Nanometers Formation Model of Iron (Fe) and Magnesium (Mg) on Graphene Nano Sheets

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Abstract: An experimental research is being conducted on the joining of dissimilar materials of grey cast iron to low carbon steel utilizing diffusion bonding method. Diffusion bonding process operates on the principle of solid-state diffusion, wherein the atoms of two solid, metallic surfaces intersperse themselves over time, moving an atomic mass form or diffusion through the lattice of a crystalline solid. Upon producing of the diffusion couples through diffusion bonding, the bonds are subjected to SEM (Scanning Electron Microscopy), EPMA (Electron Probe Micro Analyzer), XRD (X-Ray Diffraction), EDS/EDX (Energy Dispersive X-Ray Spectroscopy), WDX's (Wavelength-dispersive X-ray spectroscopy) micro-structural analysis and mechanical properties examination. Subsequent investigation is to be carried out to establish the diffusion mechanism, inter-diffusion coefficients and activation energy of the diffusion system. To study the optimum conditions that produce excellent and ultimate bond, various bonding parameters and variables are taken into consideration. This paper describes the research progress undertaken to date, explaining the materials involved, equipment, method and preliminary as well as current results on microstructure analysis, tensile test and micro-hardness test.

1 INTRODUCTION

Graphene is a two-dimensional (2D) carbon with a flat surface (Novoselov,2004). Graphene has special features compared to other materials, namely large surface area (2630 m2g-1) (Choi, 2012), high electrical conductivity (1250 S cm-1) thermal conductivity (4840-5300 Wm-1K-1) (Bianco, 2013), can interact with nanoparticle catalysts (Sharma, 2012) and have orbital π (Terrones et al., 2010). Therefore, graphene has been widely applied to super capacitors (Stoller et al., 2008), the electronics industry (O'Cornor et al., 2016), aircraft (Barret et al.,2010), automotive industry (Alonso et al.,2012), batteries (Zhu Yanwu, 2010), conductors (Ho et al.,2018), capacitors (Moldovan et al.,2016) and fuel cells (Geim and Novoselov, 2007). Synthesis of Graphene can be done by applying several methods including Chemical Vapor Decomposition (CVD) (Ismach et al., 2010), micromechanical exfoliation using tape scout and epitaxial growth on SiC substrates. However, the micro chemical exfoliation method is not efficient to do, while the CVD method and epitaxial growth are very expensive

(Jin et al.,2018). The other way to do graphene synthesis is to use the chemical synthesis method through the synthesis of graphene oxide (OG) first (Chen, X., and Chen, B, 2015) then the oxide bond in OG is reduced using a reducing agent chemical compound. Chemical OG synthesis using graphite powder which is oxidized with strong acid is called Hummer's method (Rafitasari et al, 2016). The interaction and size of the crystals of each Fe and Mg in Graphene have not been widely reported (Wang et al., 2016), especially with the analysis of X-ray Diffraction. Therefore, research of Interaction of Iron (Fe) and Magnesium (Mg) in Graphene Nano Sheets (GNS) Using X-ray Diffraction needs to be done.

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2 MATERIALS AND METHODS

2.1 Materials

Materials used in this study such as graphite, aquadest, grapheme, $MgCl_2.3H_2O$, $FeCl_3.6H_2O$, $NaNO_3$, H_2SO_4 96 %, H_2SO_4 5 %, H_2O_2 30 %, Ammonia 10 M.

2.2 Synthesis of Fe/GNS and Mg/GNS

A total of 0.5 grams of graphene is put into a glass beaker which contains 1.0 ppm standard iron and magnesium solution. Insert the magnetic bar into the beaker glass and sterilize it for 1 hour. Then filtered using Whatmann filter paper no. 42. So that the filtrate and sediment are obtained. The filtrate is not treated with anything. While the sediments obtained were weighed and characterized using XRD. The same is done for standard iron and magnesium solutions 2.0; 3.0;4.0; 5.0 and 10 ppm.

3 RESULTS AND DISCUSSION

3.1 Diffractogram of Graphite and Graphene Nano Shet (GNS)

Graphite and GNS diffraction patterns differ significantly. At C (002) Graphite, sharp and narrow peaks appear (Figure 1). That is, there is a buildup of Graphene layers to produce Graphite. After Graphite is oxidized with strong acids and oxidizers and reduced by ammonia, GNS is produced. Peak C (002) on the GNS is broad and weak which indicates that the GNS was successfully synthesized (Figure 1). The weak and widening peak proves that the resulting graphene is still nano sheets (not single-layered).

