




Benchmarking Report on Nanotechnology and Electric Vehicle Technology from the Perspective of Patent Analysis

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Outline

-  **The Research Methodology**.....●
-  **The Analysis Results of Nanotechnology Studies**.....●
-  **The Analysis Results of Electric Vehicle Studies**.....●



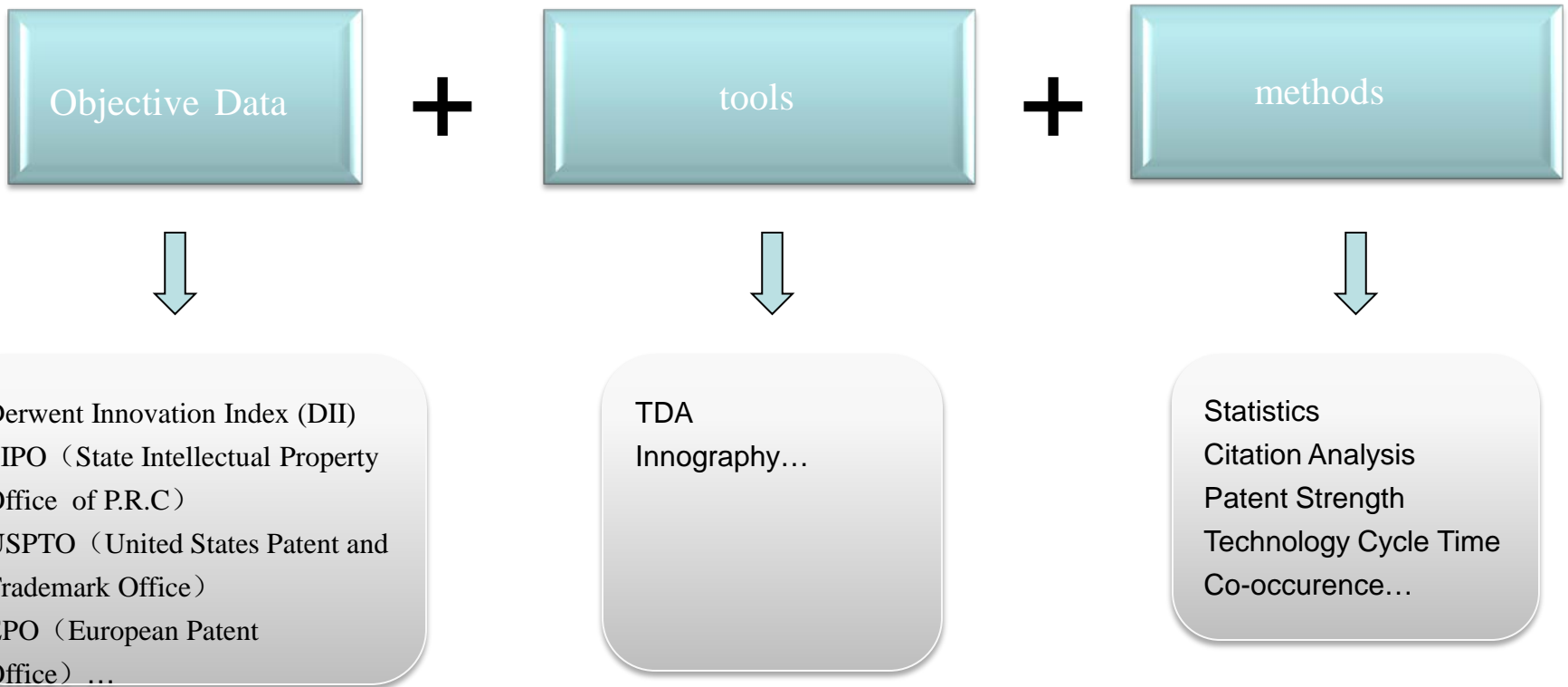
The Research Methodology

- Nowadays, Competition among countries depends on comprehensive national strength, and the key is science and technology development.
- As a result, intellectual property rights become an important strategic resource for countries and regions.
- As an important indicator of IP, patents can be used to measure the level of technology development.

- Key Technology Studies is a major research area of ISTIC.
- Field of Key Technology Studies include: biotechnology, energy technology, nanotechnology, information technology, and ocean technology
- Research methods include system analysis, S&T policy analysis, bibliometric analysis, and patent analysis.

Key Technology Studies Based on Patent Analysis

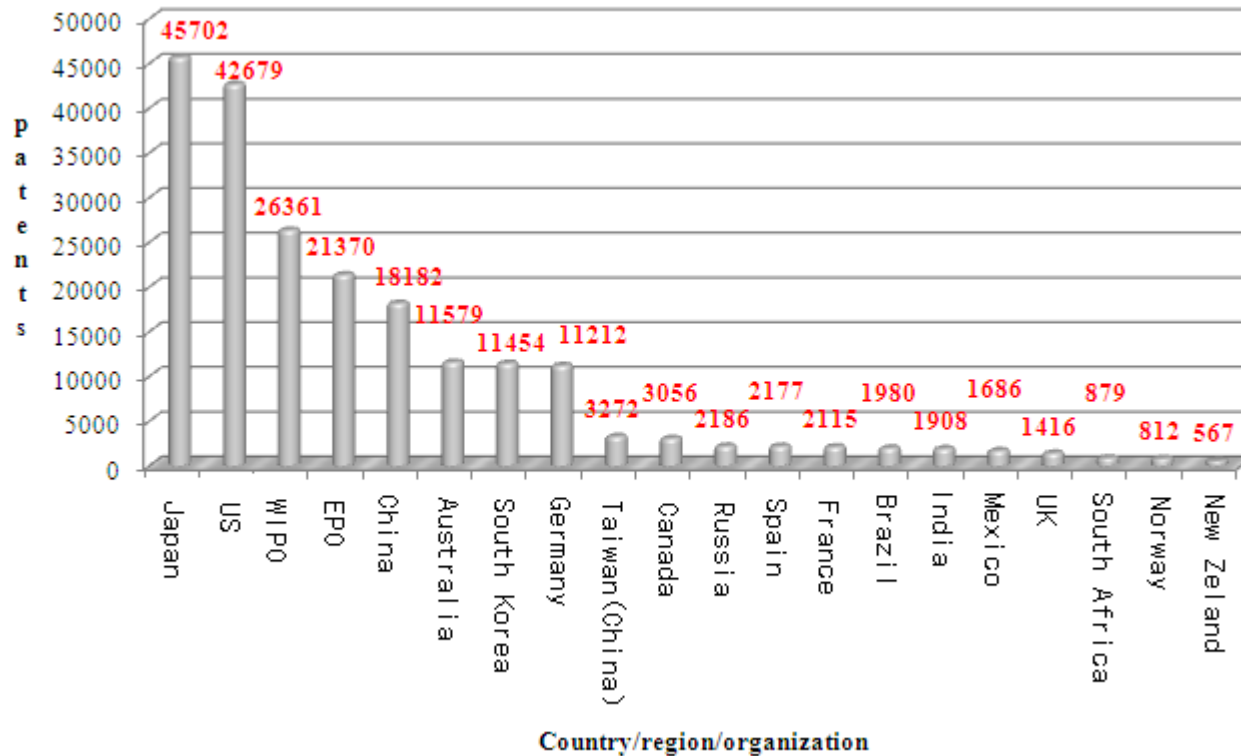
Based on objective data(patent), the ISTIC investigates development situation and trend of key technologies by applying special software and methods.





The Analysis Results of Nanotechnology Studies

Part of Analysis Results of Nanotechnology Studies -1

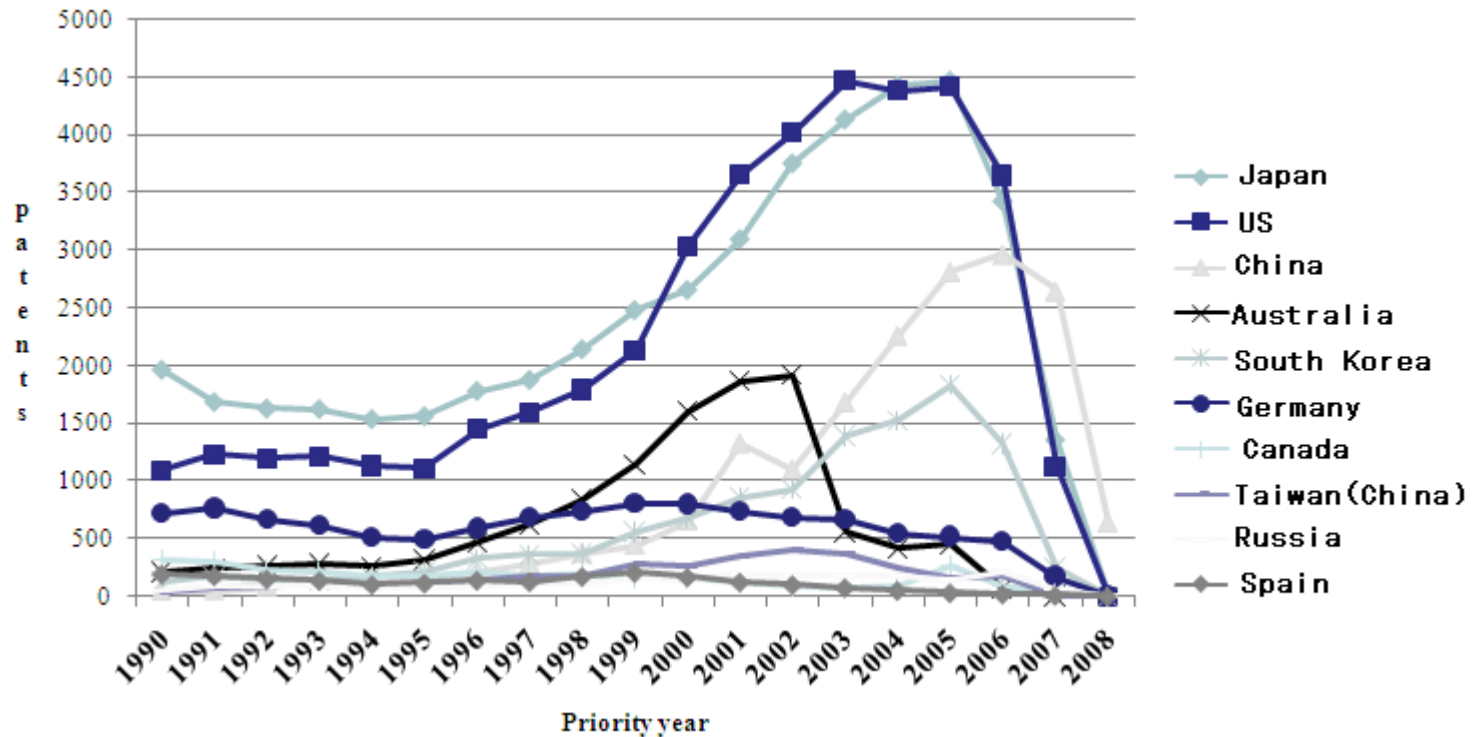


The distribution of nanotechnology patents across countries/regions

Source: Derwent patent database.

