



# IP Landscape in Nanotechnology

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## Competitive Intelligence and Freedom to Operate

Casey K. Chan MD, Seeram Ramakrishna PhD and Linda Lee

Division of Bioengineering

Nanotechnology Initiative at National University of Singapore

Michelle Ngaim

WizPatent

Presented at the International Congress of Nanotechnology, October 31-November 3, 2005 San Francisco



# Agenda

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- Competitive intelligence
- Freedom to Operate
- Nanotechnology IP challenges
- Our methodology
- Results
- Case studies



# Competitive Intelligence

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- Strategic knowledge about competitors' positions, research efforts, and trends
- Sources of Competitive Intelligence
  - Scientific Literature
  - Conferences
  - Media
  - **Patents**



# Patents as a Source of Competitive Intelligence

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- Publicly available documents
- Excellent source of info for emerging technologies → **Nanotechnology**
- Mining of patent information, usually bibliographic data reveals:
  - Top inventors
  - Top assignees
  - Year
  - Patent classification
  - References to other patents
  - Referenced by other patents
  - Abstract

# Bibliographic Data

- 1<sup>st</sup> page of patent document
- Contains:
  - Inventor's name and Country
  - Assignee and Country
  - Date filed, Date issued
  - Classification
  - References Cited
  - Referenced By
  - Abstract

United States Patent		[19]	[11] Patent Number:	5,965,267
Nolan et al.			[45] Date of Patent:	Oct. 12, 1999

[54] METHOD FOR PRODUCING ENCAPSULATED NANOPARTICLES AND CARBON NANOTUBES USING CATALYTIC DISPROPORTIONATION OF CARBON MONOXIDE AND THE NANOCAPSULATES AND NANOTUBES FORMED THEREBY

[75] Inventors: Peter E. Nolan, Andrew H. Cutler, David G. Lynch, all of Tucson, Ariz.

[73] Assignee: AirForce Board of Regents on behalf of the University of Arizona, Tucson, Ariz.

[21] Appl. No.: 09/056,963

[22] Filed: Mar. 31, 1998

Related U.S. Application Data

[62] Division of application No. 08/380,900, Feb. 17, 1995, Pat. No. 5,780,055.

[51] Int. Cl.<sup>7</sup> ..... B22F 5/16, C01B 33/08

[52] U.S. Cl. .... 428/408, 423/444 R, 423/447 R, 427/216, 427/248

[58] Field of Search ..... 428/402, 343, 428-406, 427/216, 249, 423/447 R, 445 R, 446 R, 448, 40

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5,165,909 11/1992 Tenno et al.

5,171,260 12/1992 Tenno et al.

FOREIGN PATENT DOCUMENTS

16/900 11/1991 U.S.S.R.

224820 4/1992 United Kingdom

OTHER PUBLICATIONS

Applied Catalysis, vol. 66, 1990, E. Tracz et al., "High Resolution Electron Microscopy Study of the Carbon Deposit Morphology on Nickel Catalysts", pp. 133-147.

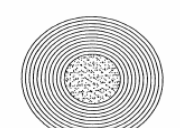
Ultramicroscopy, vol. 34, pp. 54-59, 1990, David J. Smith et al., "Characterization of Filamentous Carbon On Ni/MGO Catalysts By High-Resolution Electron Microscopy", Comptes Rendus Academie des Sciences, vol. 11, pp. 774-777, 1990, Paul et Leon Schutzenberger, "Sur Catalyseurs Fais Relatifs A L'Hydrogene Du Carbone", Journal of Catalysis, vol. 27, pp. 343-356, 1972, Jon R. Rostrup-Nielsen, "Equilibria of Decomposition Reactions of Carbon Monoxide and Methane over Nickel Catalysts", Metallurgical Transactions, vol. 5, pp. 21-26, Jan. 1974, R. G. Johnson, et al., "Catalytic Effect of Iron on Decomposition of Carbon Monoxide. II. Effect of Additions of H<sub>2</sub>, H<sub>2</sub>O, CO<sub>2</sub>, SO<sub>2</sub> and H<sub>2</sub>S", Journal of Crystal Growth, vol. 32, pp. 335-349, 1976, A. Oberlin, et al., "Filamentous Growth of Carbon Through Boreless Decomposition", UASERC Annual Progress Report, pp. 73-82, 1994, Peter E. Nolan, et al., "Carbon Formation in Space Oxygen Processes: The Importance of Hydrogen", Engineering, Construction, and Operations in Space IV, vol. 2, pp. 1199-1209, 1994, Peter E. Nolan, et al., "Carbon Formation Theory for Space Oxygen Processes", (List continued on next page.)

Primary Examiner—Hsu T. Le  
Attorney, Agent, or Firm—Oblon, Spivak, McClelland, Matter & Neststad, PC

ABSTRACT

[57] A method for the production of carbon encapsulated nanoparticles, carbon nanotubes and other closed carbon structures, including containing a catalyst of a transition metal, or a compound or alloy thereof, with a gas mixture containing carbon monoxide, and an amount of available molecular hydrogen which is insufficient to cause formation of graphite along edges through capping, as a compressant in the range from 300-1000° C. to provide closed carbon structures, which are useful in the preparation of thermal composites, reinforcement composites and magnetic particle recording media.

7 Claims, 5 Drawing Sheets





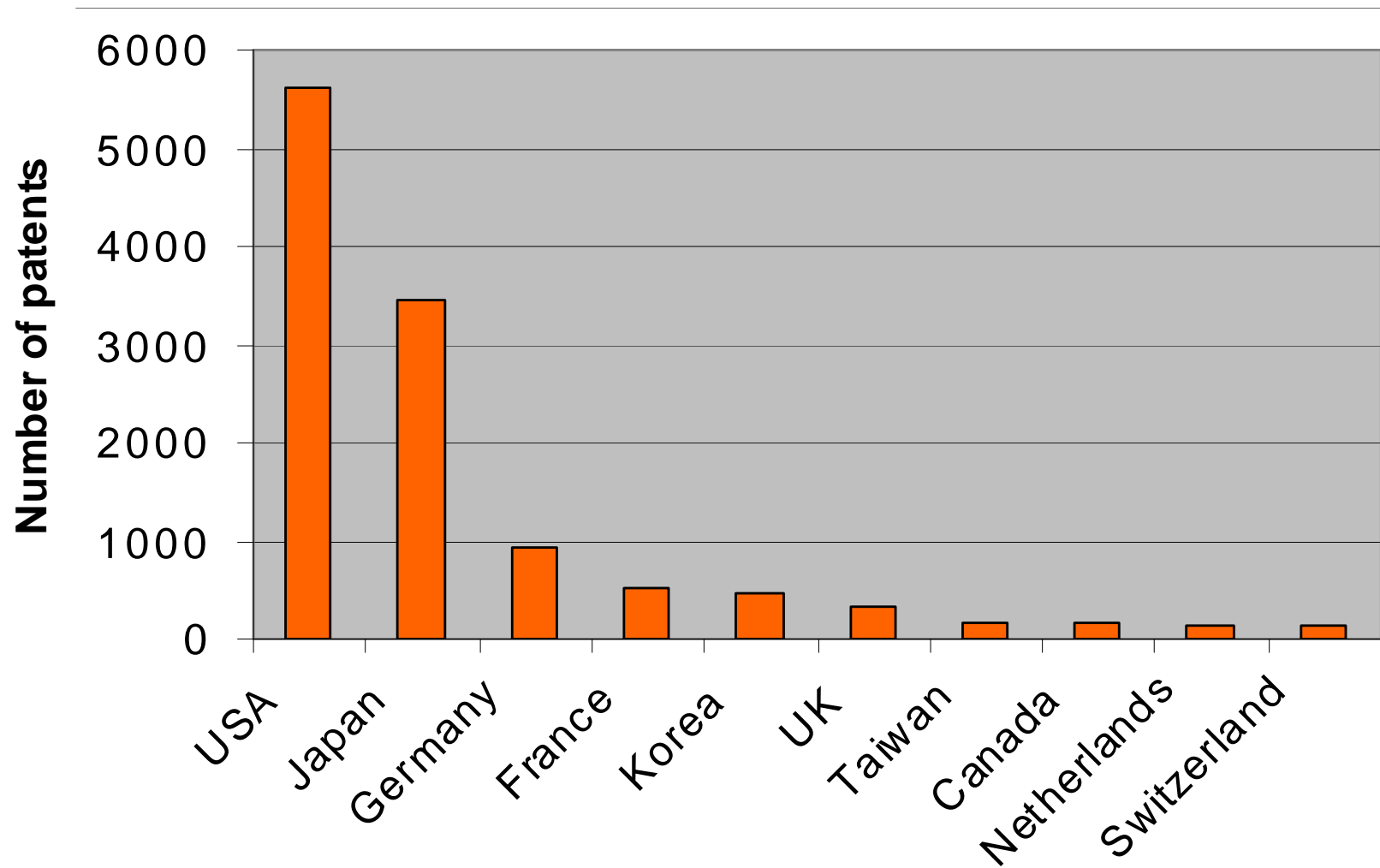
## How many Nanotech patents?

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8630 in 2003 alone	University of Arizona report
3818 from 1985 to Mar. 2005	Lux Research Report
5613 in 2004	Nanotechnology Researchers Network of Japan
1377 in Class 977	USPTO search on 17 Oct 2005

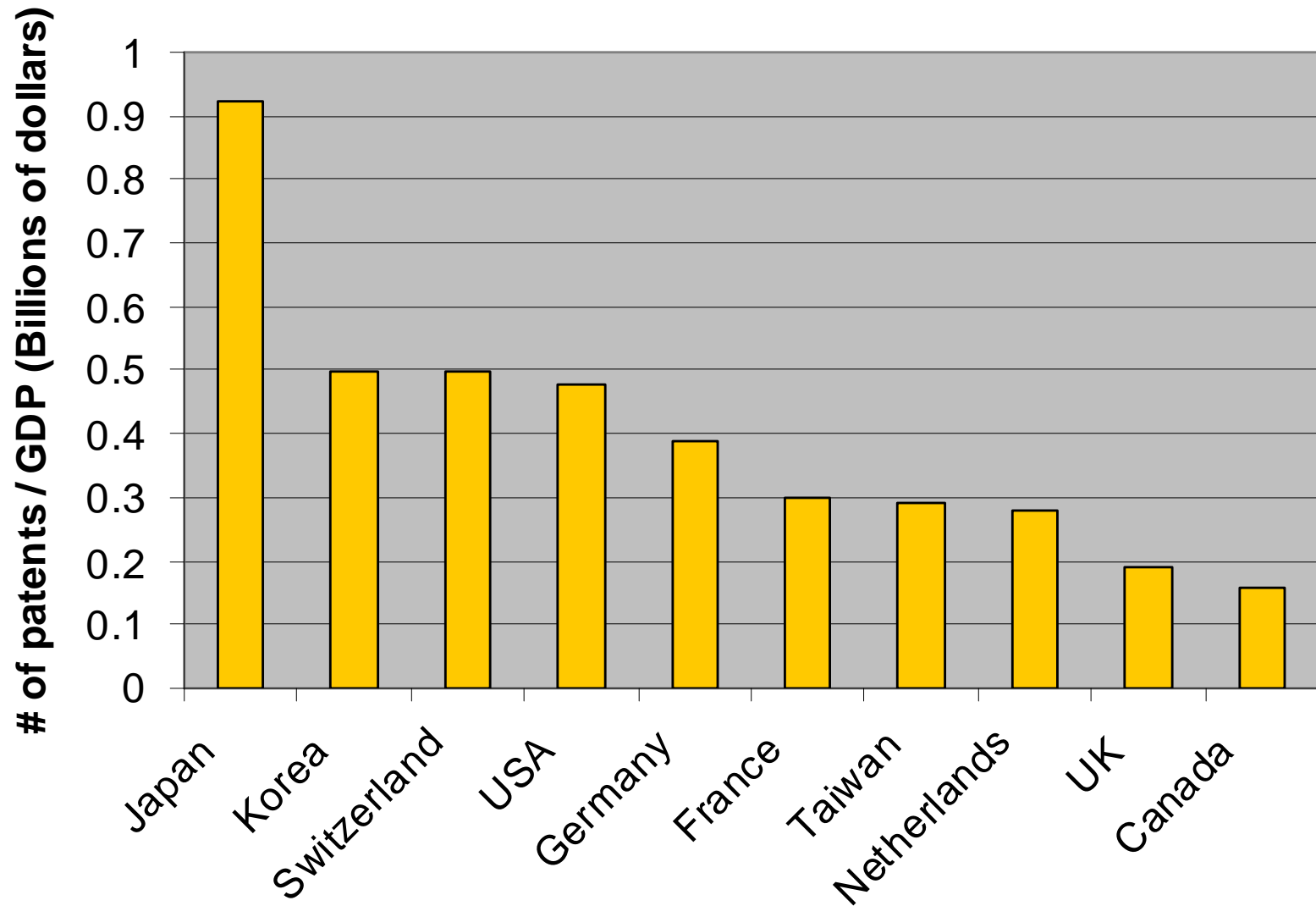
- Different keyword searches and databases leads to confusion