The research data obtained is consistent with the crystallographic data of JCPDS 008-0415 (Sankaran, M. 2009), where Graphite and GNS diffraction angles are synthesized close to the diffraction angle in the JCPDS data, meaning that GNS is successfully synthesized.

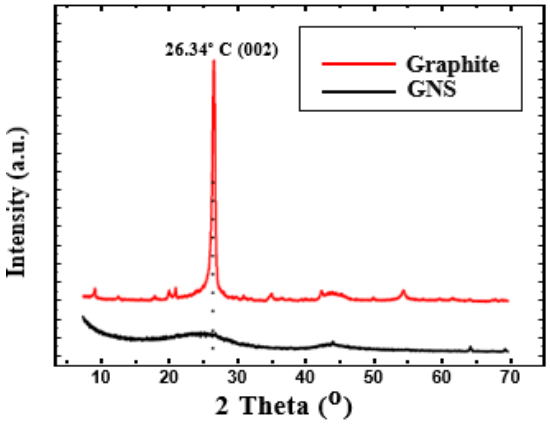

Figure 1: Diffractogram of graphite and GNS.

3.2 Diffractogram of Fe/GNS and Mg/GNS

To see whether Fe is deposited in the GNS and find out the effect of Fe and Mg concentration on the size of Fe and Mg crystals in the GNS, XRD analysis is carried out. Analysis of Fe / GNS and Mg/GNS with variations in concentration was carried out by X-ray Diffraction (XRD). The diffractogram of Fe / GNS and Mg/GNS obtained is shown in Figure 2 and Figure 3.

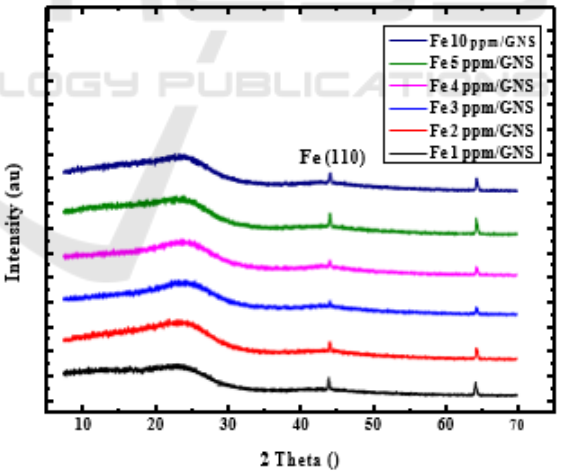

Figure 2: Diffractogram of variation in concentration Fe/GNS.

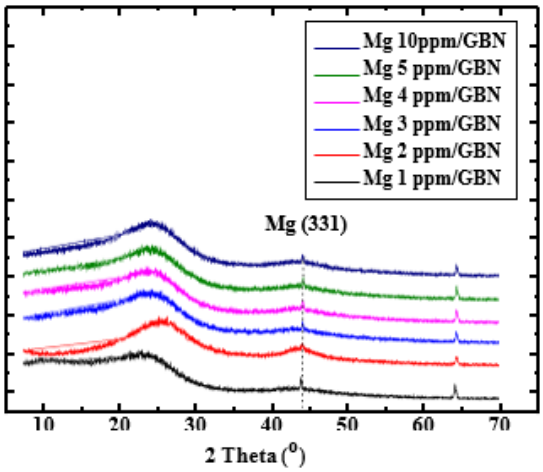

Figure 3: Diffractogram of variation in concentration Mg/GNS.

The XRD data shows that there is a sharp peak at 2θ = 43.79 - 44.04°, indicating that the peak is Mg with miller index 331 (Ramachandran, T. 2016), usually denoted as Mg (331). Mg (331) means that Mg zero valence is deposited in Graphene (Figure 3). According to Askeland, D. R (2016) Mg crystals with zero valence have hexagonal crystal structures/shapes. Peak Mg (331) on Mg / GNS with variations in concentration shows that the peaks also have a significant difference in intensity, except that the change in intensity on Mg / GNS is not like that of Fe / GBN. At Mg 3 ppm, Mg 4 ppm, Mg 5 ppm and Mg 10 ppm it appears sharp peaks and transient meetings for Mg 1 ppm and Mg 2 ppm, the peaks are weaker and wider. This means that the size of Mg crystals in GNS varies depending on the percentage. This is due to the distance between atoms and the difference in crystal size of Mg in the GNS.

4 CONCLUSIONS

Fe and Mg can be deposited into the GNS with chemical interactions, where the GNS plays a role in the properties / characteristics of the metal.

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