Study of Morphology of Film Reduced Graphene Oxide from Coconut Shell

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***Abstract* – Coconut shell as the main ingredient in this study were converted into charcoal. The resulted sample coconut shell charcoal was used as a powder and heated. After heating, the powder was dissolved into distilled water. They were coated on the glass substrates using a spin-coating method. Furthermore, this study characterizations using Scanning Electron Microscopy-Energy Dispersive X-ray (SEM-EDX) were conducted for all samples. r-GO layer coconut shell has been successfully made on glass substrates, is shown with layers that have accumulated weight percentage of carbon atoms in each sample layer, that is equal to 84.55% and 20.61%.**

***Index Terms* – coconut shell, film r-GO, morphology, spin-coating.**

INTRODUCTION

Indonesia is one of thr biggest coconut producers in the world, until now most the parts of coconut can be used. But there is underutilized waste from coconut product, it is coconut shell. Coconut shell has a hard layer with thickness of about 3-5 mm consisting of lignin, cellulose, methoxyl and various minerals. The weight of coconut shell is about 15-19% of the overall weight of coconut. Coconut shell is organic material used for produce elements of carbon then it can be produce charcoal and activated carbon.

Charcoal contains impure carbon produced with removing water and volatile matter. In contrast to activated carbon, this product needs activator to produce a large surface area so it can be used as adsorbent. Activated carbon and graphite has same structure, it is HCP (Hexagonal Close-Peaked) however, the regularity of graphite structure is higher than activated carbon [1]. Graphite formation can be occurred on carbonization process of coconut shell fiber at a given temperature. However this needs further investigation regarding the carbon phase is formed in each of the carbonization process to form crystalline graphite.

Graphene is a material phase with the main elements of carbons arranged in a similar hexagonal honeycomb bonds that only form a two-dimensional layer. Graphene is found experimentally in 2004 [2]. Graphene as one of the advanced material derived from carbon bond has some superior properties, such as high electron transport with thin dimensions, as well as the strongest material beyond the diamond. Graphene phase can be found in all materials having a high purity carbon bonds, one of which is found in coconut shell with a particular treatment. Graphene is an exciting material, having a large theoretical specific surface area (2630 m^2g^{-1}), high intrinsic mobility (200.000 $cm^2v^{-1}s^{-1}$) [3,4,5], and thermal conductivity (~5000$Wm^{-1}K^{-1}$) [6], and good electrical conductivity merit attention for applications such as for transparent conductive electrodes [7], among many other potential applications.

Among various methods for obtaining thin films graphene (exfoliation, epitaxial growth, chemical vapour deposition) [8,9] and r-GO, the solution process method reported hitherto has several advantages like low cost, ease of fabrication and large scale application. Many researchers adapt spin coating technique consuming lot of solution even for obtaining thin coating.

METHOD

r-GO solution of coconut shell is used as a layer of r-GO. The liquid is coated on the glass substrate using a spin-coating method. Substrate layer using a glass slide (amorphous silica glass) cut to the size of 1x2 cm and washed into 50 ml of alcohol with ultrasonic cleanser for 1 hour. Then the glass substrate was dried over a hotplate at a temperature of 400C for 30 minutes. R-GO solution of coconut shell is coated on the glass substrate using a spin-coating at a speed of 2000 RPM for 50 seconds.

Spin-coating method is a method of growing a thin film on a substrate by means of liquid dripping into the center of the substrate is rotated. The substrate used was glass. The material used as a thin layer deposited or placed at the center of the substrate either by manual or robotic assistance. The material is poured on the substrate. Spin-coating is based on the assumption that the flow of solution to be in stable condition when the centrifugal force and the force of viscosity by then satisfy the equation:

$$-\eta \frac{\partial^2 v}{\partial z^2} = \rho\omega^2 r \quad (1)$$

z and r is a cylindrical coordinate system the direction of the axis of rotation of the substrate

v is the solution velocity in the radial direction

ρ is the density of the solution

ω is the rotational speed in radians per second

η is the viscosit

RESULT AND DISCUSSION

Figure 1a) shows layers stacked very much like to form stratified layers arranged. To ensure that the layers are stacked this is an element of the sample r-GO coconut shell do mapping and EDX. Figure 1b) shows that the layer of r-GO coconut shell formed on the glass substrate marked with red color during the process of mapping. This is reinforced by the results of EDX in the layer stack containing the elements carbon (C) with a weight percentage of 84.55% and the rest is the element of the glass substrate (can be

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seen in Table 1). Whereas in Figure 2a) also shows the layers stacked very much in the SF-8. On the picture there seemed plenty of bright colors (such as bright white colored). So that should be mapped in order to know the elements contained in the layer.

