Patent Map for Emerging Technologies: A Case of Solar Cells Technology

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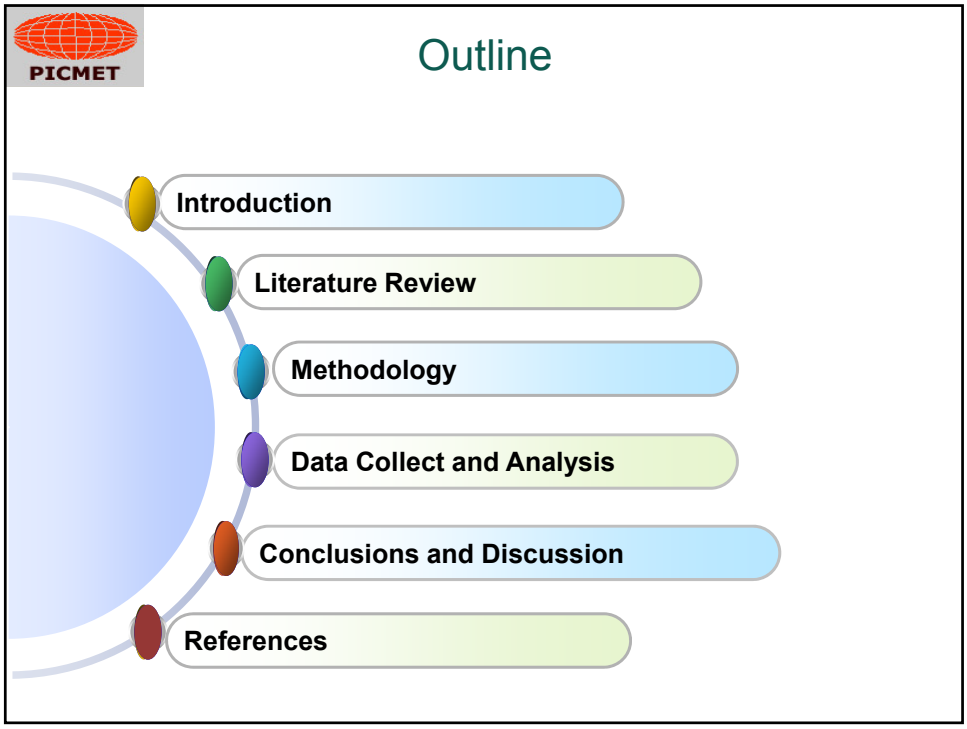
Abstract

