

# The Intellectual Property Landscape of Carbon Nanotubes

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Communication

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CNS/INSET Summer Internship Program  
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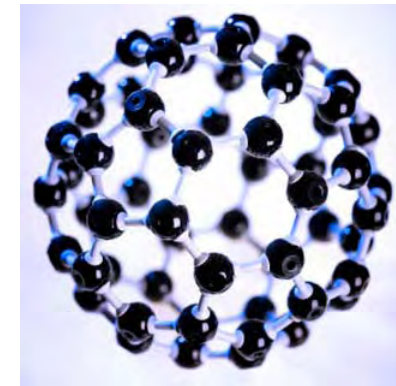


## How can we reduce uncertainty about nanotechnology?

### – CNS Workgroups & Principle Investigators:

- WG1: Origins, Institutions & Communities
  - Patrick McCray (History, UCSB)
- WG2: Innovation Group
  - Chris Newfield (English, UCSB)
- WG3: Risk Perception and Media
  - Barbara Herr Harthorn (Anthropology, UCSB)
  - Bruce Bimber (Political Science, UCSB)
- WG4: Globalization and Nanotechnology
  - Richard Appelbaum (Sociology, UCSB)

Photo and caption from  
ScientificAmerican.com

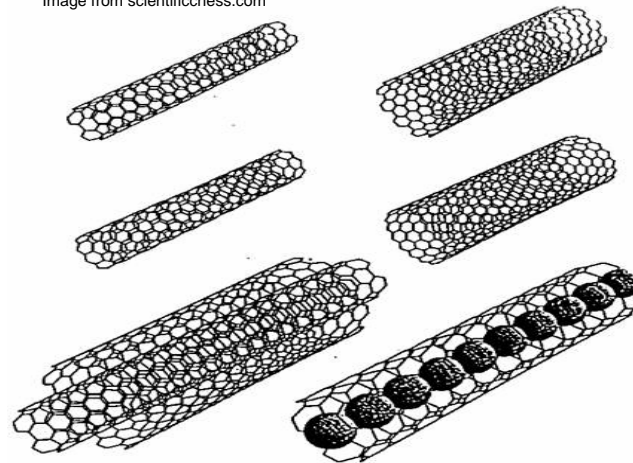


**“SMALL  
PARTICLE,  
BIG  
DANGER?”**

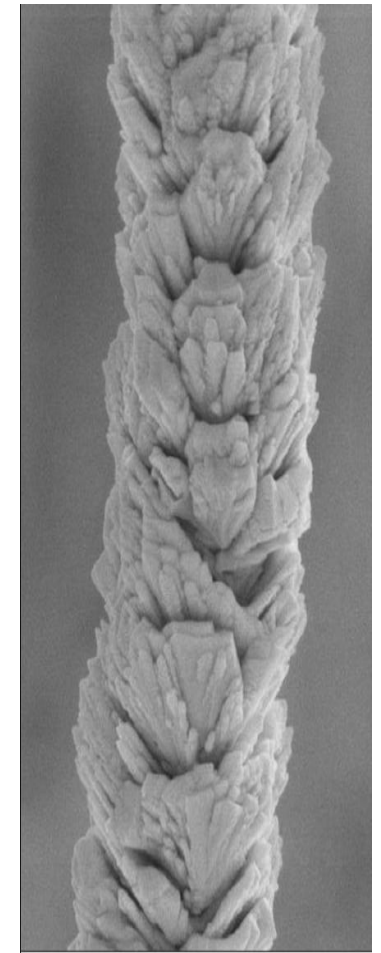
# The Carbon Nanotube (CNT)

- Layers of hexagonally oriented carbon atoms arranged in tubular shapes
- Carbon Nanotubes have novel properties:
  - Strength & Pliability
  - Metallic /Semi-Conducting
  - Thermal Conductivity
  - Relatively Simple to Produce

Image from scientificchess.com



- Early mention of forming carbon filaments from was reported in 1889. (Monthieux, M., [2006] Carbon, 44, 1621)
- Industry growth attributed to recent advancements in microscopy



1  $\mu$ m

Image Courtesy of Zyvex

## From Innovation to Litigation

US Patent #5,424,054 (June 13, 1995)

- Nanotech is facing barriers to forward innovation

### We claim:

1. A process for producing hollow carbon fiber having a wall consisting essentially of a single layer of carbon atoms comprising the step of contacting carbon vapor and recovering the fiber product under conditions effective to produce the hollow fiber with cobalt vapor.
2. The process of claim 1 wherein the carbon vapor and cobalt vapor are formed by electric-arc heating.
- 3. A hollow carbon fiber having a wall consisting essentially of a single layer of carbon atoms.