# Nanotech-related patents (US, Japan, Europe, Worldwide) in 2004



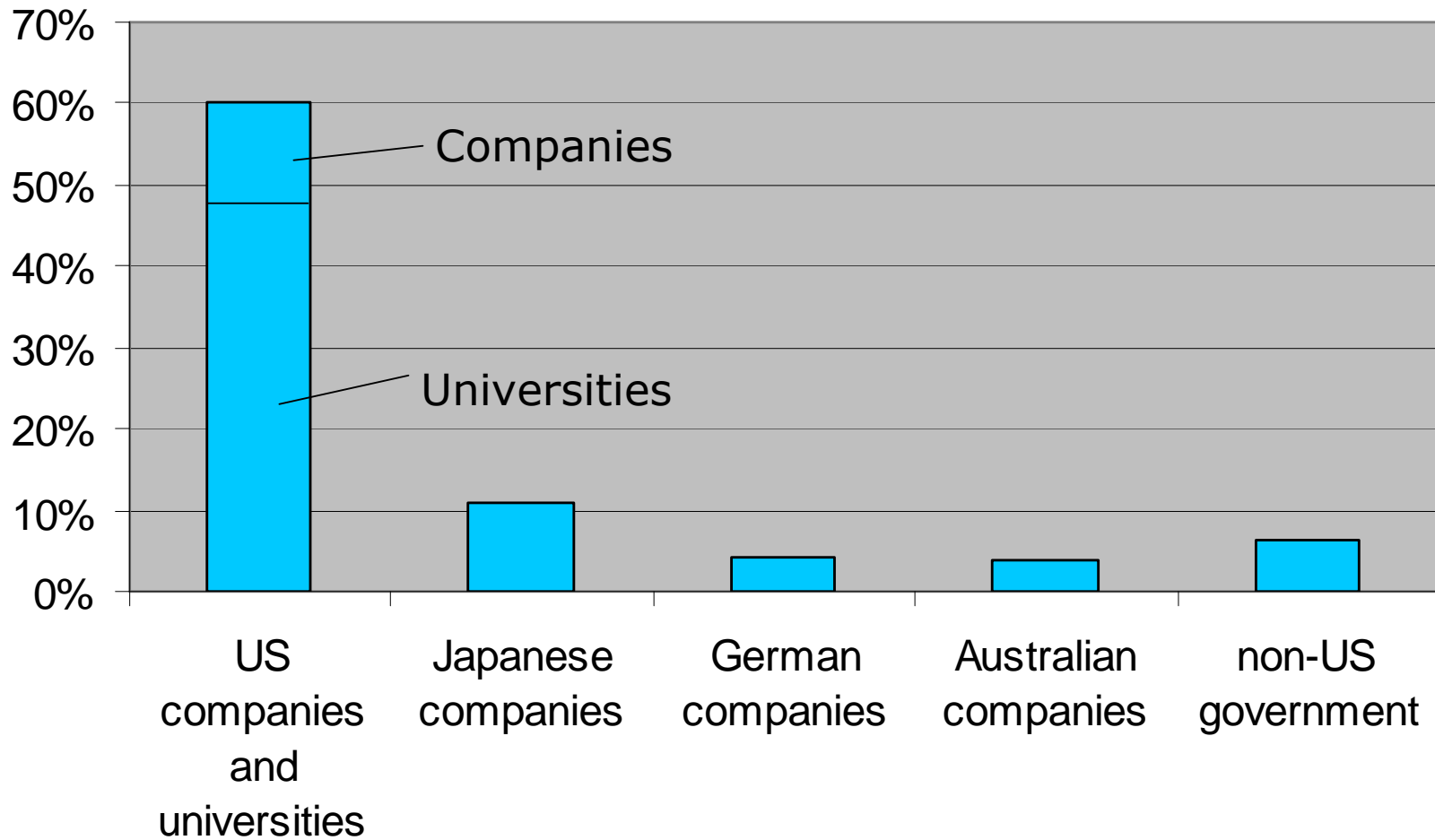
Source: Nanotechnology Researchers Network of Japan

# Adjusted to Size of Economy





# Class 977 Breakdown in 2003



Source: ETC Group



# Nanotechnology IP Challenges

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- Nanotech defines a scale of measurement, not a particular application
- Lack of uniform definitions and terminology for nanotechnology
- USPTO Class 977 “Nanotechnology”
  - 1) 1-100 nm
  - 2) Novel properties due to nanoscale size
- “Patent land grab” and “patent thickets”

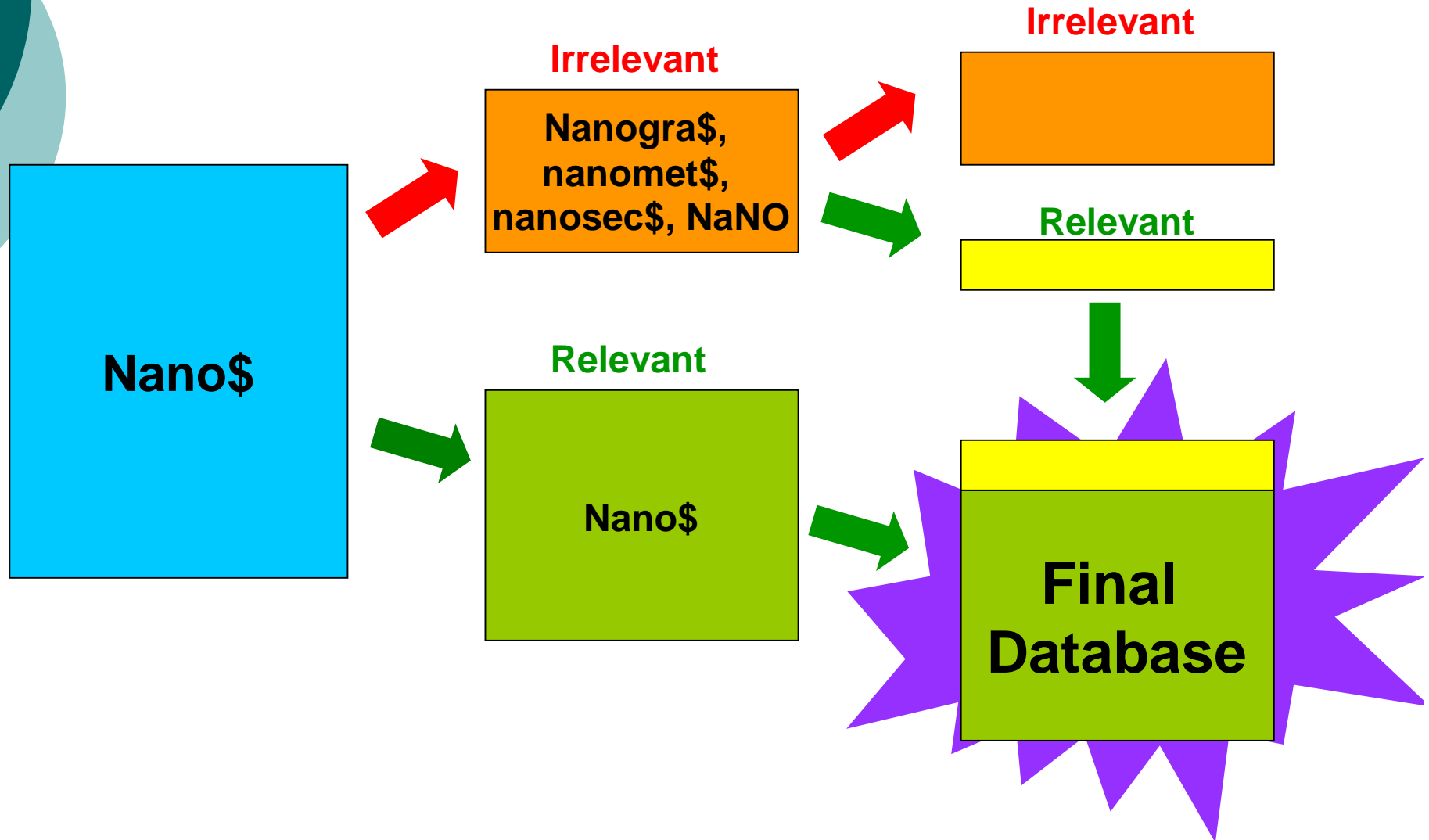


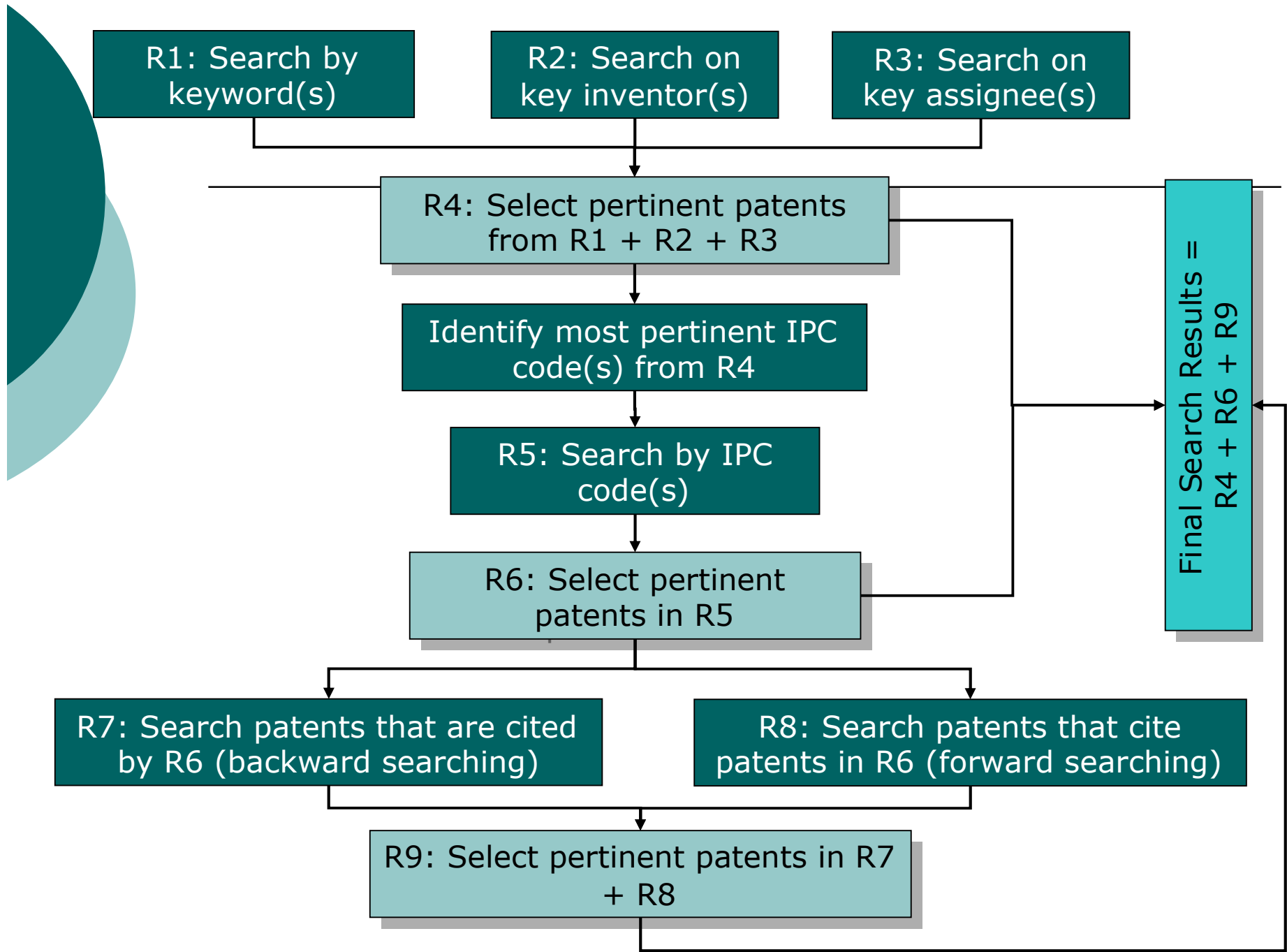
# Methodology (1)

