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Patent Application Trends in the Field of Nanotechnology

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1 Introduction

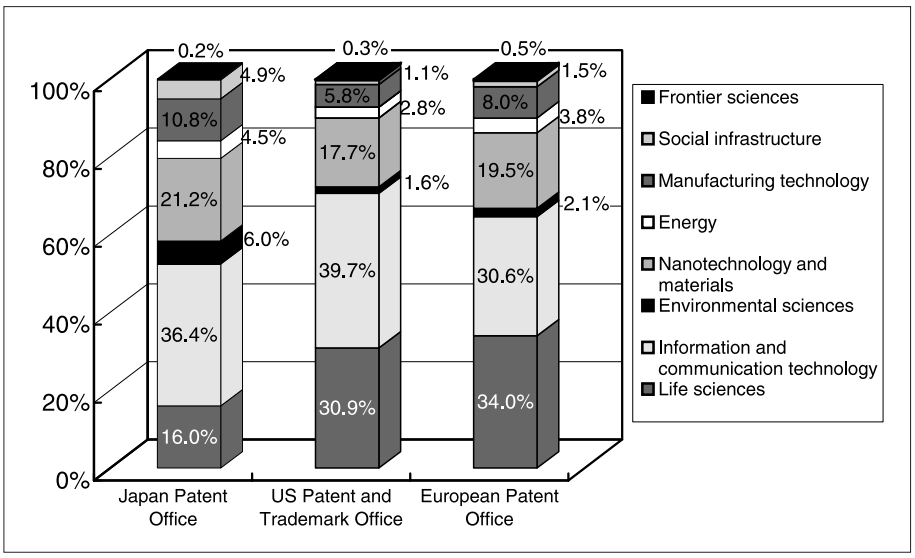
Nanotechnology became a prioritized area of research in the US in 2000. In Japan, the government prioritized the areas of nanotechnology and materials in 2001. Nanotechnology has a wide range of possible applications, and several years have passed since it became a prioritized area; as such expectations for nanotechnology are growing, from the standpoint of innovation creation and social contribution. In March 2006, the Council for Science and Technology Policy formulated the "Promotion Strategy for Prioritized Areas" which states "in order to strengthen industrial competitiveness in the nanotechnology and material fields, it is necessary to promote R&D activities and to link the outcomes of basic research to intellectual property in order to facilitate the effective application of such outcomes to industry", thus stressing the need to implement an intellectual property strategy targeted at specific areas of application.

The Japan Patent Office has produced reports on patent application trends by area with a focus on elemental technology, which seems to warrant particular attention among the eight prioritized areas[1]. However, almost no research has been conducted to obtain an overview of patent application trends in the field of nanotechnology. Therefore, this article outlines these trends by country, sector and application, with the objective of providing a brief overview of patent application trends.

This article was compiled by reorganizing the results of research and analysis conducted by the Nanotechnology Researchers Network Center of Japan[Note1], together with the cooperation of the same center.

2 Background: patent application trends within each prioritized area in Japan

The Third Science and Technology Basic Plan continues to address the eight prioritized areas, which were designated as such in the Second Science and Technology Basic Plan. This prioritization has been reinforced through further selection and concentration. In this Third Basic Plan, the prioritized areas have been re-designated into "four priority promotion areas" and "four promotion areas" (Some changes have been made to the names given to those areas covered). Information on the number of patent applications in these eight areas is available from the Japan Patent Office[2] and these figures show where nanotechnology is positioned among the eight areas. Figure 1 shows patent applications by technological area, based on the number of applications to the Japanese, American and European patent offices in 2004. It is easy to see that Japan is far behind the US and Europe in terms of the percentage of applications from the area of life sciences. The areas in which Japan is ahead of the US and Europe in percentage terms are the environmental sciences and social infrastructure, although the applications in these areas account for only a fraction of the total number of applications lodged with the patent office in Japan. Among the three patent offices, the United States Patent and Trademark Office received the largest number of applications from the information and communication technology area. In Europe, the percentage of applications from the life sciences area is higher than in the



Prepared by the STFC based on Reference [2]

Figure 1 : Percentage of patent applications to patent offices in Japan, the US and Europe according to eight specified areas (2004)

US and Japan. Nanotechnology and materials account for approximately 20% of the total applications at each of the three patent offices, with the figure for Japan being the highest.

3 Analysis of patent application trend in the area of nanotechnology

3-1 Classification[6]

The Nanotechnology Researchers Network Center of Japan defines the world's four largest patent organizations as the Japan Patent Office, the United States Patent and Trademark Office, the European Patent Office and the World Intellectual Property Organization (WIPO)[Note2]. The center extracts nanotechnology-related patents from monthly patent publications released by these patent organizations using preset keywords. Extracted patents are then categorized according to nine defined technology areas. The center makes a list that includes the name of the inventor, invention and applicant and other information, and compiles a database.

The areas of technology targeted are materials, medicine and life sciences, electronic devices, information and communications, optoelectronics, measurement and testing, environment and energy, processing, printing and photography. These nine areas of technology cover almost every potential field of application for nanotechnology. Table 1 shows the technologies designated for each of the nine areas.