\* \* \* \* \*

...shall be entitled to a patent unless...  
 ...in this case a person named by the inventor...  
 ...Novelty and Loss of Right to...  
 ...the invention was known or used by others...  
 ...the invention described in a printed publication...  
 ...the invention was known or used by others...  
 ...the invention was known or used by others...

Image courtesy of patentlaw.info

# Workgroup 2 Research Goals

Tracking innovation: a patent thicket from the Handbook of Nanotechnology, Business, Policy & Intellectual Property Law (2005).

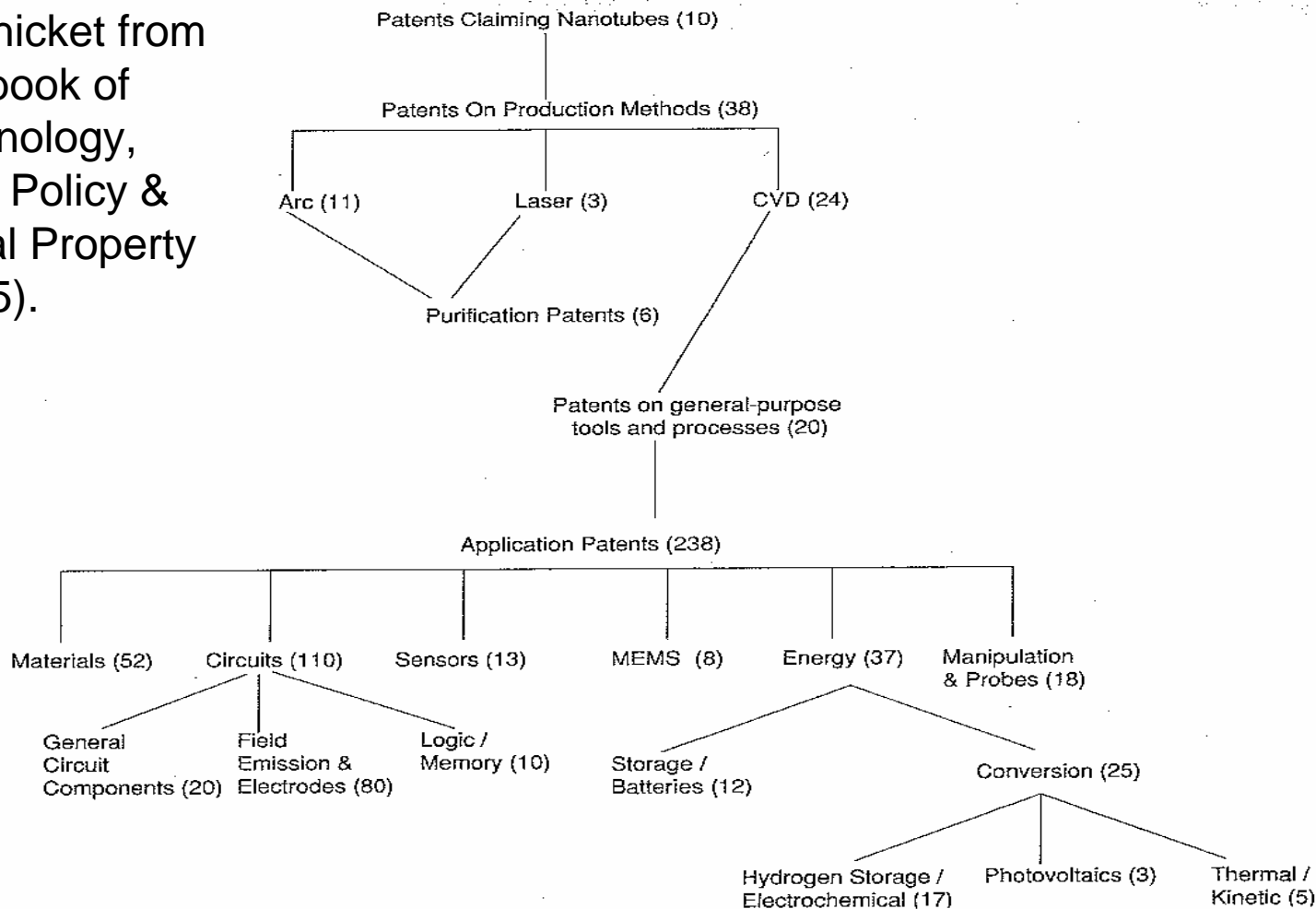


Figure 5.4 Navigating the carbon nanotube patent thicket.

## Data Collection

- Data is collected from

### USPTO PATENT FULL-TEXT AND IMAGE DATABASE

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Data current through July 14, 2009.

