NanoKorea 2004 Symposium, Aug. 25.

Nano Trends and Prospects based on Patent Analysis

Yong-Byung Ban

Department of Organic Chemistry
Chemical and Biotechnology Patent Examination Bureau
Korean Intellectual Property Office(KIPO)

특허청 Korean Intellectual Property Office

Contents

- What is a Patent ?
- Nanotechnology Patenting
- Patent Informations in R&D
- Patent Map – Patent Information Analysis
- Nano-patent Analysis Project
- Trends in Nano-patents
- Nano-materials : Carbon Nanotube/Composites
  - ✓Selected patents of carbon nanotube
- Nano-patent Claims
- Patent Citations
- Summary

What is a Patent?

- Invention means the highly advanced creation of technical ideas utilizing the Rules of Nature.
- A Patent for an invention is granted by a government to the inventor, giving the inventor the right for a limited period to stop others from making, using or selling the invention without the permission of the inventor.
- When a patent is granted, the invention becomes the property of the inventor, which (like any other form of property or business asset) can be bought, sold, rented or hired.
- Patents are exclusive rights.
  - ✓ Virtually no rights in unclaimed subject matter.
  - ✓ Strategic claim drafting is important.

To be patentable, your invention must;

- Be new
- Involve an inventive step
- Be capable of industrial application

Invention in Nano World ?

Patents in Technological Activity

- Technology in which there exists a protectable, legal property right.
- To use data collected by patenting agencies to construct level, structure, evolution of technological activities.
- Direct measurement of technological fields, Internationally comparable.
- But, patents are different greatly in their economic value
  - ✓Technical class do not fit into industry class

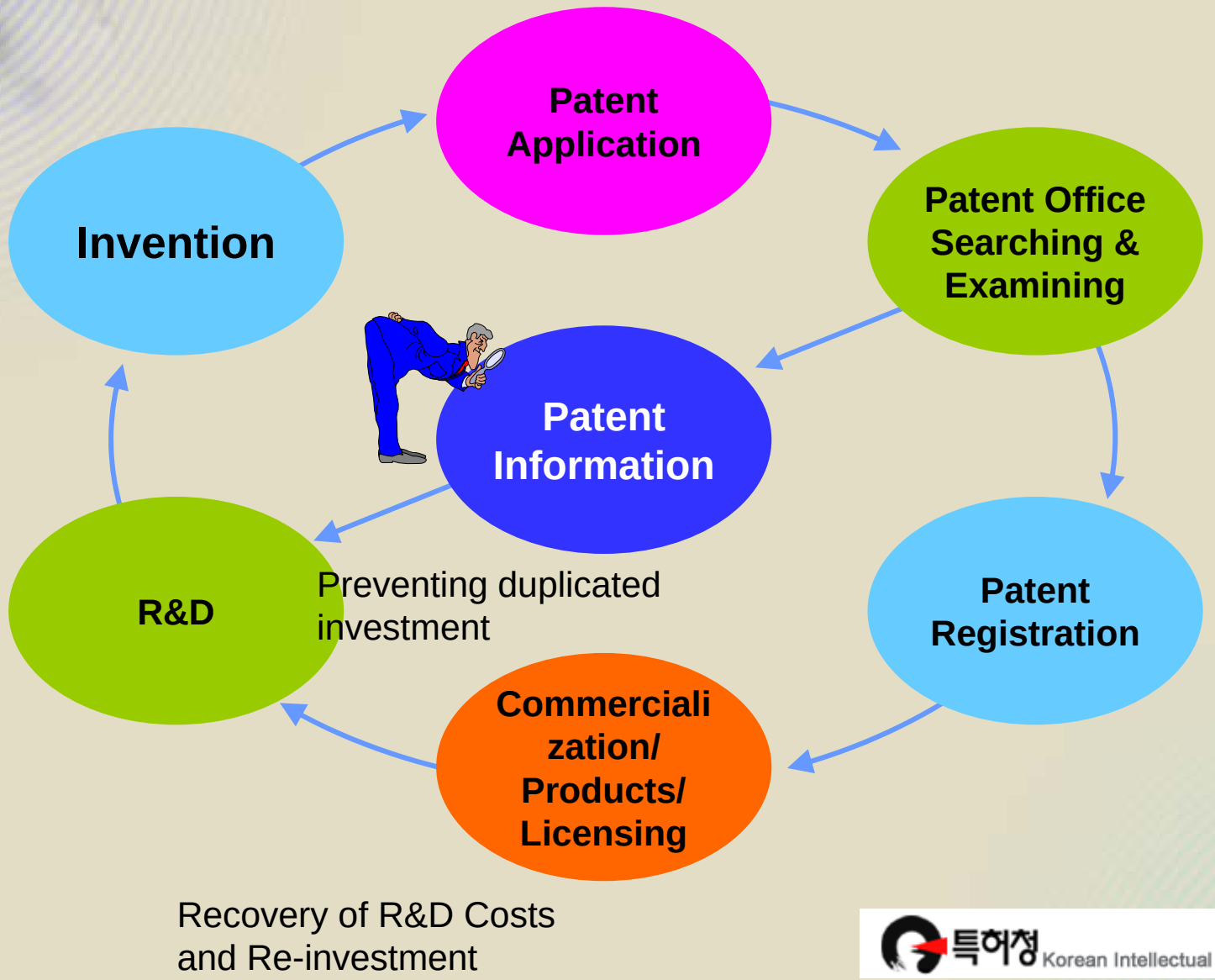
Nanotechnology Patenting

- **Nanotechnology brings together many disciplines of sciences.**
  - ✓ Chemistry
  - ✓ Physics/Electronics
  - ✓ Materials
  - ✓ Bio/Pharma

New Rules = New Inventions

- **Challenge of Patenting in Nanotechnology**
  - ✓ What is it?

The Role of Patent Informations in R&D



특허청 Korean Intellectual Property Office

Patent Map (Tool)

- A patent map is a process that shows the whole picture of the situation like a **map** through analysis of the result of the search.

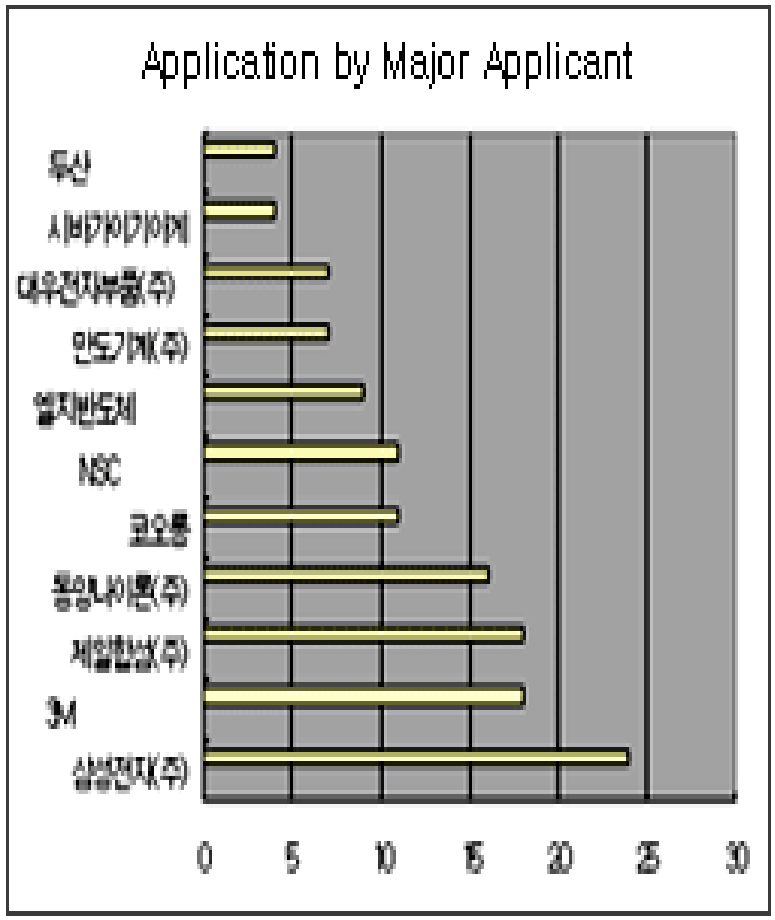
1) To understand the trend of the new technology (ex, NT) through patent information
2) To understand the main point of the technology described in the patent
3) To prevent dispute over patent rights
4) To acquire objective self-assessment and comparison with competitors
5) To establish strong strategy with regard to the matters of patents and technology

