the new material $\text{La}_{15/8}\text{Sr}_{1/8}\text{NiO}_4$, which has a gigantic dielectric constant of 10^5 - 10^6 . The composite exhibits semiconductor conductivity in the range of 293-333 K, metallic conductivity at 333-363 K, and semiconductor conductivity again at 363-483 K. The band gap at 293-333 K is 0.60 eV, and at 363-483 K - 0.34 eV can be attributed to narrow-probe semiconductors. The data obtained demonstrate the prospects for using this product in the electrochemical industry, having already at 293 K a colossal dielectric constant, especially 1 and 5 kHz, is of interest for microcapacitor, and as a semiconductor is also important for semiconductor technology.

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