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```
ttl/"carbon nanotubes" OR abst/"carbon nanotubes" OR acim/"carbon nanotubes"
```

Examples:

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ttl/(tennis and (racquet or racket))
isd/1/8/2002 and motorcycle
in/newmar-julie
```

Select Years [\[Help\]](#)

1976 to present [full-text] ▼

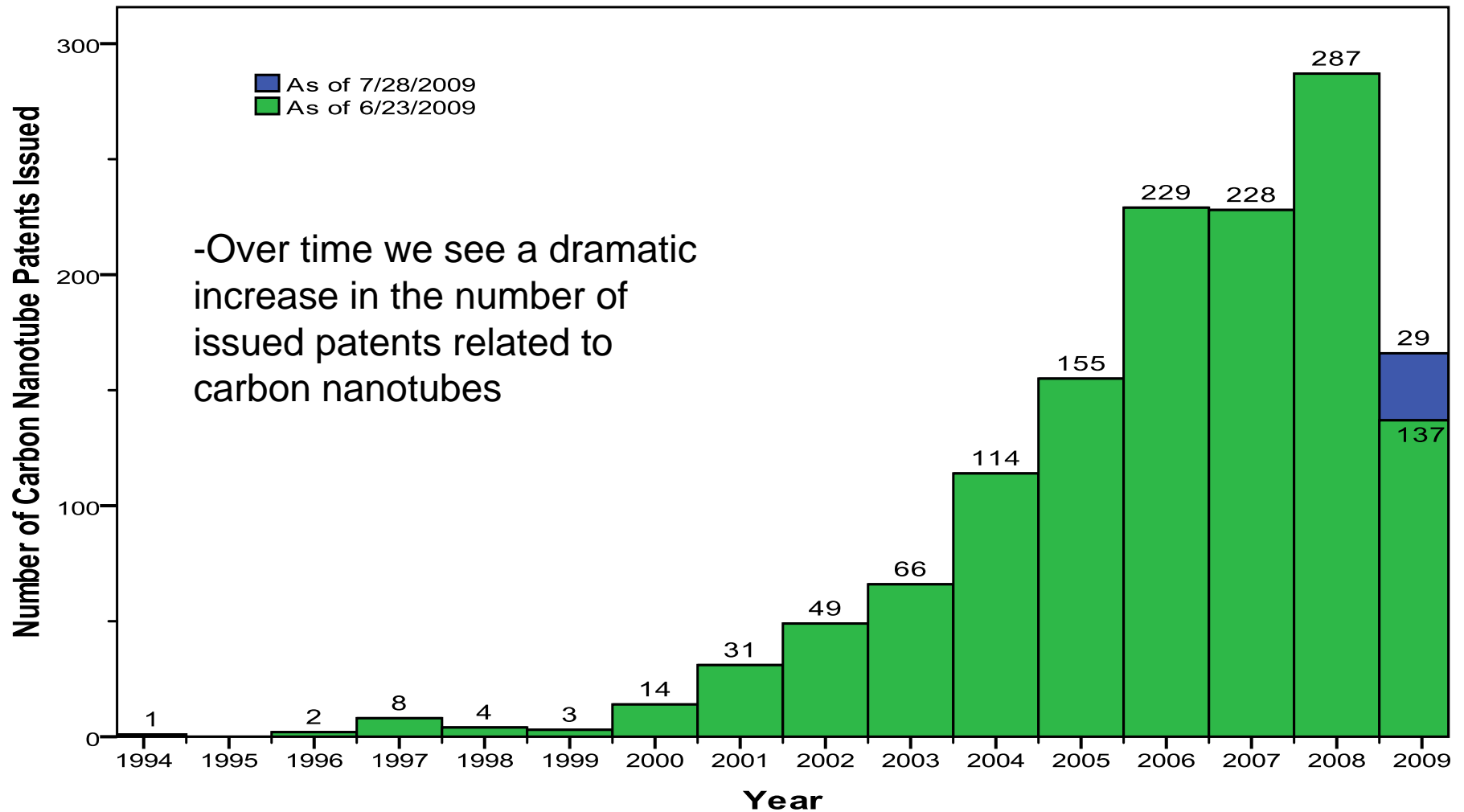
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15	<a href="#">1236</a>	6,437,329	Use of carbon nanotubes as ch	United States Patent 6,437,329	Yedur, et
16	<a href="#">1258</a>	6,354,133	Use of carbon nanotubes to ca	United States Patent 6,354,133	Yedur, et
17	<a href="#">1287</a>	6,250,984	Article comprising enhanced n	United States Patent 6,250,984	Jin, et al.
18	<a href="#">1225</a>	6,465,132	Article comprising small diam	United States Patent 6,465,132	Jin Octob
19	<a href="#">1255</a>	6,383,923	Article comprising vertically na	United States Patent 6,383,923	Brown, e
20	<a href="#">1262</a>	6,340,822	Article comprising vertically na	United States Patent 6,340,822	Brown, e
21	<a href="#">1280</a>	6,286,226	Tactile sensor comprising nan	United States Patent 6,286,226	Jin Septe
22	<a href="#">1282</a>	6,283,812	Process for fabricating article	United States Patent 6,283,812	Jin, et al.
23	<a href="#">1284</a>	6,277,318	Method for fabrication of patte	United States Patent 6,277,318	Bower, e
24	<a href="#">1123</a>	6,727,720	Probe having a microstyllet	United States Patent 6,727,720	Houge, e