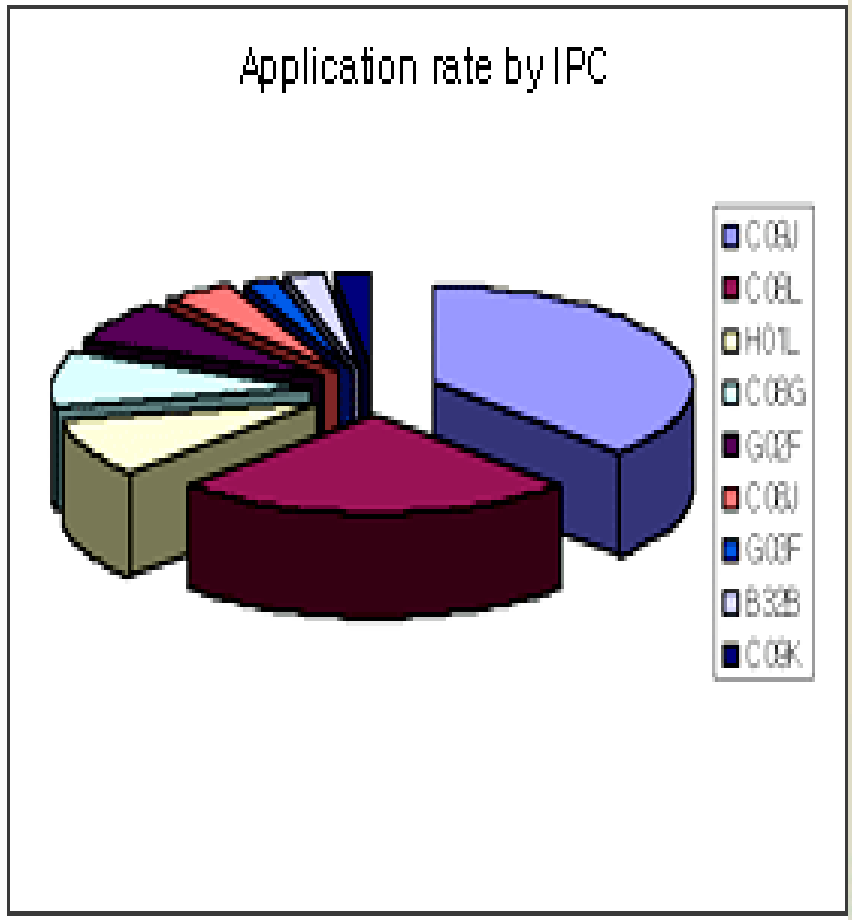
Analyzing Patent Information

- **Quantitative** Analysis; most usable data comes from bibliographical information including the number of patent applications.
    1) Quantity-based Analysis
    2) Time-based Analysis
    3) Ranking Analysis

- **Qualitative** Analysis; this method is performed by the inter-relationship of technologies concerned.
    1) Selection of core patent
    2) Technology development map, etc

Examples (Patent Map)

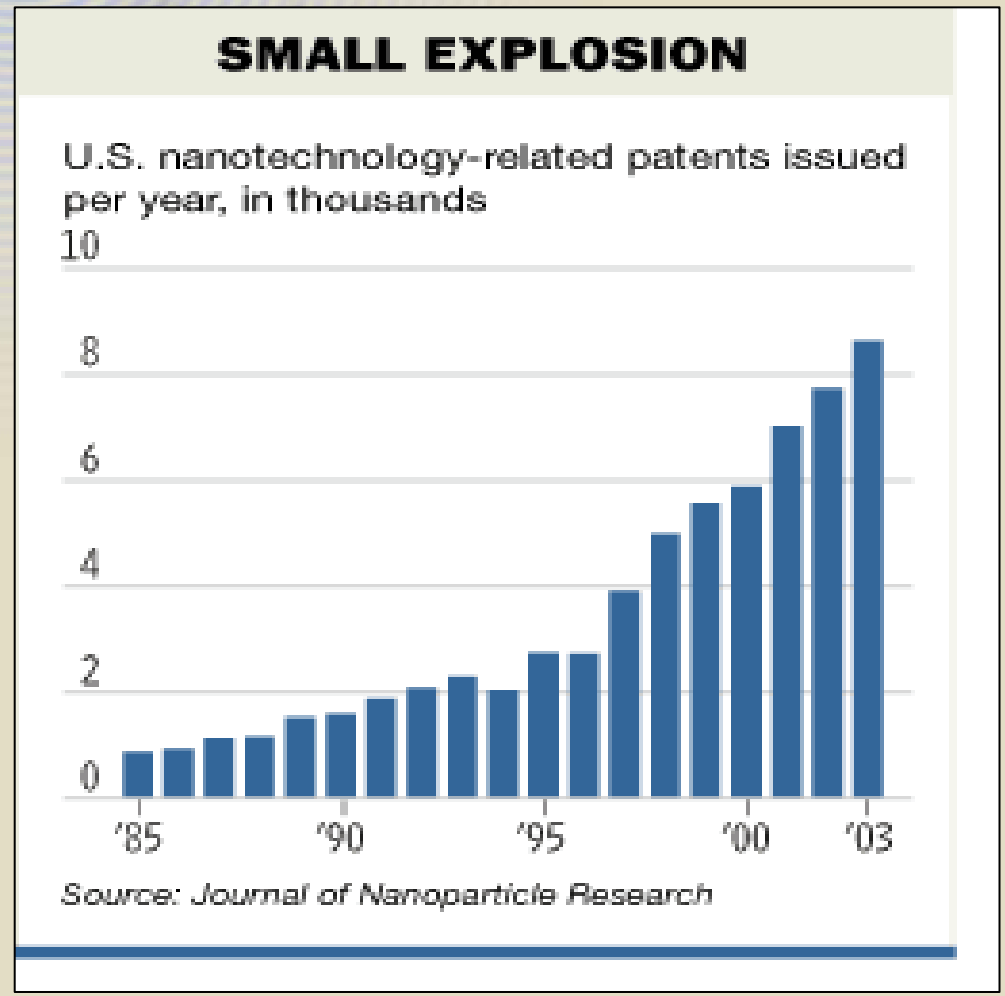




Examples for Nano-Patents Analysis

- Foreign Countries
  - ✓ USA - Longitudinal Patent Analysis for Nanoscale Science and Engineering (J. of Nanoparticle Research, 2003, supported by NSF)
  - ✓ JAPAN - Trends of Patent Applications in Nanotechnology (JPO, 2002, 2003) etc
  - ✓ Begium - NANOTECHNOLOGY Analysis of an Emerging Domain of Scientific and Technological Endeavor (Steunpunt O&O Statistieken, 2003)
- Domestics
  - ✓ The Importance of Patent Information in Nanotechnology (KIPO, NT Study Club, 2003)
  - ✓ Competition Analysis in Nanotechnology by Korean and US Patents (STEPI,2002)
  - ✓ Information Analysis of Technology and Industry in Nanotechnology (KISTI, 2002-present)

USA - NSF Results (1)



IBM won the most nanotech-related patents in 2003.

Driving the patenting boom is the potential for licensing revenue and power to control emerging technologies.