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- USPTO Issued Patents
- 1976 to Present
- TXT data
  - Robust
  - Forward and Backward citations
- Preliminary Search
  - Nano\$ in patent abstract
- Secondary Search
  - Identify possible irrelevant patents (Nanomet\$, Nanogra\$, Nanosec\$, NaNO)
  - Review individual patents and make decision
- Data Cleaning

# Methodology (2)





R1: Search by keyword(s)

R2: Search on key inventor(s)

R3: Search on key assignee(s)

R4: Select pertinent patents from R1 + R2 + R3

Identify most pertinent IPC code(s) from R4

R5: Search by IPC code(s)


R6: Select pertinent patents in R5

R7: Search patents that are cited by R6 (backward searching)

R8: Search patents that cite patents in R6 (forward searching)

R9: Select pertinent patents in R7 + R8

Final Search Results = R4 + R6 + R9



# Methodology(3)-Data Cleaning

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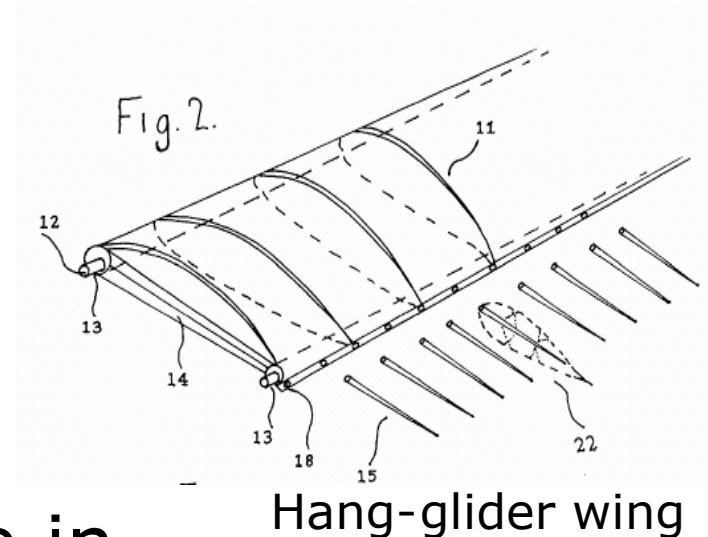
- Patent analysis is further complicated by inconsistent records of assignee or inventor names
  - International Business Machines Corp.; International Business Machine(s) Corporation; Internation Business Machines Corporation
  - The Regents of the University of California; The Regents, University of California; Regents of the University of California
  - L'oreal; L'oreal SA, Societe L'oreal
- Data cleaning is time-consuming and cannot be fully automated

# US 6,260,795

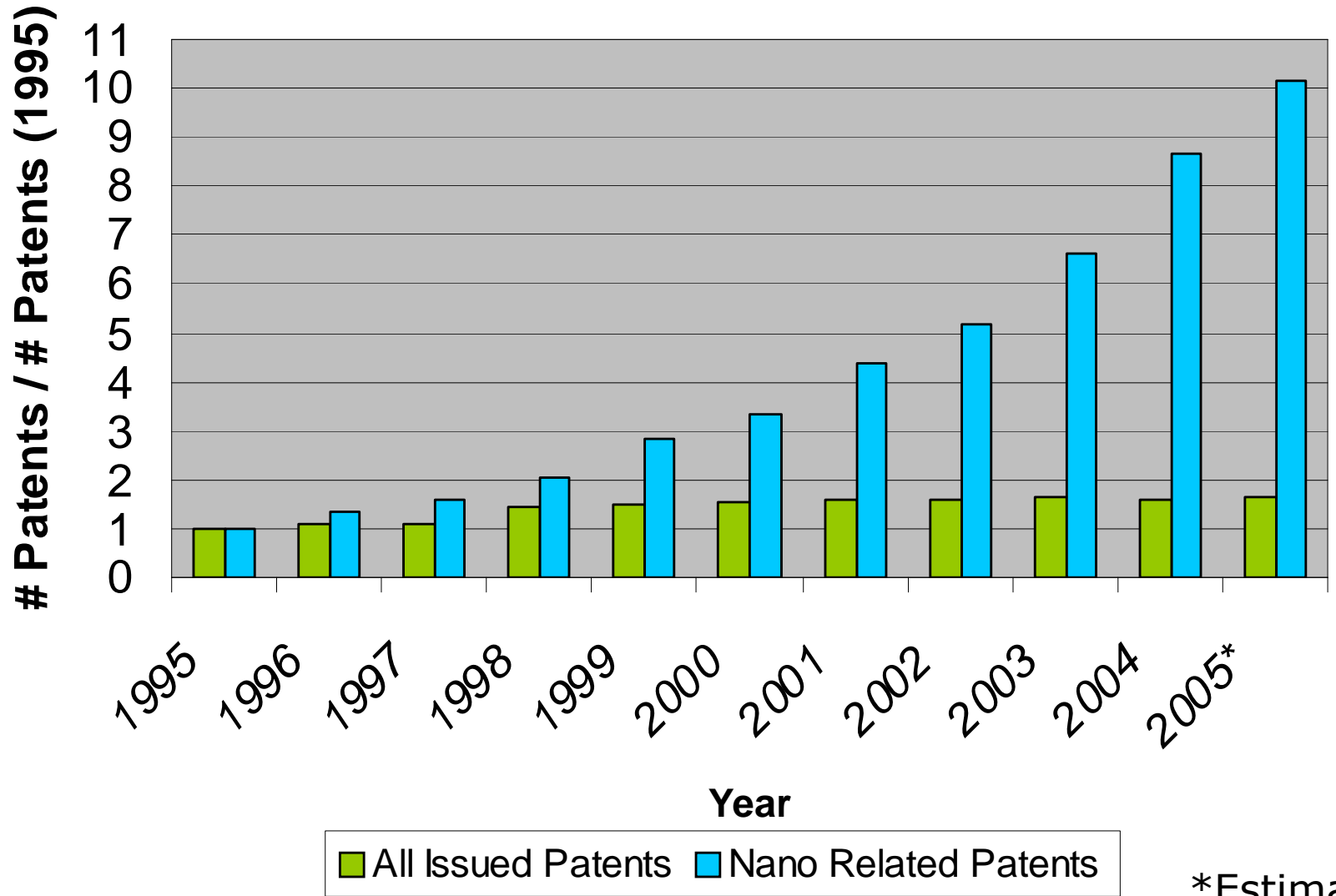
## Oya Computerized Glider

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- Irrelevant patent that was not eliminated in preliminary or secondary searches
- Modified hang-glider
- “Nano” mentioned once in patent abstract
  - “...incorporates...nano wires, and nano cables, for electrical connections and manual control levers.”



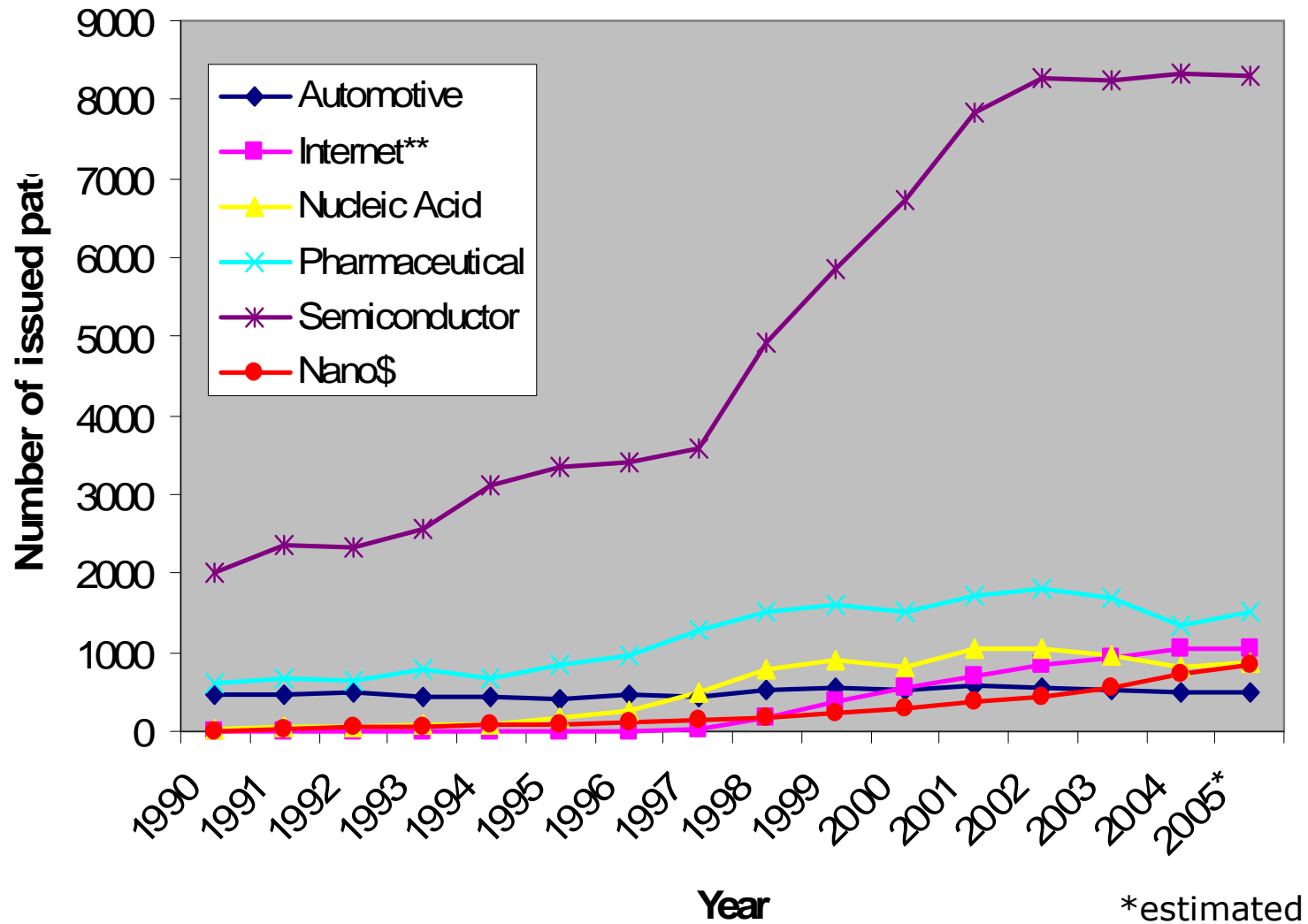
# Dramatic Rise in Number of Nanotech-related Patents



