

Fuel Cell Technology Innovation Trend Analysis Based on Patent Map

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Abstract: This paper analyses the international fuel cell technology innovation trends nearly 10 years with the method of patent map, and visualizes the international trend of fuel cell technology innovation, the main innovation countries distribution, main institutions and the technology layout. The research result can provides effective intelligence supports for the strategic decision of government, as well as the technology research of enterprises and looking for partners.

1 INTRODUCTION

Under the background of the global petrochemical resources depleting and the ecological environment worsening, energy and environmental protection have been becoming the main two questions hindering the economic developing sustainably, looking for alternative energies becoming the world's key methods to solve energy and environmental problems. Fuel Cell is a kind of power generation device which turns chemical energy exists in the fuel and oxidant into electrical energy directly. Because the character of safety, environmental protection, high energy conversion efficiency and low noise, fuel cell becomes the key technology to research and development of the national energy strategy.

Patent is the important symbol of technology marketization and industrialization, and it also is the important basis of enterprise technology innovation and guides to imitate innovation.(Guo Jieting, Xiao Guohua 2008; Huang Lei and Zhang Lu 2015; Shi Xingguang and Lu Ping 2003) The paper analyses the international fuel cell technology information through the perspective of patent information, and it accurately shows the international trend of technology innovation, and provides reference for domestic enterprise technology innovation.

2 DATA SOURCES AND ANALYSIS

The research patent data searched from Derwent Innovation patent database, and the patent search strategy is compiled by combining the key words, IPC classification number, and the manual code, and obtained the international fuel cell 64548 patents from 2006 to 2016. Then the patent has been processed normally by using the data analysis software TDA of Thomson Corporation. Then the patent data was visualized analysis by using the method of patent measuring and patent map.

3 TECHNOLOGY INNOVATION PROCESS ANALYSE

3.1 Technological Innovation Trends

Figure1 is the patent development trend of the international fuel cell technology nearly ten years, it shows that the global fuel cell technology patent application and publication declines since 2006 after experiencing the rapid development, although there was a short rebound trend from 2012 to 2013, but the overall trend shows down.

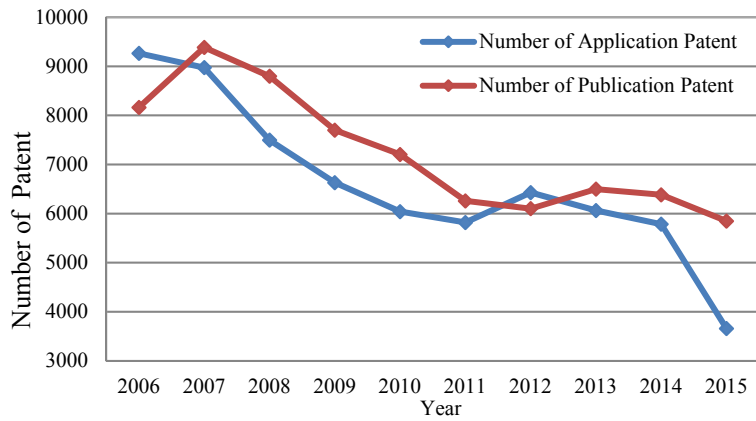


Figure 1. Fuel cell patent application and publication trend

3.2 Patent Technology Life Cycle

Patent technology life cycle is divided into bud, development, maturity and decline four stages, patent information analysis of specific technology can show the development stage and trend of the technology. (Liu Binqiang and Jiang Yude 2011; Li

Chunyan 2012) Figure2 is the fuel cell technology life cycle, it shows that the global fuel cell application number and the applicant number is declining since 2006. But each year the patent application number is still at a certain level, expect the technical breakthrough in this field.