USA - NSF Results (2)

Year	United States	Japan	France	United Kingdom	Switzerland	China (Taiwan)	Italy	Republic of Korea	Netherlands	Australia
1976	538	40	21	0	7	0	6	0	2	1
1977	670	21	19	0	6	0	6	0	0	5
1978	670	36	34	5	8	0	1	0	4	8
1979	516	27	20	3	9	0	4	0	2	2
1980	718	39	24	15	6	0	5	0	1	2
1981	806	53	20	13	8	0	12	0	4	5
1982	724	43	29	17	3	0	5	0	2	2
1983	874	57	41	10	7	0	7	0	2	5
1984	975	65	25	21	12	0	5	0	4	2
1985	1005	64	56	16	2	0	7	0	4	4
1986	1104	93	44	14	9	0	8	0	1	6
1987	1376	112	51	24	5	0	14	0	4	4
1988	1263	129	52	22	10	0	8	0	1	5
1989	1647	172	59	30	13	0	13	0	5	6
1990	1666	179	65	33	11	2	12	1	5	8
1991	1824	214	60	45	12	4	9	4	4	3
1992	2072	280	68	24	16	6	10	2	5	13
1993	2289	312	67	38	10	5	18	3	6	11
1994	2049	373	73	29	9	2	12	7	4	16
1996	2519	423	75	40	11	17	15	14	5	13
1997	3623	513	146	56	15	16	26	18	8	19
1998	4731	643	164	82	27	36	28	51	12	25
1999	4883	694	182	84	37	60	28	56	18	22
2000	5181	820	182	68	45	65	33	43	21	28
2001	6254	923	256	74	63	80	38	76	114	25
2002	6425	1050	245	100	55	86	44	87	66	61

Rank	Assignee Country	Number of Patents
1	United States	56828
2	Japan	7574
3	France	2087
4	United Kingdom	871
5	Switzerland	419
6	China (Taiwan)	382
7	Italy	377
8	Republic of Korea	368
9	Netherlands	308
10	Australia	307
11	Sweden	264
12	Belgium	193
13	Finland	125
14	Denmark	104

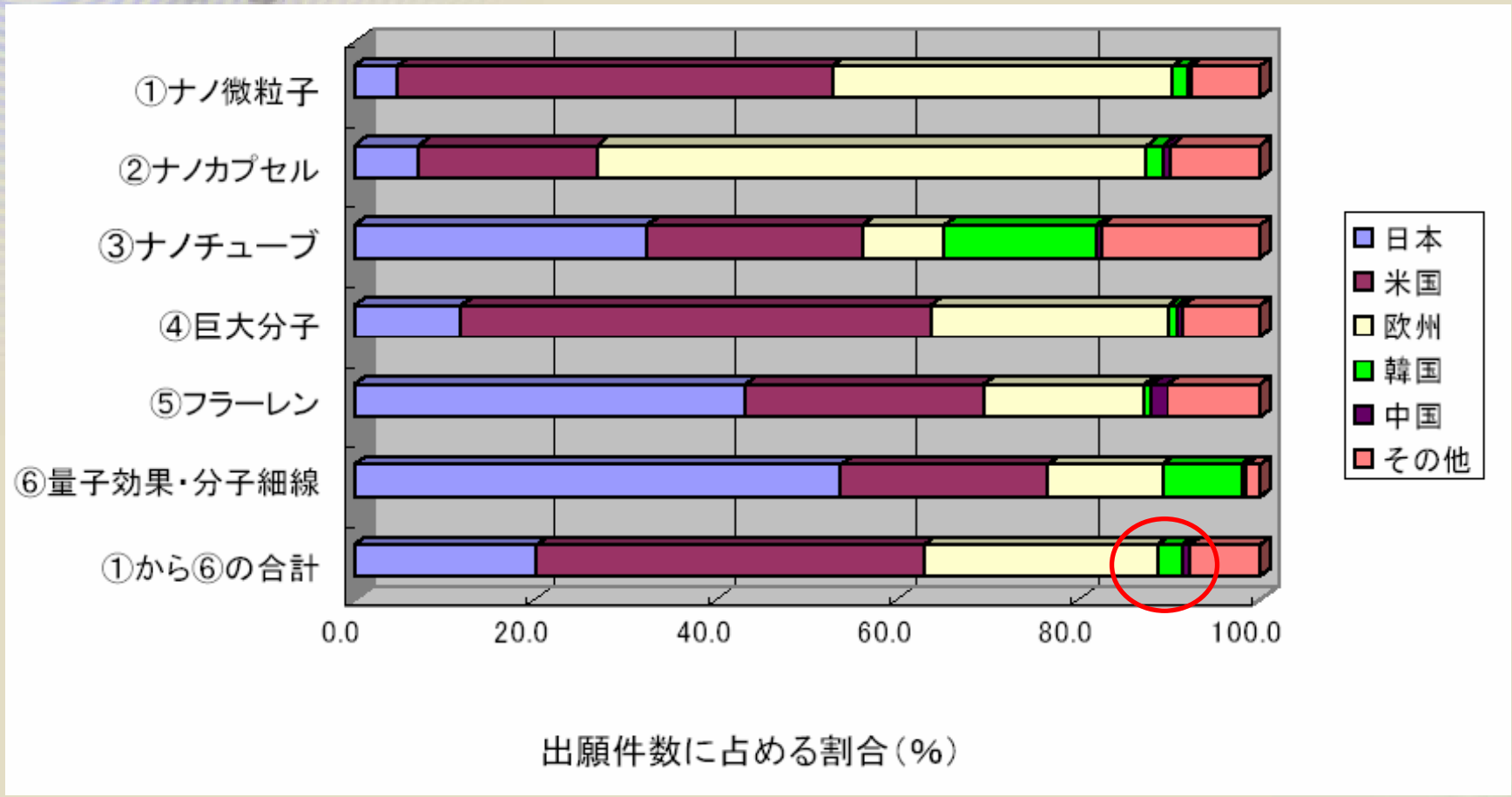
USA - NSF Results (3)

Field Name	Number of Patents
Chemistry: molecular biology and microbiology	7946
Drug, bio-affecting and body treating compositions (CCL-514)	6183
Drug, bio-affecting and body treating compositions (CCL-424)	4683
Radiant energy	4657
Stock material or miscellaneous articles	3939
Active solid-state devices (e.g., transistors, solid-state diodes)	3933
Semiconductor device manufacturing: process	3877
Organic compounds -- part of the class 532-570 series	3756
Chemistry: natural resins or derivatives; peptides or proteins; lignins or reaction products thereof	3753
Optics: systems (including communication) and elements	3404
Coating processes	3265
Chemistry: analytical and immunological testing	3027
Radiation imagery chemistry: process, composition, or product thereof	2983
Optics: measuring and testing	2957
Static information storage and retrieval	2310
Miscellaneous active electrical nonlinear devices, circuits, and systems	2286
Chemistry: electrical and wave energy	1864
Chemical apparatus and process disinfecting, deodorizing, preserving, or sterilizing	1829
Coherent light generators	1775
Compositions	1680
Multiplex communications	1638