- Data can be analyzed
- Data is analyzed by statistical software (SPSS, Excel)

gather patent information

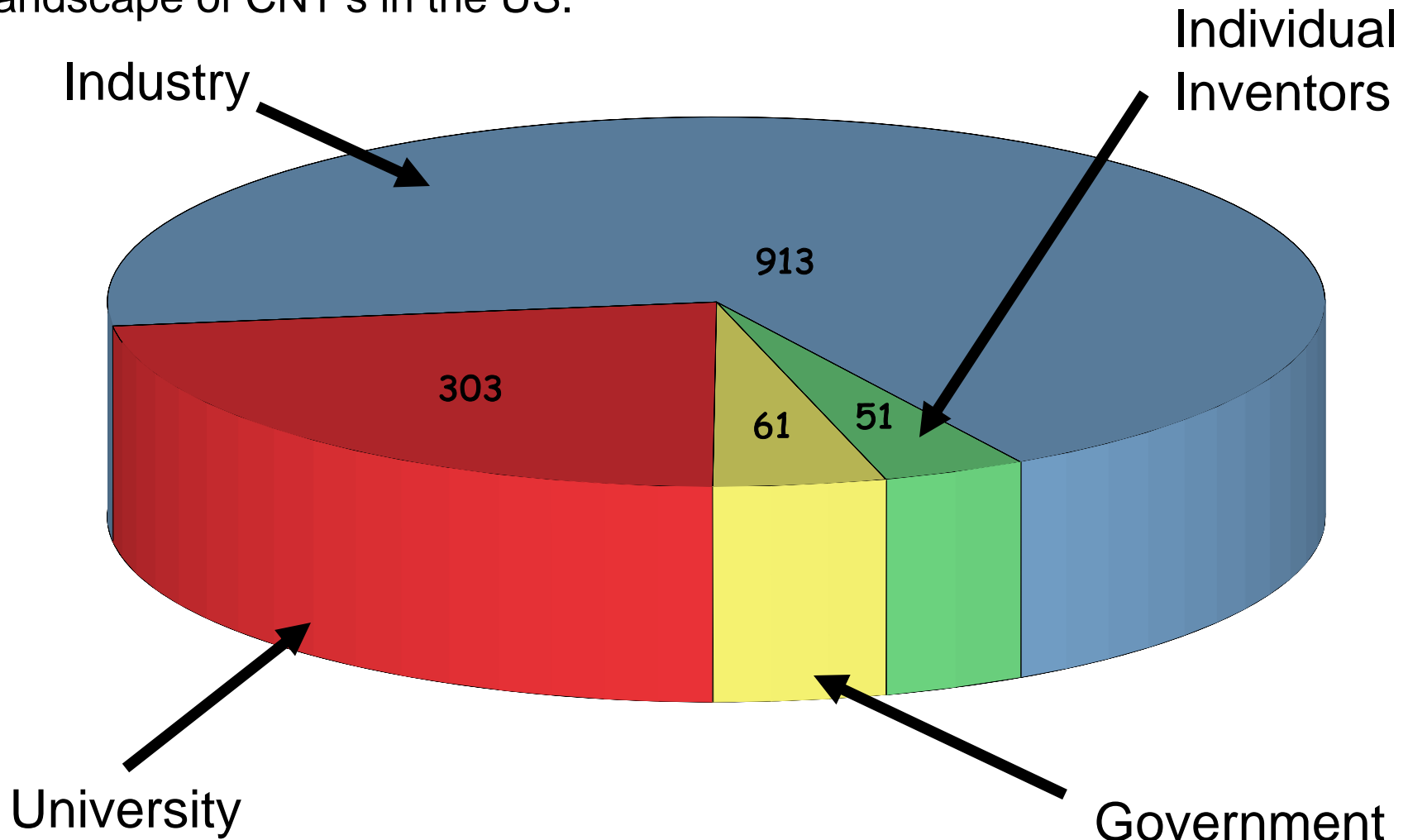
- Trends in CNT related patent issuances



# CNS-UCSB

Center for Nanotechnology in Society

- Looking at the number of issued CNT patents arranged by sector we can see private industry dominates the IP landscape of CNT's in the US.