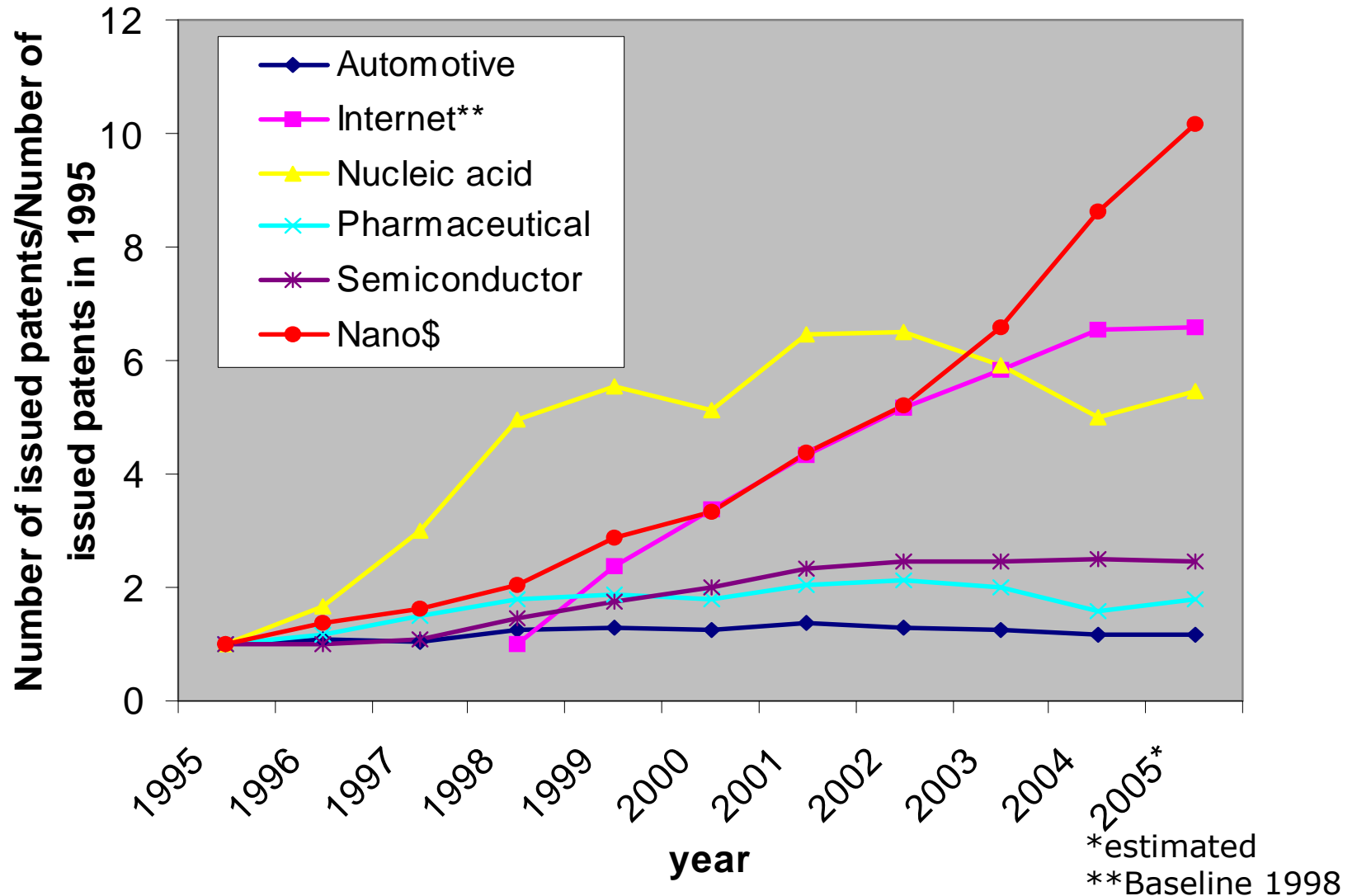
\*Estimated



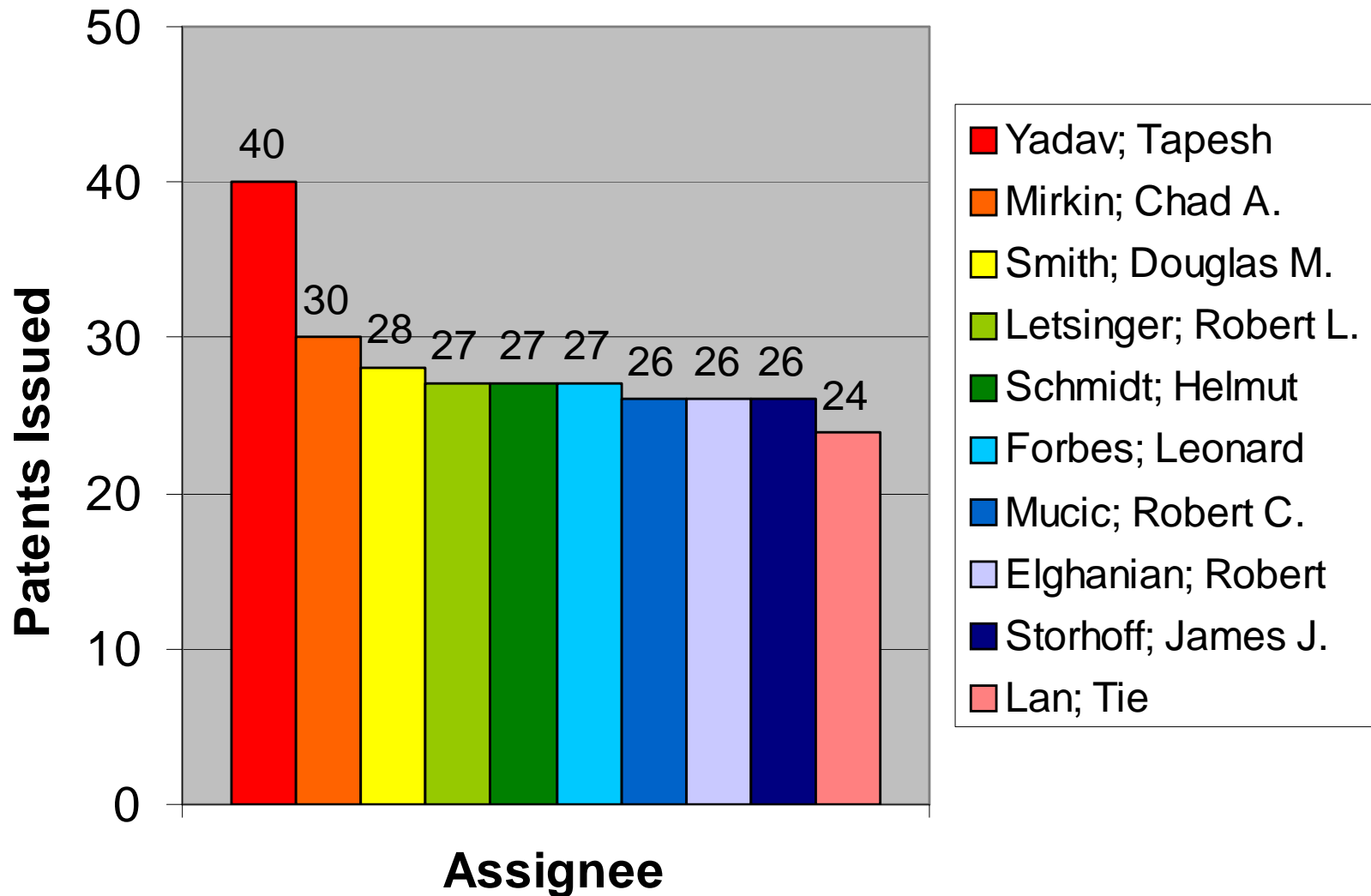
# Nanotech-related patents and patents across selected industries 1990-2005



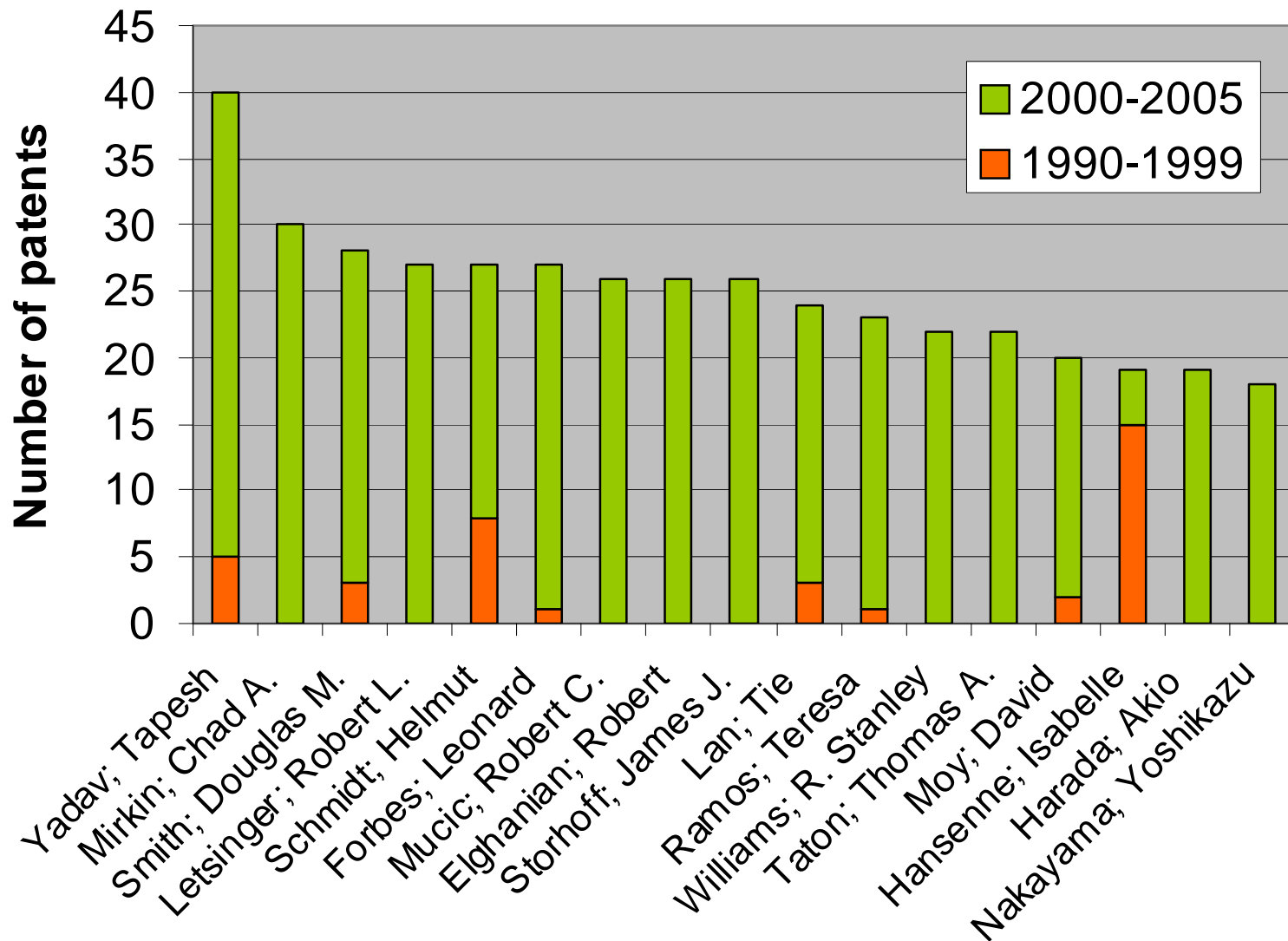
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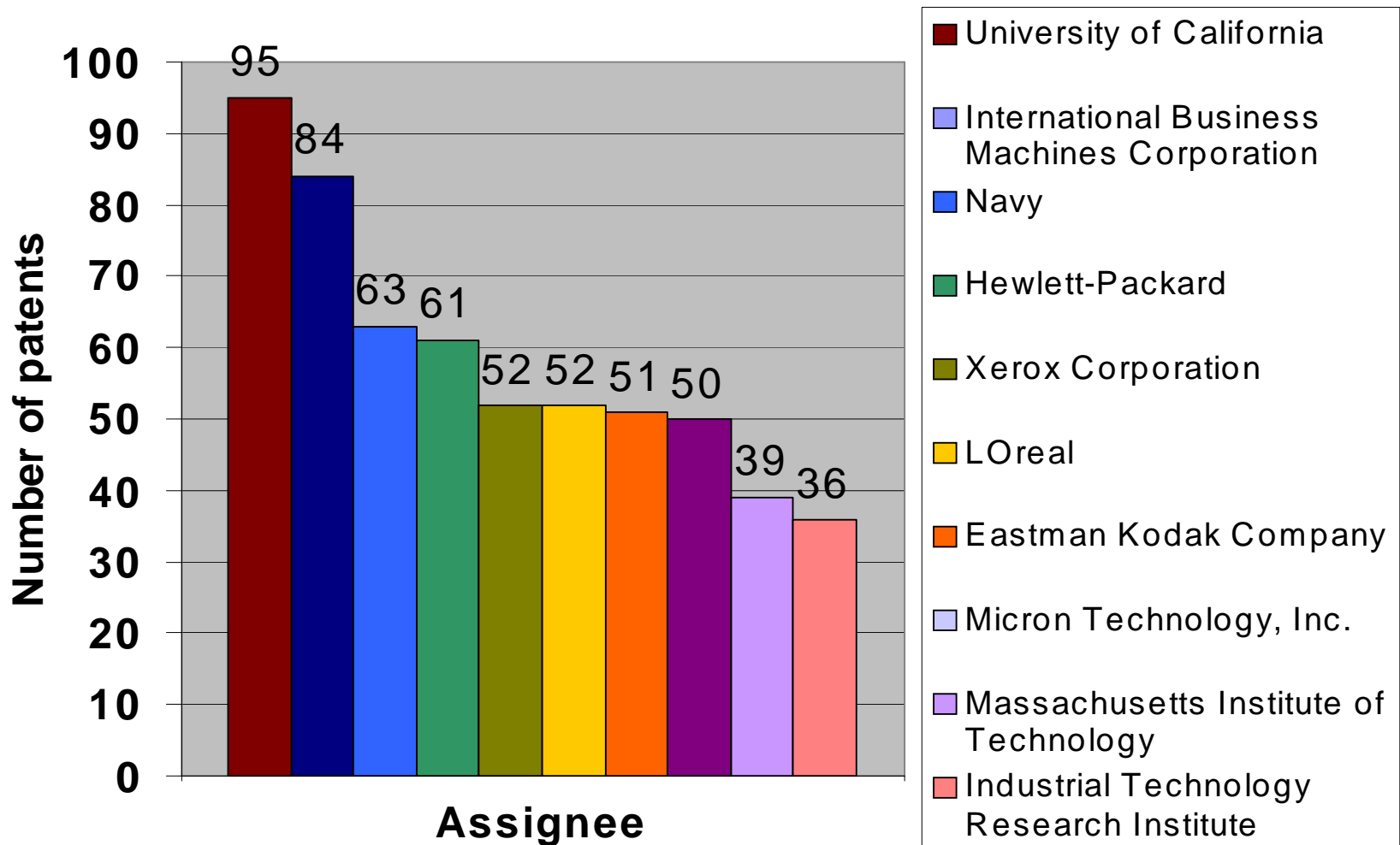
# Top Ten Inventors