Citation

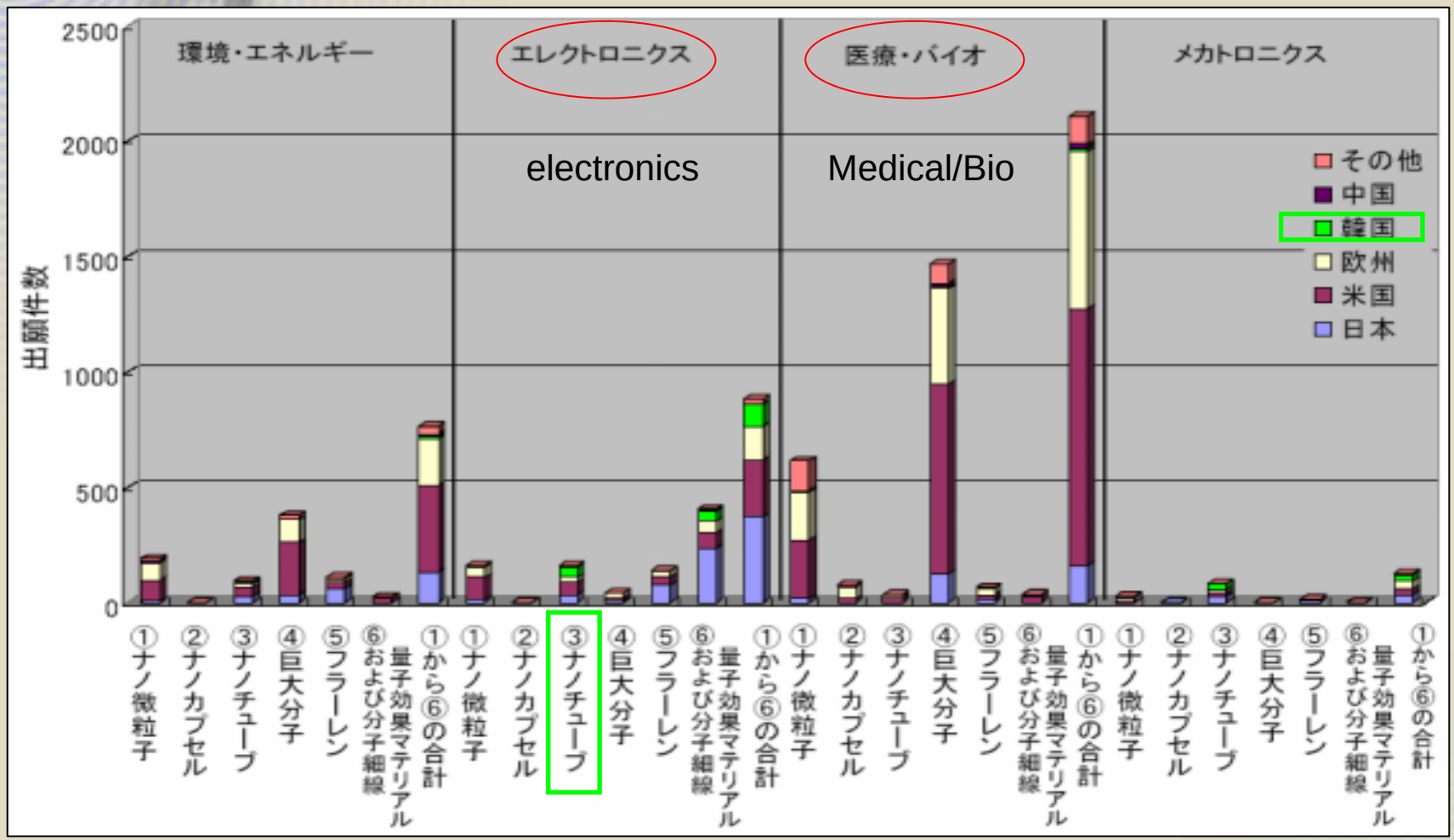
Industry	Number of Patents	Cites Per Patent
Chemical/catalyst/pharmaceutical	18784	4.22
Electronics	16704	3.53
Materials	4860	4.37
Others	41352	3.73

Japan - JPO Results (1)



- Ranking : USA, Europe, Japan, Korea, China
- Japan - Fullerene, Quantum Effect / Korea - Nanotube

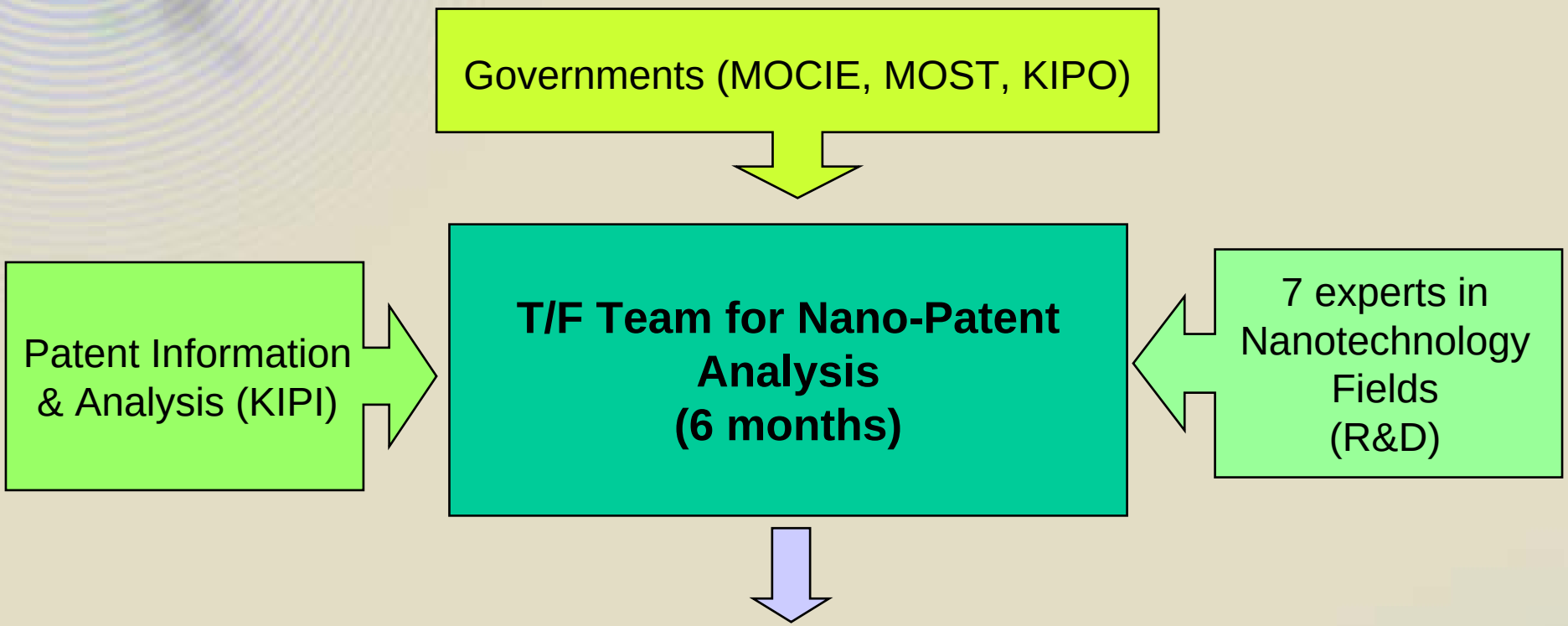
Japan - JPO Results (2)



- USA – Medical/Bio
- Korea - Nanotube

특허청 Korean Intellectual Property Office

NT Patents Analysis Project



- Quantitative and Qualitative Analysis in Korea and Foreign Countries.
- Trying to improve the efficiency of government-funded R&D.
  - ✓ An indicator for planning and evaluating government-funded R&D projects

Searching Nanopatents

- Nanotechnology is not clearly defined as a term.
- There is no formal classification scheme for Nano-patents.
- Additionally, KIPO lacks effective automation tools for nanotechnology “prior art” searching.

