PROGRAM SCHEDULE

CARBON 2019

LEXINGTON, KY

JULY 14 - 19

MONDAY POSTER SESSION 5:20 - 8:20PM, BLUEGRASS BALLROOM

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18 Nanoscopic combination of edge and flat planes in active site for oxygen reduction and evolution **Maruyama**

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227 A facile synthesis of pitch-based carbon microbeads and its superior performance for sodium-ion batteries **Song**

228 Functionalization of commercial carbon for superior capacitance enhancement **D'Souza**

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304 Generation of a mesoporous web-like carbon-vanadium oxynitride as an electrode material for symmetric supercapacitors **Ndiaye**

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RESEARCH OF THE EFFECT OF THE CONDITIONS OF SYNTHESIS OF CARBON MATERIAL FROM RICE HUSK ON THE ELECTROCHEMICAL PROPERTIES OF THE SUPERCONDENSATOR ELECTRODES

Prikhodko N[1,2*], Lesbayev B[1,3], Yeleuov M[1,4], Taurbekov A[1], Temirgaliyeva T[1,3], Turganbay A[1,3], Ustayeva G[1,3], Nazhipkyzy M[1,3], Mansurov Z[1,3]

[1]*Institute of Combustion Problems, Almaty, Kazakhstan*
[2]*Almaty University of Power Engineering and Telecommunications, Almaty, Kazakhstan*
[3]*Al-Farabi Kazakh National University,Almaty, Kazakhstan*
[4]*Satbayev University, Almaty, Kazakhstan*
**e-mail:nik99951@mail.ru*

Introduction

Despite the diversity of carbon material used as electrodes for a supercapacitor and methods for their modification, the search for new efficient carbon nanostructures continues.This is due to the fact that currently used carbon materials do not always meet all operational and economic requirements. In this paper, a study was conducted and the method of carbonization and activation of rice husk was developed, which made it possible to obtain nanoporous carbon material with a large specific surface. The results of the study of the influence of methods of rice husk carbonization (CRH) with subsequent activation on the electrochemical properties of the supercapacitor electrodes are presented. The parameters of the pore size distribution in the nanoporous structure and the specific surface greatly influence the capacity and kinetics of the charge-discharge characteristics of the supercapacitor[1].

Materials and Methods

Carbonized rice husk was used as a carbon precursor for the preparation of activated carbon and potassium hydroxide as an activation agent for thermochemical treatment. To increase the specific surface area, the CRH is subjected to activation processes. To obtain activated carbon from CRH, physical and chemical activation was investigated. The obtained samples were examined on a scanning electron microscope (JSM-6490LA). The specific surface area was studied by the BET method («Sorbtometr M» and «Micromeritics Instrument Corp. ASAP 2400 V3.07»). Measurements of the electrochemical characteristics of the electrodes were carried out using a two-electrode cell in an alkaline electrolyte using anelectrochemical work station (Elins P-40X). The specific capacitance was calculated from cyclic voltammetry and galvanostatic charge-discharge curves. Physical activation was carried out at a temperature of 900 °C with a steam-gas mixture consisting of water vapor and carbon dioxide fed into the reactor. Thermochemical activation of CRH was carried out at a temperature of 850 °C in an inert gas, pre-mixed with potassium hydroxide powder.

Results and Discussion

A BET analysis of the treated CRH samples was performed. The results are presented in **Table 1**. Standard calculations for determining the specific surface by the BET method of carbonized rice

husk before activation show that the specific surface area of the samples ranges from 270 to 350 m^2 g^{-1}. It was established that the carbon material obtained during physical activation does not have sufficient specific surface area 900 m^2 g^{-1} and porosity necessary 0.39 cm^3 g^{-1} for the effective use of an electrode material for supercapacitor. The highest gravimetric capacity of the supercapacitor based on physical activation has low values, not exceeding 85 F g^{-1}. However, porous carbon obtained by chemical activation showed a specific surface area of up to 3200 m^2 g^{-1}, with a specific pore volume of 1.1-1.4 cm^3 g^{-1}. As a result of the research, it was found that the optimal temperature for thermochemical activation is 850° C and the activation time is 90 minutes. In this case, the gravimetric capacity of the electrode material varies from 187 to 254 F g^{-1} at a sweep speed of 160 to 1 m V s^{-1}, respectively (**Figure 1**).

Table 1. The BET results of carbon samples

Samples	Specific surface area, m^2 g^{-1}	Specific pore volume, c^2 g^{-1}
Carbonized rice husk	270-350	-
Physical activation	780-900	0.39
Chemical activation (degree of impregnation KOH: CRH = 4: 1)	2800-3200	1.1-1.8

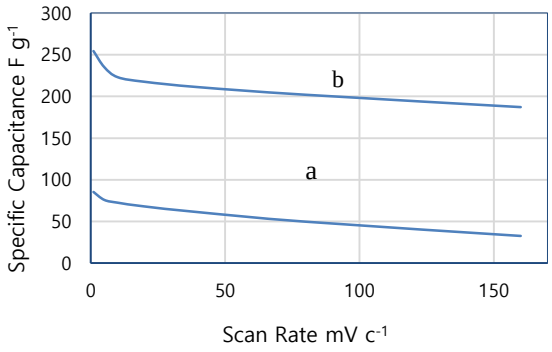

Figure 1. The specific capacitance of physical (a) and chemical (b) activated CRH based electrodes calculated from CV

Conclusions

It is established that thermochemical activation, as compared with physical activation, allows obtaining carbon material having a developed specific surface area and specific pore volume, which ensures its high gravimetric capacity.

Acknowledgment

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References

1. Gao, Y., Li, L., Jin, Y., Wang, Y., Yuan, C., Wei, Y., Chen, G., Ge, J. and Lu, H.(2015). Porous carbon made from rice husk as electrode material for electrochemical double layer capacitor. *Appliedenergy153*, 41-47.