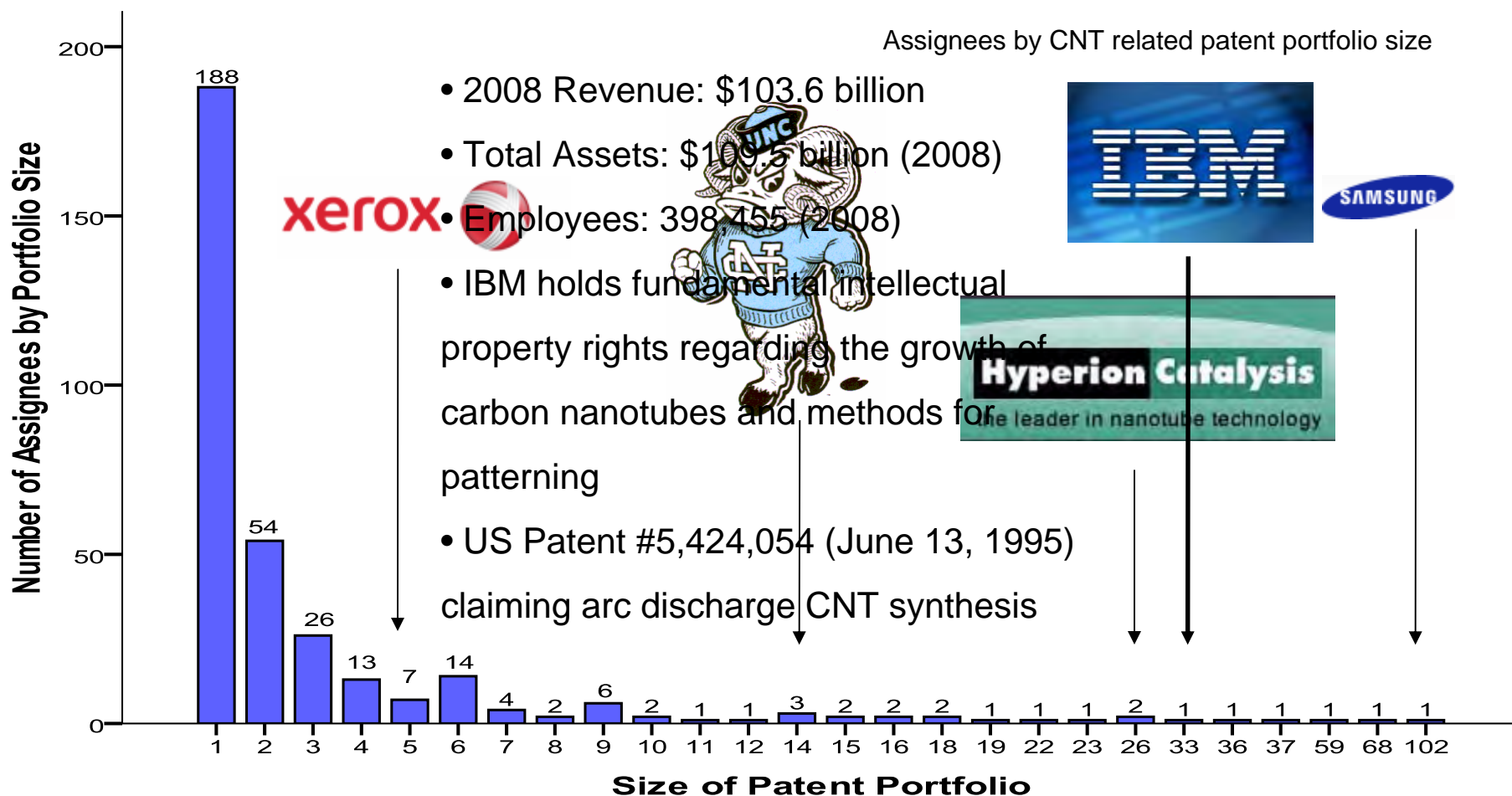




# CNS-UCSB

Center for Nanotechnology in Society

- Descriptive statistics can be helpful in analyzing industry trends but in order to identify key players in the CNT industry patents need to be analyzed on a case by case basis