Based on the following principles, patents retrieved from the keyword search were screened to be nanotechnology-related patents (hereinafter referred to as nanotechnology patents).

(a) There are two main directions for nanotechnology: the first is to alter and develop materials at the atomic or molecular level or add new characteristics to existing materials, and the second is to process materials and fabricate a nanostructure. For the purposes of this article, both of these areas were screened.

(b) Also screened were nanotechnology patents that include the manipulation or processing at the nano-scale, or predicted "time," "wavelength," "mass" and "volume." One example is the nanotechnology patent that proposes a method of using a picogram amount of protein to screen crystallization conditions.

(c) Nanotechnology patents that selectively use a nanotechnology technique were also included. For example, patents for conductive polyamide compounds that include the application of nanomaterials were screened, even if electrically conductive particulate materials were selectively used from among graphite, carbon black and carbon nanofibers.

Table 1 : Classification of technology areas related to nanotechnology

Classification Number	Technology Area	International Patent Classification	Technology Content
1	Materials	B01J	Catalysts/colloid science (scientific or physical method) / hydrophobic magnetic particles
		B81B	Microstructure devices and systems / carbon nanotubes
		B82B	Microstructure techniques and nanotechnology / carbon nanotubes / functional nanostructures
		C01B	Carbon structure / manufacturing of fullerenes / manufacturing of carbon nanotubes / synthetic porous crystalline substances
		C01G	Metal-bearing compounds / metal particles
		C03B	Manufacturing, molding or supplementary processes
		C03C	Glass or glassy enamels
		C04	Artificial stone/ceramics
		C07	Organic chemistry
		C08	Organic polymer compounds / biopolymer nanoparticles / conductive polyamide compounds / toughened polymers through introduction of carbon nanotubes / photopolymers
		C09	Inks / dyes / resins / adhesives
		C22	Metals / Iron or non-ferrous alloys, and their processing
		C23C	Coatings / dispersion across surfaces / surface finishing through chemical transduction or substitution / diamond coating / nanoparticle coating
		C30	Crystal growth / synthesis of organic nanotubes / synthesis of ultra-thin nanowires
2	Medicine and Life Sciences	A61	Medical science / cosmetics containing electrochemically and biologically active particles / biodegradable nanocapsules / stents coated with nanoparticles / using optical contrast factor consisting of quantum dots / optically active nanoparticles for treatment and diagnosis / cancer drugs / personalized medicines
		C12	Microbiology / enzymology / genetic engineering / determination of nucleic acid molecule sequence / measuring equipment
3	Electronic Devices	H01L	Basic electric elements/semiconductor equipment / patterning of silicon nanoparticles / membrane sensors consisting of semiconductor film containing nanocrystals / quantum dot phosphor / monoelectron transistors
		H01J	Field emission type electron source
4	Information and Communications	G06N	Signaling polymers / quantum computers
		G11	Information storage / memory with nanomagnets / memory media with nanometer-order memory layer
5	Optoelectronics	G02	Microstructure optical fibers / accumulation type photonic circuits / microlens EUV lithography / silicon nanoparticle luminescent devices / optical waveguide that creates a core and clad with nano-porous materials
		H01S	Optic amplifiers and lasers formed on the surface of semiconductor nanocrystals
6	Measurement and Testing	G01	Method of analysis that uses nanocrystal index / nanopumps / gene sequencers / manufacturing of DNA chips / ultramicro liquid dispensers / nanothermometers
7	Environment and Energy	C02F	Treatment of water, wastewater, sewage or sludge / treatment of exhaust gas
		H01M	Batteries / positive electrode of a rechargeable lithium battery
8	Processing	B01	Separation / mixing / manufacturing of self-cleaning surfaces
		B21	Processing / forming / diamond polishing of coated layers
		B23	Machine tools / use of femtosecond lasers / forming of silicon nano-scale dots
		B32B	Laminated bodies
9	Printing and Photography	B41J	Printing / ink jet heads / forming of nano thickness images of goods
		G03	Photographs / electronic photographs

Prepared by the STFC based on Reference[6]

(d) As for MEMS (Micro Electro Mechanical System), superlattice structures, photonic crystals and quantum wells, a large number of applications, such as machines with a microstructure (electric elements and lights) and electric elements, were proposed. The screening decision was made based on whether the patents used nanotechnology described in (b) as a material or as part of the fabrication process.

3-2 Nanotechnology patent trends at the four largest patent organizations

First, this article outlines the number of nanotechnology applications lodged with the world's four largest patent organizations, which were screened and classified according to the above screening criteria (Figure 2). This chart shows that all four patent organizations saw a significant increase in the number of nanotechnology applications from 2003 to 2005. In recent years, the total number of applications to the Japan Patent Office has remained at a level slightly exceeding 400,000. Nanotechnology patents thus accounted for approximately 1% of the total number of patent applications submitted to the Japan Patent Office in 2005. Similarly, the figure for the United States Patent and Trademark Office was approximately 1.5%, that for the European Patent Office was approximately 1%, and that for the WIPO was approximately 2.5%[6].