Japan ranked the 1st, followed by the US.

Part of Analysis Results of Nanotechnology Studies -2

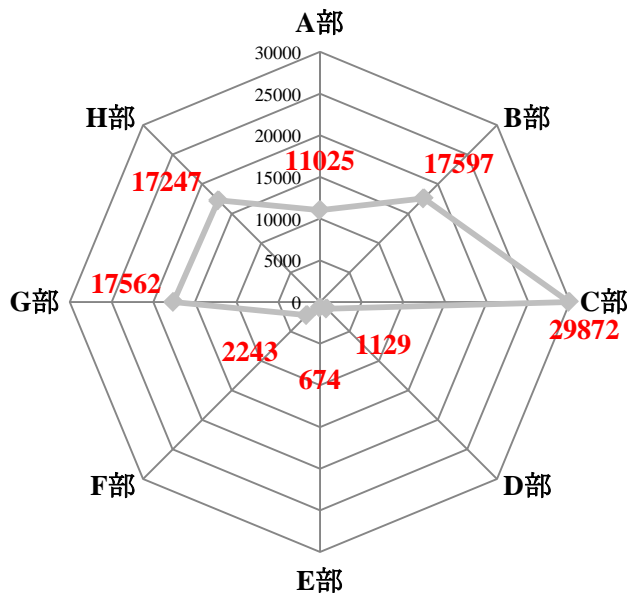


The number of patents in countries/regions by year.

Most of them exhibited rapid increase after the year of 2000.(US initiate NNI in 2000. from then on, many countries initiated their own nanotechnology program)

(Due to the time lag between patent application and publication, the number of patents in 2007 and 2008 here did not reflect the true situation.)

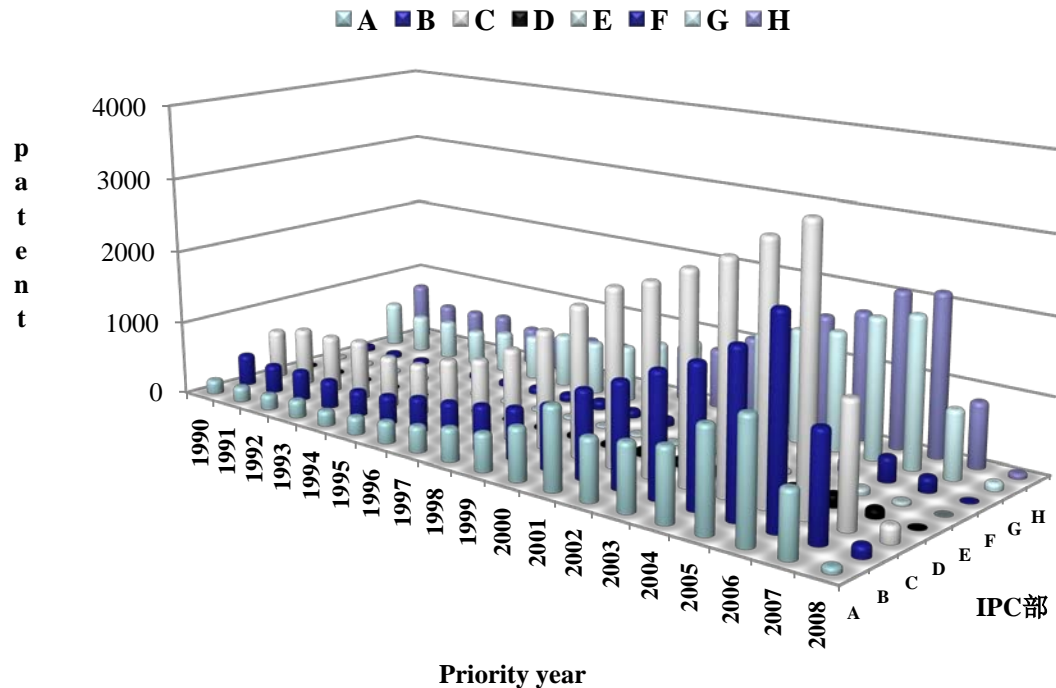
Part of Analysis Results of Nanotechnology Studies -3



The technology distribution according to IPC classes. Among them, most nanotechnology patents belong to chemistry and metallurgy area (C class).

| IPC部 | 专利数量 (件) | 注释 |
|------|----------|--|
| A部 | 11,025 | HUMAN NECESSITIES |
| B部 | 17,597 | PERFORMING OPERATIONS; TRANSPORTING |
| C部 | 29,872 | CHEMISTRY; METALLURGY |
| D部 | 1,129 | TEXTILES; PAPER |
| E部 | 674 | FIXED CONSTRUCTIONS |
| F部 | 2,243 | MECHANICAL ENGINEERING; LIGHTING; HEATING; WEAPONS; BLASTING |
| G部 | 17,562 | PHYSICS |
| H部 | 17,247 | ELECTRICITY |

Part of Analysis Results of Nanotechnology Studies -4

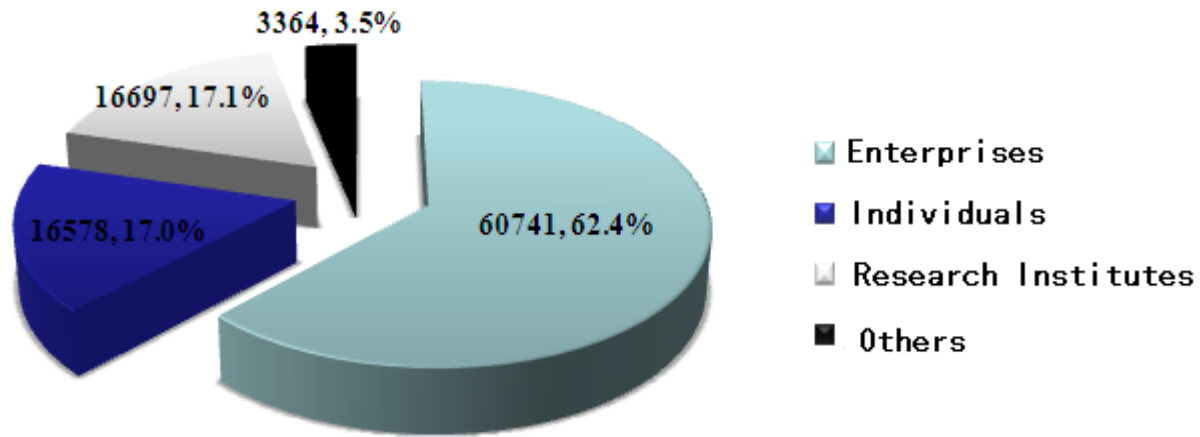


the number of patents in different IPC classes by year

Most of them exhibited rapid increase after the year of 2000, especially the chemistry and metallurgy area (C class).

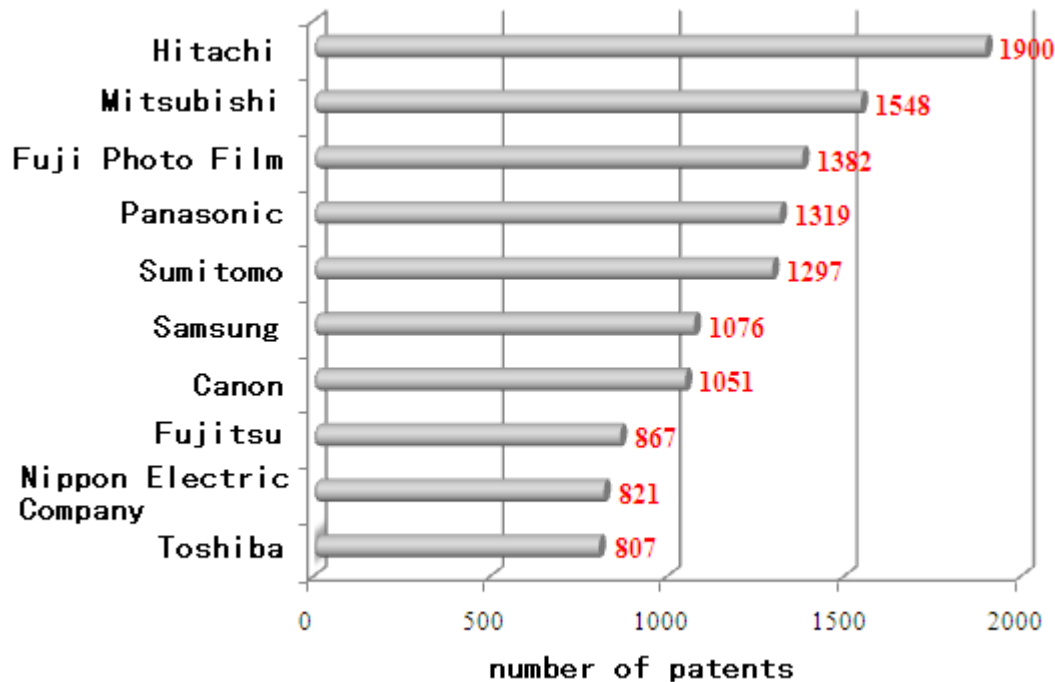
(Due to the time lag between patent application and publication, the number of patents in 2007 and 2008 here did not reflect the true situation.)

