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Opinion

Electrochemical Properties of Activated Carbon Cloths

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Opinion

In this work we studied activated carbon cloths (ACC) CH900 from Kuraray (Japan) and VISKUMAK, Russia. To study the porous structure and hydrophilic-hydrophobic properties of these ACCs, the method of standard contact porosimetry (MSCP) was used [1,2]. This method allows not only to study the porous structure of any materials in the widest possible range of pore radii ~ from 1 to 3x105 nm, but also to study their hydrophilic-hydrophobic properties. This method has been recognized by IUPAC [3]. Figure 1 shows SEM micro images for ACC VISKUMAK and ACC CH900. As can be seen from the table, the porous structure of both ACCs includes both hydrophilic and hydrophobic porosity (Table 1).

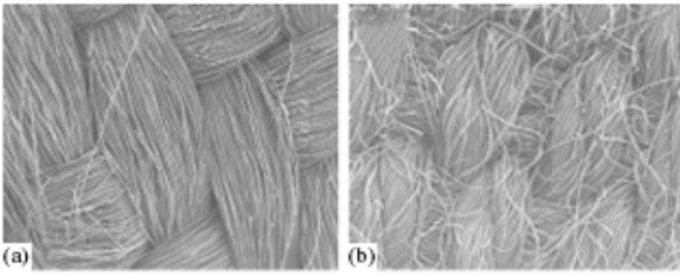

Figure 1: SEM micro images for a) ACC VISKUMAK and b) ACC CH900

Table 1: The characteristics of the porous structure and hydrophilic-hydrophobic properties of ACC.

Carbon Cloth Activated	Total Surface Area, m^2/g	Hydrophilic Surface Area, m^2/g	Total Porosity, cm^2/cm^2	Hydrophilic Porosity, cm^2/cm^2	Hydrophobic Porosity, cm^2/cm^2
CH900	1520	850	0.85	0.786	0.064
VISKUMAK	600	416	0.729	0.623	0.106

It is known that activated carbons contain a large number of ionogenic functional groups (FGs). FG have a significant impact on various properties of activated carbons. Functional group counterions provide surface conduction (SC) for activated carbons. In [4], a technique was developed for measuring surface conductivity (SC) in porous electrodes using activated carbon cloths as an example.

Surface conductivity is the longitudinal (tangential) conductivity of the electric double layer (EDL). On Figure 2 shows the dependence of the electrical conductivity (κ) on the KCl concentrations (c) for the CH900 electrode (a similar dependence was obtained for the WISKUMAK fabric). As you can see, this dependence is almost linear. The value of the surface conductivity was obtained by extrapolating this dependence to the value c=0. Thus, even in pure water, ACC have ionic electrical conductivity due to the presence of a large amount

of FGs. It was found that in CH900 the anion exchange and cation exchange capacities are 0.7 and 0.06mmol/g, respectively.

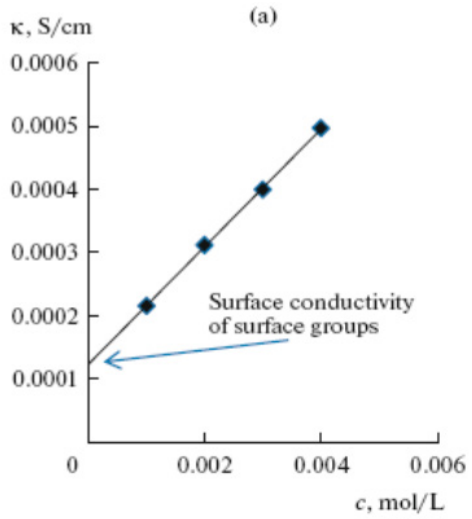

Figure 2: Dependence of the conductivity (κ) on the KCl concentrations (c) for electrode of ACC CH900. Illustration of determination SC by extrapolation.

According to the literature, the specific capacity of porous carbon materials is typically 50-200F/g [5]. However, the specific capacitance values reaching 1100F/g were obtained [5]. In this study, concentrated sulfuric acid with the concentration from 30 to 60% was used as the electrolyte. ACC CH900 was used as the electrode. The measurements were carried out in a wide potential interval from -0.8 to 1.0V (R.H.E). The possibility of carrying out the deep cathodic charging to so negative potentials was provided by the high polarization of hydrogen evolution reaction on carbon materials. Very high specific capacitance 1100F/g were obtained mainly due to the high pseudo capacitance of the reaction of hydrogen intercalation into carbon. This corresponds to the formation of a new compound C6H, which means carbon hydride or hydrogen carbide [6]. Consequently, activated carbon cloth CH900 can be used as high effective supercapacitor electrode.

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