3-3 Nanotechnology patent application trends by the applicant's nationality

In this section, I examine the nationality of applicants[Note3] filing nanotechnology patent applications to the world's four largest patent organizations. Figure 3 compares the nationality

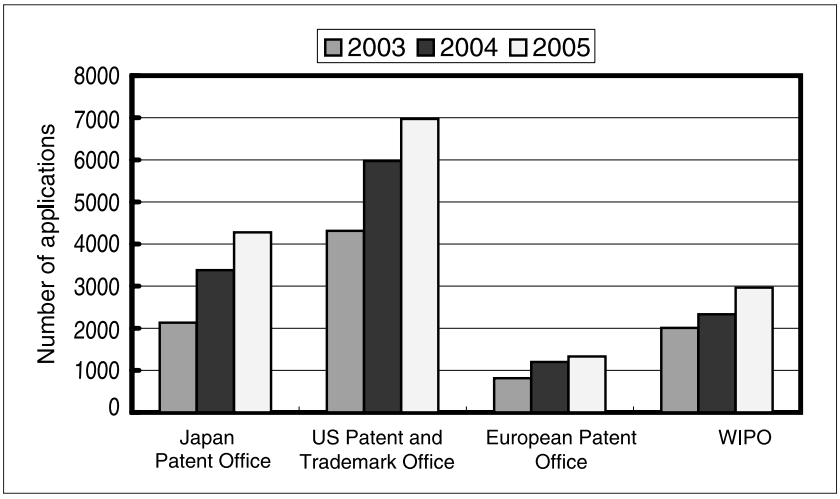


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Figure 2 : Number of nanotechnology patent applications submitted to the four largest patent organizations

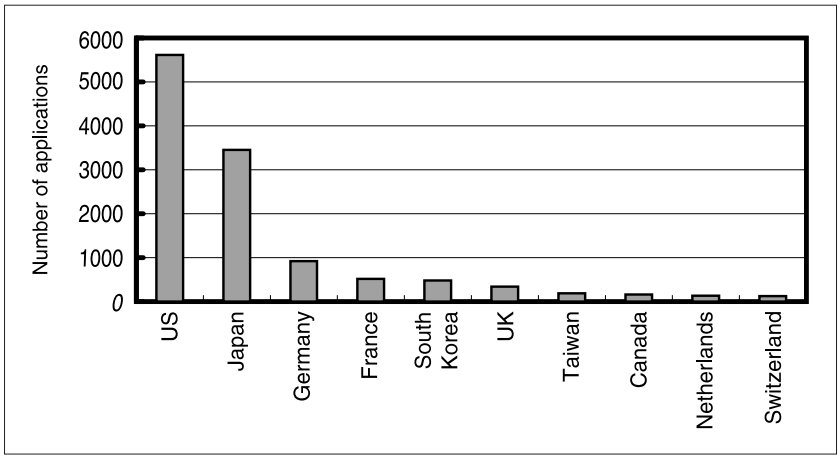

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Figure 3 : Number of nanotechnology patent applications submitted to the four largest patent organizations according to nationality of applicant (2004)

of applicants in ten countries that received a large number of applications in 2004. These figures show that US applicants were ahead with approximately 5,600 patent applications, which was approximately 1.6 times the number of applications filed by Japanese applicants (ranked second) and approximately 6.1 times that by German applicants (ranked third)[6].

The next chart shows the classification results for the nationality of applicants who filed applications to the patent organizations in 2004 (Figure 4). In Japan, approximately 72% of applications submitted to the Japan Patent Office were filed by Japanese applicants. In comparison, approximately 62% of applications to the United States Patent and Trademark Office were filed by US applicants, which was a smaller proportion of native applicants than that for Japan. According to the report released by the Japan Patent Office, similar trends were observed in other fields[3]. To manufacture or sell goods in a foreign country, it is necessary to obtain a patent right in that country. Looking at this another way, filing applications to a patent organization in a foreign country may reflect the applicants strong intention to develop, manufacture and sell goods in that country. I examined patent applications from Asian countries from that

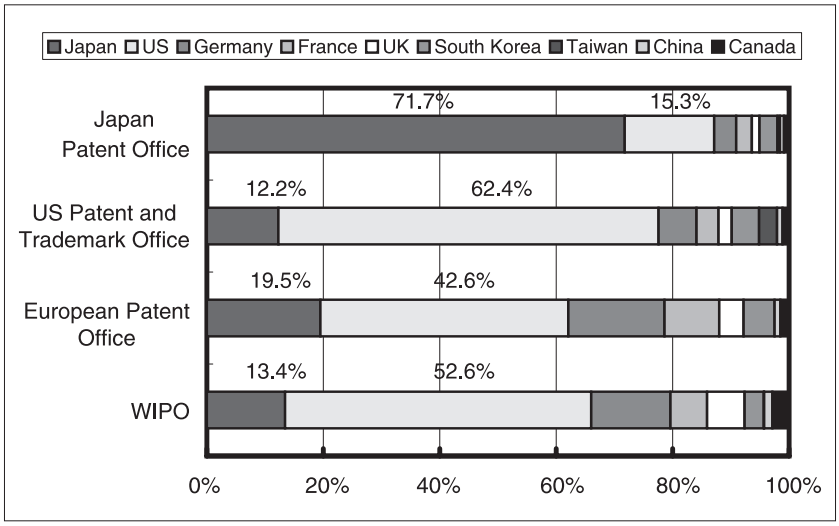

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Figure 4 : Breakdown of the nanotechnology patent applications submitted to the four largest patent organizations by nationality (2004)