Part of Analysis Results of Nanotechnology Studies -5



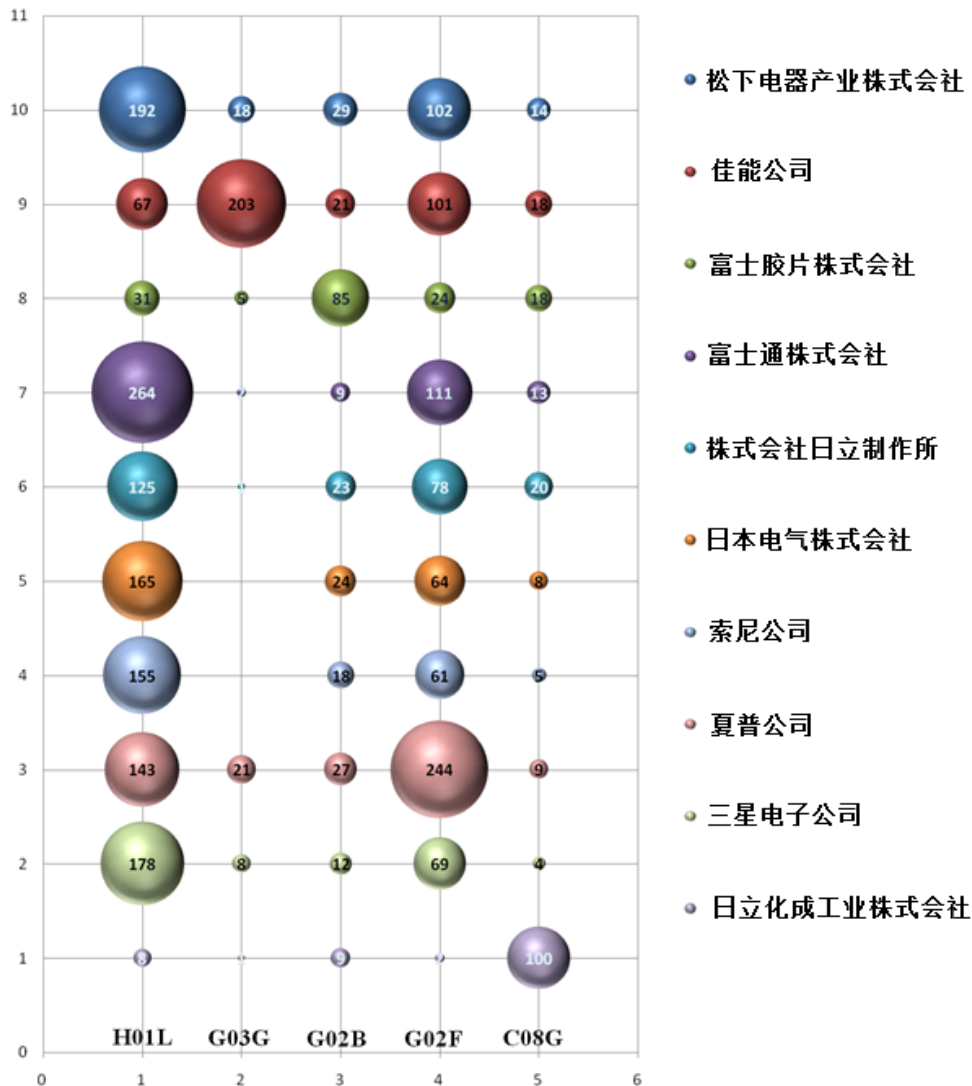
The number of patents held by different assignees
 62.4% of nanotechnology patents were held by enterprises.
 17.1% of nanotechnology patents were held by research institutes.
 17% were held by individuals.

Part of Analysis Results of Nanotechnology Studies -6



The patent held by top 10 companies in the world
the top 10 companies were all Japanese companies except Samsung. Japan obviously took the leading position in global nanotechnology innovation.

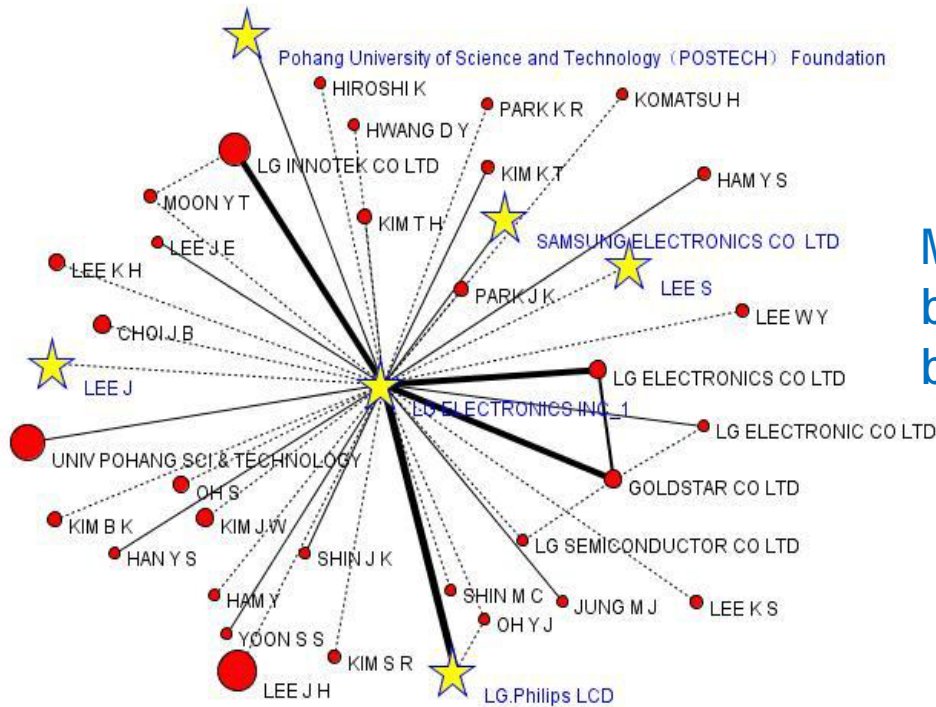
Part of Analysis Results of Nanotechnology Studies -7



The patent focus of company
This figure can tell people
what the technology innovation
focus is in each of the companies.
And the differences of their
technology development can be
clearly revealed.

| | |
|------|-----------------------------------|
| H01L | SEMICONDUCTOR DEVICES |
| G03G | ELECTROGRAPHY; ELECTROPHOTOGRAPHY |
| G02B | OPTICAL ELEMENTS, SYSTEMS, |
| G02F | DEVICES OR ARRANGEMENTS |
| C08G | MACROMOLECULAR COMPOUNDS |

Part of Analysis Results of Nanotechnology Studies -8



Meanwhile, the collaboration relationship between the companies can be reflected by the co-occurrence analysis on the left.

★ Patent assignees with more than 50 patents.

● Patent assignees with less than 50 patents. The large ring means more patents.

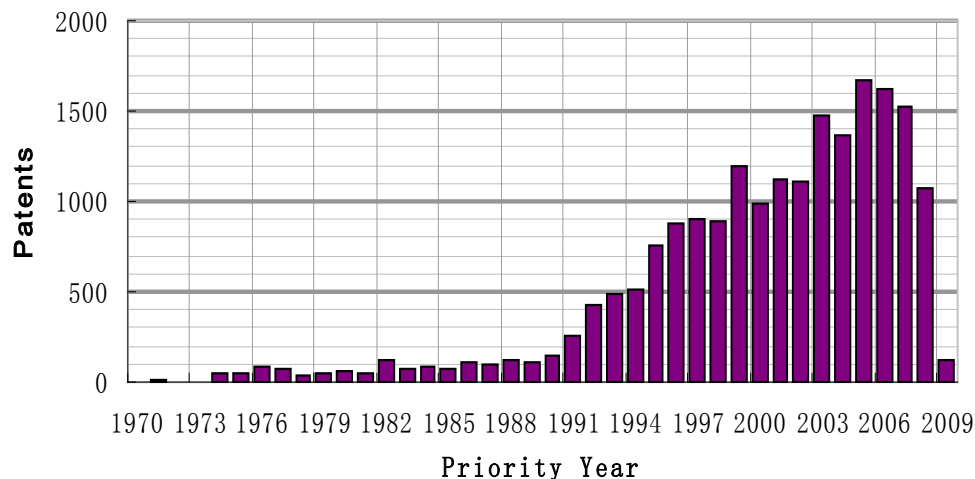
The black line between two assignees represents the cooperation between them. The thicker the line, the more close collaboration relationship between the two assignees.



The Analysis Results of Electric Vehicle Studies

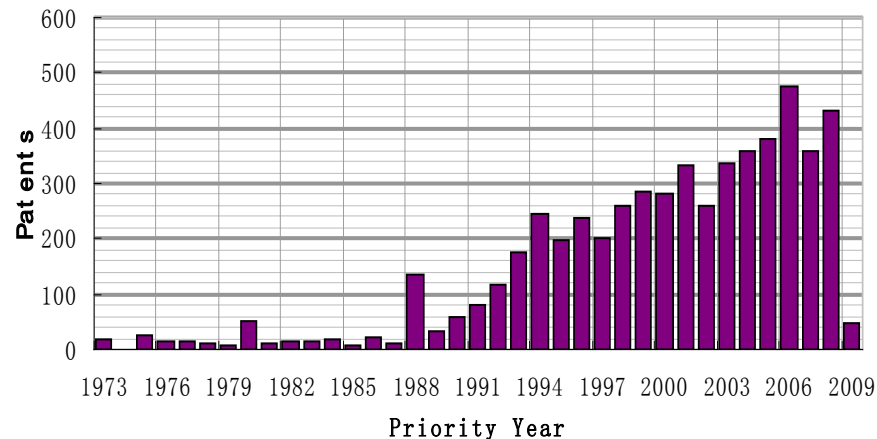
- **Electric Vehicle Technology mainly include:**
 - Battery technology
 - BMS (Battery Management System)
 - Traction Motor
 - Motor Control Unit
 - Vehicle Control Unit

