Graphene 산화물의 전기 특성
Electrical Characteristics Of Graphene Oxide

카티케이엔 [1], 구나세카란 [1], #김상재 [2]

*K. Karthikeyan[1], V. Gunasekaran[1], Sang-Jae Kim (kimsangj@jejunu.ac.kr)[2]

[1] Nano Materials and System Lab, Dept of Mechanical system Engineering, Graduate School of Engineering, Jeju National University

[2]Faculty of Mechatronics Engineering and Research Institute of Advanced Technology, Jeju National University

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1. Introduction

The graphene, a two dimensional form of carbon, was first reported in 2004 and has generated curiosity among material scientists to study its properties like very low resistivity, high mobility of charge carriers, and new quantum hall effect at room temperature[1-2]. The interest also comes from the presence of various oxygen bearing functional groups (C=O, C–O, –OH) in the structure of graphene oxide. The band gap can change from 1.7 to 2.1 eV, depending on the oxygen content. Recently, Graphene oxide sheets have been identified as a possible candidate for dielectrics [3]. However, their transport properties have not yet been investigated.

In this paper we are reporting the synthesis of graphene oxide with their electrical properties and their future applications.

2. Experimental Procedure

2.1. Synthesis of Graphene oxide

The graphene oxide particles are synthesized by using Hummer's method. The expanded graphite powder (1g) is put into concentrated H_2SO_4 (46 mL). $KMnO_4$ (6 g) is added gradually with stirring and cooling, so that the temperature of the mixture is not allowed to reach 20°C. The mixture is then stirred at 35°C for 2 h, and deionized water (92 mL) is added. In 1h, the reaction is terminated by the addition of a large amount of deionized water (280mL) and 30% H_2O_2 solution (5 mL), causing violent effervescence and an increase in temperature to 100°C, after which the color of the suspension changes to bright yellow. The suspension washed with 1:10 HCl solution (0.5 L) in order to remove metal ions by filter paper and funnel. The paste collected from the filter paper is dried at 60°C, until it becomes agglomeration. The agglomeration is dispersed into deionized water in static state for 2~3 hours and slightly stirred by glass bar. The suspension is washed with much deionized water days by filter paper and funnel, until the PH is nearly 7. The paste collected on the filter paper is dispersed into water by ultrasonication. The obtained brown dispersion is then subjected to 0.5 hour centrifugation to remove any unexfoliated GO using centrifuge. The GO platelets are obtained by dehydration at 60°C in air. The GO hydrosol is obtained by the GO platelets dispersed into water by ultrasonication and centrifugation for 2 hours to remove any unexfoliated GO.

2.2. Graphene oxide film formation

The graphene oxide film is prepared by the drop casting method by transferring 5mg/ml solution of graphene oxide in water into the Si/SiO_2 substrate followed by heating the substrate into 70 ^{0}C. After solvent evaporation, the GO films on the Si/SiO2 substrate is used for further electrical transport measurement. The thickness of the graphene oxide film was approximately 1.5 μm.

3. Results and Discussion

The graphene oxide particles synthesized by the Modified Hummer's method was characterized by X-ray diffraction, UV-Vis spectroscopy, FTIR

spectroscopy and Scanning Electron Microscopy. GO is an oxidation product of graphite, and it has a lot of functional groups on the surface of carbon sheets, such as hydroxyl, carboxyl, and epoxyl groups.

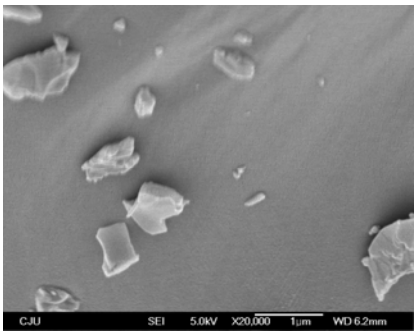

Fig. 1. SEM of Graphene oxide

The XRD results show that the peak of the graphene oxide was located at 12.84, corresponding to an interlayer distance of 0.78 ± 0.02 nm. The absorption peak of graphene oxide at 236 nm is closely matched well with the already reported values. The presence of hydroxyl, carbonyl and epoxy functional groups is confirmed by the FTIR spectroscopy (data not shown). The surface morphology of the graphene oxide particles are analyzed by Scanning Electron Microscopy. It shows the sheet like morphology in the range of several micron meters in length. The larger particles are probably due to the good adhesion between the graphene oxide particles due to its amphiphilic nature.

The IV curve of the graphene oxide thick films is shown in Fig.2. The resistance measured from the IV curve is 1.6 mega ohms. The IV curve of graphene oxide film shows linear behavior at higher voltages and non-linearity at the lower voltages. The observation of hysteresis in the graphene oxide film is mainly due to the space charge limited current (SCLC) conduction in the GO layers due to the presence of more functional groups such as carbonyl, hydroxyl and epoxy groups in the plane of graphene oxide.

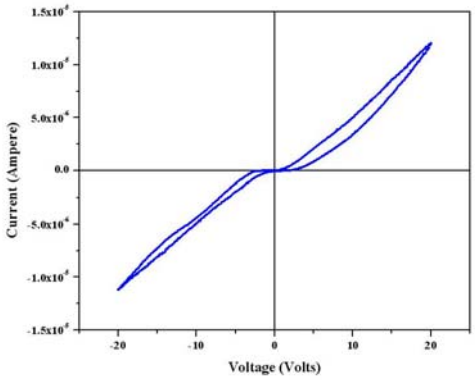

Fig. 2. IV characteristic of graphene oxide film.

4. Conclusion

In conclusion, our preliminary work in the electrical characteristic of graphene oxide thick film shows SCLC due to the more number of functional groups in the graphene oxide. However, our future work focus on reducing the thickness thereby decreasing the amount of oxygen content will pave the way for achieving good results in graphene oxide based systems for future electronic applications.

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