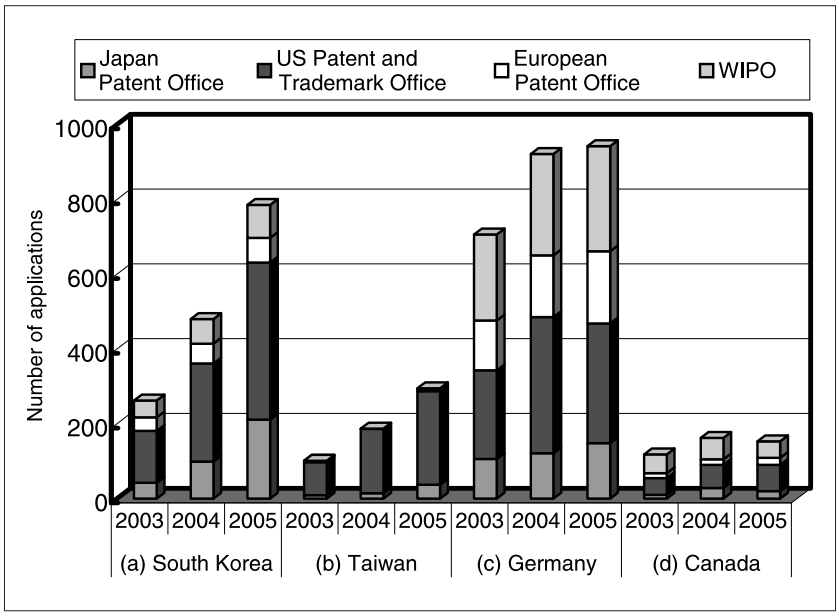

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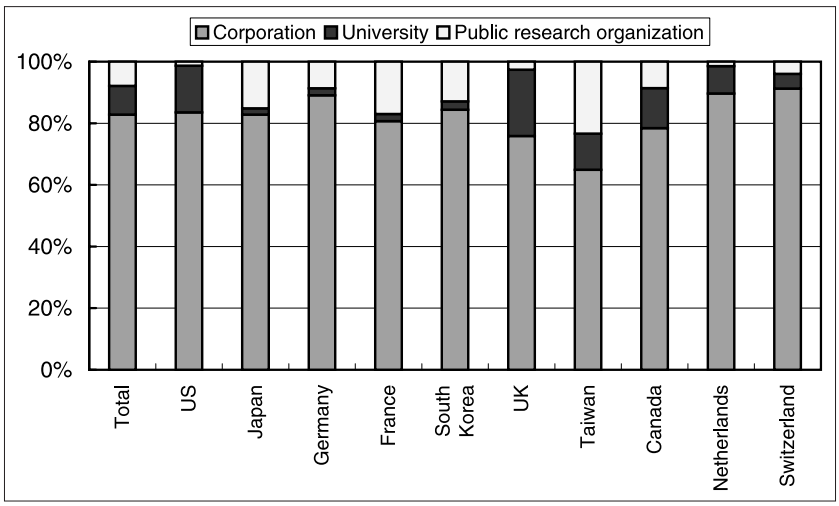
Figure 5 : Nanotechnology patent applications by nationality (South Korea, Taiwan, Germany and Canada) (2004)



Prepared by the STFC based on Reference[6]

Figure 6 : Percentage of nanotechnology patent applications by sector (1)

perspective. The examination revealed that, for example, South Korea and Taiwan submitted a large number of applications to the United States Patent and Trademark Office (Figure 5 (a) and (b)). By contrast, the number of applications to the European Patent Office and the WIPO from these countries was small. These countries strive to strengthen their competitiveness in the field of nanotechnology, particularly in ICT and electronics. The fact that the US is a leading force for these industries is probably one of the factors that determine their application behavior. Therefore, it is necessary to give consideration to more specific subsections of the area of technology concerned when comparing and examining patent application trends by nationality.

For reference, Figure 5 (c) and (d) show patent applications lodged with the world's four largest patent organizations by German and Canadian applicants. A high proportion of patent applications from these countries were to the United States Patent and Trademark Office and the WIPO. More interestingly, patent applications from these countries continued to increase until 2005 when they suddenly either leveled off, or alternatively began to decrease. This trend was also observed among other European countries.

3-4 Percentage of nanotechnology patent applications by corporation, university and public research organization

This section shows the results of an analysis of the percentage of nanotechnology patent applications by sector: corporations, universities and public research organizations. The chart below shows the percentage of nanotechnology patent applications by sector in the top ten countries in terms of the greatest number of applications in 2004 (Figure 6). Overall, corporations filed more than 80% of the total number of nanotechnology patent applications. This trend is expected to continue, with figures showing a small but steady increase between 2003 (81%) and the first half of 2005 (83.3%)[6]. Corporations filed the largest number of nanotechnology patent applications, and this was common to all countries. Interestingly, while universities filed the second largest number of applications in such countries as the US, the UK, Canada and the Netherlands, it was public research organizations that were the second largest applicants in such countries as Japan, Germany, France and South Korea. Hence, two major trends are observed; the US-type trend and Japanese-type trend. The chart also shows that the percentage of applications from corporations was approximately 63% in Taiwan, which was the lowest among these countries.