Part of Analysis Results of Electric Vehicle Studies -1



The trend of battery patent in the world

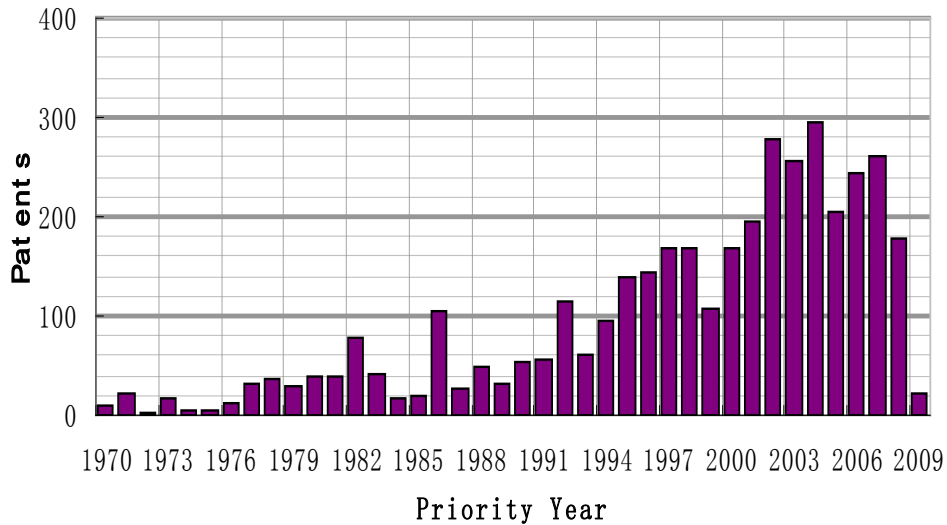
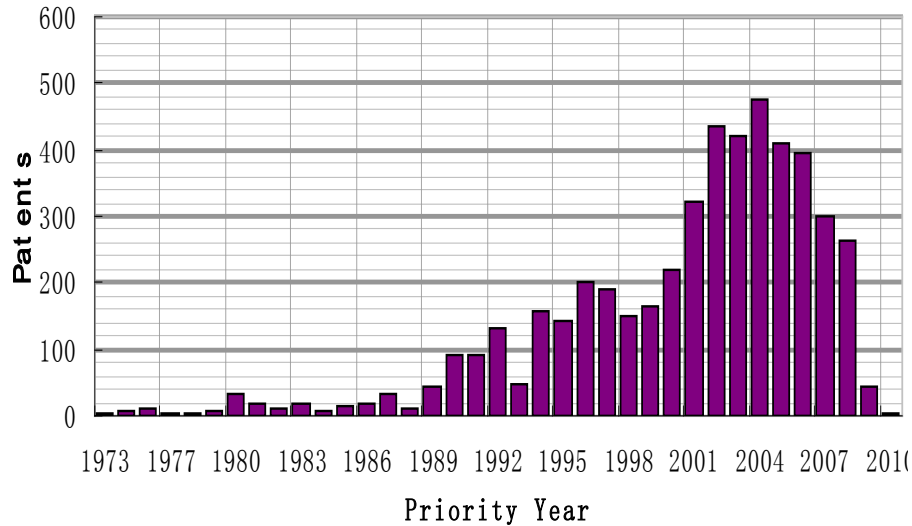
The first patent application was in 1970, and the number of patent has exhibited rapid increase since 1990.



The trends of BMS patents in the world

The first patent application was in 1973, and the number of patent has exhibited rapid increase since 1990.

Part of Analysis Results of Electric Vehicle Studies -1



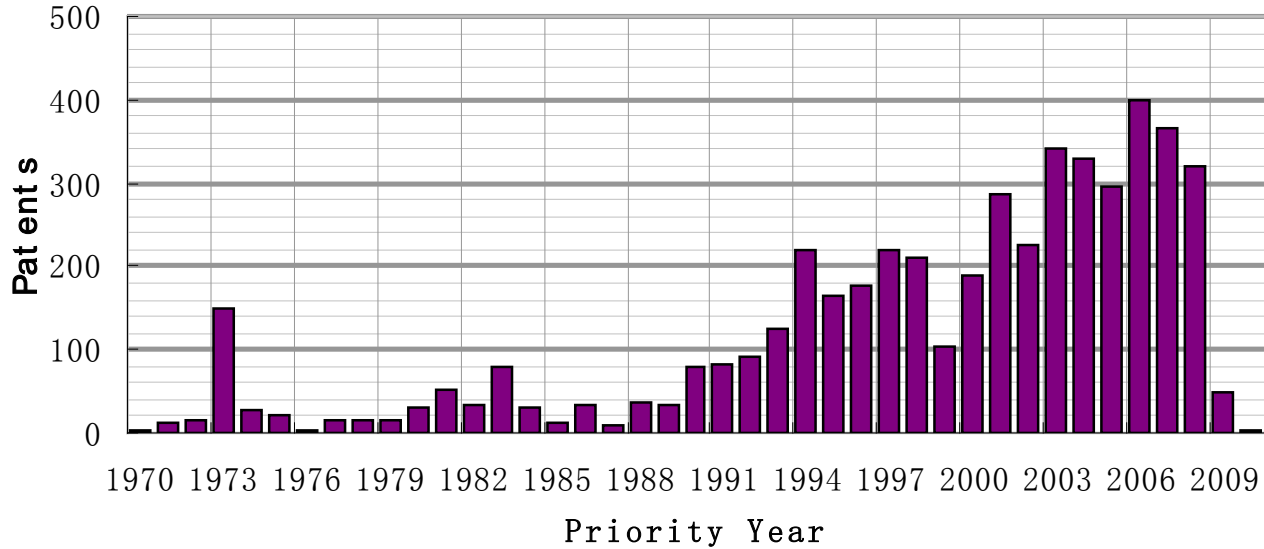
The trend of traction motor patent in the world

The first patent application was in 1973, and the number of patent has exhibited rapid increase since 1989. After 2005, the patent began to decrease.

The trend of motor control patent in the world

The first patent application was in 1970, and the number of patent has exhibited rapid increase since 1994.

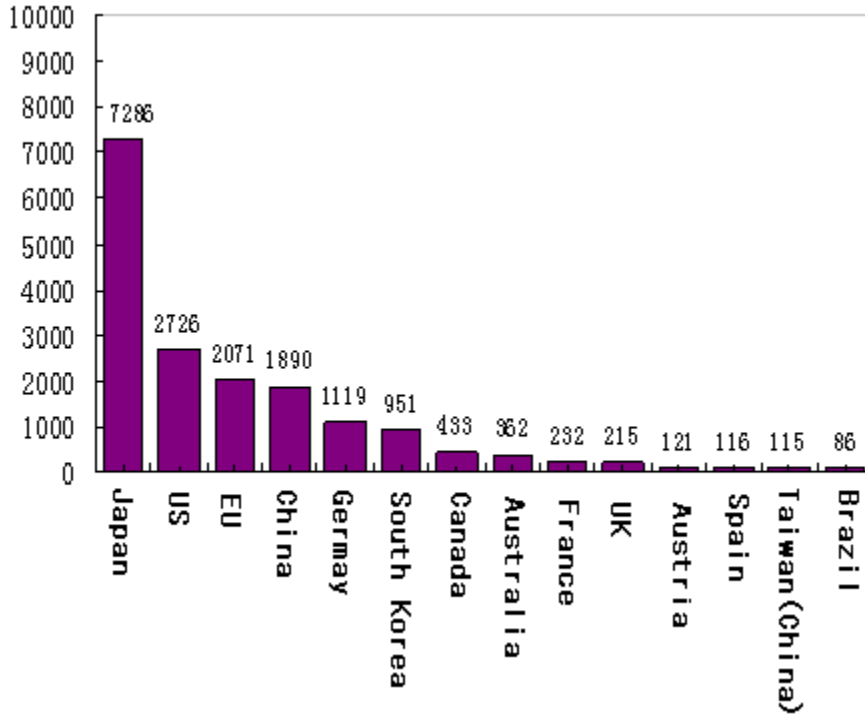
Analysis Results of Electric Vehicle Studies –1



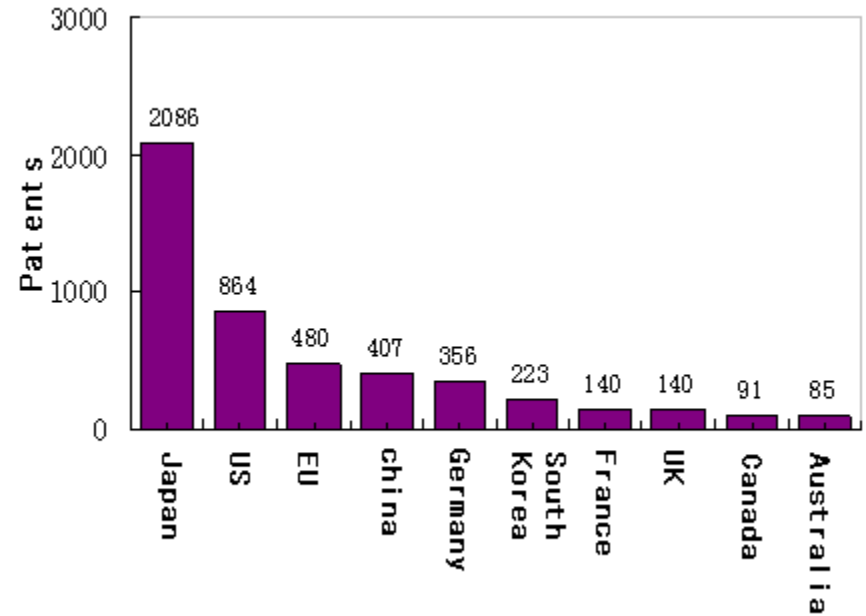
The trend of Vehicle Control Unit patent in the world

the number of patent has exhibited rapid increase since 1990.