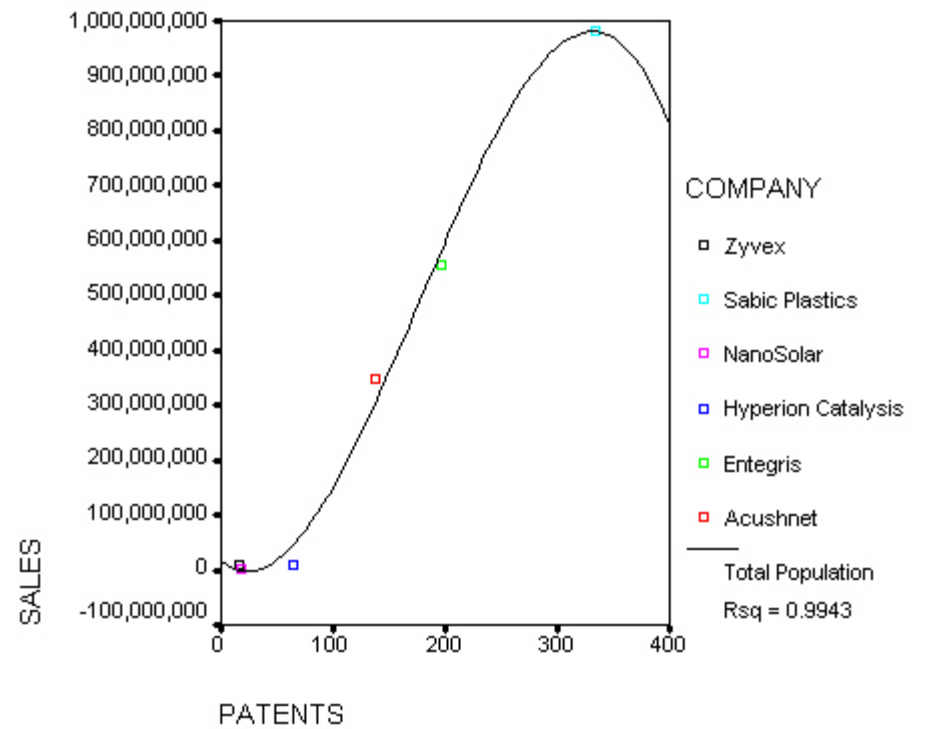
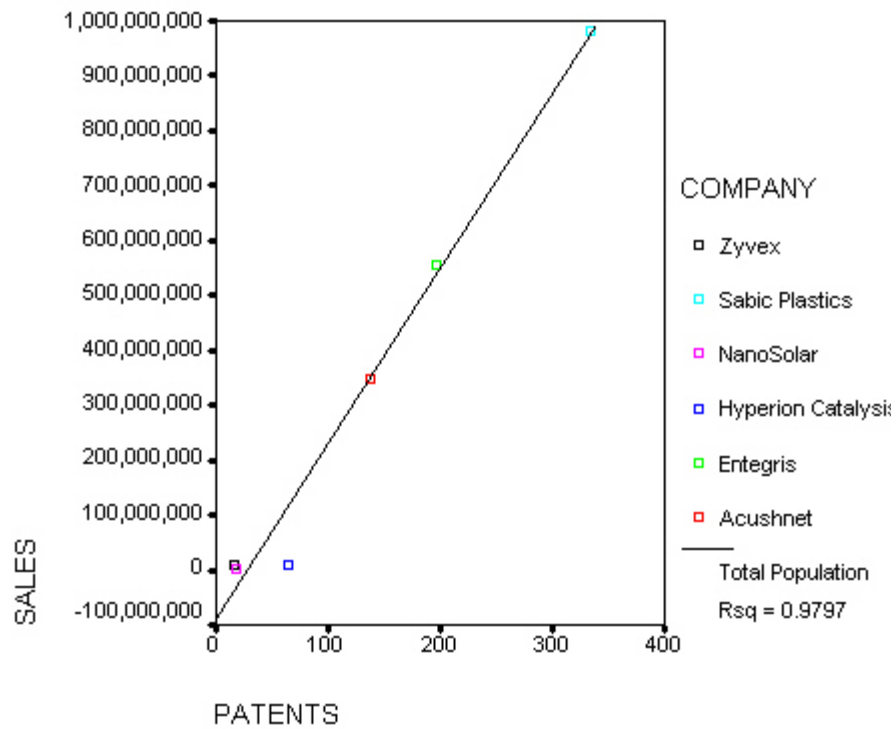


# Questions for Future Research

- How does the CNT industry compare to other nanoscale industries?
- With billions of dollars going into R & D why are there so few CNT enabled consumer products?
- What is the true value of a CNT patents?
- How can we avoid the patent thicket?
- How does the US compare to other countries in relation to the innovation and diffusion of nanotechnology

# Acknowledgements

- Special thanks to:
  - The National Science Foundation
  - The Center for Nanotechnology in Society
  - The Internship in Nanosystems, Science, Engineering & Technology
  - Kasim Alimahomed, Communication, CNS Graduate Fellow (UCSB)
  - Christopher Newfield, English, CNS Workgroup 2 Principle Investigator (UCSB)
  - Dr. Kuhn, Dr. Arnold, Dr. Garard & Dr. Cropley (Santa Barbara City College)