The following charts show the percentage of nanotechnology patent applications by sector for each country (Figure 7 (a), (b) and (c)). In 2004, the US accounted for the largest proportion of nanotechnology patent applications by corporations, which was followed by Japan. These results correspond to the overall ranking.

The charts also revealed that the US accounted for an overwhelming percentage

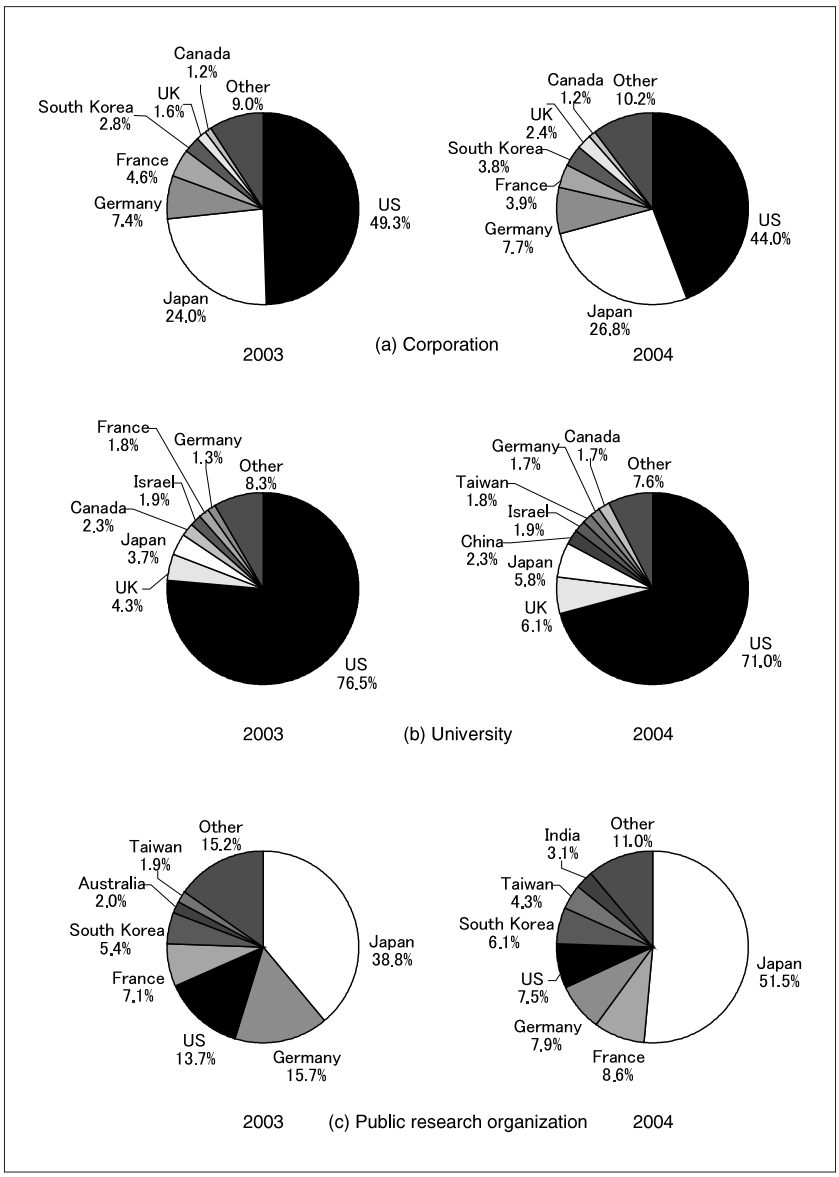


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Figure 7 : Percentage of nanotechnology patent applications by sector (2)

of the nanotechnology patent applications by universities, which is totally different from the trend observed for corporations. In this category, the US headed up the table, followed by the UK (ranked second) and Japan (ranked third). It is worth noting that China and Israel were ranked among the top ten countries in this category, although they were not among the top ten countries in the overall ranking. In particular, Israel is filing an increasing number of nanotechnology patent applications in the field of medicine and life sciences.

The percentage of nanotechnology patent applications by public research organizations shows that, unlike the figures for the corporation category, Japan accounted for the largest percentage of applications, followed by France, Germany and the US. It is worth noting that many applications from Japan were filed by such public research organizations as the Japan Science and Technology Agency and the National Institute of Advanced Industrial Science and Technology.

Looking at changes over the 2003 to 2004 period, there were no noticeable shifts in rankings for the corporation and university categories. However, there was a slight decrease in the percentage of applications from the US. In the public research organization category, Japan upped its percentage sharply, while Germany and the US saw their percentage cut in half. Such organizations as the Max-Planck-Institut and the Fraunhofer Gesellschaft filed many applications in Germany and the Centre National de la Recherche Scientifique (CNRS) in France.

