

Formation Process of Graphene Nano Sheets

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Abstract: Formation process of Graphene Nano Sheets (GNS) was described in this paper. The aims of this paper are to synthesize of GNS and to propose formation process of GNS base on magnesium (Mg) as a reductor agent. This research is an experiment laboratory research. The modification of Hummer's method was chosen to generate GNS. Then, GNS was characterized with FTIR. The results data show that Mg may be used to reduce epoxide functional groups.

1 INTRODUCTION

Graphene may be applied to many applications (Geim, 2007; Xu, 2015; Novoselov, 2004; Terrones, 2010; Soldano, 2010). Unfortunately, it cannot be produced naturally. It is possible to synthesize base on graphite as a raw material (Choi, 2011; Bhuyan, 2016; Lee, 2016). Generally, GNS may be synthesized by using CVD (Wang, 2009; Juang, 2010; Bárcenas, 2018; Jacobberger, 2015) and chemical method (Siburian, 2012, 2013, 2014, 2017; Ratih, 2018; Supeno, 2018; Sebayang, 2018). GNS may be generated with facile method. Commonly, chemical method in term of producing graphene uses graphite as a raw material (Bhuyan, 2016; Eigler, 2013; Saleem, 2018; Dimiev, 2014). Chemically method may be expected to large scale graphene production (Kairi, 2018; Li, 2014; Zhong, 2015; Parvez, 2015; Park, 2009), and exfoliated graphite (Gao, 2017). The commercialization of graphene and its derivatives product will be visible if it may produce on low cost, best quality, large scale and green material (Tatarova, 2017; Zhong, 2015). Therefore, in this paper the formation of GNS base on chemically method was studied, thereby large scale production of GNS may be done in future.

2 MATERIALS AND METHODS

2.1 Synthesis of GNS

In this research, GNS was produced with Hummer's modified method (Siburian, 2012). Briefly, 1 gram graphite was mixed with 75 mL H₂SO₄ 96% and 1 gram NaNO₃, stirred for 4 hours. Then, 5 gram KMnO₄ gradually was added into solution, stirred 4 hours, T = 20 °C at ice water bath condition. At the end of 4 hours, the solution was move from ice water bath and it was continue stirred for 48 hours at room temperature to form dark brown solution. Subsequently, 5 mL H₂O₂ 30% and 100 mL H₂SO₄ 5% was put into solution, respectively, stirred 2 hours to form graphite oxide. After that, graphite oxide solution was centrifuged at 6500 rotor per minute (rpm) for 20 minutes to separate between residue and supernatant. Then, residue was added 10 mL piranha solution and aquades, centrifuged at 6500 rpm for 20 minutes, respectively to form graphite oxide solution.

100 mL graphite oxide solution was ultrasonicated on 5060 Hz for 5 hours to form graphene oxide. Finally, 10 mL graphene oxide solution was added 0.01 mg magnesium (Mg) powder, stirred for 72 hours, filtrated and heated at T = 80 °C for 24 hours to produce GNS. Graphite,

graphite oxide, graphene oxide and GNS were characterized by using FTIR, respectively.

3 RESULTS AND DISCUSSION

First of all, graphite as a raw material was characterized with FTIR (Figure 1).

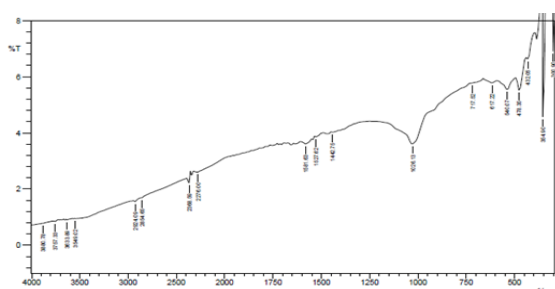


Figure 1: FTIR spectrum of graphite.

Figure 1 show that there is a weak and broad peak at 1581 cm^{-1} , indicating graphite consists of double bond aromatic carbon. In contrast, FTIR spectra of graphite oxide is totally different compare to graphite (Figure 2).

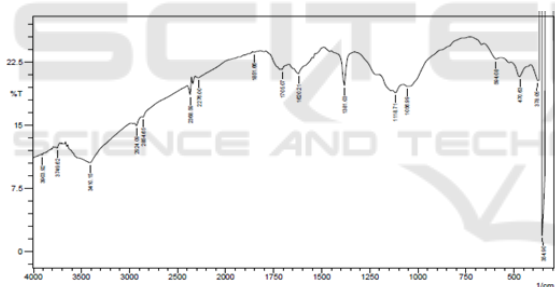


Figure 2: FTIR spectrum of graphite oxide.

FTIR data indicates that graphite oxide has hydroxyl functional group (-OH) (wave number (ν) = $3,410\text{ cm}^{-1}$), CH_2 ($2,924\text{ cm}^{-1}$), CH_3 ($2,854\text{ cm}^{-1}$), $\text{C}=\text{O}$ ($1,705\text{ cm}^{-1}$), and $\text{C}-\text{O}$ ($1,118\text{ cm}^{-1}$). Meanwhile, FTIR data of graphene oxide may be seen in Figure 3.

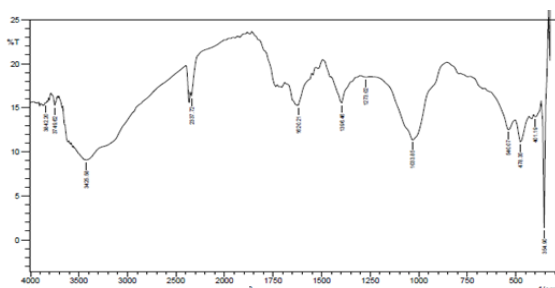


Figure 3: FTIR spectrum of graphene oxide.

The formation of graphene oxide may be indicated with $\nu = 3,410\text{ cm}^{-1}$ (-OH), $1,620\text{ cm}^{-1}$ ($\text{C}=\text{O}$), and $1,273\text{ cm}^{-1}$ ($\text{C}-\text{O}$). Finally, graphene oxide was reduced by using Mg to form GNS (Figure 4). In the presence of Mg, the epoxide functional group may be replaced by Mg.

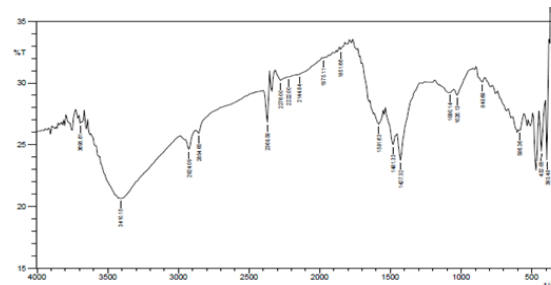


Figure 4: FTIR spectrum of graphene.

4 CONCLUSIONS

The formation of graphene occurs when functional group of graphene oxide was reduced by Mg. Mg may only reduced epoxy functional group.

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