CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
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Project Number
S1908

Project Title
Mechanical Exfoliation and Characterization of Graphene via Raman Spectroscopy

Abstract

Objectives/Goals
Graphene, a one-atom-thick planar sheet of carbon atoms arranged in a honeycomb crystal lattice, has the ideal properties to be an excellent component of integrated circuits, but must be mechanically exfoliated onto a substrate and characterized using Raman spectroscopy prior to any implementation into future devices. By reliably identifying certain mechanically exfoliated graphene samples as single layer or bilayer, the samples can be utilized in the fabrication of novel quantum devices.

Methods/Materials
To mechanically exfoliate graphene onto a silicon dioxide substrate, layers of graphite were cleaved onto the full length of a piece of tape, which was then applied to a substrate and removed slowly to maximize graphite/graphene deposition. A raster scan was performed with an optical microscope to find graphene flakes, and pictures were taken to record the location of the graphene flakes. Graphene flakes were then characterized with a Renishaw Ramascope.

Results
The full width at half-maximum of the single layer suspect sample was recorded to be 24.3 cm-1, confirming it was indeed single layer graphene. The full width at half-maximum of the bilayer suspect sample was recorded to be 50.9 cm-1, confirming it was indeed bilayer graphene. The full width at half-maximum of the multilayer suspect sample was recorded to be 69.7 cm-1, confirming it was indeed multilayer graphene.

Conclusions/Discussion
The photon-phonon interactions during Raman spectroscopy resulted in energy shifts (in units of cm-1 of the photons from the laser) that can be used as #fingerprints# for the particular material investigated. Characterized graphene samples can now be used to engineer new devices in nanotechnology, such as graphene-based transistors. Carbon electronics will hopefully become the successor to silicon electronics and the solution to Moore#s law, which has predicted a bottleneck effect for the continued scaling of transistors.

Summary Statement
Analyzing Raman spectrum plots of graphene samples after creating said samples through the mechanical exfoliation process is vital for the future implementation of graphene in novel quantum devices.

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