The following chart shows the top ten organizations in terms of the number of nanotechnology patent applications filed in 2004 (Table 2). Rankings for the previous year are also indicated. It is worth noting that three of the top five organizations (including the top and the second-ranked organizations) that filed applications to the Japan Patent Office were public research organizations. The Japan Science and Technology Agency[Note4] was also ranked first in terms of the number of applications to the European Patent Office and the WIPO. The names of US public research organizations are not to be found in the rankings. Only three US institutions - the University of California, the Massachusetts Institute of Technology, and Northwestern University - featured in the rankings for the United States Patent and Trademark Office and the WIPO. As already mentioned, the number of nanotechnology patent applications has been increasing in recent years. It is expected that there will be major changes in the ranking of applicant organizations, especially for PCT-route applications.

Table 2 : Top 10 applicant organizations submitted to the four largest patent organizations (2004)

Ranking (Previous year)	Japan Patent Office	Number of applications
1 (1)	JAPAN SCIENCE AND TECHNOLOGY AGENCY (Japan)	137
2 (4)	NATIONAL INSTITUTE OF ADVANCED INDUSTRIAL SCIENCE AND TECHNOLOGY (Japan)	115
3 (3)	SONY CORPORATION (Japan)	96
4	NATIONAL INSTITUTE FOR MATERIALS SCIENCE (Japan)	73
5 (7)	MITSUBISHI CHEMICAL CORPORATION (Japan)	70
6 (6)	CANON INC. (Japan)	59
7	SHARP CORPORATION (Japan)	48
8 (8)	HITACHI, LTD. (Japan)	47
9	RICOH COMPANY LTD. (Japan)	46
10 (2)	FUJI PHOTO FILM CO., LTD. (Japan)	44
10	MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD. (Japan)	44

Ranking (Previous year)	US Patent and Trademark Office	Number of applications
1 (1)	IBM (US)	89
2 (2)	MICRON TECHNOLOGY (US)	63
3 (3)	THE UNIV. OF CALIFORNIA (US)	58
4 (7)	EASTMAN KODAK (US)	53
5 (9)	L'OREAL (France)	50
6 (5)	XEROX (US)	49
7 (8)	GENERAL ELECTRIC (US)	43
8	SAMSUNG ELECTRONICS (South Korea)	42
9	HITACHI LTD. (Japan)	39
10	INDUSTRIAL TECHNOLOGY RESEARCH INSTITUTE (Taiwan)	38
10	CANON INC. (Japan)	38

Ranking (Previous year)	European Patent Office	Number of applications
1 (8)	JAPAN SCIENCE AND TECHNOLOGY AGENCY (Japan)	36
2 (1)	L'OREAL (France)	27
3 (4)	SAMSUNG ELECTRONICS (South Korea)	25
3 (4)	HEWLETT-PACKARD (US)	25
5	CNRS (France)	16
6 (4)	EASTMAN KODAK (US)	13
7 (3)	SONY CORPORATION (Japan)	12
7	BASF (Germany)	11
9	CANON INC. (Japan)	9
10	INFINEON (Germany)	8

Ranking (Previous year)	World Intellectual Property Organization (WIPO)	Number of applications
1 (1)	JAPAN SCIENCE AND TECHNOLOGY AGENCY (Japan)	33
2 (3)	THE UNIV. OF CALIFORNIA (US)	32
3	PHILIPS (Netherlands)	30
4	DU PONT DE NEMOURS (US)	25
5	CNRS (France)	22
6	COMMISSARIAT A L'ENERGIE ATOMIQUE UNIVERSITE (France)	18
7	INFINEON (Germany)	17
8 (5)	MASSACHUSETTS INSTITUTE OF TECHNOLOGY (US)	16
9 (9)	SONY CORPORATION (Japan)	15
9	NORTHWESTERN UNIV. (US)	15
9 (4)	3M INNOVATIVE PROPERTIES (US)	15

Prepared by the STFC based on Reference[6]

3-5 *International comparison of nanotechnology-related patents in nine designated areas of technology*

Finally, nanotechnology patent applications have been categorized into nine specific areas of technology in order to compare trends by country (Please refer to Table 1 for details of classification). Figure 8 shows the results of classification for all nanotechnology patent applications submitted to the world's four largest patent organizations, according to the nine areas of technology. The largest number of patent applications was found in the field of materials, followed by electronic devices, then medicine and life sciences. Patent application trends within these nine areas vary significantly from one patent organization to another. In the case of the Japan Patent Office, the percentage of applications from the medicine and life sciences area was small. By contrast, the United States Patent and Trademark Office received a small percentage of applications from the materials field, which was offset by a large percentage of applications from the electronics device area. Patent applications lodged with the European Patent Office and the WIPO showed the same tendency.

Next, an international comparison of the number of nanotechnology patent applications filed in 2004 by three specific areas of technology - materials, electronic devices, medicine and life sciences - was also carried out, as these areas constituted a large proportion of the total number of applications (Figure 9 (a), (b) and (c)). In the area of materials, American patents accounted for the largest percentage, with Japanese patents falling a little short of the American figure. Together, American and Japanese patents accounted for approximately 70% of the total number of patent applications in the materials area. American and Japanese patents also lead others in the electronic device area, in which South Korea and Taiwan were ranked third and the fifth, respectively. The US dominates in the area of medicine and life sciences, with Japan accounting for only a fraction of the applications submitted in this area[Note5]. It is important to remember that Ireland and Israel were ranked among the top ten in this field. Ireland achieved a remarkable breakthrough when it was ranked fifth in the first half of 2005, compared to a position of 13th in 2003. This leap in the rankings reflects the country's stance of placing importance on the areas of medicine and life sciences[6].