Judicious use of Key terms and Class codes

- ✓ Patents are analyzed by using PIAS program and KIPO database (KIPASS).
- ✓ Keyword Search + IPC(International Patent Class)
- ✓ Carbon nanotube/Nanocomposites/Nanoparticles

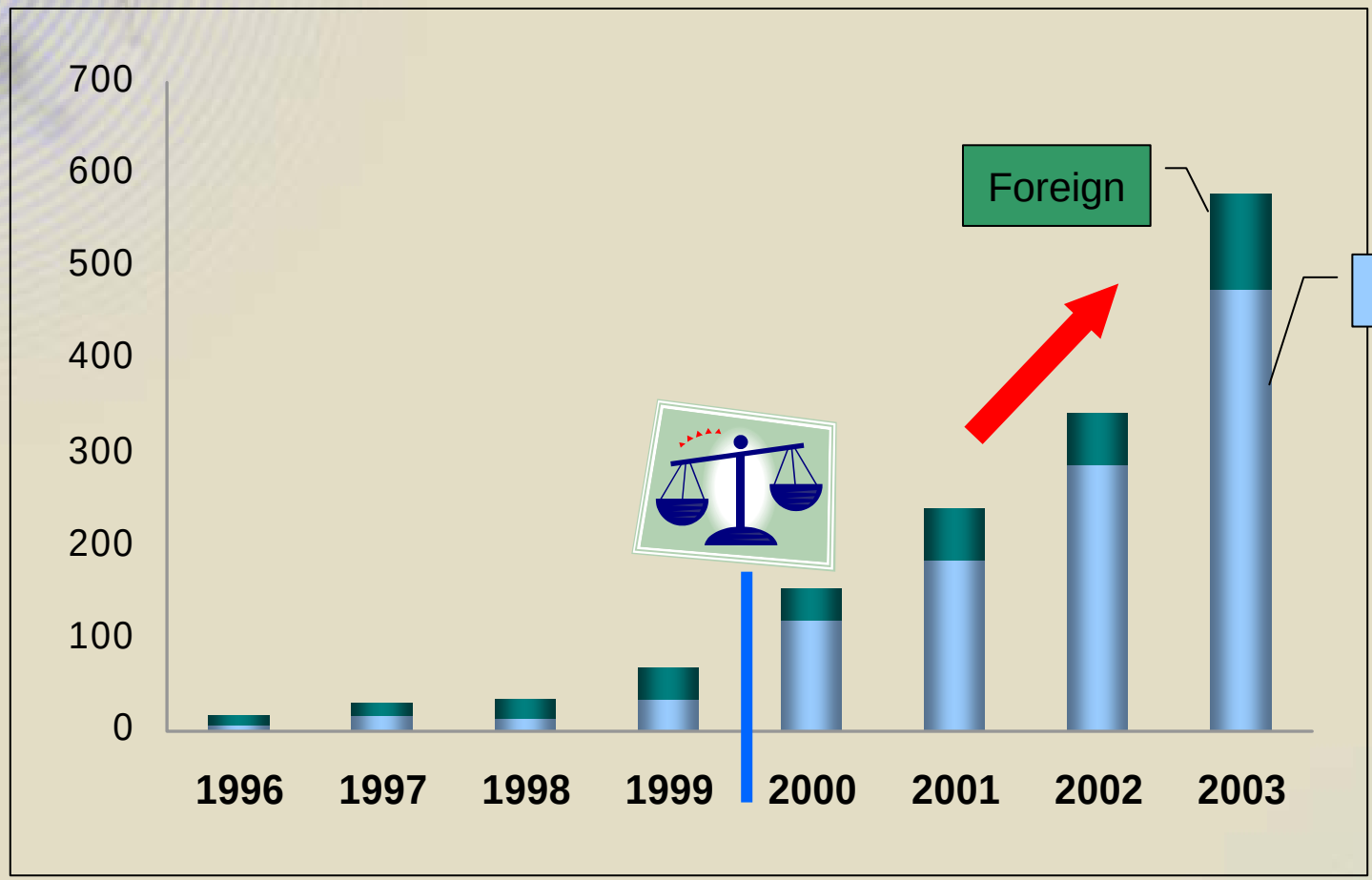
Production of Smoked Pottery having Silver Luster (Patent Abstract of Japan S55-42280)

- PURPOSE: To remarkably enhance the luster of pottery by coating the surface of a base material with an aq. soln. or a suspension of an alkali (earth) metal salt and by facilitating the effect of depositing a carbon film in a smoking process to form a **silver**-colored carbon film uniformly and smoothly.
- CONSTITUTION: The surface of a base material such as a tile is coated with an aq. soln. of a suspension contg. 0.5~50wt% of an alkali (earth) metal salt such as NaOH, **NaNO**3 or KNO3. The coated tile is calcined at about 1000°C as usual and smoked to produce smoked pottery. To the above aq. soln. or suspension may be added an aq. soln. (water glass) of a melt of glassy solid such as an alkali (earth) silicate or a mixt. of an alkali silicate and silicic acid. By this method the base material surface is made water-impermeable, and a smoked tile undergoing no discoloration and fading can be produced cheaply.

Not a nano-patent !

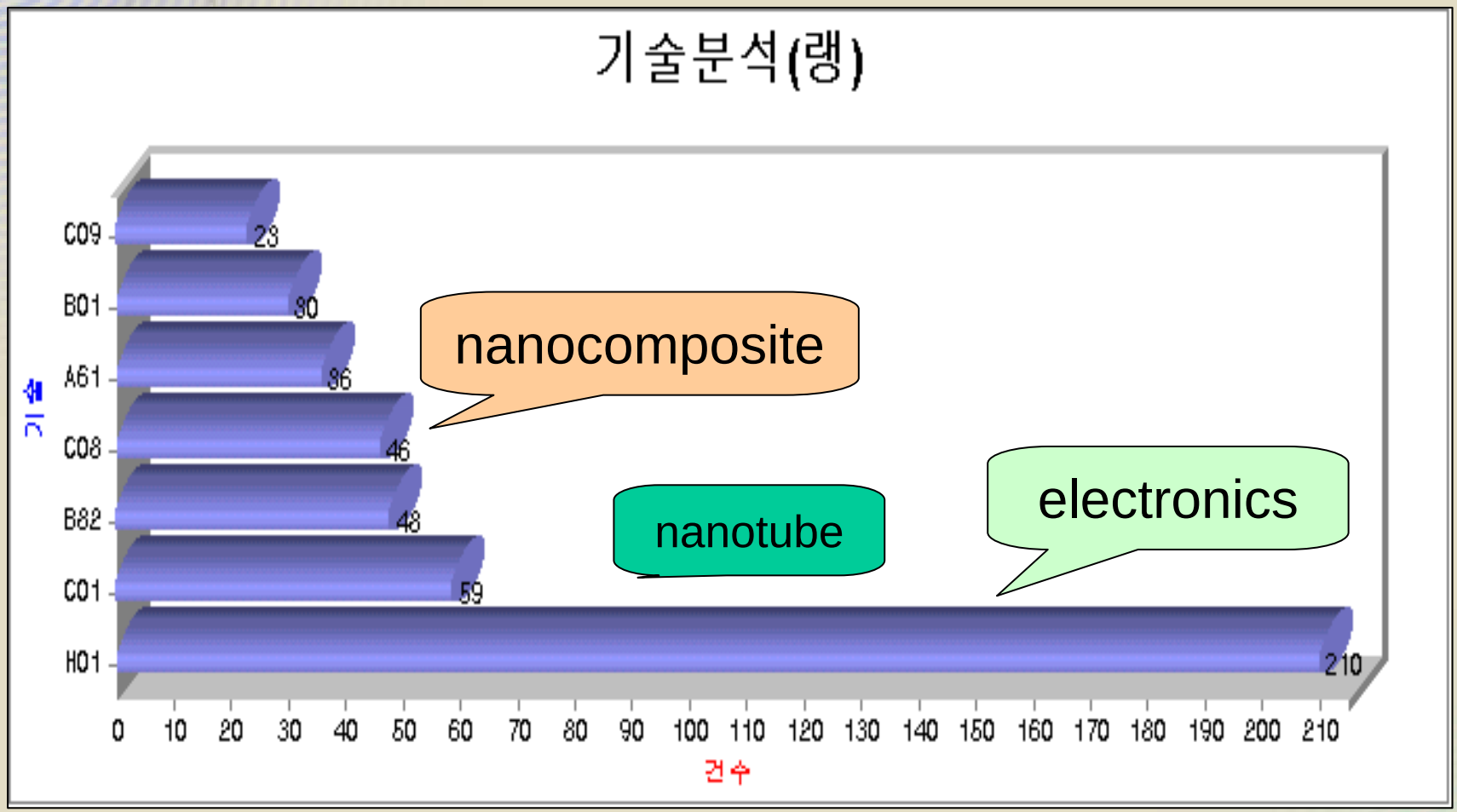
특허청 Korean Intellectual Property Office

Numbers of Patents by year in KIPO



- Foreign/Domestic = 22% / 78%, based on application processed.
- After 2000 year, nano-patents were increased rapidly (Domestic case)

Ranking Map by IPC in KIPO



In domestic case, Carbon Nanotube is major in nanotechnology fields.

