Comparative study of Infrared Sensors Based Graphene Oxide and Graphene Oxide/Carbon Nanotube Nanocomposites

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Abstract

Graphene, the two dimensional carbon material, has a high potential for applications in electronic and optoelectronic devices [1]. Owing to its unique band structure, photodetectors with a wide range of wavelengths can be realized [2].
Mono- or multilayered graphene can be produced by several methods, such as chemical vapor deposition (CVD), mechanical exfoliation and sonication of graphite oxide [3]. Graphene oxide is a precursor to produce conductive graphene sheets by reduction; known as reduced graphene .This can be seen as an alternative way to produce large amounts of graphene beside CVD techniques and exfoliation. GO dispersions with about 60% monolayered GO were deposited by spin coating on capton and glass substrates. The obtained films were chemically or thermally reduced to increase their electrical conductivity. In addition, hybrid nanocomposites films of graphene oxide/single wall carbon nanotubes GO/SWNT and graphene oxide/multiwall carbon nanotubes GO/MWNT were fabricated by spin coating. Reduction is carried out as well after the deposition either by heating the substrate to above 200 or by hydroiodic acid HI.

The deposited films were characterized by scanning electron microscopy SEM and x-ray photoemission XPS. Images from SEM demonstrate the homogeneity of the CNT/GO solution where CNT is dispersed well in GO that acts as a surfactant as well, as shown in Figure 1. Characterization of the prepared films is also carried out by x-ray photoemission XPS measurements, see Figure 2. The change in carbon and oxygen contents can be monitored by the change of atomic concentrations. This reveals the degree of reduction as well the quality of reduction.

The optical sensitivity was measured using a laser diode with a wave length of 980 nm and an optical power of 50 mW in air and at room temperature. The VI characteristics are measured for films based in both composites, i.e. rGO/SWNT and rGO/MWNT. The dark and light currents are shown in Figure 3. The optical response of rGO/SWNT based films shows better light to dark current and hence better sensitivity.

Graphene oxide gives optical response comparable to those of pure monolayer exfoliated graphene sheets. Further than that, rGO/CNT nanocomposites showed improved optical response compared with GO only (see Figure 3). Moreover, it seems that rGO/SWNT can have not only thermal but also photoeffect. These properties make GO/SWNT nanocomposites suitable for optical sensors.

References

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Figures

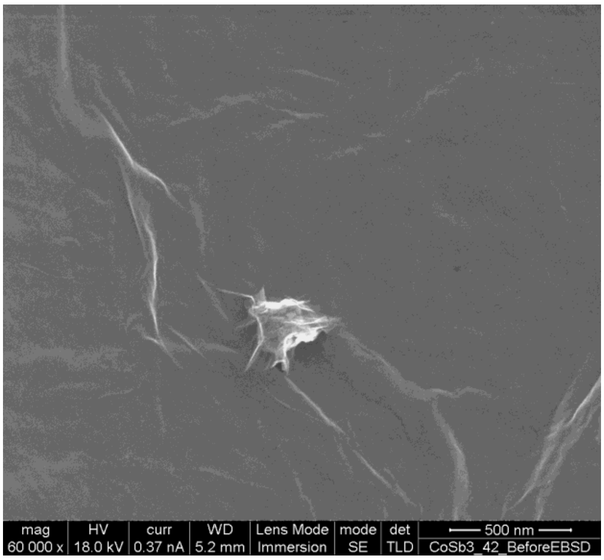

Figure 1SEM image for chemically reduced graphene oxide/single wall nanotubes composites rGO/SWNT spin coatd on Si substrate and reduced by HI

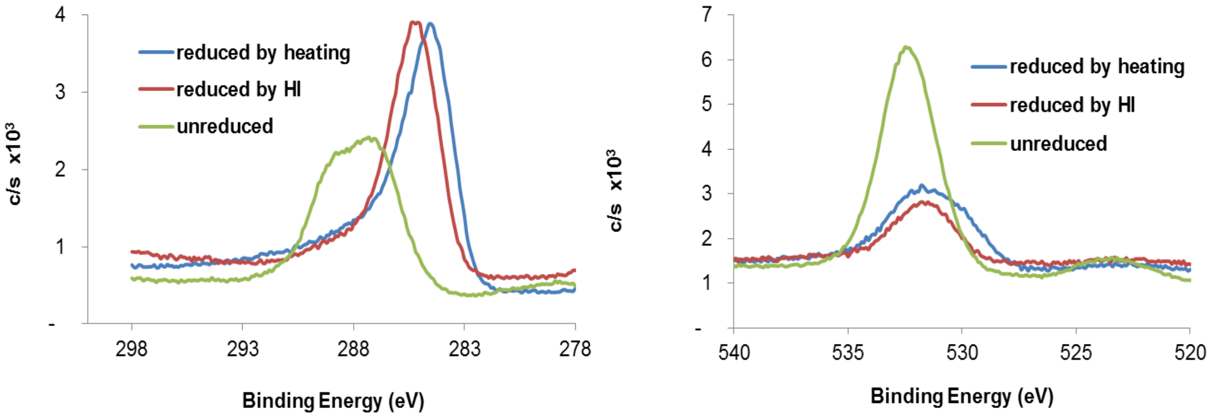

Figure 2 XPS spectrum, C1s (left side) and O1s (right side) for thermally, chemically reduced and unreduced GO films

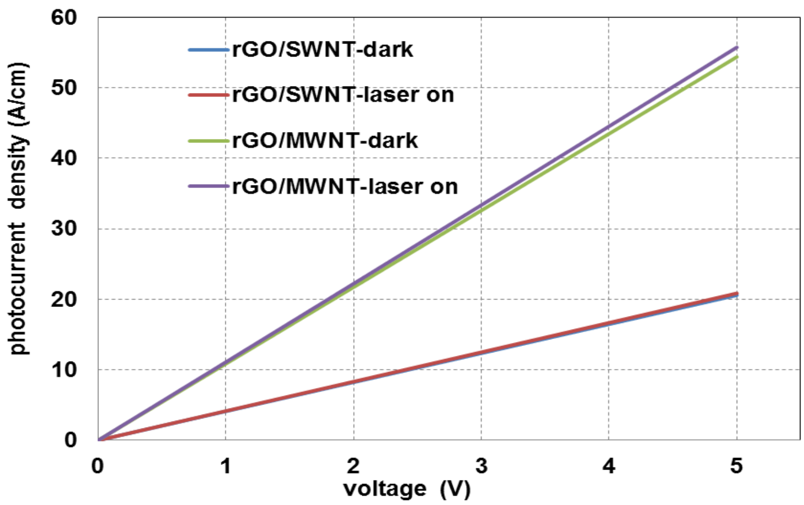

Figure 3 current density measured for rGO/SWNT and rGO/MWNT composites on spin coated films (thickness ~50 nm) irradiated by of infrared laser