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RF and Optical properties of Graphene Oxide

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The best part of graphene is - charge-carriers in it are mass less particles which move in near relativistic speeds. Comparing to other materials, electrons in graphene travel much faster – at speeds of 10^8cm/s. A graphene sheet is pure enough to ensure that electrons can travel a fair distance before colliding. Electronic devices few nanometers long that would be able to transmit charge at breath taking speeds for a fraction of power compared to present day CMOS transistors. Many researches try to check a possibility to make it a perfect replacement for silicon based devices. Graphene has shown high potential to be used as interconnects in the field of high frequency electrical devices. With all those advantages of graphene, we demonstrate characteristics of electrical and optical properties of graphene such as the effect of graphene geometry on the microwave properties using the measurements of S-parameter in range of 500 MHz - 40 GHz at room temperature condition. We confirm that impedance and resistance decrease with increasing the number of graphene layer and w/L ratio. This result shows proper geometry of graphene to be used as high frequency interconnects.

This study also presents the optical properties of graphene oxide (GO), which were deposited in different substrate, or influenced by oxygen plasma, were confirmed using different characterization techniques. 4-6 layers of the polycrystalline GO layers, which were confirmed by High resolution transmission electron microscopy (HRTEM) and electron diffraction analysis, were shown short range order of crystallization by the substrate as well as interlayer effect with an increase in interplanar spacing, which can be attributed to the presence of oxygen functional groups on its layers. X-ray photoelectron Spectroscopy (XPS) and Raman spectroscopy confirms the presence of the sp^2 and sp^3 hybridization due to the disordered crystal structures of the carbon atoms results from oxidation, and Fourier Transform Infrared spectroscopy (FTIR) and XPS analysis shows the changes in oxygen functional groups with nature of substrate. Moreover, the photoluminescent (PL) peak emission wavelength varies with substrate and the broad energy level distribution produces excitation dependent PL emission in a broad wavelength ranging from 400 to 650 nm. The structural and optical properties of oxygen plasma treated GO films for possible optoelectronic applications were also investigated using various characterization techniques. HRTEM and electron diffraction analysis confirmed that the oxygen plasma treatment results short range order crystallization in GO films with an increase in interplanar spacing, which can be attributed to the presence of oxygen functional groups. In addition, Electron energy loss spectroscopy (EELS) and Raman spectroscopy confirms the presence of the sp^2 and sp^3 hybridization due to the disordered crystal structures of the carbon atoms results from oxidation and XPS analysis shows that epoxy pairs convert to more stable C＝O and O-C＝O groups with oxygen plasma treatment. The broad energy level distribution resulting from the broad size distribution of the sp^2 clusters produces excitation dependent PL emission in a broad wavelength range from 400 to 650 nm. Our results suggest that substrate influenced, or oxygen treatment GO has higher potential for future optoelectronic devices by its various optical properties and visible PL emission.

Keywords: Graphene oxide, Radio Frequency properties, Optical properties, Photoluminescent

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Monolithic Integration of Arrays of Single Walled Carbon Nanotubes and Sheets of Graphene

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We present a scheme for monolithically integrating aligned arrays of single walled carbon nanotubes (SWNTs) with sheets of graphene, for use in electronic devices. Here, the graphene and arrays of SWNTs are formed separately, using chemical vapor deposition techniques onto different, optimized growth substrates. Techniques of transfer printing provide a route to integration, yielding two terminal devices and transistors in which patterned structures of graphene form the electrodes and the SWNTs arrays serve as the semiconductor. Electrical testing and analysis reveal the properties of optically transparent transistors that use this design, thereby giving insights into the nature of contacts between graphene and SWNTs.

Keywords: graphene, single-walled carbon nanotubes, thin film transistor