Foreign vs. Domestic

Points	Comparison
Application Date	• Foreign inventors have applied (or invented) for patents early. • It means that there is a big gap in technology • Searching prior art more widely and precisely before inventing something
Claims	• Every foreign patent has many claims per patent. ✓ Product Claim, Process Claim, Method Claim, Use Claim ✓ It is a pioneering patent. • Keep in mind that strategic claim drafting is as important as invention
Interesting Fields	• Foreign patents covered most fields of key nanotechnology. • Find out the strategic policies and plans in our R&D direction • Selection of Research Fields & Concentration of Investment

Trends in Nano-Patents

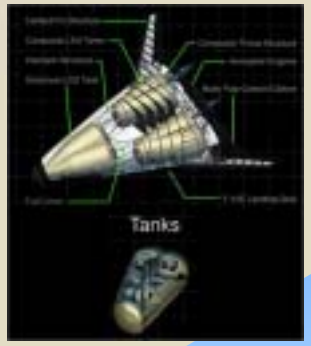
- Thousands of nano-patents have shown recently.
  - ✓ Claim terminology as an indicator of trends
  - ✓ Nano, nanoparticle, nanotube, nanowire etc.
- From Materials to Applications
  - ✓ From Vision to Commercialization
- Major Fields
  - ✓ Carbon Nanotube/Nanocomposite/Nanoparticles
- Focus on Pioneering (or Core) Patent
  - ✓ There are a lot of patent applications in quantity.
  - ✓ There is no Core Patent.
- Nano-Invention, Nano-Patent
  - ✓ Maximizing patent protection
  - ✓ Building Bulletproof Patents

Nano-Materials Roadmap
Impact on Space Transportation, Space Science and HEDS

2002 **2005** **2010** **2015**

Mission Complexity

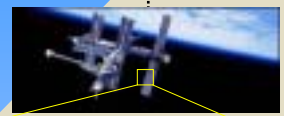
Production of single CNT



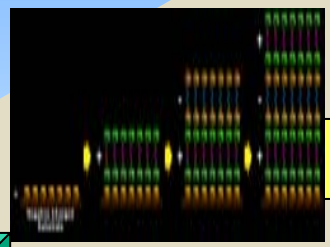
RLV Cryo Tanks

CNT Tethers

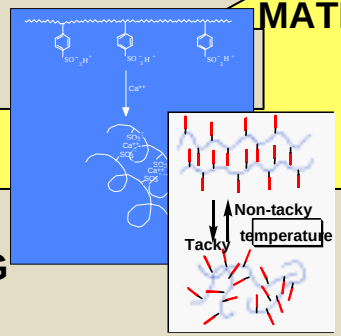
Generation 3 RLV HEDS Habitats



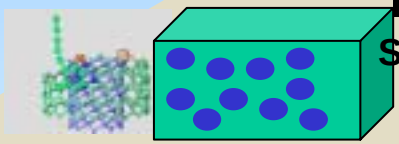
SELF-HEALING MATERIALS



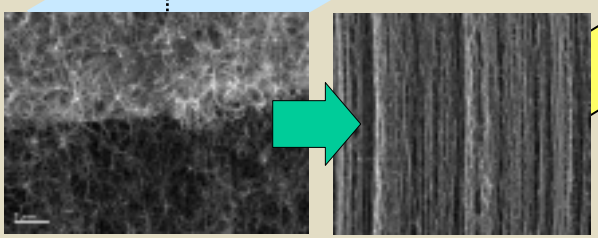
SELF-ASSEMBLING MATERIALS



MULTIFUNCTIONAL MATERIALS



NANOTUBE COMPOSITES



Nanotextiles

Strong Smart Structures

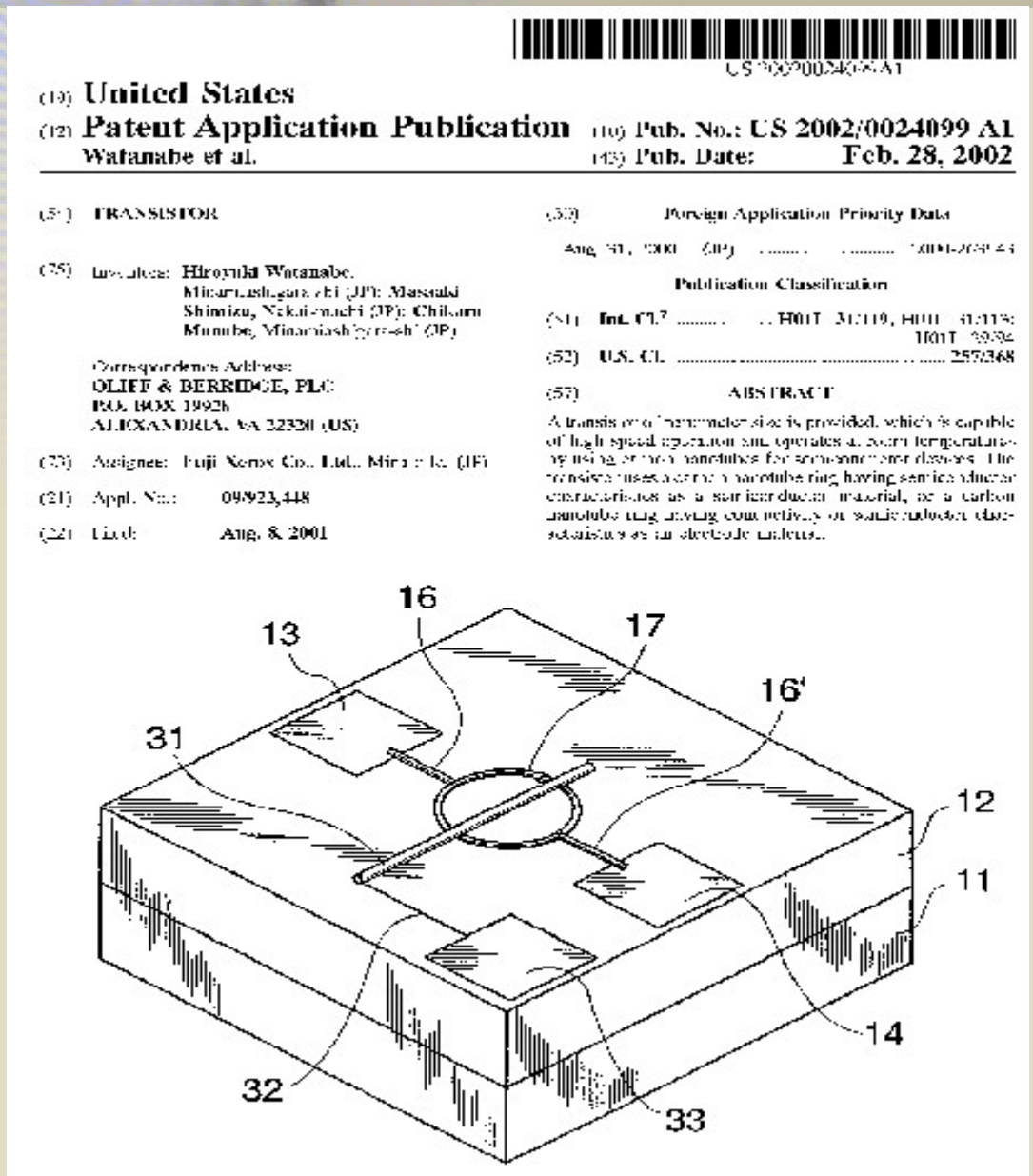
특허청 Korean Intellectual Property Office

Selected Patents of Carbon Nanotube

- Thermochemical vapor phase deposition apparatus and low-temperature **synthesis** of carbon nanotube using the same
- **Field emission display** element using carbon nanotube and its manufacture
- Nanosize vertical **transistor** using carbon nanotube and method of manufacturing the transistor
- DNA nanocage by self-organization of DNA and method for producing the same, and **DNA nanotube and molecular carrier** using the same