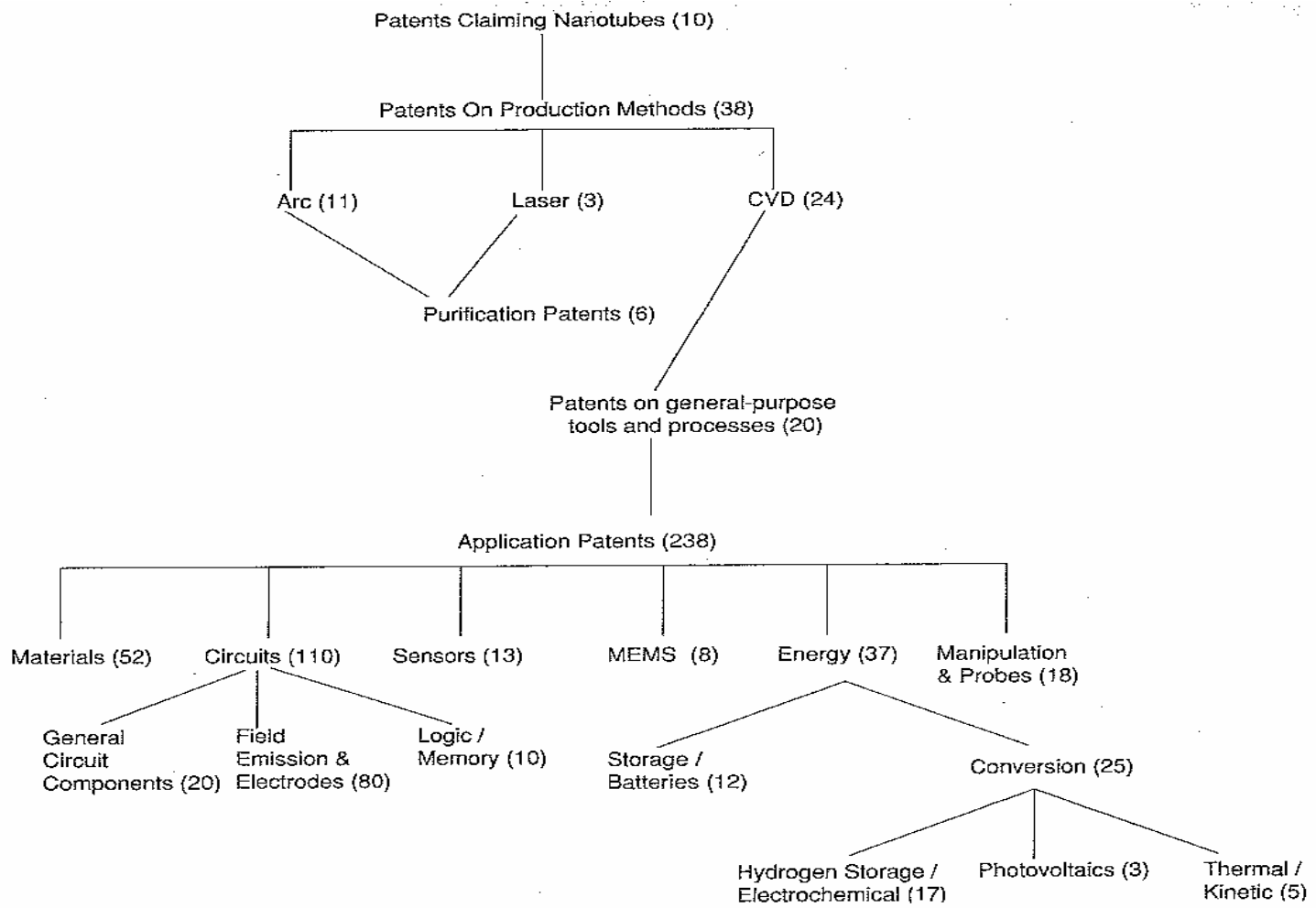
**We claim:**

**1. A process for producing hollow carbon fiber having a wall consisting essentially of a single layer of carbon atoms comprising the step of contacting carbon vapor and recovering the fiber product under conditions effective to produce the hollow fiber with cobalt vapor.**

**2. The process of claim 1 wherein the carbon vapor and cobalt vapor are formed by electric-arc heating.**

**3. A hollow carbon fiber having a wall consisting essentially of a single layer of carbon atoms.**

**\* \* \* \* \***



**Figure 5.4** Navigating the carbon nanotube patent thicket.