In recent years, emerging technologies have been attracting increasing attention worldwide, due to the emergence of these emerging technologies may have a profound influence on the global industrial and economic structure. How to identify and grasp the opportunity to develop emerging technologies is an important issue for companies, enterprises, and governments. This paper, therefore, proposes a framework that integrates patent map with experts' intelligence, attempts to identify emerging technologies, map the development of the emerging technologies, and find China's status in the emerging technologies domain. The solar cells technology is selected as a case study. This paper will contribute to the emerging technology studies, and will be of interest to solar cells researchers, business managers, and policy makers.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Outline
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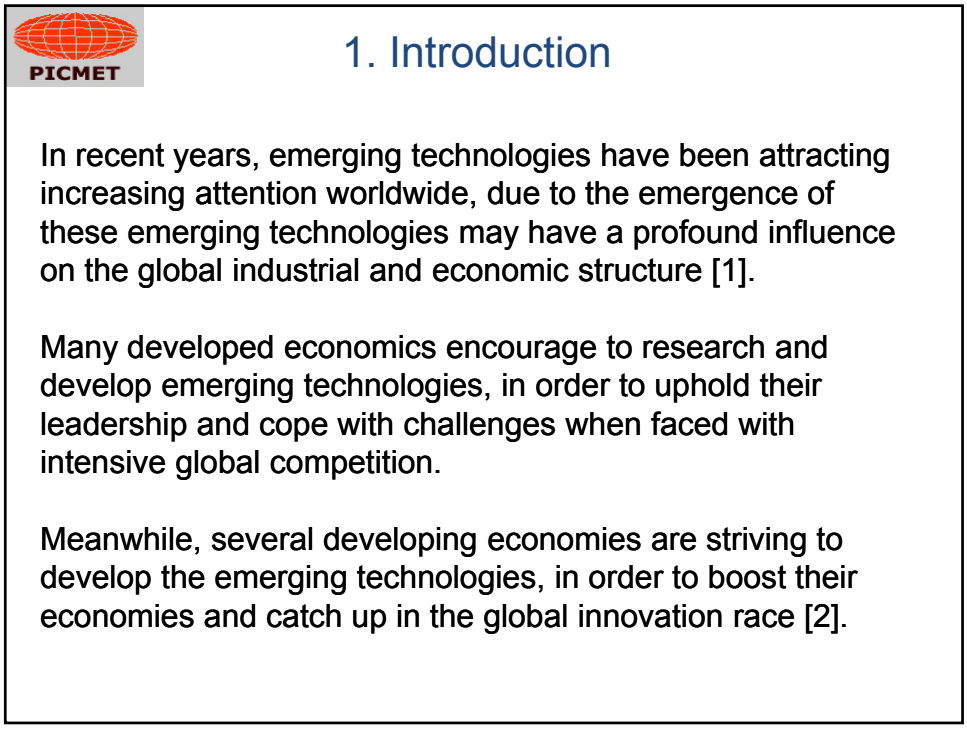
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1. Introduction
In recent years, emerging technologies have been attracting increasing attention worldwide, due to the emergence of these emerging technologies may have a profound influence on the global industrial and economic structure [1].
Many developed economics encourage to research and develop emerging technologies, in order to uphold their leadership and cope with challenges when faced with intensive global competition.
Meanwhile, several developing economies are striving to develop the emerging technologies, in order to boost their economies and catch up in the global innovation race [2].

1. Introduction

It becomes a strategic concern for all nations to identify and grasp the opportunity to develop emerging technologies, which will ultimately contribute to their international competitiveness and sustainable development.

In these circumstances, how to identify and grasp the opportunity to develop emerging technologies is an important issue for companies, enterprises, and governments [3].

In response to these questions, this paper attempts to develop a framework for identifying emerging technologies and mapping the development of the emerging technologies by combining patent analysis and experts' intelligence.

2. Literature review

Patent information contains enormous and rich technical items, and it is a useful indication for the technological development strategies or global strategies of individual enterprises in response to intensifying competition [4].

Patent analysis is an objective method to identify the trends of technological development by analyzing patent information [5].

Patent analysis has been widely applied by enterprises and governments to avoid unnecessary investment and gain the seeds for technological development [6]. Many patent analysis methods have been developed [7-12]. Patent analysis has also been applied to forecast emerging technologies [5, 6, 13].

2. Literature review

Patent map is the visualized expression of the patent analysis results to identify current status of patent development and understand patent information easily and effectively [6]. And it is produced by gathering, processing, and analyzing patent documents of a target technology domain. One of patent maps is ThemeScape map which can be created by Thomson Innovation [14].

This paper will apply patent map including ThemeScape map to map the development of the emerging technologies.