Materials - Applications

Some Features in Nano-patents (1)



US 20020024099A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2002/0024099 A1**

Watanabe et al. (43) **Pub. Date: Feb. 28, 2002**

(54) **TRANSISTOR**

(75) Inventors: **Hiroyuki Watanabe**, Minamiashigara-shi (JP); Masataki Shimizu, Nakai-machi (JP); Chikaru Munube, Minamiashigara-shi (JP)

Correspondence Address:
OLIFF & BERRIDGE, PLC
P.O. BOX 19928
ALEXANDRIA, VA 22320 (US)

(73) Assignee: Fuji Xerox Co., Ltd., Minato-ku (JP)

(21) Appl. No.: 09/923,448

(22) Filed: Aug. 8, 2001

(30) Foreign Application Priority Data

Aug. 31, 2000 (JP) 2000-263424

Publication Classification

(51) Int. Cl.[7] H01L 31/119; H01L 31/113; H01L 29/94

(52) U.S. Cl. 257/368

(57) ABSTRACT

A transistor of nanometer size is provided, which is capable of high speed operation and operates at room temperature by using semiconducting nanotubes for semiconductor devices. The transistor uses a carbon nanotube ring having semiconductor characteristics as a semiconductor material, and a carbon nanotube ring having conductivity or semiconductor characteristics as an electrode material.

- Nano-transistor
- Material Replacement
- Carbon nanotube

Some Features in Nano-patents (2)

(54) 탄소나노튜브를 이용한 고용량의 바이오분자 검출센서

요약

본 발명은 기질 위에 복수의 탄소나노튜브를 배열하고, 표적 바이오분자와 결합하는 리셉터의 순전하(net charge)와 반대되는 극성의 전하를 탄소나노튜브에 인가하여, 한 종류 또는 여러 종류의 리셉터를 원하는 위치에 선택적으로 부착할 수 있는 나노 수준으로 고집적화된 나노어레이형(nanoarray-type) 바이오칩에 관한 것이다. 또한, 본 발명은 기질 위에 마이크로 또는 나노 크기의 멀티채널을 제작하고, 채널내의 특정위치에 하나 또는 둘 이상의 탄소 나노튜브를 배열하고, 그 위에 표적 바이오분자와 결합하는 리셉터를 선택적으로 부착할 수 있는 멀티채널형(multichannel-type) 바이오칩에 관한 것이다.

본 발명에 따르면, 부착된 다양한 종류의 리셉터
오분자(target- biomolecules)들을 직접 검출하기
진단을 보다 정확히 한번에 대량으로 할 수 있다.

대표도

도3

명세서

도면의 간단한 설명

도 1은 수직 탄소 나노튜브(vertical carbon nano

도 2는 다양한 형태의 모양을 갖는 탄소나노튜브

도 3은 본 발명의 나노어레이 타입(nanoarray typ

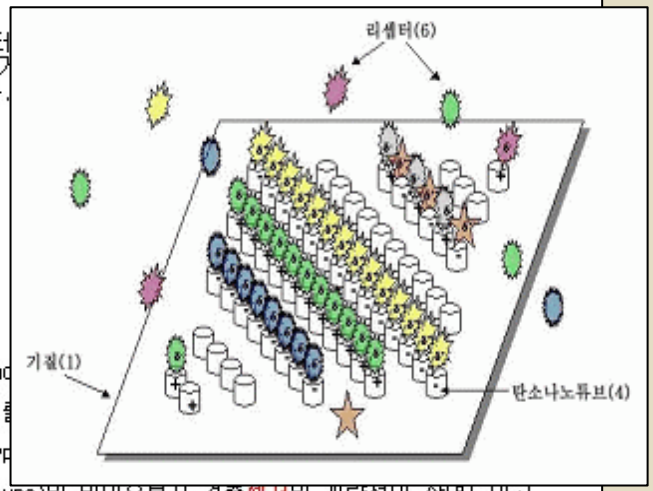
도 4는 본 발명의 멀티채널 타입(multichannel type)의 바이오분자 검출센서의 개략적인 상면도이고,

도 5는 본 발명의 나노어레이 타입의 바이오분자 검출센서에서 리셉터-프로브(receptor-probe)들과 표적-단백질(target-protein)의 상호작용을 보여주는 개략도이고,

도 6는 본 발명의 멀티채널 타입의 바이오분자 검출센서에서 리셉터-프로브(receptor-probe)들과 표적-단백질(target-protein)의 상호작용을 보여주는 개략도이다.

<도면의 주요부분에 대한 부호의 설명>

1. 기질	2. 전도층
3. 절연층	4. 탄소 나노튜브
5. 소혈청알부민(BSA)	6. 리셉터
7. 표적단백질	8. 일반단백질
9. 광 또는 레이저	10. 유리 커버



- A high capacity of biomolecule detecting sensor using carbon nanotubes is provided, thereby rapidly detecting various kinds of target-biomolecules bound with receptors on a nanoarray-type biochip.

특허청 Korean Intellectual Property Office

Nano-patent : What is being claimed

1. A nanocomposite comprising clay and an organic compound, in which the clay is a clay bridged with a metal compound.

2. A nanocomposite according to claim 1, in which the metal is iron and/or aluminum.

3. A nanocomposite according to claim 1, in which the clay of the nanocomposite is selected from montmorillonite, laponite, beidellite, nontronite, saponite, sauconite, hectorite, stevensite, kaolinite, halloysite, vermiculite, and sepiolite, or one of their synthetic or naturally interstratified mixtures.

4. A nanocomposite according to claim 1, in which the clay of the nanocomposite is laponite or montmorillonite.

Nanocomposite

(57) 청구의 범위

청구항 1. 발광하도록 유도될 수 있는 표지 화합물에 결합된 성분에 부착되는 나노튜브.

청구항 2. 제 1 항에 있어서, 나노튜브가 흑연질이고 발광이 전기화학발광인 나노튜브.

청구항 3. 제 1 항에 있어서, 성분이 효소 바이오센서인 흑연 나노튜브.

청구항 4. (i) 작용그룹을 함유하는 흑연 나노튜브, 및

(ii) 작용그룹에 결합되어 있고, 해당 분석물에 결합할 수 있는 분석-수행 물질을 포함하는, 샘플에 존재하는 해당 분석물 검출용 조성물.

청구항 5. (i) 작용그룹을 함유하는 흑연 나노튜브, 및

(ii) 작용그룹에 결합되어 있고, 해당 분석물에 결합되는 분석-수행 물질을 포함하는, 샘플에 존재하는 해당 분석물 검출용 조성물.

청구항 6. 제 5 항에 있어서, 분석물에 결합되어 있고, 발광하도록 유도될 수 있는 표지 화합물에 결합되는 제 2 분석-수행-물질을 추가로 포함하는 조성물.