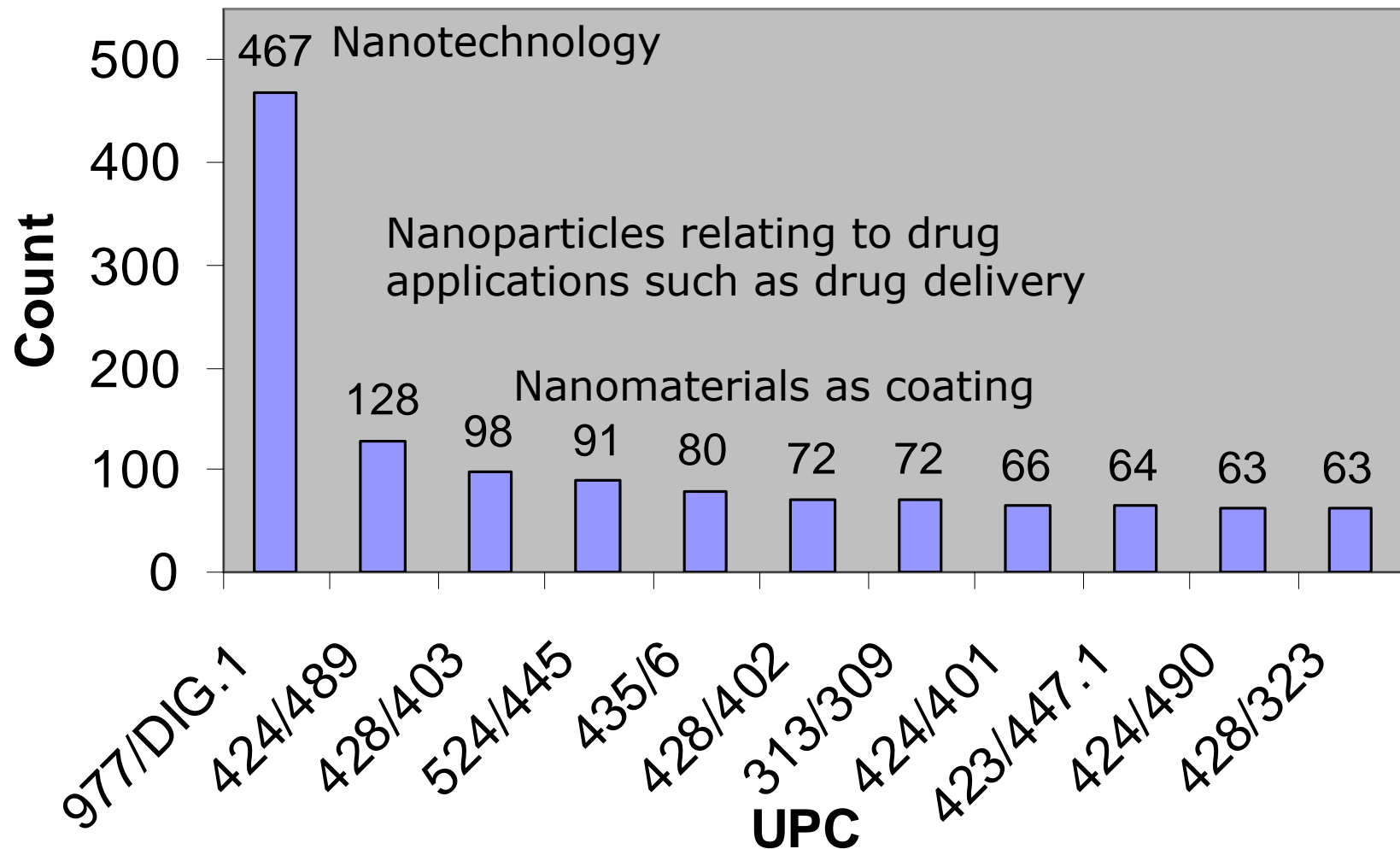
# Top Inventors – Pre- and Post-Y2K



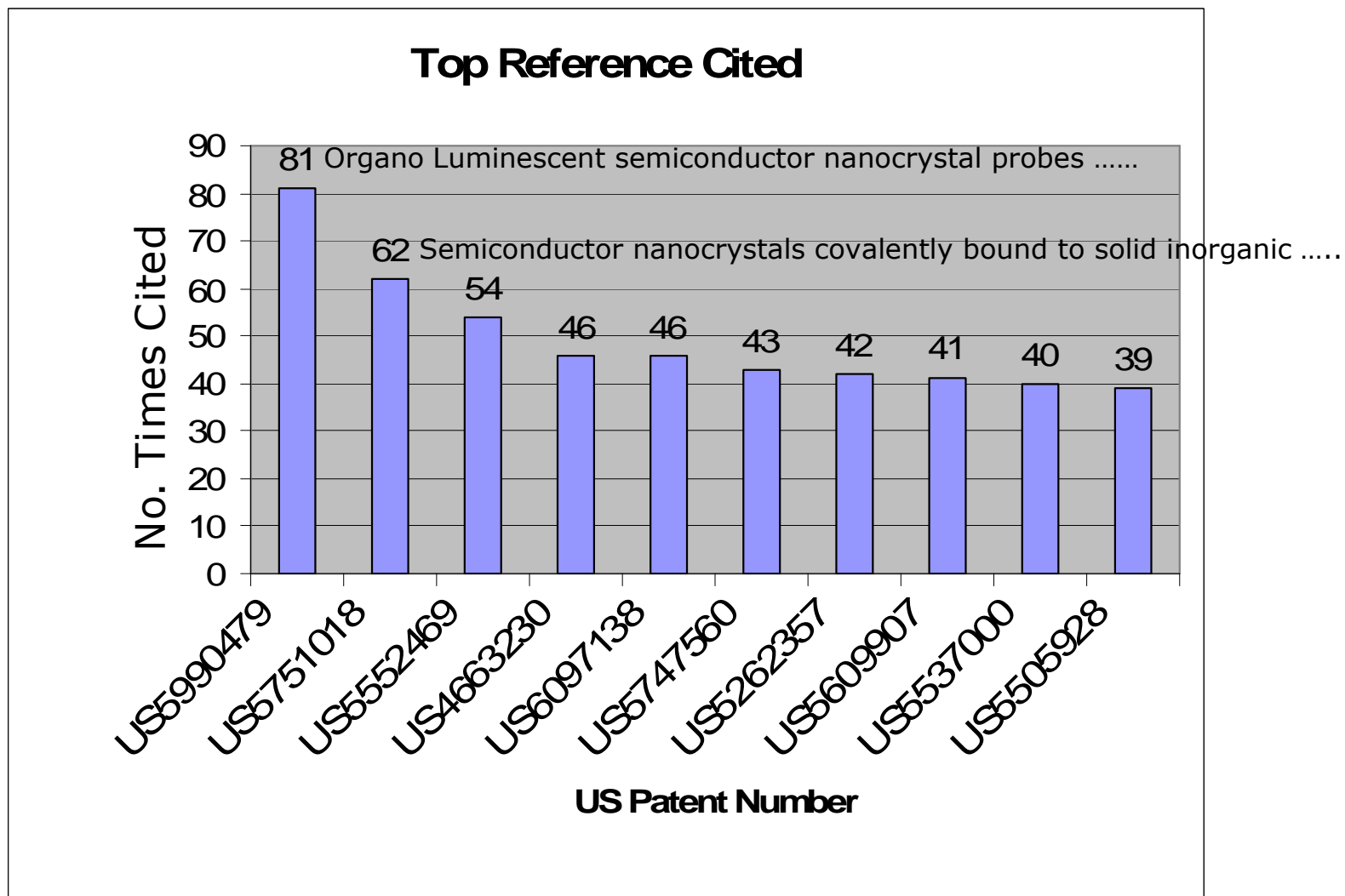
# Top Ten Assignees



# Top Ten US Classifications

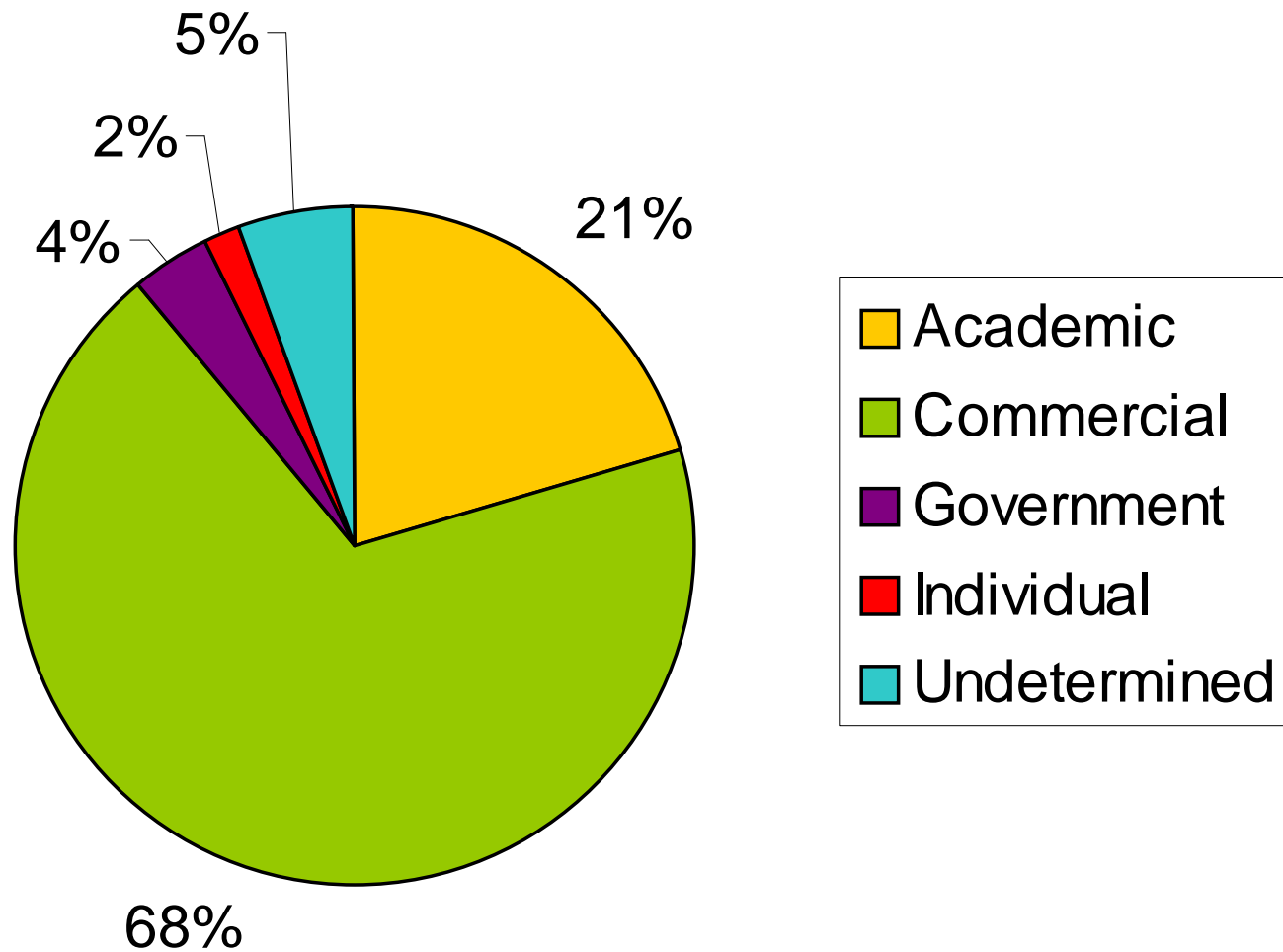