3. Methodology

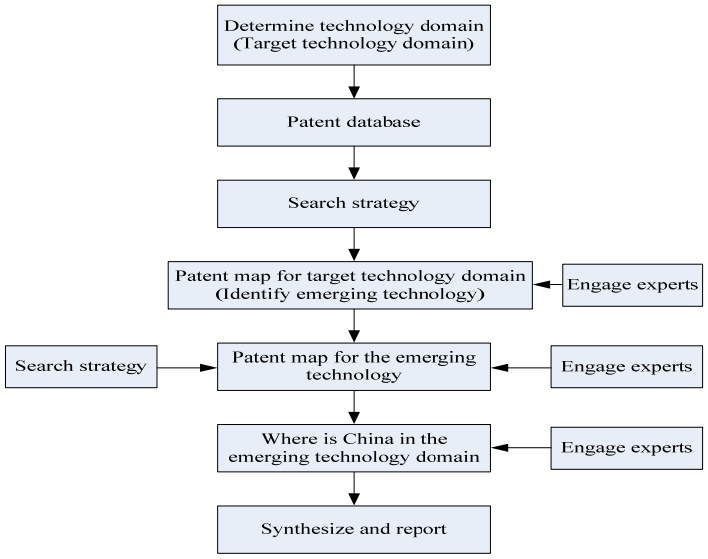

Fig.1 The framework of patent map for emerging technologies

4. Case study

(1)Data collect

a. Patent map for solar cells—identify emerging technology

Database: Derwent World Patent Index and Patents Citation Index

Search strategy :

ABD=(solar* ADJ cells* or solar* ADJ cell*) AND IC=(F21 OR B62 OR H01 OR H02)

Retrieve time: April 29, 2014.

b. Patent map for the emerging technology—

dye-sensitized solar cells

Database: Derwent World Patent Index and Patents Citation Index

Search strategy :

ABD=(solar* ADJ cells* or solar* ADJ cell*) AND IC=(F21 OR B62 OR H01 OR H02) AND (MC=((X15-A02D1) or (U12-A02A8) or (L03-E05B1))

Retrieve time: April 30, 2014.