Part of Analysis Results of Electric Vehicle Studies -2



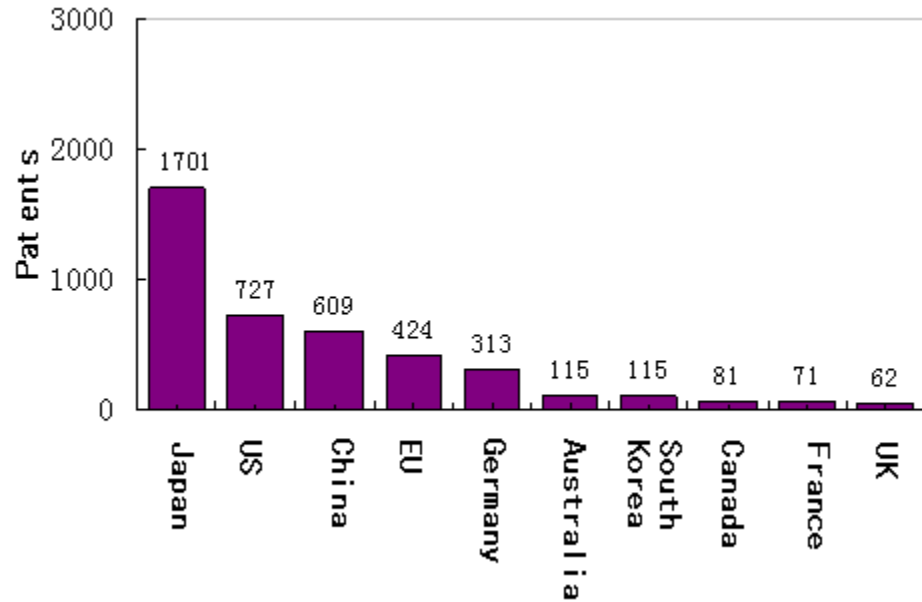
Battery patents by countries



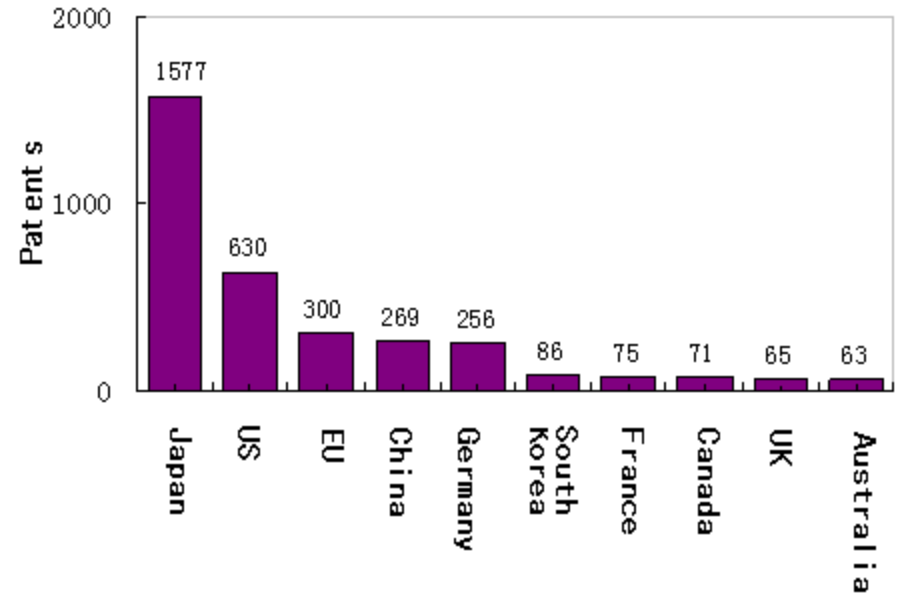
BMS patents by country

Above is the battery patent and BMS patents distribution among countries, Japan obviously took the leading position, followed by the US.

Part of Analysis Results of Electric Vehicle Studies -2



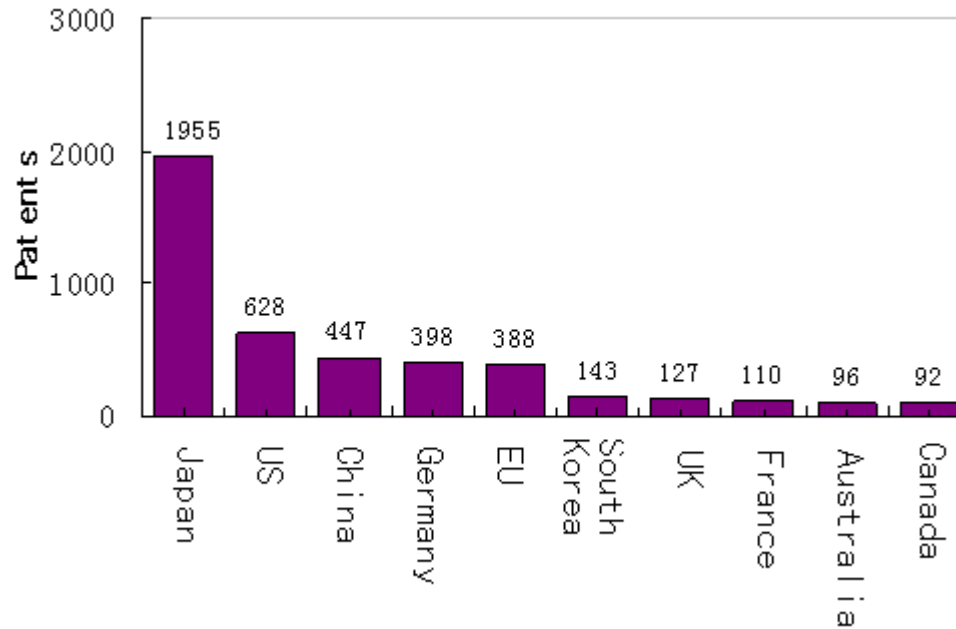
Traction Motor patents by country



Motor Control patents by country

Above is the Traction Motor and Motor Control patents distribution among countries, Japan obviously took the leading positions, followed by the US.

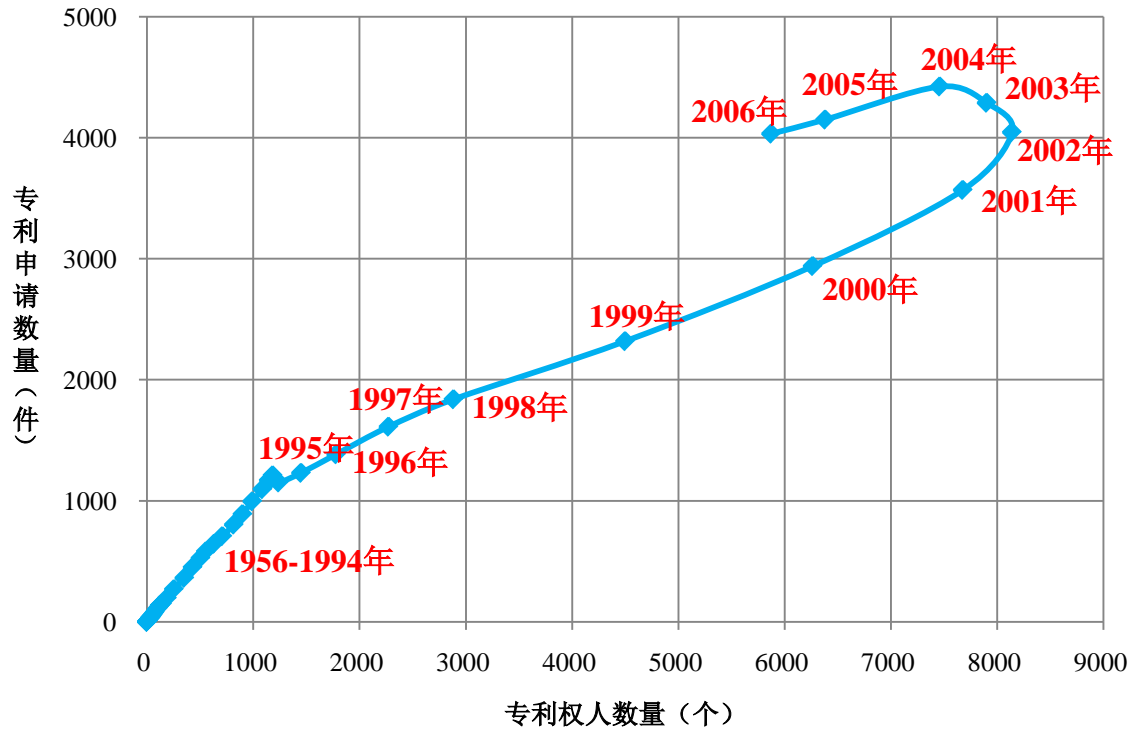
Analysis Results of Electric Vehicle Studies –2



Vehicle Control Unit patents by country

Above is the Vehicle Control Unit patent distribution among countries, Japan obviously took the leading position, followed by the US.

