STRUCTURAL ANALYSIS OF ACTIVATED CARBONS AS AN ELECTRODE MATERIAL FOR EDLCS USING THE TEM IMAGE PROCESSING METHOD

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Introduction

Activated carbons obtained by chemical activation with potassium hydroxide (KOH) are utilized as an electrode material for electric double layer capacitors (EDLCs). The basic concept of EDLCs is that the ions in electrolyte are desorbed and absorbed to the pore on the surface of activated carbon during charge-discharge cycle. Therefore the characteristics of EDLCs are strongly depending upon the differences in the nanostructure of the pore on the surface of activated carbon. In this study, we computed the pore size distribution by performing frequency analysis to the raw transmission electron microscope (TEM) image of activated carbon. And we also performed an analysis using the TEM image simulation.

Experimental

Firstly, we carried out TEM image simulation for the model containing various sizes of defects in graphene sheet (Figure 1). Then, we performed frequency analysis for a provided simulation image and identified the difference of peaks as a function of defocus and pore size. Secondly, we utilized activated carbon fibers (ACFs) that was chemically activated by potassium hydroxide (Table 1). We obtained the raw TEM images for these samples, and carried out frequency analysis for a provided TEM image. Finally, comparative study was done for the simulated results.

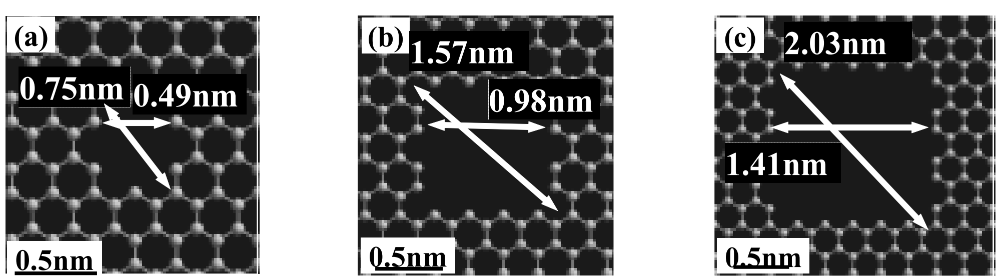

Figure 1. Pore model. Pore size are (a)0.49-0.75nm (b)0.98-1.57nm (c)1.41-2.03nm.

Table 1. Specific surface area and activation condition.

Sample	BET surface area (m^2/g)	Activation (℃-h)	KOH (wt.%)
(1)	721	800-2	150
(2)	1,054	800-2	250
(3)	2,442	800-2	400

Results and Discussion

Simulation results of TEM images are shown in Figure 2. Figure 2 (a) and (b) reproduce the size of the real pore. In Figure 2(c), virtual image has appeared in the center of pore. From this result, it is sure that a data obtained from a frequency analysis is not similar to that of real pore size. Figure 3 (c) shows result of frequency analysis. With the increase in quantity of KOH weight percent, it is shown that pore size become larger. From the result of (3), there are two large peaks. This can be explained by the influence of a virtual image appeared like in the result of simulation. From these results, we cannot precisely obtain the pore size. Therefore, in order to obtain a meaningful data from TEM images, we have to get TEM images as a function of defocus, then perform frequency analysis for each image, and then finally compare the simulated result compared to that of examined result.

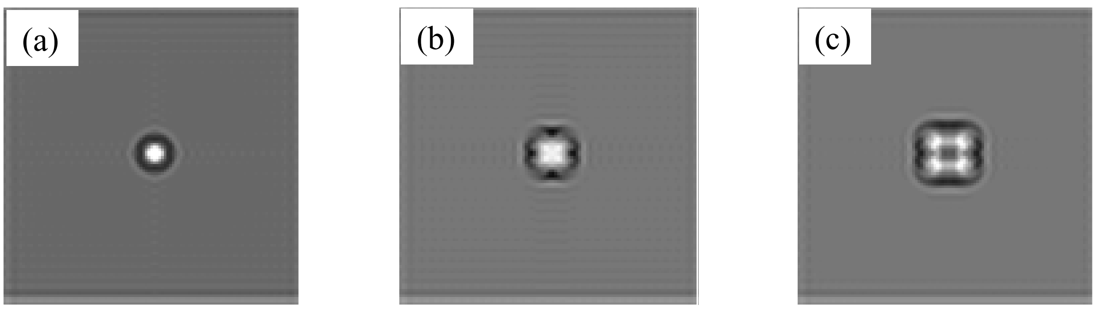

Figure 2. Simulation of TEM image for pore model (df=-13nm).

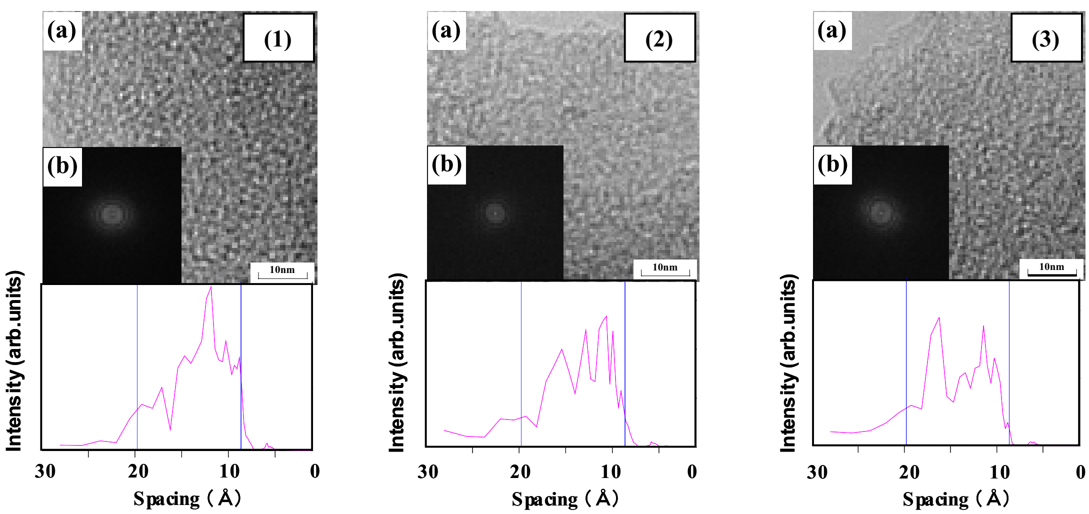

Figure 3. (a)HRTEM image of MPCF. (b)2D power spectrum. (c)Pore size distribution.

References

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Acknowledgements

This work was supported by the CLUSTER of Ministry of Education, Culture, Sports, Science and Technology.