c. Analysis tools: Thomson Data Analyzer, Thomson Innovation

4. Case study

(2)Results and analysis

a. Identify emerging technology

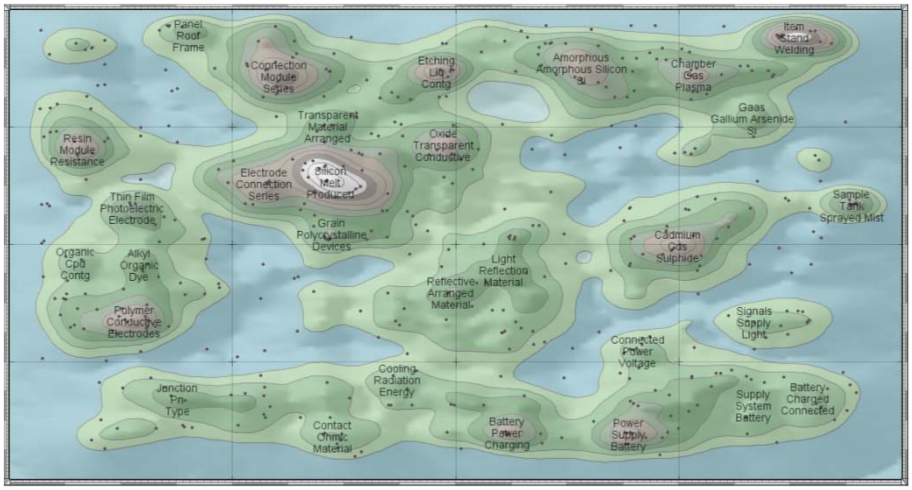

Fig.2 Patent map for solar cells technology from 1976 to 2000

4. Case study

(2)Results and analysis

a. Identify emerging technology

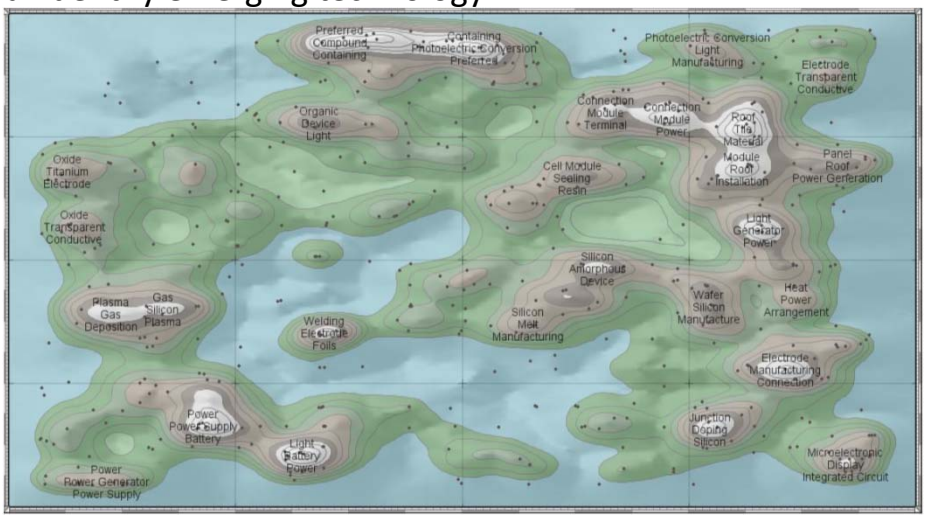

Fig.3 Patent map for solar cells technology from 1976 to 2005

4. Case study

(2)Results and analysis

a. Identify emerging technology

Emergence

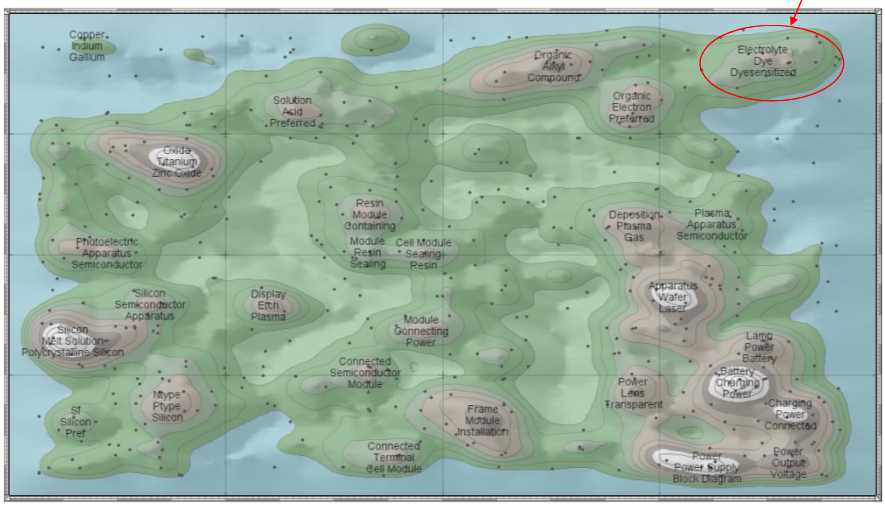

Fig.4 Patent map for solar cells technology from 1976 to 2010

4. Case study

(2)Results and analysis

a. Identify emerging technology

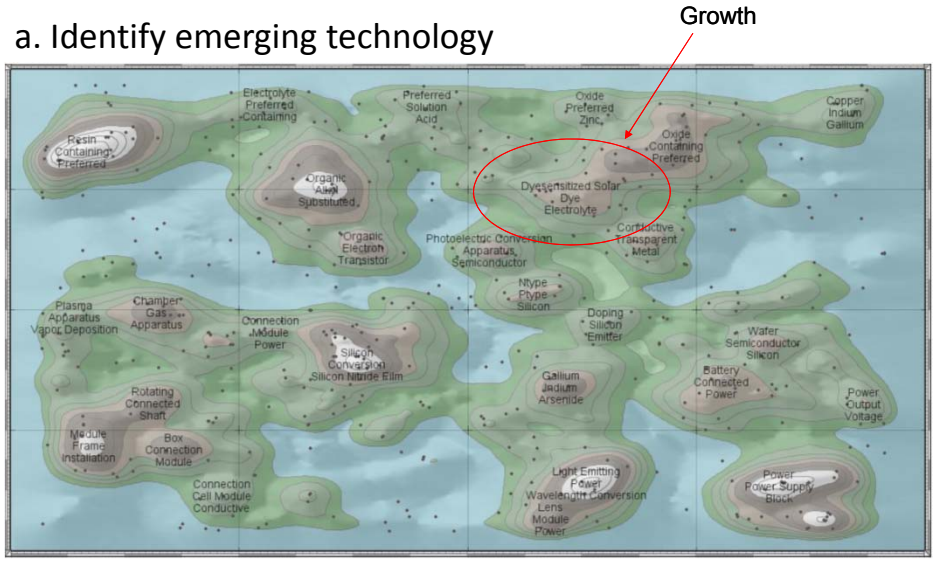

Fig. 5 Patent map for solar cells technology from 1976 to 2013

4. Case study

(2)Results and analysis

a. Identify emerging technology

- As can be seen from Fig.2, Fig.3 , Fig.4 , Fig.5, and combining with experts' opinions, we conclude that dye-sensitized solar cells (DSSC) is one emerging technology among solar cells technology domain in recent years.
