Low Temperature Electrical Transport and Field Effect Transistor Characteristics of Graphene-oxide Thin Films

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We report in this paper the low temperature transport characteristics of graphene-oxide (GO) thin films. GO thin films are now become as attractive due to their unique physical-chemical properties and potential candidate in resistive switching memory (RRAM) and as a dielectric layer for graphene based electronic devices. It can be readily obtained through oxidizing graphite with strong oxidants, followed by an exfoliation process. We used modified Hummers method for GO synthesis and thin films of GO prepared using spin-casting. The GO nanoparticles were characterized with UV-vis spectroscopy and XRD techniques for product quality. Approximately 60 nm thick GO film(thickness was confirmed by using AFM) was used for this study in temperatures from 300 K to 90 K. The resistance versus temperature (R-T) measurement shows a semiconducting behavior of GO thin film when the temperature goes down. The current-voltage characteristics reveal an ohmic behavior at room temperature; however, the same behavior is turned into nonlinear characteristics when the temperature goes down. This will be discussed with Poole-Frenkel conduction mechanism in detail. Further the transfer characteristics (I_{DS} versus V_{GS}) of GO-FET device structure show p-type semiconducting property of GO thin films.