EFFECT OF POLY METHYL METHACRYLATE ON THE MICRO-PHOTOLUMINESCENCE OF INDIVIDUAL SWCNTS

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The photoluminescence (PL) of single-walled carbon nanotubes (SWCNTs) has been studied extensively. PL has been proven to be a powerful tool for characterizing SWCNTs' chirality by appearance of PL distribution each nanotube. Understanding SWCNTs' optical properties is expected to lead to the design of photonic devices for telecommunications and nonlinear optics. The PL of individual, bridged SWCNTs is a function of their strong interaction with light. However, SWCNTs on a substrate emit a very weak signal. Therefore, our goal is to enhance the signal to collect more information for chirality. Poly methyl methacrylate (PMMA) is expected to enhance their emission by suppression of tunneling effects in and out of the SWCNTs. We propose to study the micro-photoluminescence of individual SWCNTs on SiO_2 substrates. Excitation is provided by a red laser diode and highly focused by an objective lens on a sample of individualized SWCNTs. Luminescence is collected and then measured with a monochromator and an InGaAs detector. The sample's luminescence is measured before and after coating with PMMA. This analysis will inform our understanding of the mechanism enhancing the photoluminescence of individual SWCNTs in the presence of PMMA and its chirality decpendence.

EFFECT OF POLY METHYL METHACRYLATE ON THE MICRO-PHOTOLUMINESCENCE OF INDIVIDUAL SINGLE-WALLED CARBON NANOTUBE

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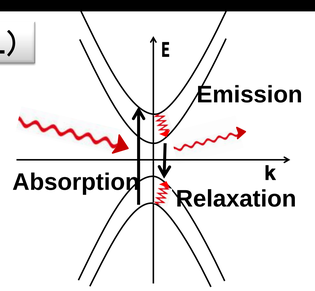
Introduction

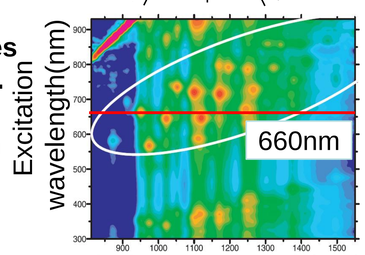
Photoluminescence(PL)

Absorption of excitation by high energy state and emission of photon by lower energy state.



PL of SWCNTs

Semiconducting single-walled carbon nanotubes have different chiralites.
→different resonant excitation and emission
→ Laser excitation resonance for many nanotubes.



Objective

Measure whether poly methyl methacrylate (PMMA) enhance PL of individual CNTs.

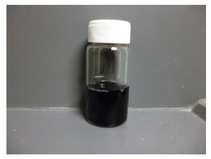
-Set up standard and micro PL measurement system
-Characterize reflection vs transmission geometry
-Measure PL on Si/SiO2 substrate
-Check the PMMA
-Micro-PL

Science **298**, 2361 (2002);Sergei M. *et al*
ACS Nano, **2011,** Nan Ai . *et al*

CNTs cuvette & Si/SiO_2

-SWCNTs are made via the high-pressure carbon monoxide(HiPco) process.

-CNT in 1% Sodium deoxycholate (DOC)



Optical glass

-Put solution in optical cuvette.

On the substrate Si/SiO_2

1)Drop-dry deposition of nanotubes on a Si/SiO_2 substrate.

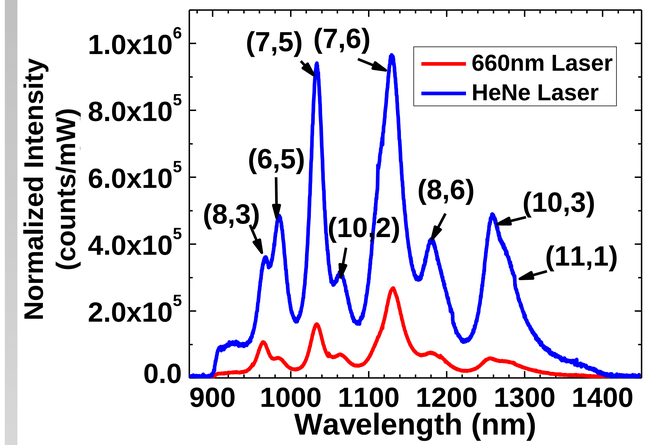
2)Coat PMMA bake it for 2days.

-C. Martinez worked about the sample.

