Patent Information Applied to Investigation on the Fullerene Field

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Abstract

Patent information consists of huge critical technological information and energy. It can serve as a vital index of scientific and economical development as well as a main device in creating and developing a specific technology. The production technique of fullerene is the key technology in the nanotechnology. This paper utilizes PATOLIS (Patent Online Information System) Data Base and Intellectual Property Digital Library (IPDL) Data Base of Japan Patent Office (JPO) as the search targets to explore what is happening in the fullerene field, including comparison of patent applications of Japan, USA, European Community (EC), Korea and China, rank of patent citation in Japan, relative research capability, and technology cluster.

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Keyword:Patent Information; Bibliographic data; Numerical data; Fullerene; Cluster

1. Introduction

Patent information is a derivative product from the legal patent system. So called patent information, including patent applications, patent descriptions, patent gazettes, patent abstracts and patent data bank shall be prepared in exact compliance with the regulations and specifications of the patent acts.1, 2, 3 Patent information, differing from other published circulating information is well legally protected. This study is dedicated to discuss these key problems and intended to bring up the feasible recommendations. For convenience, this study classifies the patent information into the bibliographic data and the numerical data as shown in Fig. 1.

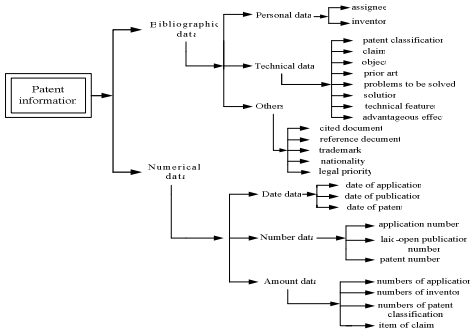

Fig. 1 Diagram of bibliographic and numerical data for patent information

The bibliographic data cover personal data, technical data and others. And the numerical data cover date data, number data, and amount data.

The bibliographic data and numerical data collected and consolidated in this study are processed by means of various analyses as shown in Fig. 2 in an attempt to identify and obtain the purpose of development and creation in a specific technical field as follows.

● Quantitative analysis: including patent number statistics, changes, rank, market share and cluster.4

● Qualitative analysis: including technical development contents, key technology, trend and forecast.5

● Relationship analysis: studying the mutual relationship among differing data terms and data relation change derived from other factors.6

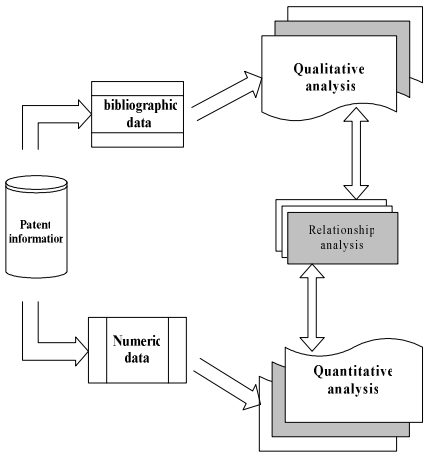

Fig. 2 Diagram of process and analysis of patent information

Patent information embraces numerous potential energies. Analysis of patent information will secure a clear map of the development trend of a specific technology, catch up what is the technical development or the technical strategies the competitors are carrying out. It is vital for you to plan the R&D work on a specific technology. In this paper, the existing conditions of the fullerene field were investigated from Japanese patent information on the internet.

2. Data Base and Methodology

2.1 Patent application numbers

The production technique of fullerene is the key technology in the nanoparticle. 7, 8 A nanoparticle (nanopowder, nanocluster or nanocrystal) is a small particle with at least one dimension less than 100 nm. Nanoparticle research is currently an area of intense scientific research, due to a wide variety of potential applications in biomedical, optical, and electronic fields. This paper utilizes PATOLIS Data Base 9 and Intellectual Property Digital Library Data Base 10 as the search targets to explore what is happening in the fullerene field. The key words used in searching are fullerene, bulkyonion, onionlikecarbon and carboncluster. 473 patent applications are collected up to date December 31, 2003. The patent information and patent map of the fullerene contained in this paper are based on 473 patent applications collected.

Fig. 3 shows the comparative sequence of patent applications submitted by Japan, USA, EC, Korea and China in which X axis represents the year and Y axis displays the patent application numbers submitted by each nation. It clearly indicates the fact that Japan took the leading since 1994. From 1994 to 2003, the application ratio among Japan, USA and EC is 1.65:1:074. Due to the geographical closeness with Japan, Samsung Korea who has good technical cooperation with Japan totals 45 patent applications and who counts 54% of a total of 84 patent applications in Korea. China has 26 patent applications. It seems China is starting the R&D environment in this fullerene field.

