



Contribution ID: 309

Type: Poster Presentation

Structural and optical properties of spin coated graphene oxide thin films

Tuesday, 26 June 2018 15:00 (2 hours)

Graphene oxide (GO) is a derivative of graphene, consisting of an atomic layer of carbon bonded to oxygen functional groups such as hydroxyl and epoxide, which make it insulating and hydrophilic. This novel material it has attracted much research recently, although there is varying information in the literature because the properties may depend on the synthesis technique and form (powder, thin film, solution). An investigation of the structural and optical properties of spin coated GO thin films was made. GO powder was purchased from Sigma Aldrich (15-20 sheets, 4-10% edge-oxidized) and used to prepare a GO suspension in distilled water (1 mg/ml) which was ultrasonicated and centrifuged. The supernatant black solution was spin coated on silicon substrates to produce thin films. The solution was characterized using photoluminescence (PL) and UV-vis absorption measurements, while the GO powder and thin films were assessed using X-ray diffraction (XRD). A broad absorption band was observed at 273 nm, although subsequent PL measurements showed that this was not an efficient excitation wavelength. Instead, the weak blue luminescence observed at 444 nm could be excited at 325 nm. Blue luminescence has been attributed to thoroughly exfoliated GO suspensions while red emission (not observed here) to poorly dispersed suspensions. The Raman peak of water was observed on the short wavelength side of this emission. The XRD pattern for the commercial GO powder had a peak near $2\theta = 13.3^\circ$. This low angle, compared to the corresponding peak of graphite (27°), indicates much wider spaced interplanar layers as a result of oxidation, but showed that the GO was stacked in multiple layers. A weak band near 30° suggested that the powder probably also contained a small amount of graphite. This was absent for the thin film since it was likely removed by centrifuging. The XRD peak of the thin film was shifted to $2\theta = 13.8^\circ$, indicating a small reduction in the interplanar spacing. Although the XRD data corresponded to stacked GO, the optical properties suggest that significant reduction was present in the commercial powder.

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Session Classification: Poster Session 1

Track Classification: Track A - Physics of Condensed Matter and Materials