# Top Ten Referenced Patents



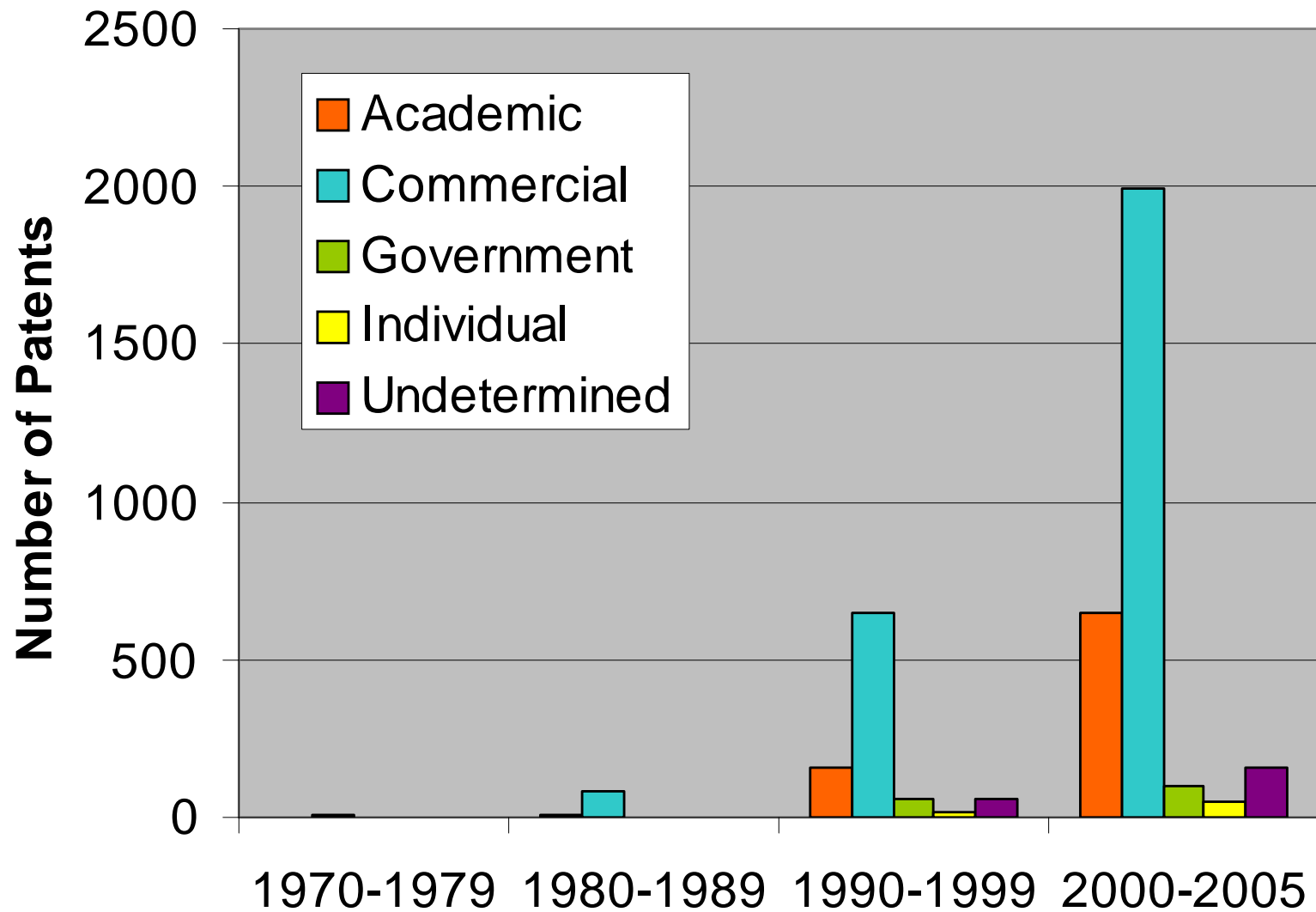
# Nanotech Patents by Assignee Type

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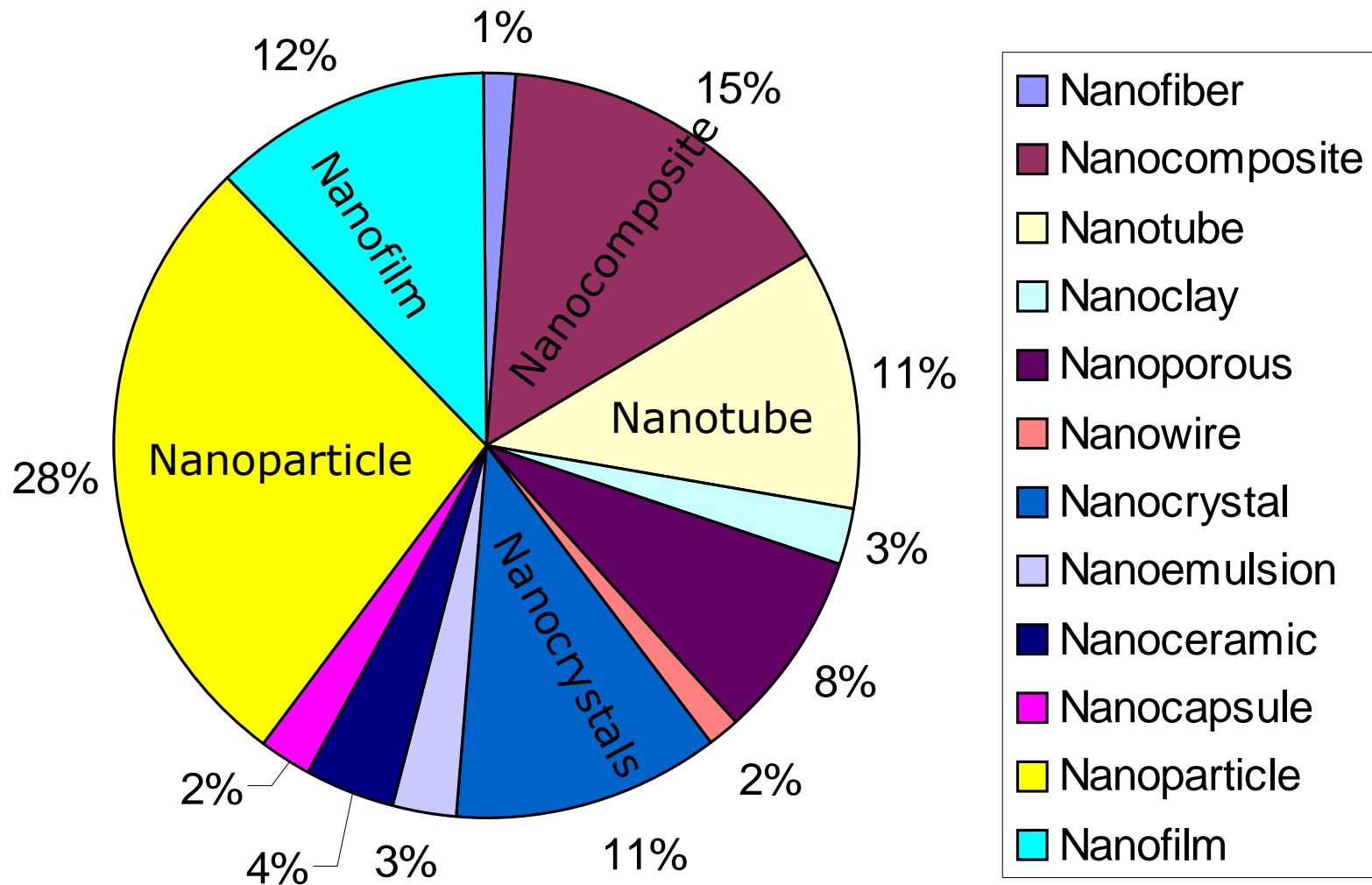