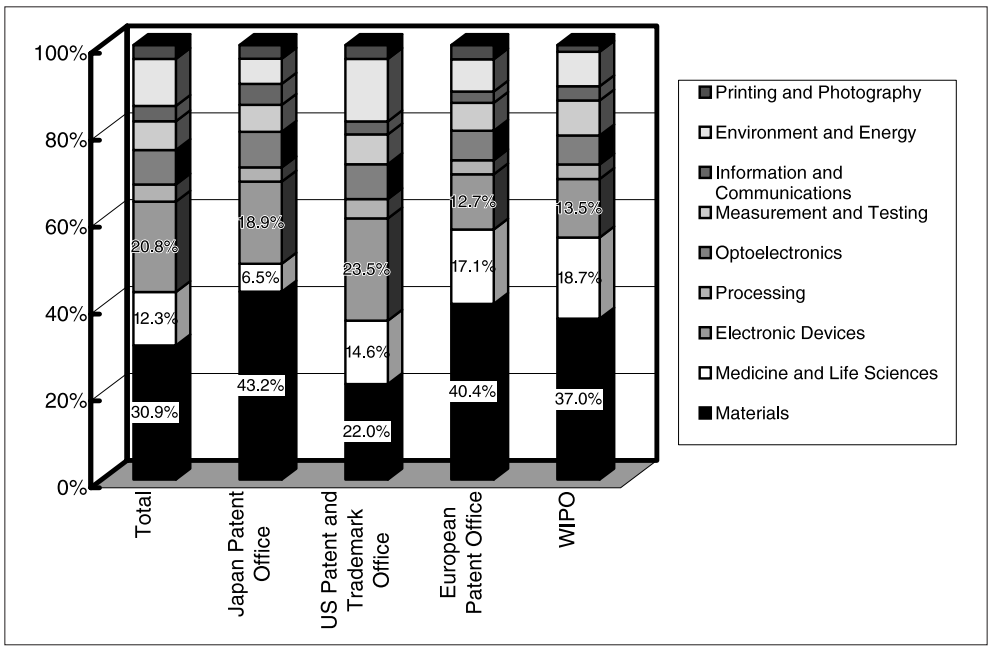

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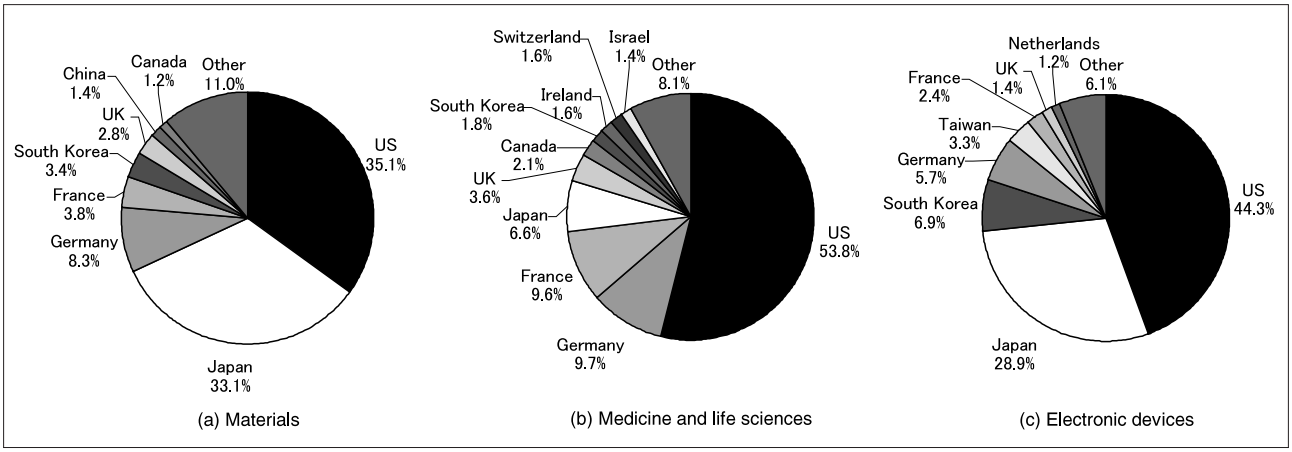
Figure 8 : Percentage of nanotechnology patent applications by nine designated areas of technology (2004)



Prepared by the STFC based on Reference[6]

Figure 9 : Percentage of nanotechnology patent applications by country in the three major areas of technology(2004)

4 Summary

As stated above, nanotechnology patent applications submitted to the world's four largest patent organizations were analyzed from various angles by examining application trends by country, by sector (such as corporation, university and public research organization), and by the area of technology concerned. The analysis was carried out with the cooperation of the Nanotechnology Researchers Network Center of Japan. The principal results of the analysis are as follows.