Measurements

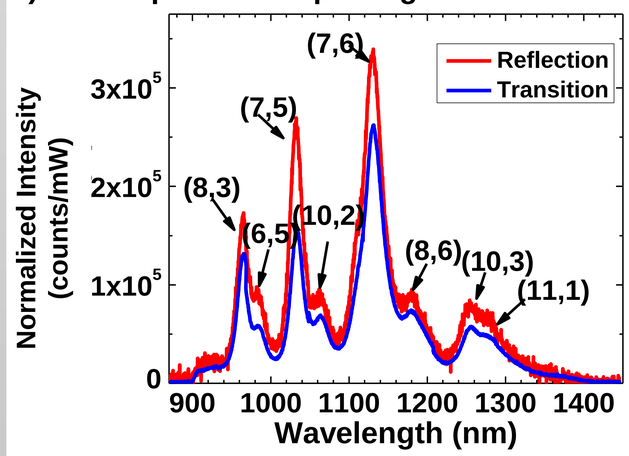
The peaks of the solution's chirality.

1)Transmission with optical glass



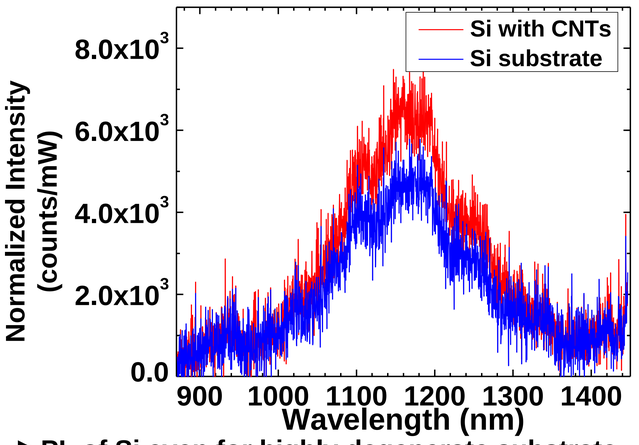
►Chirality assignment shows that MC is correctly calibrated, relative amplitude each laser matches PLE data

2)Both of pass with optical glass



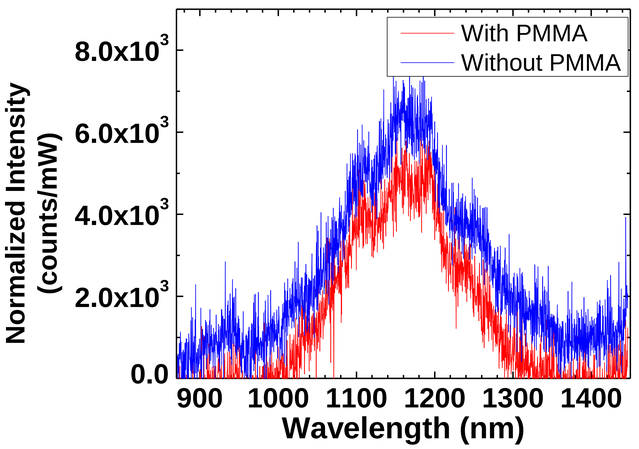
►Both geometries give the same result

Photoluminescence of substrate sample at room-temperature.



►PL of Si even for highly degenerate substrate
PL of CNTs did not appear at room-temperature.

PMMA effect on photoluminescence



►The peak did not change after PMMA coating

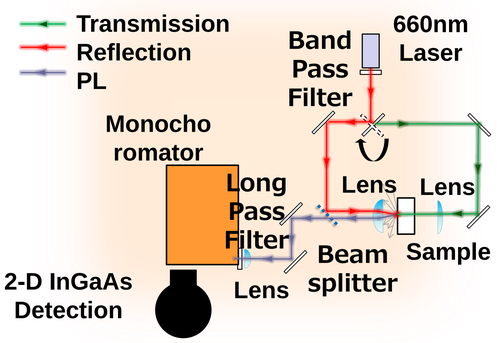
Note: μ-PL is ready, but no result yet

Photoluminescence & Micro-Photoluminescence Set Up

・Laser: 660nm and HeNe(632.8nm, for test).
・Detection: Measure light intensity vs emission wavelength with using monochoromator(MC) and 2-D InGaAs detection(Det).

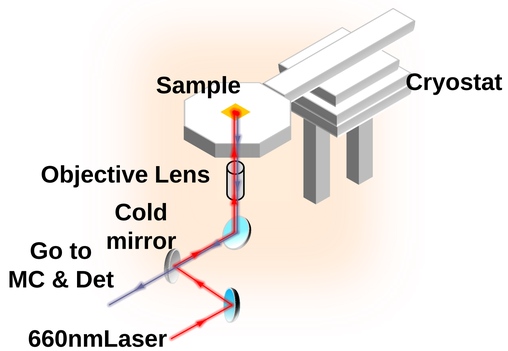
1) Photoluminescence

・Focal point size: About 25μm
・Fast switch between transmission and reflection geometry



2)Micro-Photoluminescence

・Focal point size: About 1μm
・Cryostat: vacuum and low-temperature.



Conclusion & Future Work

►Conclusion
-Set up ready for fast preliminary characterization.
-No signal in PL even after PMMA coating
►Future Work
-Extend study to μ-PL.
-Check the electric field effect.

This material is based upon work supported by the National Science Foundation's Partnerships for International Research & Education Program (OISE-0968405).

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