Technology Cycle Analysis



Before 1995: Emerging Stage
1996-2000: Growing Stage
2001-2004: Maturing Stage
2005-2006: Fading Stage

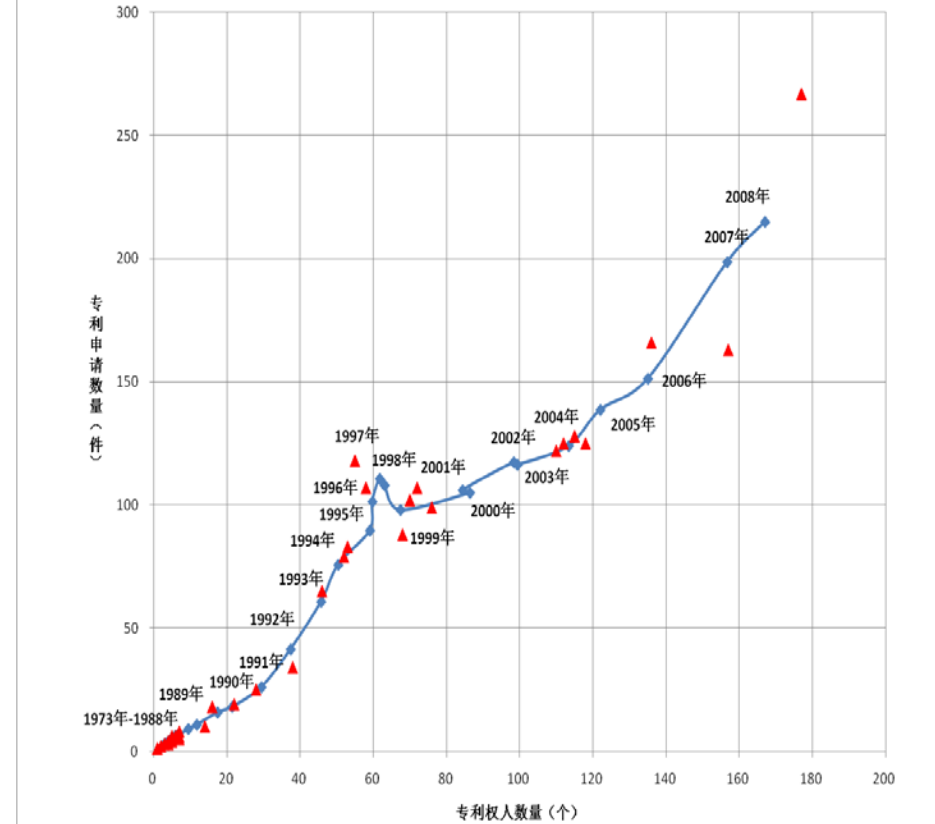
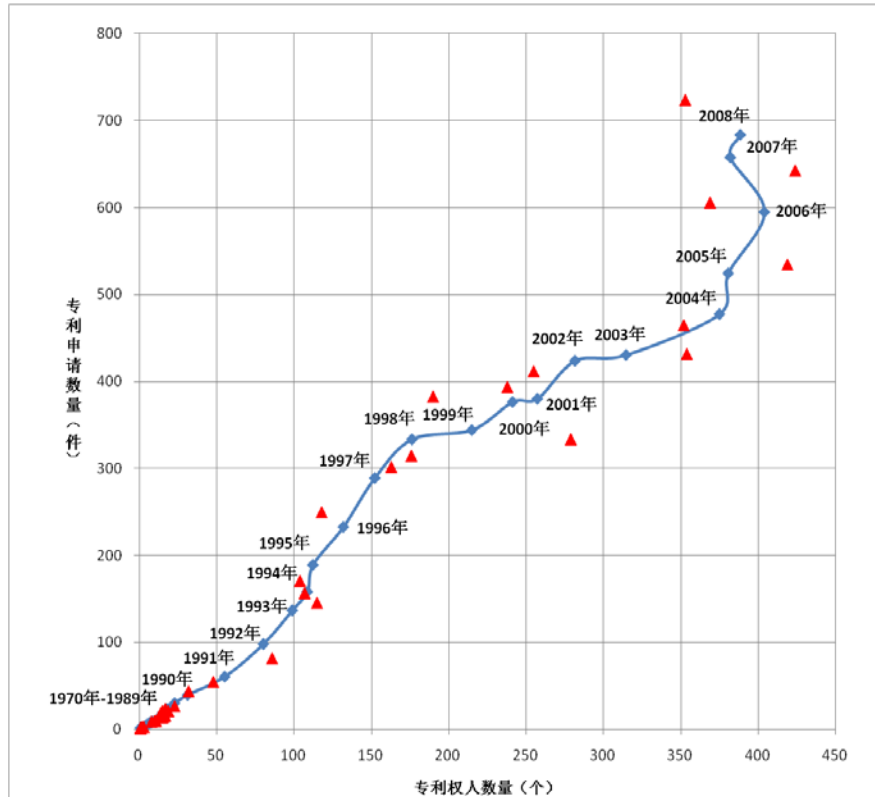
At the emerging stage, only a few companies apply patents in this field. Both the number of patents and patent assignees are very small.

At the growth stage, with the development of technology and the increase of market, more companies enter this field. Both the number of patents and patent assignees increase rapidly.

At the maturing stage, the number of new entrant is small, the number of patent assignees will increase slowly.

At the fading stage, some companies will exit the market. Both the number of patents and patent assignees show negative growth.

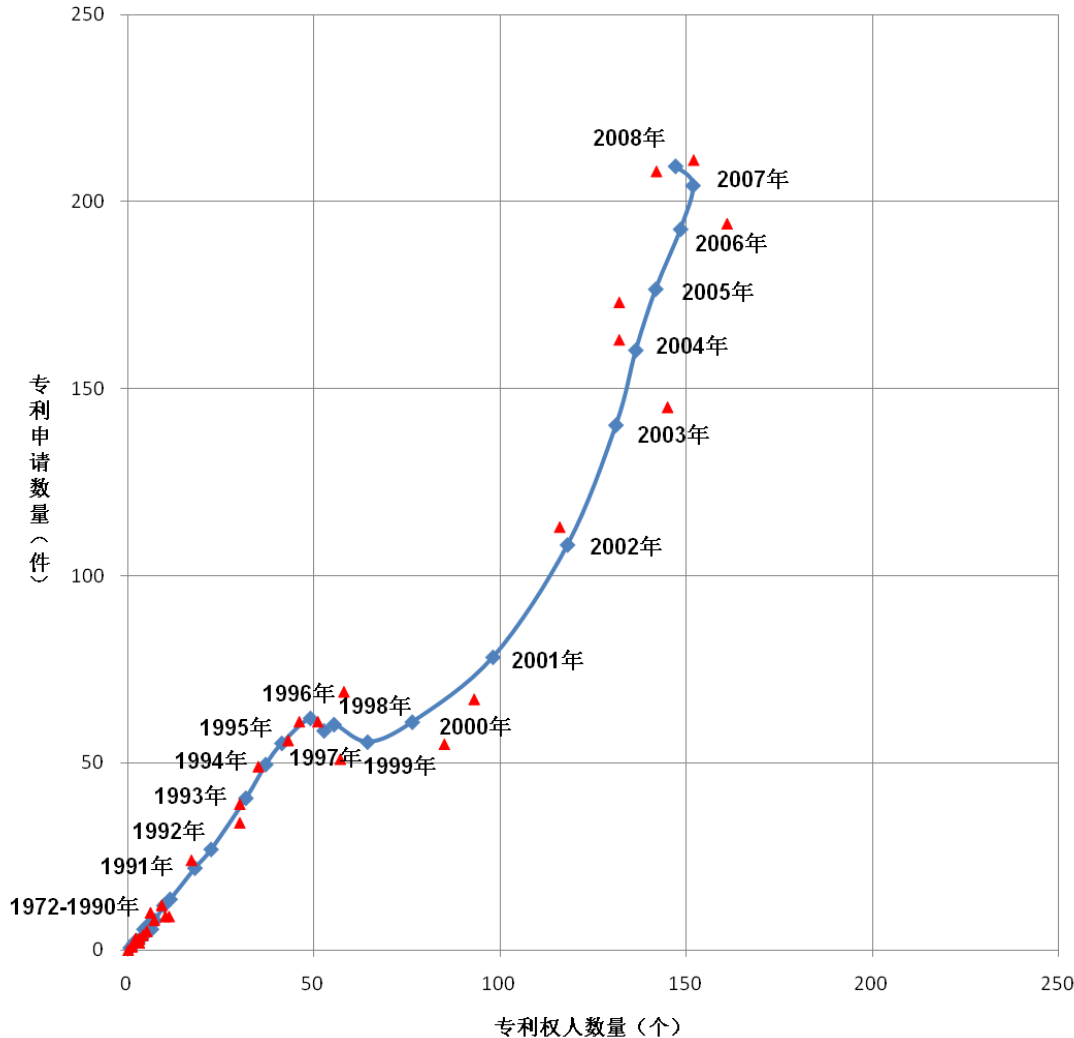
Part of Analysis Results of Electric Vehicle Studies -3



Technology Cycle Time (TCT) of battery technology and BMS.

It can be seen that before 1990, the Battery Technology was at emerging stage;
before 1988, the BMS Technology was at emerging stage;
after 1990, they came into a rapid growing stage.

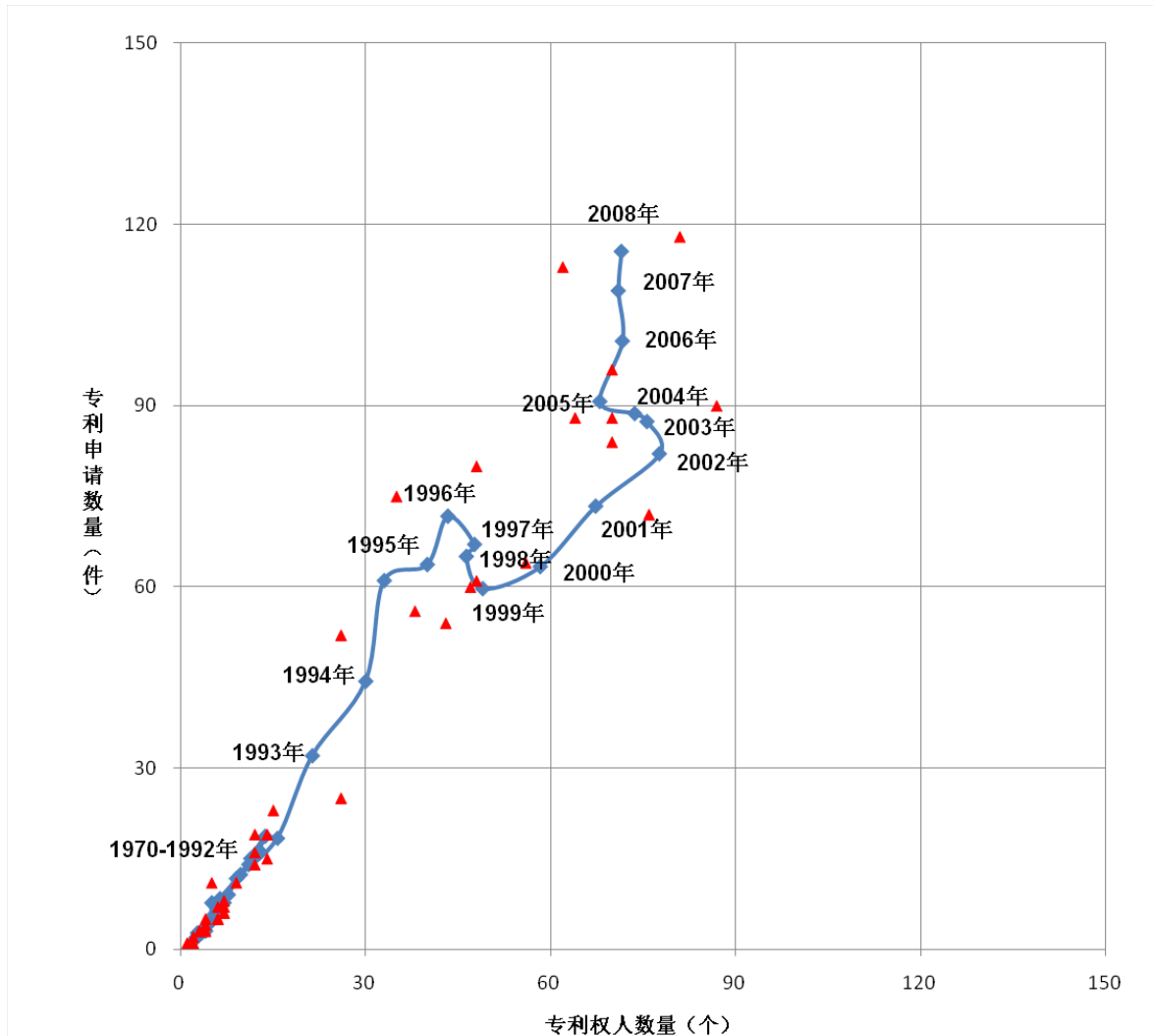
Part of Analysis Results of Electric Vehicle Studies -3