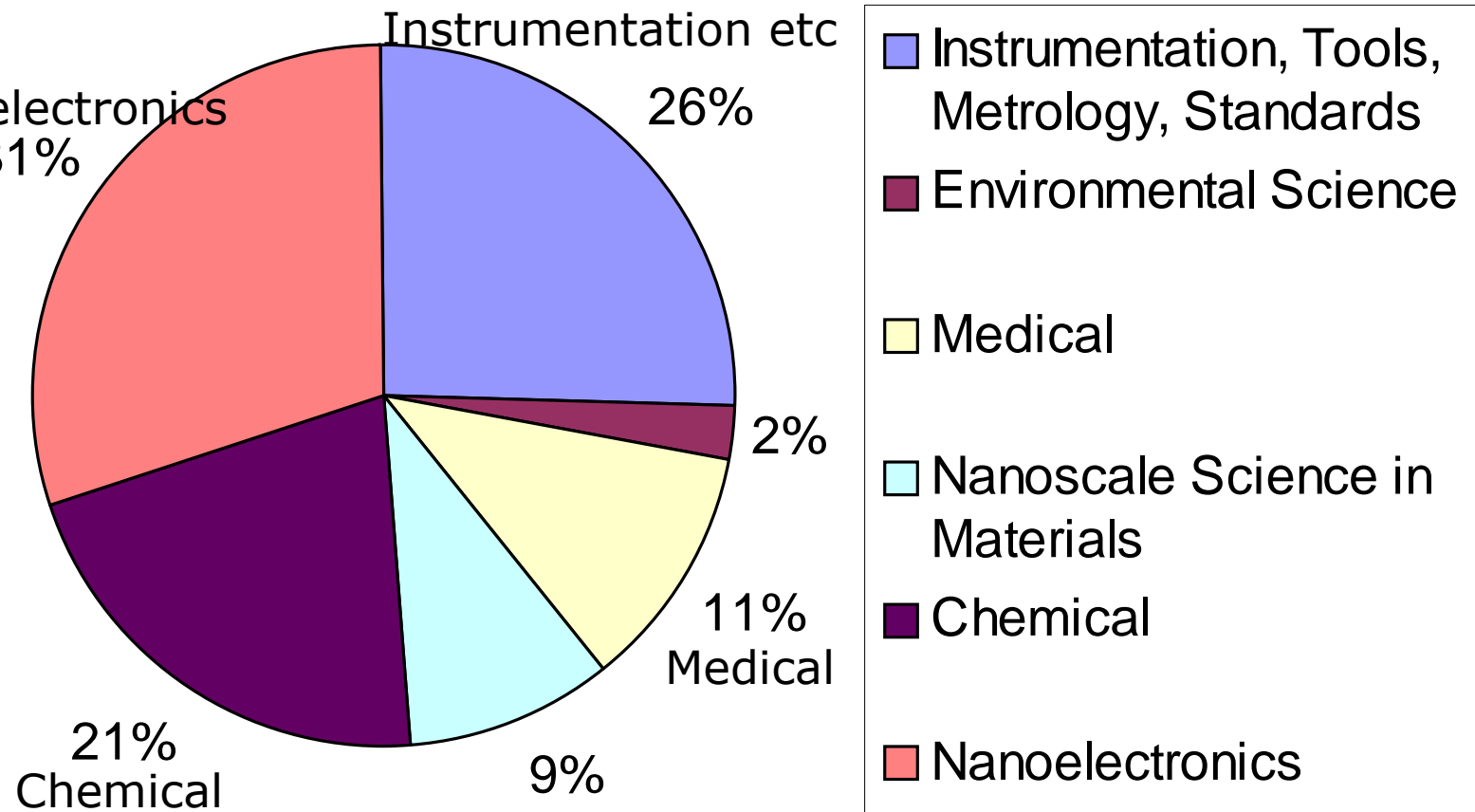
# By Assignee Type Over Time



# Nanotech Patents by Structure



# Nanotech Patents by Application

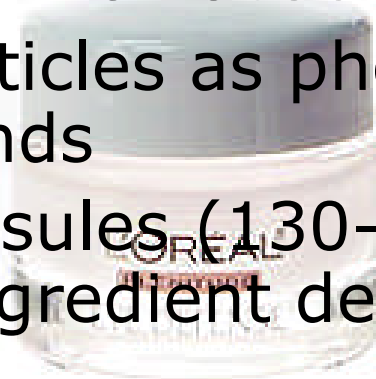
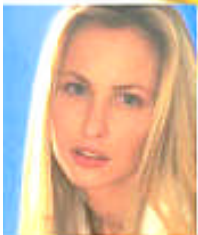


# L'oreal: "Because I'm Worth It"

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- World's leading cosmetic company
- \$3 billion research investment in past 10 yrs (3% of sales)
- 17 research labs in USA, France, and Japan
- 586 patents filed worldwide in 2004
- 52 USPTO nanotech-related patents

- Nanoparticles as photoprotective cosmetic compounds
- Nanocapsules (130-600 nm) for effective active ingredient delivery to skin



# Tapesh Yadav: Most Prolific Inventor

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- MIT Ph.D. and minor in business at Sloan
- 41 issued patents, of which 33 assigned to NanoProducts Corp.
- Founder and CEO of NanoProducts Corp. (Longmont, CO)
  - 45 issued patents, 45 patents pending
  - Produce commercial quantities of nanomaterials



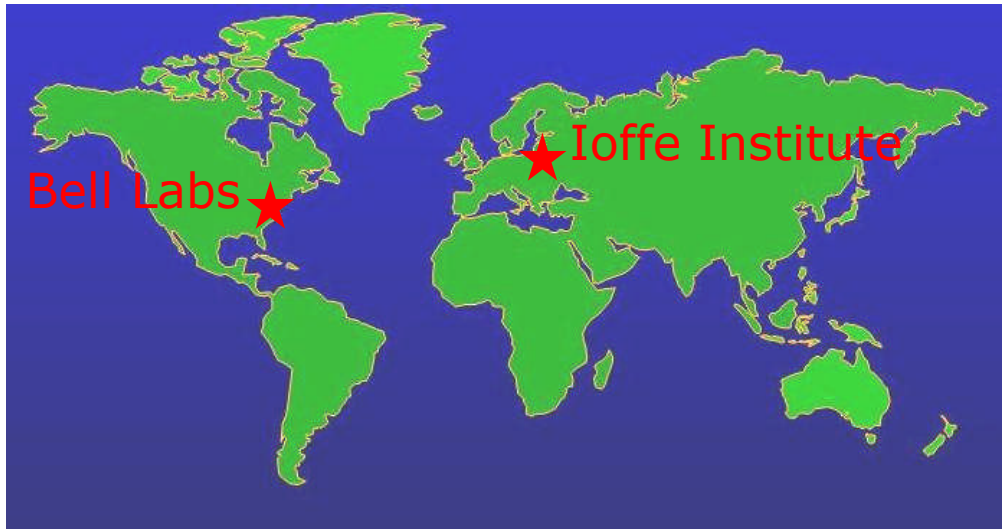
# NanoProducts Corp.

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- A different approach:
  - A common trend in nanotechnology is for companies to license patents from universities
  - However, all patents developed and owned by NanoProducts Corp.
- Diverse patent portfolio covering production and engineering processes to products and applications
- Manufactures and sells nanoscale powders, dispersions, and powder-based products, including single metal, multi-metal and doped oxides.

# Who Controls Quantum Dots?

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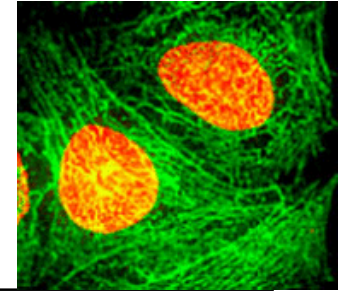


- Paul Alivisatos “Inventor of Quantum Dot technology”\*
- Alex Ekimov “Father of Quantum Dots”\*\*

\*[www.qdots.com](http://www.qdots.com)

\*\*[www.evidenttech.com](http://www.evidenttech.com)

# Who Controls Quantum Dots?

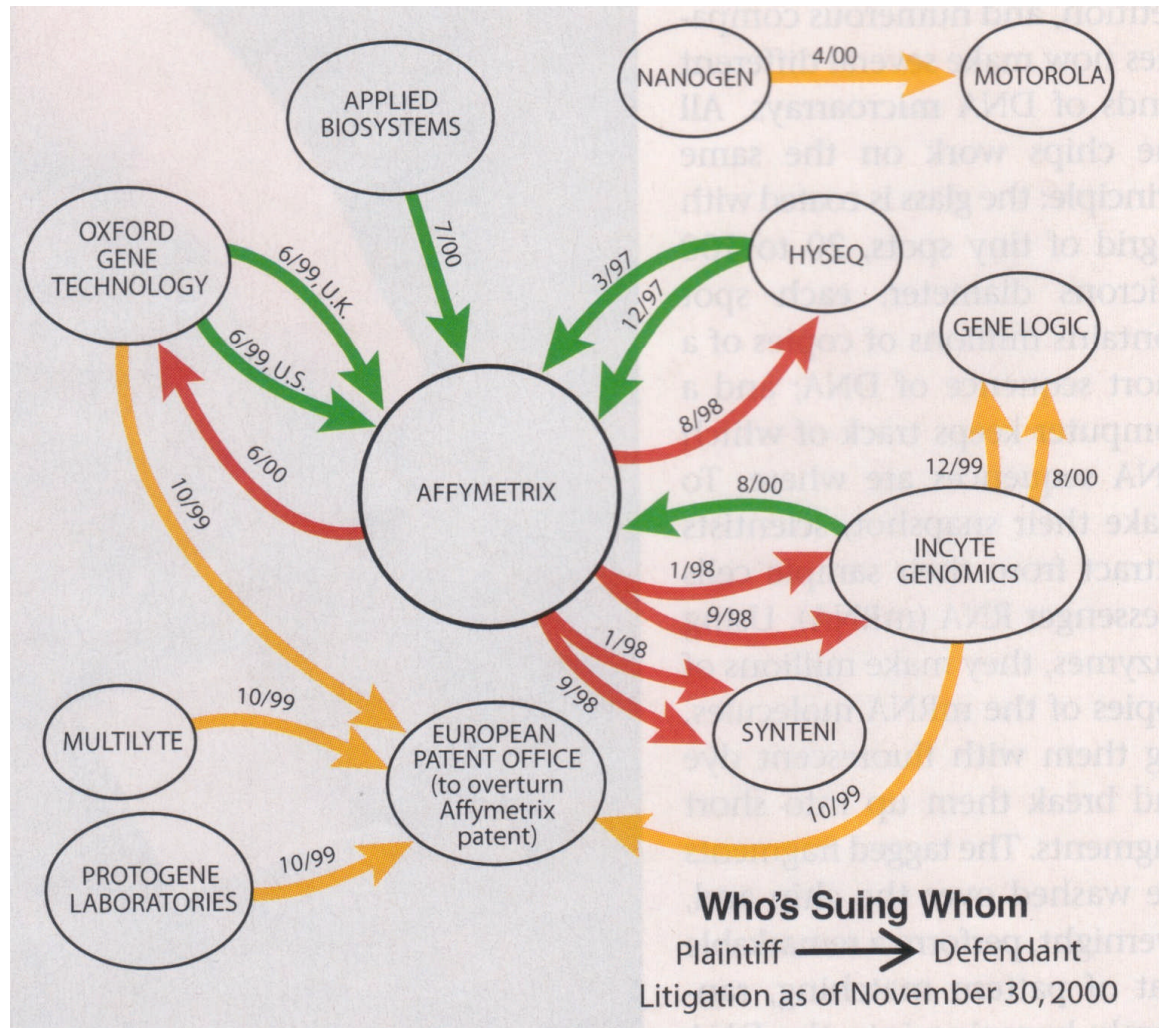


		Assigned patents	Licensed patents
Quantum Dot Corp.	Biological applications	10	22 (MIT and UC)
Evident Technologies	Biological applications	5	
Nanosys	All other applications	3	400 patents and applications

- Complicated by hidden license agreements
- "If you want to look for a place where there will be an intellectual property battle, this is it." (Matthew Nordan, Lux Research)



# The Future of Nanotech IP Landscape?





## What is Freedom to Operate?

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- The ability to commercialize a product without being sued
- Bibliographic data is of no use
- It is all in the claims
- Careful examination and interpretation of claim language is of utmost importance
- Cannot be automated



# Ambiguity

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I shot the monkey in my pajamas.

Possible scenarios:

1. I am wearing my pajamas and shot the monkey in the tree.
2. The monkey is in the tree wearing my pajamas.
3. I am wearing my pajamas and the monkey is hiding in the pant leg of my pajamas.



## How to avoid ambiguity

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### **Claim Construction:**

By declaring specifically the elements of the invention.

### **Claim Interpretation:**

By parsing into separate and more easily processed elements.



# Characteristics of Patent Claims

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1. Define Invention
2. Public Notice
3. Claims allowed cover only patentable subject matter in a proffered patent specification.