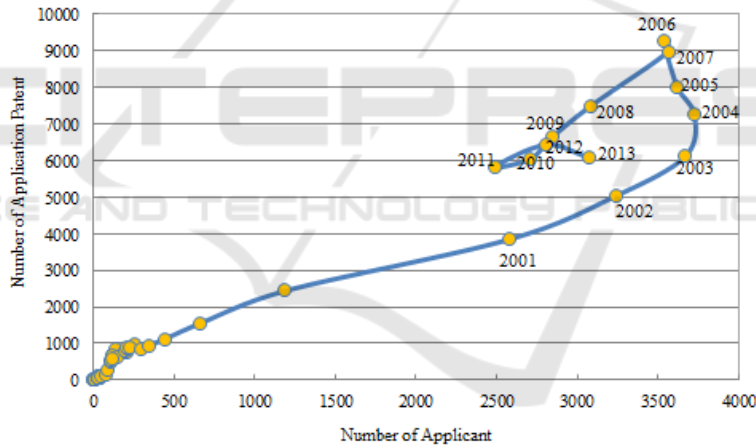


Figure 2. Fuel cell patent life cycle

4 SUBDIVISION TECHNOLOGY ANALYSIS

4.1 Subdivision Technology Layout

Fuel cells can be divided into the Proton Exchange Membrane Fuel Cell (PEMFC), Solid Oxide Fuel Cell (SOFC), Direct Methanol Fuel Cell (DMFC),

Molten Carbonate Fuel Cell (MCFC), Phosphoric Acid Fuel Cell (PAFC), Alkaline Fuel Cell (AFC) according to the different electrolyte and fuel (HouMing and Yi Baolian 2012). Figure3 is the patent application number of six type fuel cells, it shows that the patent number of PEMFC and SOFC is significantly higher than other types of fuel cells.

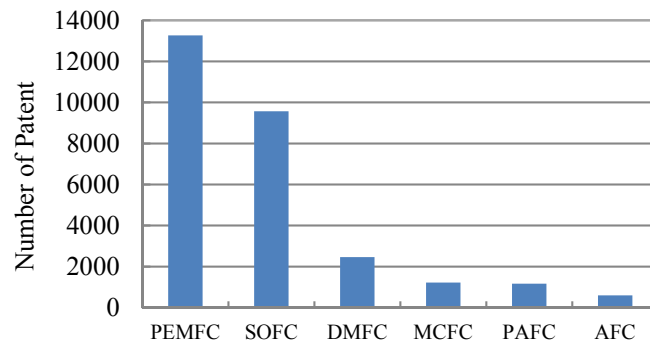


Figure 3. Fuel cell subdivision technology layout

5 MAJOR TECHNOLOGY INNOVATION COUNTRIES ANALYSIS

5.1 Major Patent Country

Figure4 is the patent priority countries of fuel cells since the year 2006, which shows that the number of patents of Japan is far higher than other countries, and the technology innovation advantage is obvious. The patent application of China ranks second. The United States, Korea and Germany rank third, fourth and fifth respectively.

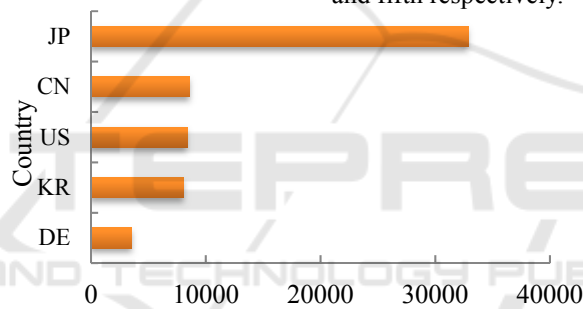


Figure 4. Major patent countries

5.2 Technology Layout of Major Countries

Figure5 is the layout of main countries in subdivision technology of fuel cells, it shows that all the countries layout patents in all subdivision

technologies, and all the countries' technology research focus on the SOFC and PEMFC technology. The patent layout proportion in the field of PAFC of China is higher than other countries. Korea pays more attention to MCFC technology than other countries.

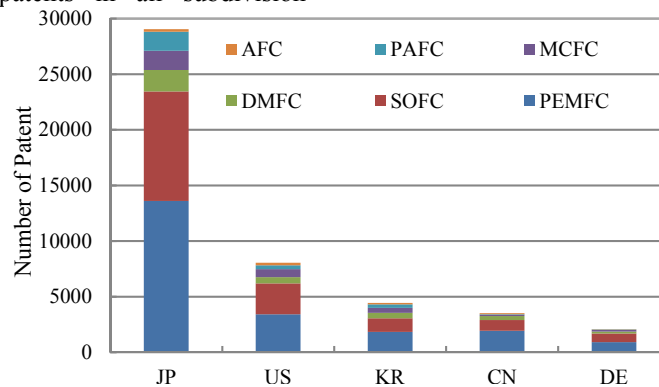


Figure 5. Technology layout of major patent countries

6 MAJOR TECHNOLOGY INNOVATION ORGANIZATION ANALYSIS

6.1 Major Organizations Distribution

Figure6 is the international top 10 patentees of fuel cells since the year 2006, it shows that automakers