Nanotube

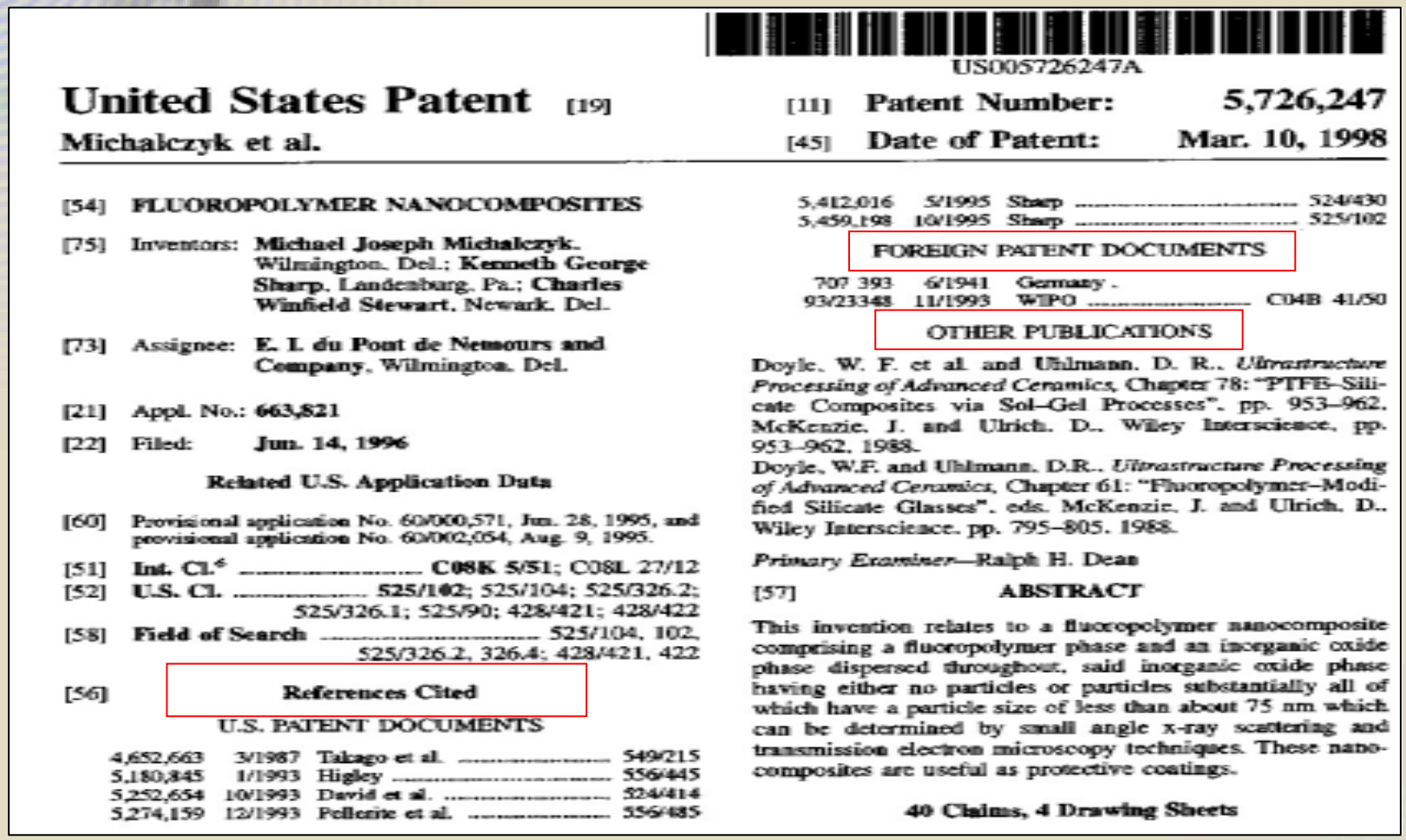
특허청 Korean Intellectual Property Office

Types of Patent Claims

1. Product claim (e.g., Polymer nanocomposites)
2. Process claim (e.g., Method of making a nanocomposites)
3. Method of using claims (e.g., Method of using nanocomposites to improve flameproof)

- Nanotechnology products have diverse end uses, so different inventors may be implicated on different use claims.
  - ✓ Claim diversity adds strength to patent !!!

Patent Citations



US005726247A

United States Patent [19]

Michalczyk et al.

[11] **Patent Number: 5,726,247**

[45] **Date of Patent: Mar. 10, 1998**

[54] **FLUOROPOLYMER NANOCOMPOSITES**

[75] Inventors: **Michael Joseph Michalczyk**, Wilmington, Del.; **Kenneth George Sharp**, Landenburg, Pa.; **Charles Winfield Stewart**, Newark, Del.

[73] Assignee: **E. I. du Pont de Nemours and Company**, Wilmington, Del.

[21] Appl. No.: **663,821**

[22] Filed: **Jun. 14, 1996**

Related U.S. Application Data

[60] Provisional application No. 60/000,571, Jun. 28, 1995, and provisional application No. 60/002,054, Aug. 9, 1995.

[51] **Int. Cl.**[6] **C08K 5/51**; C08L 27/12

[52] **U.S. Cl.** **525/102**; 525/104; 525/326.2; 525/326.1; 525/90; 428/421; 428/422

[58] **Field of Search** 525/104, 102, 525/326.2, 326.4; 428/421, 422

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,652,663	3/1987	Takago et al.	549/215
5,180,845	1/1993	Higley	556/445
5,252,654	10/1993	David et al.	524/414
5,274,159	12/1993	Pellerite et al.	556/485
5,412,016	5/1995	Sharp	524/430
5,459,198	10/1995	Sharp	525/102

FOREIGN PATENT DOCUMENTS

707 393	6/1941	Germany .	
93/23348	11/1993	WIPO	C04B 41/50

OTHER PUBLICATIONS

Doyle, W. F. et al. and Uhlmann, D. R., *Ultrastructure Processing of Advanced Ceramics*, Chapter 78: "PTFE-Silicate Composites via Sol-Gel Processes", pp. 953–962, McKenzie, J. and Ulrich, D., Wiley Interscience, pp. 953–962, 1988.

Doyle, W.F. and Uhlmann, D.R., *Ultrastructure Processing of Advanced Ceramics*, Chapter 61: "Fluoropolymer-Modified Silicate Glasses", eds. McKenzie, J. and Ulrich, D., Wiley Interscience, pp. 795–805, 1988.

Primary Examiner—Ralph H. Dean

[57] **ABSTRACT**

This invention relates to a fluoropolymer nanocomposite comprising a fluoropolymer phase and an inorganic oxide phase dispersed throughout, said inorganic oxide phase having either no particles or particles substantially all of which have a particle size of less than about 75 nm which can be determined by small angle x-ray scattering and transmission electron microscopy techniques. These nanocomposites are useful as protective coatings.

40 Claims, 4 Drawing Sheets

- Every highly cited patent is important
- Quality Index – Citation Analysis

What is a Well-being Patent?

- Frontier / Pioneering Patent ?
- Core Patent / Key Patent / Milestone Patent ?
  - ✓ Strong Protection Strategy
  - ✓ Having key nanotech claims
- Well-being Nano-patent
  - ✓ well-designed, well-analyzed, well-claimed, well-protected, etc
- Patent Analysis : Quantity & Quality aspects
  - ✓ Patent citation analysis, etc.

I think that well-being (nano) patent is not something special. It is very important for us to catch up developed countries in nanotechnology fields by using well-being patents.

Summary(1)

- Nano-patents in the exponential phase – moving into application development and the second wave.
- Pro-Patent Policy on R&D in Nanotechnology
- Well-informed and Global policies in patent system will be needed to prepare to meet these new challenges.
- Patent information is very important in R&D and Commercialization in Nanotechnology.

Summary(2)

- International Patent Strategies
  - ✓ Core technology or patent
  - ✓ Strong protection, Claims
- Improving the quality of patents issued
  - ✓ Patent Citation Analysis
- Well-being nano-patent
- From Patent to Profit
  - ✓ Commercialization
  - ✓ Patents become valuable when they cover commercial products.

No nanotechnology without patenting

Acknowledgements

- Director General, H.W. Kim (KIPO)
- Members in Nanotechnology Study Club (KIPO)
  - ✓ S.K. Jwa, S.H. Kim, R.S. Chung, etc.
- Members in Information Planning Team (KIPO)
  - ✓ E.T. Hwang, etc.
- Members in Nano-patent Analysis Team (KIPI)
  - ✓ J.W. Lee, etc.

특허청 Korean Intellectual Property Office