Study on Trapping Condition by Dielectrophoresis to Fabricate GNR Devices

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[Introduction] Graphene has attracted attention due to high carrier mobility and high conduction even in low cross section. Various reports suggested forming graphene with sub-10 nm width, called graphene nanoribbons (GNR), to make the finite band gap. Sub-10 nm GNR can be obtained by longitudinal unzipping of single-walled carbon nanotubes (SWNTs)[1)]. Although it can produce sub-10 nm width GNR by synthesis process and suitable for mass production, the application of unzipped GNR is still limited because of the difficulty in assembly of the GNR to make electronic devices.

[Experiment] In the present study, we tried to trap and align the unzipped GNRs using dielectrophoresis (DEP) method by varying the frequency ranged from 100 kHz to 15 MHz and voltage ranged from 5 to 10 Vpp. The GNR was synthesized by unzipping 0.01 mg of Hipco SWNTs using 3 mg poly [(*m*-phenylenevinylene)-*co*-(2,5-dioctoxy-*p*-phenylene-vinylene)] (PmPV) in 10 ml dicloroethane solvent. The solution was bath sonicated for 50 minutes to initiate unzipping process. The GNR solution was casted to electrodes and followed by DEP process. GNR and electrode was annealed in ambient environment at 350°C for 3 hours after DEP process to remove PmPV and increase the adhesion between GNR and electrode.

[Results and discussion] AFM result in Figure 1 shows GNRs were successfully trapped and aligned by DEP method with 500 kHz of frequency and 5 Vpp of applied AC voltage as the best parameter for DEP process. Since, GNR has semiconducting behavior, I-V characteristics was taken into account in order to prove the existence of GNR. The I-V characteristics is shown in Figure 2 and semiconductor properties was appear indicating the successful of longitudinal unzipping of SWNTs. The details will be presented at the conference.

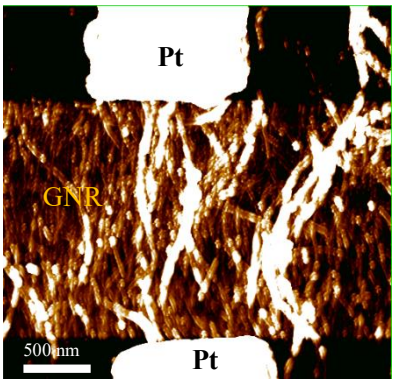

Figure 1. AFM image of trapped GNR between 1.8μm gap electrode by DEP with 500 kHz frequency and 5 Vpp

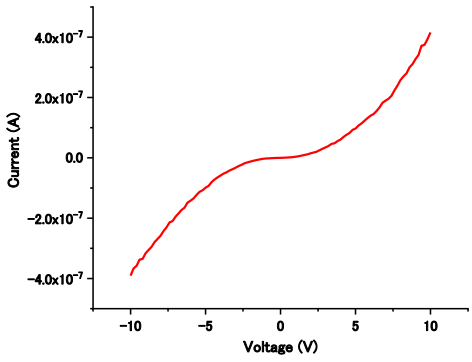

Figure 2. I-V result of trapped GNR

Keyword: *DEP, Graphene nanoribbons, Longitudinal Unzipping*

Reference: 1) M. Fukumori *et. al.,* Jpn. J. Appl. Phys. 56 06GG12 (2017).