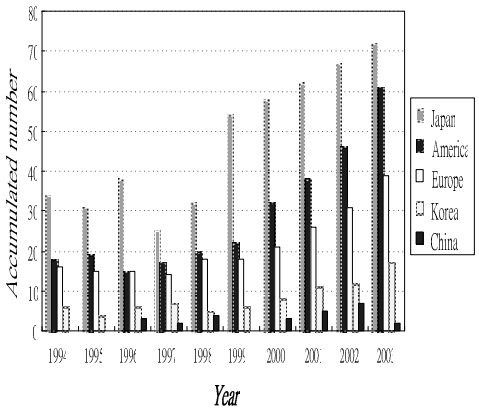

Fig. 3 Comparison of patent applications by nations

2.2 Ranking and Relative Research Capability in Japan

Rank of the top ten of company in Japan and patent citation status as shown in Table 1. Up to 2003, NEC obtains 45 patent application numbers and its patent was cited by most corporations. In Japan, the patent applications submitted by the top ten corporations' amounts to 197 cases, 42% of the total national patent applications implying the fullerene R&D work are concentrated in the giant corporations. Particularly, NEC is the leader in number of the patent application submitted.

The patent citation analysis is frequently employed as an assessment index of science and technology. 11, 12, 13 This paper conducted an analysis to assess the relative research capability of the top ten companies in Japan as shown in Table 2.

Table 1. Rank of the top ten in Japan and patent citation numbers

Rank	Company	Application numbers	Cited numbers	Self Cited numbers	Cited numbers by others
1	NEC	45	30	4	26
2	JST	32	12	5	7
3	Sony	24	8	5	3
4	Mitsubishi	21	18	8	10
5	AIST	21	22	4	18
6	Toshiba	16	11	3	8
7	Hitachi	12	7	1	6
8	Sumitomo	10	0	0	0
9	RITE	8	2	2	0
10	Showa	8	16	7	9

Table 2. Relative research capability of the top ten companies

Company	NEC	AIST	JST	Mitsubishi	Sony	Toshiba	Showa	Hitachi	Sumitomo	RITE
Relative research capability	79.4	45.8	44.4	39.4	31.6	28	24.4	20	10	9.6
%	100	57	55	49	39	35	30	25	12	12

The assessment comprises the number of patent publication and the number of

patents cited. In this paper, the number of patent publication, α, the number of patents ever cited by the company itself, β, and the number of patents cited by other companies, γ, were introduced in the expression (1) to assess the relative research capability, Δ. Each parameter is assigned with a different weight value. The weight value of the parameter "α" is set to be 1.0. The weight value of the parameter "β" is given a lower weight value of 0.8 to reflect possible preferences and biases associated with the self citation of patents. The weight value of the parameter "γ" is assigned with a higher value of 1.2, which means a higher quality of the patents cited by other companies. The relative research capability "Δ" is calculated as

$$\Delta = \alpha \times 1 + \beta \times 0.8 + \gamma \times 1.2 \qquad (1)$$

For example, in NEC

$$\Delta = 45 \times 1 + 4 \times 0.8 + 26 \times 1.2 = 79.4$$

The relative research capability of NEC was 79.4, and it was defined as 100% for comparison with other companies. Based on the patent citation status as shown in Table 2, an analysis of relative research capability is drawn displaying the top ten in Japan using the radar diagram as shown in Fig. 4

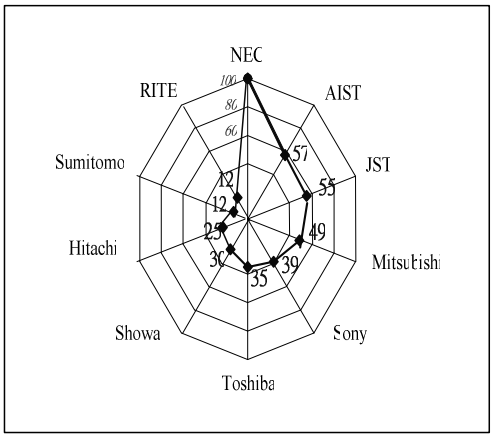

Fig. 4 Relative research capability of the top ten in Japan

2.3 Technology Cluster

From the patent citation network which it is clearly seen the development track of the patent technology, it is easy to learn the fullerene cluster condition.