Technology Cycle Time (TCT) of Traction Motor

It can be seen that before 1990, the Traction Motor Technology was at emerging stage; after 1990, It came into a rapid growing stage.

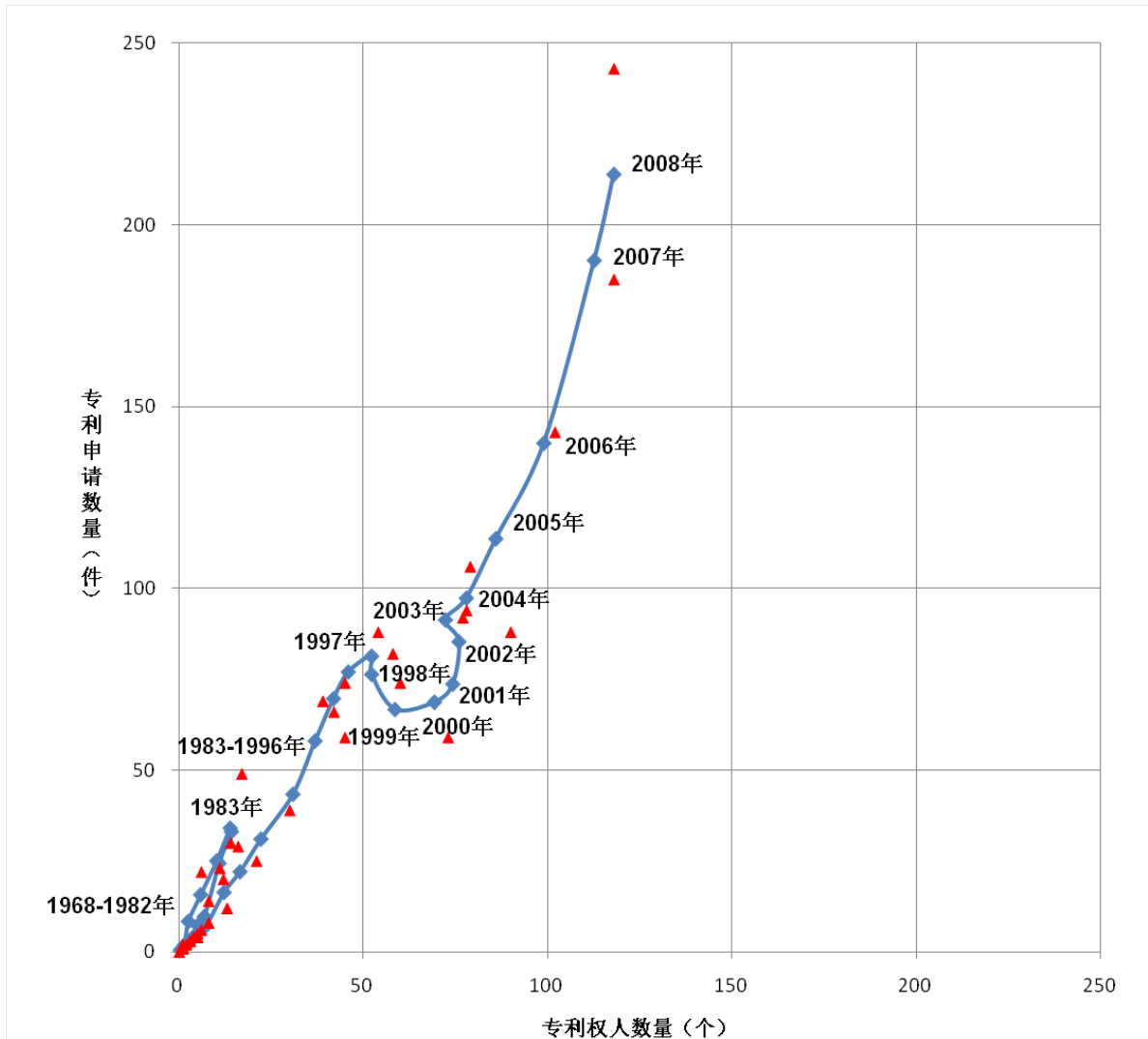
Part of Analysis Results of Electric Vehicle Studies -3



Technology Cycle Time (TCT) of Motor Control Technology

It can be seen that before 1992, the Motor Control Technology was at emerging stage;
1992-2002, It came into a rapid growing stage;
2003-2008, maturing stage.

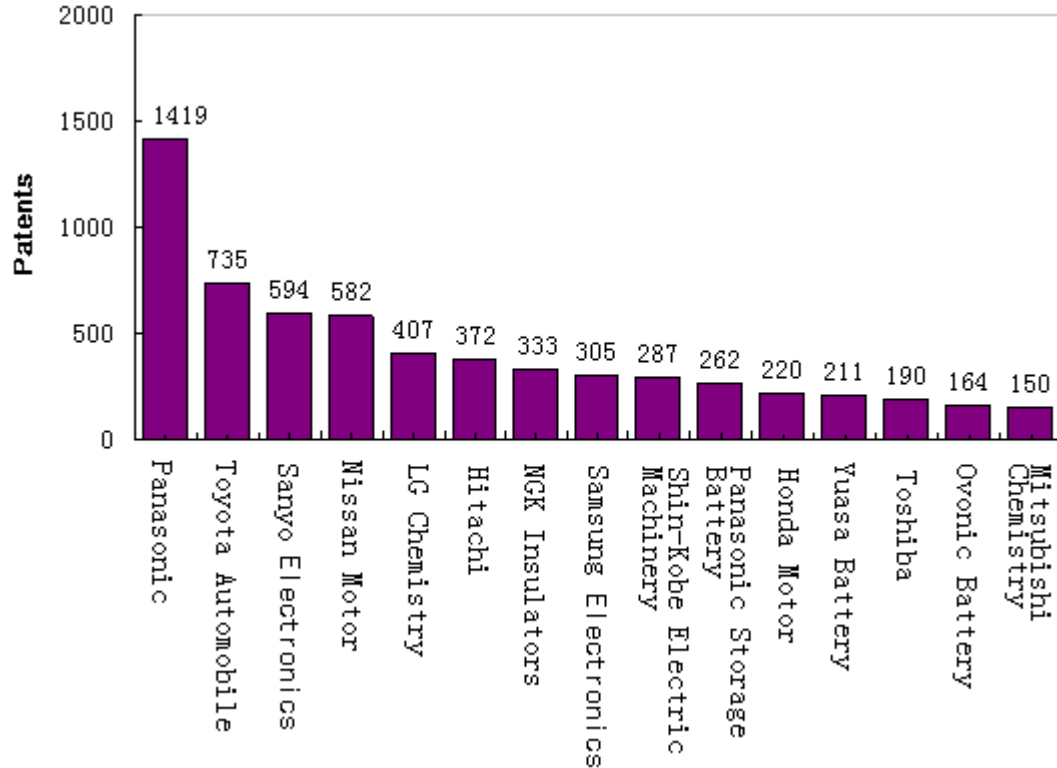
Analysis Results of Electric Vehicle Studies –3



Technology
Cycle Time (TCT) of
Vehicle Control Unit.

It can be seen that before 1996, the Vehicle Control Unit Technology was at emerging stage; After 1996, It came into a rapid growing stage.