# Initial patent review

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- Front Page
  - Patent Number and Title
  - Applicant (s), Assignee
  - Issued Date/ File Date
  - Class and Field of Search
  - Attorney, Examiner
  - References
  - Abstract
  - *Representative Drawing*
- Back Page
  - Claims



# Five Types of Claims

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- **Independent Claim (3)**

- Apparatus
- Method
- Composition of Matter

- **Dependent Claim (2)**

- Additional element
- Restriction of an element



# Object Oriented Programming

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- Object = Element
- Parent-Child Relation
- Object (sub-object, attributes)
- Child Object inherit Parent's characteristic





# Review of Claim Structure

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- Main Element +- attribute(s)
  - Element +- attribute(s)
    - Sub-element +-attribute(s)
  - Element +- attribute(s)
    - Sub-element +-attribute(s)
- Two types of elements
  - Structural elements
  - Step elements



# Punctuation of Claim

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1. One sentence with a comma after preamble (title) and a colon after transitional phrase.
2. Element has its own paragraph ending with a semicolon
3. The word "and" between the last two elements
4. Each claim has only one period.
5. Rule #2 does not apply to subelements



I claim:

1. A vehicle storage battery system, comprising:
  - a storage battery having three integrally manufactured separate storage battery portions, including a main battery portion having a capacity sufficient for starting the engine of a vehicle under normal circumstances, a first standby battery portion and a second standby battery portion, said first and second standby battery portions when connected in series having a combined nominal voltage which is greater than the voltage of said main battery portion, said nominal voltage of said first and second standby battery portions each being less than the nominal voltage of said main battery portion, said first and second standby battery portions having a rated capacity smaller than said main battery portion but sufficient to transfer enough charge to said main battery portion when in a discharged state to start the engine of the vehicle;
  - a battery control having a first circuit connecting said first and second standby battery portions in series for charging said main battery portion when in a discharged state, said first circuit including means for restricting a charging current flow from said standby battery portions to said main battery portion to a predetermined safe level, and a second circuit connecting said first and second standby battery portions in parallel for recharging said standby battery portions from said main battery portion, said second circuit including means for restricting a recharging current flow to said standby battery portions to a predetermined safe level; and
- switch means for switching between said first and second circuits.

# US 4,564,797

## Claim Analysis

### 1. Vehicle storage battery system comprising

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#### ▶ Storage battery

- 3 separate portions
  - ⇒ Main battery position
  - ⇒ 1<sup>st</sup> standby
  - ⇒ 2<sup>nd</sup> standby
    - 1<sup>st</sup> + 2<sup>nd</sup> in series > voltage of main
    - 1<sup>st</sup>, 2<sup>nd</sup> voltage < voltage of main
    - 1<sup>st</sup>, 2<sup>nd</sup> < capacity then main
    - 1<sup>st</sup> + 2<sup>nd</sup> capacity sufficient to start car

#### ▶ Battery control

- 1<sup>st</sup> circuit
  - ⇒ Connecting 1<sup>st</sup> + 2<sup>nd</sup> in series
    - For charging main
  - ⇒ Means for restricting current
- 2<sup>nd</sup> circuit
  - ⇒ Connecting 1<sup>st</sup> + 2<sup>nd</sup> in parallel
    - For recharging 1<sup>st</sup> and 2<sup>nd</sup>
  - ⇒ Means for restricting current

#### ▶ Switch means

- Switching between 1<sup>st</sup> and 2<sup>nd</sup> circuit



Patent Collections

- Patent Document Folder
  - Fruits
    - Apple
    - Orange
  - Medical Device
    - Chan
    - Wade
- GroupBy Folders - [Chan,Wade]

Documents in - [Chan]

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Rec	DocNo	TXT	PDF	ANN	Title	Source
1	US4973168				Vacuum mixing/bone cement cartridge and kit	USPTO-Issued Patent
2	US5893488				Bone cement injector gun	USPTO-Issued Patent
3	US6359611				Finger controlled computer mouse	USPTO-Issued Patent
4	US6368335				Surgical repair kit and its method of use	USPTO-Issued Patent
5	US6516977				System and method for mixing bone cement	USPTO-Issued Patent
6	US6547807				Suture relay for surgery	USPTO-Issued Patent
7	US6562043				Apparatus and method for ligament fixation	USPTO-Issued Patent
8	US6607535				Universal bone cement plug and method of use	USPTO-Issued Patent
9	US6629984				Surgical repair kit and its method of use	USPTO-Issued Patent
10	US6663605				Removable protective cannula for use in surgery	USPTO-Issued Patent

View - [Text of US5893488]

advantages are produced by two fulcrums engageable during different portions of the trigger stroke. In a second embodiment, the first and second mechanical advantages are produced by a fixed fulcrum and a rotatable fulcrum. The first mechanical advantage is greater than the second such that the first facilitates pressurizing the bone cement and the second facilitates high volume dispensing of the bone cement. The injector gun also includes a pair of U-shaped slots. One of the slots is sized to accept a large cement cartridge and the other slot is sized to accept a small cement cartridge. An alternative embodiment provides a hinged cartridge retaining gate for closing the U-shaped slots for positive retention of the cartridge.

Inventors: **Hoag; Stephen H.** (Warsaw, IN); **Stalcup; Gregory C.** (Columbia City, IN); **Chan; Kwan-Ho** (Lubbock, TX); **Hawkins; Michael E.** (Columbia City, IN); **Case; Kirt L.** (Warsaw, IN)  
 Assignee: **Bristol-Myers Squibb Co.** (New York, NY)  
 Appl. No.: **877324**  
 Filed: **June 17, 1997**

**Current U.S. Class:** 222/391; 74/141.5; 74/169; 74/516; 74/522; 222/327; 604/209; 606/68; 606/94; 606/234  
**Intern'l Class:** A67D 005/42  
**Field of Search:** 222/327,391 606/92,93,94,95 604/71,181,187,207,208,209,282,73,68,232,233,234 74/141.5,169,516,522,94

References Cited [Referenced By]

U.S. Patent Documents			
<a href="#">Re34487</a>	Dec., 1993	Keller	222/327.
<a href="#">D261425</a>	Oct., 1981	Bruhn	D24/26.
<a href="#">546073</a>	Sep., 1895	Mix.	
<a href="#">795713</a>	Jul., 1905	Letts	222/391.
<a href="#">1495924</a>	May., 1924	Quale	604/232.
<a href="#">2224967</a>	Dec., 1940	Kaye	259/47.

- Search and Retrieve
- Working Lists
- Patent Collections
- ShortCuts



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Claim Analysis  
Segmentation and Tagging  
Natural Language Processing  
Regular Expressions





Patent Collections

- Patent Document Folder
  - Fruits
    - Apple
    - Orange
  - Medical Device
    - Chan
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**Intern'l Class:** A67D 005/42

**Field of Search:** 222/327,391 606/92,93,94,95 604/71,181,187,207,208,209,282,73,68,232,233,234 74/141.5,169,516,522,94

References Cited [\[Referenced By\]](#)

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<a href="#">D261425</a>	Oct., 1981	Bruhn	D24/26.
<a href="#">546073</a>	Sep., 1895	Mix.	
<a href="#">795713</a>	Jul., 1905	Letts	222/391.
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9	US6629984				Surgical repair kit and its method of use
10	US6663605				Removable protective cannula for use in surgery

View - [Text of US5893488]

**United States Patent** **5,893,488**  
**Hoag, et al.** **April 13, 1999**

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**Bone cement injector gun**

**Abstract**

A paste injector gun, especially adapted for injecting bone cement, has first and second mechanical advantages. In a first embodiment, the first and second mechanical advantages are produced by two fulcrums engageable during different portions of the trigger stroke. In a second embodiment, the first and second mechanical advantages are produced by a fixed fulcrum and a rotatable fulcrum. The first mechanical advantage is greater than the second such that the first facilitates pressurizing the bone cement and the second facilitates high volume dispensing of the bone cement. The injector gun also includes a pair of U-shaped slots. One of the slots is sized to accept a large cement cartridge and the other slot is sized to accept a small cement cartridge. An alternative embodiment provides a hinged cartridge retaining gate for closing the U-shaped slots for positive retention of the cartridge.

---

Inventors: **Hoag; Stephen H.** (Warsaw, IN); **Stalcup; Gregory C.** (Columbia City, IN); **Chan; Kwan-Ho** (Lubbock, TX); **Hawkins; Michael E.** (Columbia City, IN); **Case; Kirt L.** (Warsaw, IN)

Assignee: **Bristol-Myers Squibb Co.** (New York, NY)

Appl. No.: **877324**

Filed: **June 17, 1997**

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**Current U.S. Class:** **222/391; 74/141.5; 74/169; 74/516; 74/522; 222/327; 604/209; 606/68; 606/94; 606/234**

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Claim Tree - US5893488 ReAnalyze

US 5,893,488 AnalyzerVer. - 1.0.1

- 1. A paste injector gun comprising:
  - ... a housing having
  - ... a drive plate mounted
  - ... a shaft mounted in
  - ... a trigger pivotably attached to the drive plate at a...
  - ... a first fulcrum mounted on the housing opposite the trigger...
  - ... a second fulcrum, the second fulcrum being mounted
- 6. A paste injector gun comprising:
  - ... a housing having
  - ... a drive plate mounted
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- 9. A paste injector gun comprising:
  - ... first pivot means for
  - ... second pivot means for
- 14. A paste injector gun *for dispensing a paste from a cartridge, the paste*
  - ... a housing having
  - ... the gate rotatable between an open position
  - ... the gate including a closure tab extending from an...
  - ... the closure tab fitting into the tab receiving slot...
  - ... and a spring loaded detent is mounted adjacent the...
  - ... the closure tab including a depression

Claim #1

1. A paste injector gun comprising: a housing having a longitudinal axis; a drive plate mounted in the housing for translation along the longitudinal axis; a shaft mounted in the housing for translation along the longitudinal axis, the shaft passing through the drive plate; a trigger pivotably attached to the drive plate at a pivot point and extending from the drive plate; a first fulcrum mounted on the housing opposite the trigger such that when the trigger pivots about the pivot point the trigger contacts and rotates about the fulcrum and the drive plate is moved along the axis carrying the shaft with it; and a second fulcrum, the second fulcrum being mounted for rotation on the housing opposite the trigger, the second fulcrum being rotatable between a first position in which it is not engageable with the trigger and a second position in which it is engageable with the trigger





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  - 5. wherein the gate further includes a closure tab extending from...
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  - and a spring loaded detent is mounted adjacent the...
  - the closure tab including a depression

Claim #4

4. The paste injector gun of claim 1 wherein the housing further includes a U-shaped opening for receiving a cartridge and the paste injector gun further includes a gate hinged at one end to the housing, the gate rotatable between an open position in which a cartridge can be positioned in the U-shaped opening and a closed position in which the gate closes the U-shaped opening for positive retention of the cartridge

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**United States Patent** [19] (11) **Patent Number: 5,893,488**  
**Hoag et al.** [45] **Date of Patent: Apr. 13, 1999**

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*Primary Examiner—Kenneth Bomberg*  
*Attorney Agent, or Firm—Cary R. Reeves*

[57] **ABSTRACT**  
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1 of 16

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ReAnalyze

- US 5,893,488, AnalyzerVer. - 1.0.1
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**Intern'l Class:** A67D 005/42  
**Field of Search:** 222/327,391 606/92,93,94,95 604/71,181,187,207,208,209,282,73,68,232,233,234 74/141.5,169,516,522,94

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**United States Patent** 6,736,537  
**Coffeen , et al.** May 18, 2004

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**Bone cement mixing and delivery device for injection and method thereof**

**Abstract**

A bone cement mixing and delivery assembly is disclosed for mixing a powdered copolymer and a liquid monomer to form a bone cement and delivering the bone cement. The assembly includes a cartridge having a distal end and a proximal end and defining a mixing chamber between the distal end and the proximal end. A transfer mechanism having a cap and a stem supporting a piston and a plunger is connected to the distal end. The transfer mechanism includes a first advancement mechanism for advancing the piston and plunger in unison and a second advancement mechanism for moving the plunger independent of the piston. The assembly further includes a removable handle having a shaft for attachment of a mixing blade and a quick-release connector and a release button for locking and unlocking the mixing blade from the removable handle.

and embodiment, the first and second mechanical advantages  
 cond such that the first facilitates pressurizing the bone cement  
 U-shaped slots. One of the slots is sized to accept a large  
 provides a hinged cartridge retaining gate for closing the U-

van-Ho (Lubbock, TX); Hawkins; Michael E. (Columbia

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## Take Home Message

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- Rapid rise in number of nanotech patents at the rate of 20%/year
- Careful interpretation of CI data
  - How data derived
  - How data is presented
- Determination of FTO
  - Cannot be automated
  - Will be an important issue in coming years





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