Figure 2b) shows the results of mapping at the SF-8. The yellow color shows the elements of r-GO coconut shell. It is able to ensure that bright colors (like white) on the stack of layers produced by the SEM image is an r-GO layer coconut shell on the glass substrate. Strengthened also by the results of EDX in the layer stack. The elements carbon (C) in the layer stack has a weight percentage of 20.61%; Oxygen (O) amounted to 62.03% and the rest is the element of the glass substrate (can be seen in 2).

Table 3 shows the different layers thick on each film sample. Thick film layer is known to use an optical microscope in the Laboratory for Optical Physics and Instrumentation Department of ITS. Differences thick film layer caused by the size of each particle in the sample solution is dripped on the glass substrate (which later in the spin-coating) during the filming of r-GO. Examples of optical microscopy test results on samples of SF-8, shown by Figure 3. SF-2 has the greatest layer thickness is equal to (81 8), and SF-4 has the thinnest coating thickness that is equal to (46). Differences thick layer homogeneity is influenced by particle size in the sample solution. SL-2 has a homogeneous particle size, indicated that formed the peak generated when the particle size test. This resulted in a thick layer on the SF-2 uniform or homogeneous. While the sample does not have a homogeneous particle size characterized by peak particle size is more than one, have thick uneven layer on its surface.

CONCLUSION

Film r-GO coconut shell has been successfully made on glass substrates is evidenced and reinforced by the results of SEM-EDX analysis on the SF-4 and SF-8, is shown with layers that have accumulated weight percentage of carbon atoms in each film sample, that is equal to 84.55% and 20.61%.

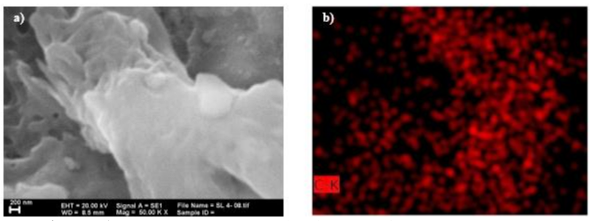

Figure 1. a) SEM Test Results, b) Mapping (EDX) on SF-4

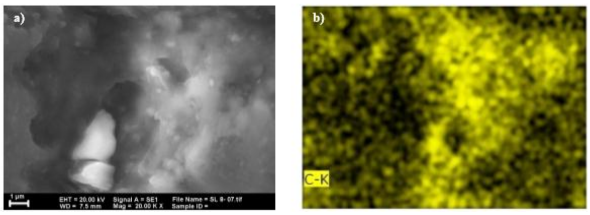

Figure 2. a) SEM Test Results, b) Mapping (EDX) in the SF-8

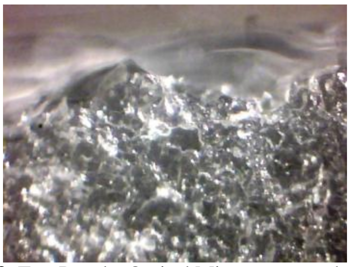

Figure 3. Test Results Optical Microscope on the SF-8

Table 1. Results of EDX SF-4

El	AN	Series	unn. C [wt.%]	norm. C [wt.%]	Atom. C [at.%]	Error [%]
C	6	K-series	84.55	84.55	93.01	2.9
Na	11	K-series	2.33	2.33	1.34	0.2
Mg	12	K-series	0.45	0.46	0.25	0.1
Si	14	K-series	8.60	8.60	4.04	0.4
K	19	K-series	2.04	2.04	0.69	0.1
Ca	20	K-series	2.03	2.03	0.67	0.1
		Total:	100.00	100.00	100.00	

Table 2. Test Results EDX on SF-8

El	AN	Series	unn. C [wt.%]	norm. C [wt.%]	Atom. C [at.%]	Error [%]
C	6	K-series	20.61	20.61	27.90	9.7
O	8	K-series	61.05	61.05	62.03	21.9
Na	11	K-series	1.71	1.71	1.21	0.2
Mg	12	K-series	0.39	0.39	0.26	0.1
Si	14	K-series	11.57	11.57	6.70	0.5
K	19	K-series	1.47	1.47	0.61	0.1
Ca	20	K-series	3.19	3.19	1.29	0.1
		Total:	100.00	100.00	100.00	

Table 3. Thick layer of r-GO Coconut Shell

No	Sample Name	Layer Thickness (μm)
1	SF-1	58,7±8,0
2	SF-2	81,0±8,0
3	SF-3	76,3±9,5
4	SF-4	46,0±5,0
5	SF-5	50,8±5,0
6	SF-6	48,0±4,0
7	SF-7	52,4±4,5
8	SF-8	51,0±5,0
9	SF-9	45,2±5,0

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