The technological cluster A as illustrated in Fig. 5, the NEC's PT No. 3008852 was cited seven times by Sharp, (JP2001-57145A, JP2000-348599A, JP2001-93404A, JP2001-155620A, JP2001-35351A, JP2001-143601A, JP2001-176378A), three times by Matsushita (JP2001-319560A, JP2001-312955A, JP2001-181842A), and two times by Ricon (JP2001-35350A, JP2001-250467A). The technological feature is when in the synthesis; the metallic catalyst is separated and precipitated in the pores of anodic oxygenated film to form the carbon nanotube by reaction of the catalyst.

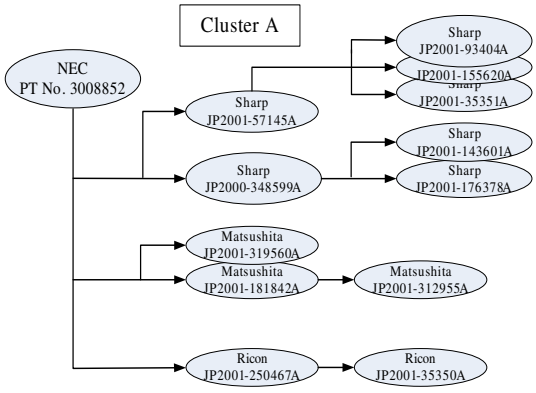

Fig. 5 Technological cluster A

The technological cluster B as shown in Fig. 6, the Toshiba's patent JP1998-149760A was ever cited six times by Matsushita (JP2000-204304A, JP2000-208025A, JP2000-208028A, JP2000-277002A, JP2000-304865A, JP2000-319763A) and once by Hitachi (JP2002-25478A). The technological feature is that the impure material is applied to adjust the crystal diameter of fullerene and strengthen bending force of the fullerene compound.

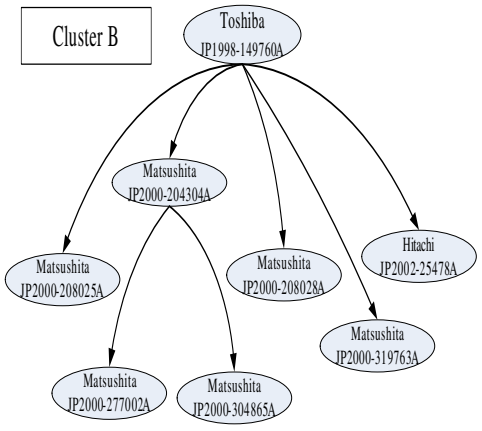

Fig. 6 Technological cluster B

The technological cluster C as shown in Fig. 7, USA Hyperion Catalysis's patent USP4,663,230 was ever cited three times by Mitsubishi (JP997-115334A, JP2000-511245A, JP997-111135A) and once by Showa (JP2002-14663A). The technological feature is that the diameter of the fullerene is 3.5-70nm and the carbon fiber forms the concentrically cylinder.

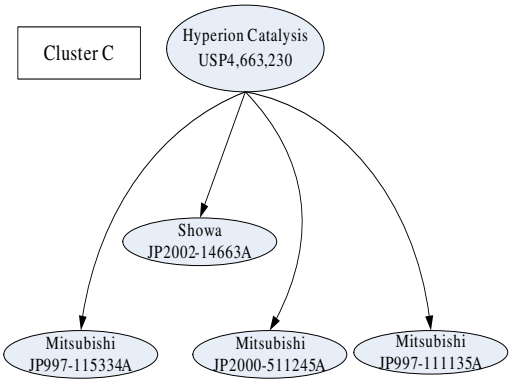

Fig. 7 Technological cluster C

By studying with care the patent citation network it is easy to get a clear picture how the patent technological cluster forms.14,15 The above technological cluster figures tell the truth that NEC, Sharp, Matsushita and Ricon are a technological cluster applying varying catalysts to achieve syntheses; Toshiba, Matsushita and Hitachi are another technological cluster in the fullerene synthesis and Hyperion Catalysis, Mitsubishi and Showa are the technological cluster concentrating in the fullerene production and application.

3. Conclusions

Patent map is a symmetric integration of patent information. Nowadays, the patent information is tremendously huge, this study provides an easy and concise way to integrate the patent information by dividing the patent information into bibliographic data and numerical data, after throughout quantitative analysis, qualitative analysis and relationship analysis and finally present the outcome in varying figures. This method offers an effective control over patent information, and opens an avenue to develop and create newest technology in most economical way. The result of using patent information, the technical features of fullerene is presented clearly, according to information which is given, can then develop the new technology. Furthermore, by way of the patent citation network, it is clear to learn the technology cluster condition of special technical field.

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