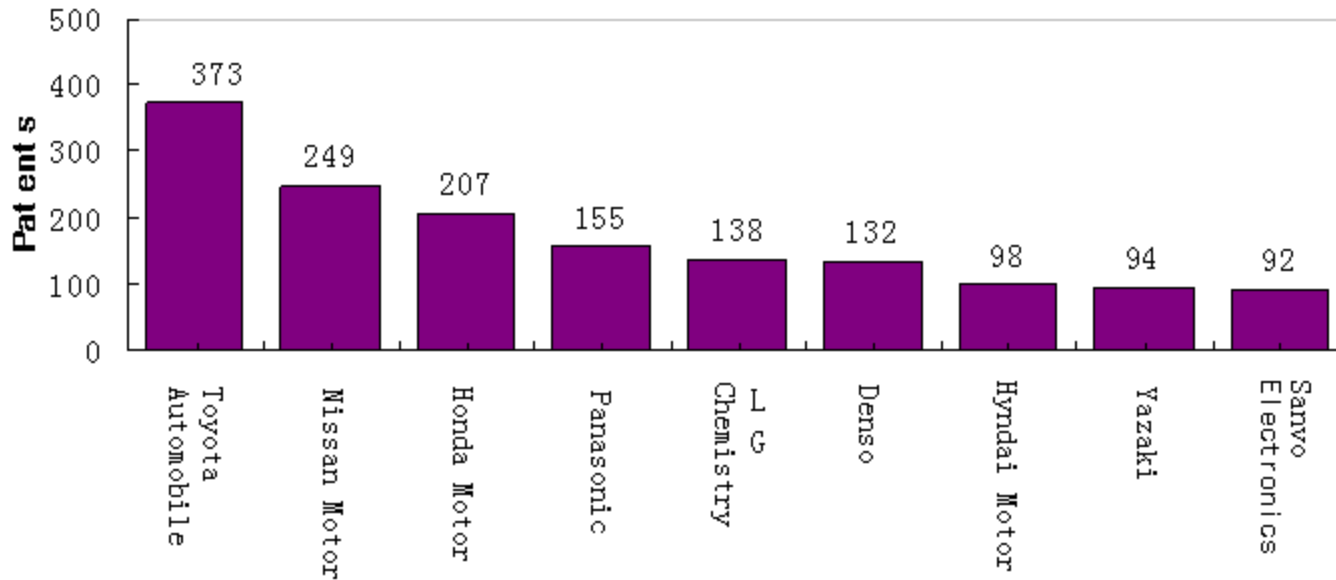
Part of Analysis Results of Electric Vehicle Studies –4



The battery patent held by top 15 companies in the world

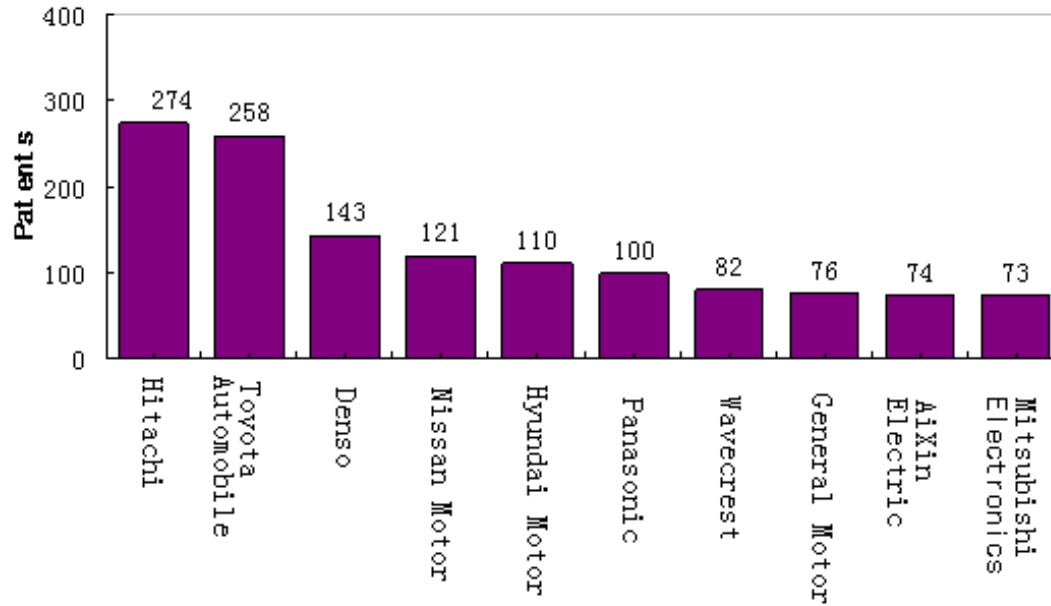
This figure revealed that the top 15 companies were all Japanese companies except Samsung and Ovonic Battery(US).

Part of Analysis Results of Electric Vehicle Studies –4



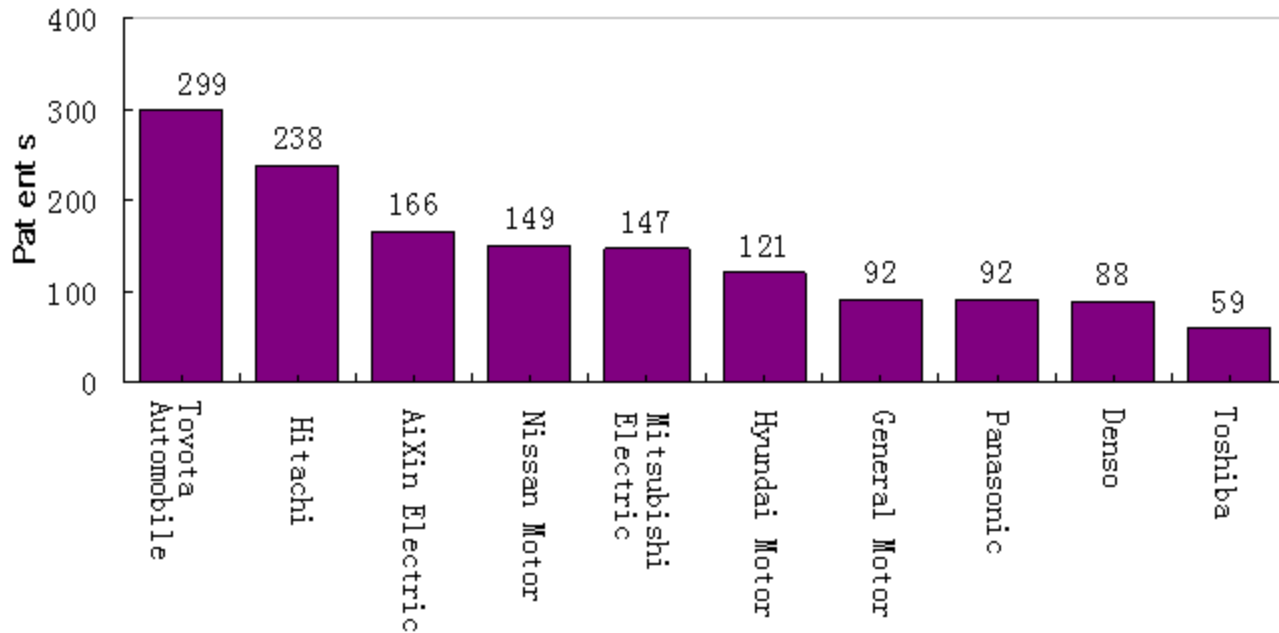
The BMS patents held by top 10 companies in the world
In the top 10 companies, 8 companies were Japanese companies.

Part of Analysis Results of Electric Vehicle Studies –4



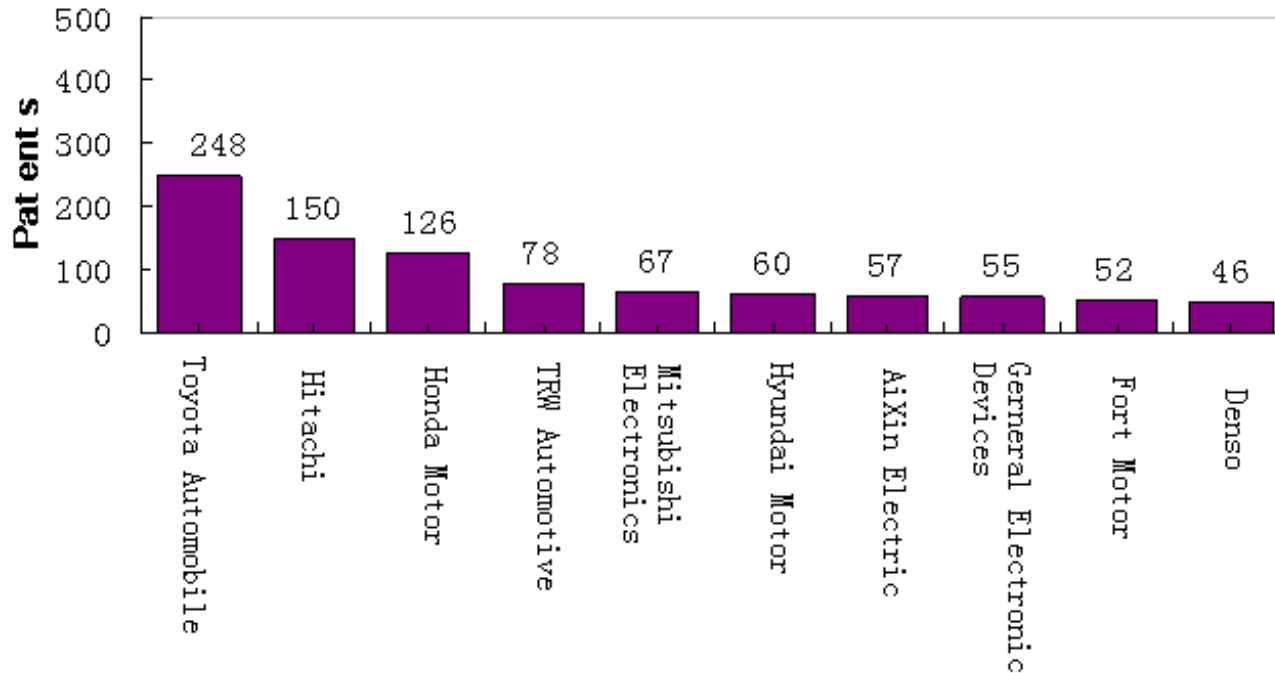
The Traction Motor patents held by top 10 companies in the world
The study of patent assignees revealed that in the top 10 companies, 7 companies were Japanese.

Part of Analysis Results of Electric Vehicle Studies –4



The Motor Control patents held by top 10 companies in the world
In the top 10 companies, 7 companies were Japanese.

Analysis Results of Electric Vehicle Studies –4



The Vehicle Control Unit patents held by top 10 companies in the world
In the top 10 companies, 6 companies were Japanese, 3 were US, 1 was Korean.

Conclusion for Electric Vehicle Technology

- From 1990s, the number of Electric Vehicle Technology patent has exhibited rapid increase.
- Except for Motor Control, other technology including Battery, BMS, Traction Motor and vehicle control technology are at growing stage.
- From the perspective of electric vehicle technology patents, the top ten countries are Japan, US, EU, China, Germany, Korea, France, UK, Canada and Australia. Japan obviously took the leading position.
- In the top 10 companies, most companies are from Japan.

Thanks for your attention!

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