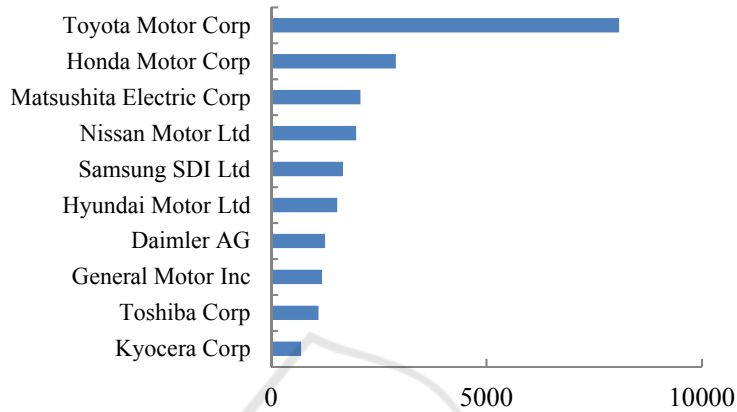


Figure 6. Major patentees distribution

6.2 Major Organization Competitiveness Analysis

Figure7 is the comprehensive competitiveness of top10 patentees, which is shaped using Innography patent analysis model, abscissa represents the

are still the main innovation bodies, six of the top 10 patentees are automakers. There are six Japanese enterprises, two Korean enterprises, one American enterprise and one Germany enterprise among the top 10 patentees. The number of patent of Toyota motor corp. is higher than other companies significantly, and occupies the leading position.

enterprise technical strength, ordinate reflect enterprise resources, including operating income, patent infringement case and the inventors area. It shows that the comprehensive competitiveness of Toyota Motor Corp. is far above other organizations.

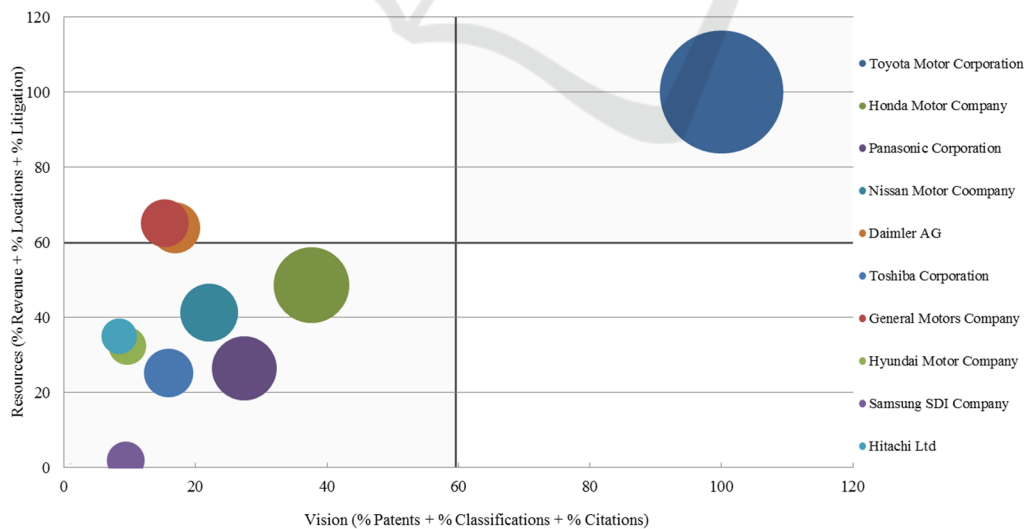


Figure 7. Major patentee competitiveness

7 CONCLUSIONS

The fuel cell technology research since 2006 presents the following features.

(1) The number of patent application and publication all showed a trend of decline since 2006.

(2) The number of PEMFC patent and SOFC patent are much higher than other fuel cells. The patent application of PEMFC, DMFC, MCFC and PAFC continue to fall since 2006, and the AFC patent and SOFC patent application rose slightly after the year 2011, but the pace is slow.

(3) The patent application of Japan, China, the United States, Korea and Germany rank the top five in the world. The patent application of four oversea countries is on the decline. Unlike the four oversea countries, the patent application has been on the rise in China Since 2006.

(4) Automakers are still the main innovation body of fuel cell technology, there are six automakers among the top10 patentees. The comprehensive competitiveness of Toyota Motor Corporation is much higher than other companies.

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