- The number of nanotechnology patents registered with the Japan Patent Office accounts for approximately 1% of the total number of patent applications. The figures for the United States Patent and Trademark Office, the European Patent Office and the WIPO were approximately 1.5%, 1% and 2.5%, respectively.
- The number of nanotechnology patent applications is increasing yearly in the case of all patent offices.
- Nanotechnology patent applicants are predominantly American, followed by Japanese and German applicants. The top two nationalities (American and Japanese) account for more than 70% of the total number of applicants.
- The percentage of patents registered by the country's own citizens varies depending on the patent office. For example, approximately 72% of patents registered with the Japan Patent Office are of Japanese origin. Approximately 62% of patents registered with the United States Patent and Trademark Office are American.
- Patent applications by sector show that the largest percentage of all applicants, approximately 80%, is from corporations. This is true for all countries. University applicants account for the second largest percentage in such countries as the US, the UK, Canada and the Netherlands. Meanwhile, public research organizations account for the second largest percentage in such countries as Japan, Germany, France and South Korea. Hence, two major trends are observed; the US-type trend and Japanese-type trend.
- A cross-country comparison of the areas of technology in which nanotechnology is applied reveals that different countries have different characteristics. The US comes out on top in all areas of technology in terms of the number of applications. Japan compares favorably with the US in the materials area, but is far behind the US in the medicine and life science areas.

5 Conclusion

This article classified patent applications in the field of nanotechnology from several different perspectives. In closing, I would like to draw attention to differences in the patent application behavior of universities and public research organizations in Japan

and the US. Industry-university cooperation has been stepped up on a global scale and technology transfers from universities have been increasingly attracting attention. Data presented in this article suggest that at least in the field of nanotechnology we should discuss the technology transfer system as a nation including public research organizations, instead of simply comparing technology transfer trends by universities.

However, although these data on patents provide a range of information on technical knowledge they do not necessarily cover all inventions and intangible assets[4]. In other words, patent applications merely reflect one aspect of technical knowledge, which takes various forms; some types of technical knowledge are disclosed in the form of academic papers, while others are accumulated and kept within an organization as technical know-how[Note6]. The significance and value of individual patents vary widely, depending on the type of industry. Thus, the value and nature of individual patents differ significantly, which makes a difference to the significance of data on patents[Note7]. It is also necessary to be aware of the patenting systems and policies (e.g. patent application fee) of different countries when we interpret data on patents.

I hope that the data and main conclusions presented in this article will lead to more discussion on the current state of nanotechnology research in Japan, on how to measure its international competitiveness, and on various other issues surrounding nanotechnology.

Acknowledgements

I would like to thank Dr. Eiichi Ozawa of the Nanotechnology Researchers Network Center of Japan, who both conducted the investigation and analyzed the investigation outcomes which have been presented in this article. I am grateful for his kind assistance in providing information and sharing his extensive knowledge with me, including his knowledge on individual patent publications.

Presently, the Nanotechnology Researchers Network Center of Japan is categorizing and analyzing US patents state by state as part of its ongoing research of nanotechnology patents[6].

Notes

[Note 1] The Nanotechnology Researchers Network Center of Japan is part of the Nanotechnology Support Project of the Ministry of Education, Culture, Sports, Science and Technology. It began its activities in July 2002. The center carries out comprehensive support in order to promote the development of nanotechnology. This support includes the provision of the latest equipment and information from both Japan and abroad, and the promotion of exchange among researchers. The National Institute for Materials Science operates the center.

[Note 2] When applying for an international patent, one may follow what is called the Paris Convention route by applying to the patent agencies of various countries, or one may follow what is known as the Patent Cooperation Treaty (PCT) route by applying through a unified international procedure. By applying through the PCT route, one can obtain results equivalent to applying in each member country, but one cannot obtain an actual patent right through the PCT. In order to obtain the patent right, the process must shift directly to those countries where the patent is desired. Patents applied for through the PCT route are published by the World Intellectual Property Organization (WIPO). The European Patent Office (EPO) serves the same function for its member countries as the PCT does. Unlike the PCT, however, the EPO has the authority to grant patent rights.

[Note 3] "Nationality of applicant" is defined herein as the nationality of the cheif inventor. In some cases, inventors applying to foreign countries do so through their local patent offices. These cases are also counted by the nationality of the chief inventor.

[Note 4] It should be noted that the Japan Science and Technology Agency is not itself a research institute. When researchers employed in its sponsored R&D projects file for patents based on their results, the Japan Science and Technology Agency becomes the applying institution.

[Note 5] Although this is not indicated in the chart, Japanese percentage in this field has

been slowly increasing. In the first half of 2005, Japan moved slightly ahead of France into third place, almost equal level with Germany[6].

[Note 6] Suzuki et al. point out that although the increase in the actual number of patent applications is not particularly significant, the number of claims per patent application filed by the top 10 major electronics manufacturers is increasing[5]. In cases such as these, it is important to understand both the number of claims as well as the number of applications.

[Note 7] The September 2005 Patent Agency survey, "Survey of Intellectual Property-Related Activities 2004," analyzes the use and nonuse of corporate patents by size of firm. (Website: http://www.jpo.go.jp/shiryou/index.htm)

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Interested in the relationship of science and technology with socioeconomics and innovation, especially focusing on the role of universities and public research organizations in the national innovation system. Nanotechnology R&D trend is another area of interest.

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