Graphene 산화 Thinfilms 의 전기 수송 특성
Electrical Transport Characteristics of Graphene Oxide Thinfilms

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1. Introduction

In recent days, most of research groups are showing great interest in graphene not only in fundamental physics but also in applications such as sensor, field effect transistors. Many methods were reported for production of graphene layers in which mechanical exfoliation technique is one of well known technique. However this method is simple, but does not allow for control of graphene layer positioning. Similarly the chemical vapor deposition technique is also found difficult to produce single layer graphene, only thicker layers are possible to make it. So we need to go for an alternative to use graphene oxide (GO) [1] because GO is easily solvable in water and can easily exfoliated in water-based solution and then simply spin-coated or sprayed on to any substrate.

GO is a chemically derived component from bulk graphite after strong oxidation process. It can be processed in many ways. Most popular method is modified Hummer's method. In recent days, thin graphene oxide (GO) has been a subject of intense scientific investigation as it can be used as a starting material for the synthesis of graphene [2]. Several studies were carried out to understand the electrical characteristics of GO thin film and to explore the possibility of integrating it with graphene based electronic applications.

In this paper, we report the synthesis and electrical transport characterization of GO thin films.

2. Materials and Methods

GO nanoparticles were prepared using modified Hummers method [3]. After preparing GO, we characterized the UV-Vis and FTIR analysis to confirm the quality of GO. Our experiments were confirmed the obtained GO were in good quality. We made GO dispersions with various concentrations and formed the thin film by spin-casting.

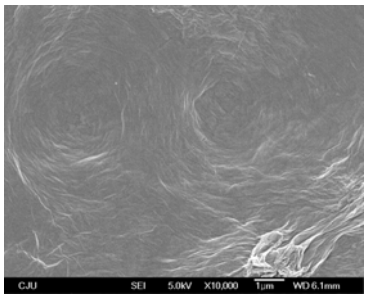

Fig. 1. SEM image of Graphene oxide film surface indicates uniform surface with good quality.

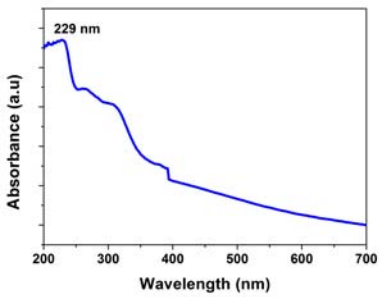

Fig. 2. UV-Vis spectrum of GO thin film.

The silver paste was used to make electrode contact. Two terminal contact method was used to measure the electrical transport measurements. Figure 1 shows the scanning electron microscope image (SEM) of GO film which shows the uniform surface morphology. The GO thin film was further characterized by UV-Vis spectroscopy analysis, which results the absorbance peak at 229 nm. The jerk found at 400 nm was due to instrument error.

3. Electrical Characteristics of GO Thin film

The current –voltage characteristics (I-V) of GO thin film was characterized with CV-IV semiconductor analyzer system (Agilent B1500). Fig. 3 represents the I-V characteristics of GO thin film. We have observed a nonlinear I-V characteristics from the IV measurement. GO thin film shows higher resistance at room temperature (~ 220 kΩ) because of extra functional groups in its basal plane of GO .

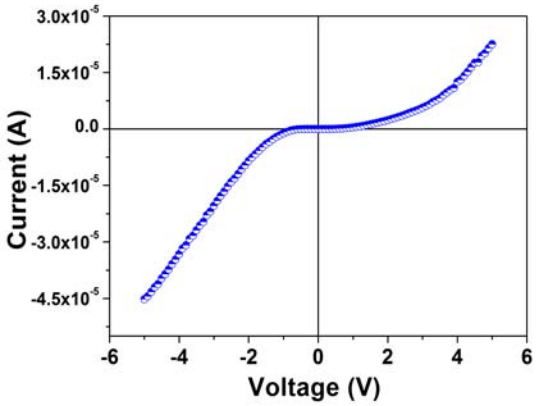

Fig. 3. I-V characteristics of GO thin film.

The nonlinear I-V characteristics can be possible from the two reasons. 1) Schottky barrier (SB) effect 2) space charge limited conduction (SCLC).

The SB effect can be arises due to the mismatch of work function between silver electrode and GO thin film.

The other reason of SCLC for observing nonlinear I-V characteristics is also possible in GO thin film. There is a difference in electro negativity of value of oxygen and carbon in GO, may create a space charge region, results the SCLC in GO thin film. The detailed analysis in this effect is in progress. The detailed report will be published very soon.

4. Conclusion

We have reported the electrical transport characteristics of graphene oxide (GO) thin films followed by the synthesis procedures using modified Hummers method. The two terminal method was used to characterize GO thin film and found GO thin film exhibits a nonlinear I-V characteristics. The reason for the nonlinear I-V behavior was explained well. The detailed analysis is under progress and will be reported about their mechanism in our further reports.

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