



Raman Spectroscopy and Carbon Spheres



Eno Shira



Where I did my project

- 33rd and Walnut
- Mostly done in Towne building
- Small part done at Drexel
 - Raman Microscope
- Eating done at Drexel + Penn campuses
- Mentor Dr. Santiago
 - Electrical and Systems Engineer Faculty
- Grad students

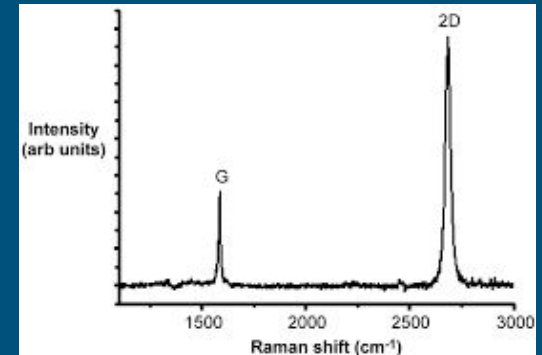


Why it was important to me

- Want to be electrical engineer in college
- Wanted to learn about lab gear
- Project simulated college experience

How I spent my time

- Reading articles XRD, Raman, Carbon, Young
- Khan academy + PBS Quantum Mechanics video
- Eating lunch
- Graphene oxide tested with raman microscope
 - Fluorescence problem messed with peaks
- Presented knowledge learned



How I spent my time cont.

I have one strict annotation rule

PROGRESS ARTICLE

NATURE MATERIALS DOI: 10.1038/NMAT4170

Table 1 | Graphene properties compared with other carbonaceous materials.

	Graphene	Carbon nanotube	Fullerene	Graphite
Dimensions	2	1	0	3
Hybridization	sp^2	Mostly sp^2	Mostly sp^2	sp^2
Hardness	Highest (for single layer)	High	High	High
Tenacity	Flexible, elastic	Flexible, elastic	Elastic	Flexible, non-elastic
Experimental SSA ($m^2 g^{-1}$)	~1,500	~1,300	80–90	~10–20
Electrical conductivity ($S cm^{-1}$)	~2,000	Structure-dependent	10^{-41}	Anisotropic: $2-3 \times 10^4$, $6'$
Thermal conductivity ($W m^{-1} K^{-1}$)	4,840–5,300	3,500	0.4	Anisotropic: 1,500–2,000 ^a , $5-10'$

^a direction, ^b direction.

Table 2 | Dimension-based graphene nomenclature.

Thickness (n, number of layers)	Lateral dimension D (nm)	Aspect ratio (length/width)
1	$2 \leq n \leq 10$	$100 \leq D \leq 10^5$
Single layer	Nano	Micro
multilayer		
		Sheet
		Flake
		Plate
		Pinpoint

Table 3 | Graphene's structural defect typologies.

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More pictures

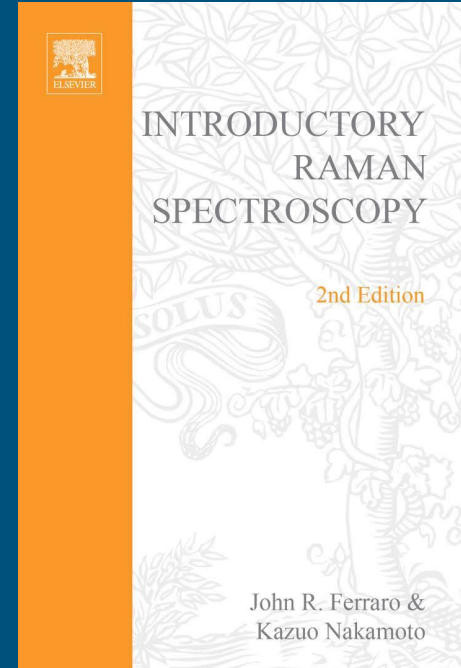


What I learned

- Learned about a variety of topics
 - XRD
 - Intro Quantum Mechanics
 - Raman Spectroscopy
 - Young's double slits
 - Carbon
- Learned that engineering is hard
- But I enjoyed it

Book

- Introductory Raman Spectroscopy
- Came out in 1994
- By John R Ferraro
- Did not really understand book
- Lots of physics and chemistry equations



Service

- Laura W. Waring School at 1801 Green Street
- Taught kids about careers in engineering
- Spent rest of time helping teacher
 - Read Charlotte's Web
 - Completed class activity
- Kids want to be engineers, role model