- How to know the technology terms of this emerging technology? (how to patent map for the emerging technology?)
- Where is China in this emerging technology domain?

4. Case study

(2)Results and analysis

b. Patent map for the emerging technology

The technology terms related on DSSC is shown in Fig. 6.

Fig. 6 Patent map for the emerging technology--DSSC

4. Case study

(2)Results and analysis

b. Patent map for the emerging technology

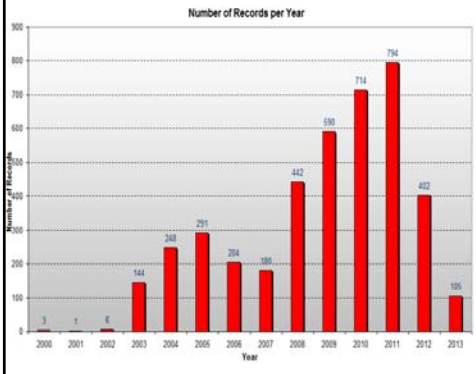

Fig. 7. Annual number of patents related to dye-sensitized solar cells

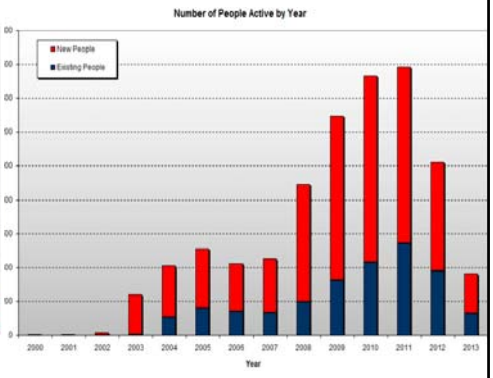

Fig. 8. Annual number of people active related to dye-sensitized solar cells.

As can be seen from Fig.7, the number of patents on dye-sensitized solar cells increased constantly since 2007.

As can be seen on Fig.8, many new researchers have studied dye-sensitized solar cells.

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4. Case study

(2)Results and analysis

c. Where is China in the emerging technology domain

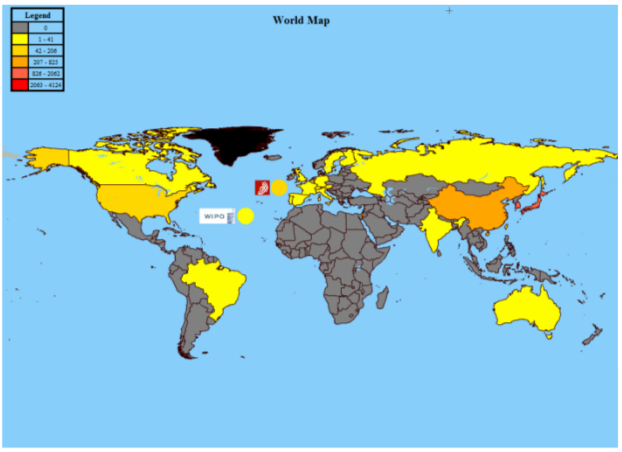

Fig. 9 World patent map for the emerging technology—DSSC (the number of patents in different countries)

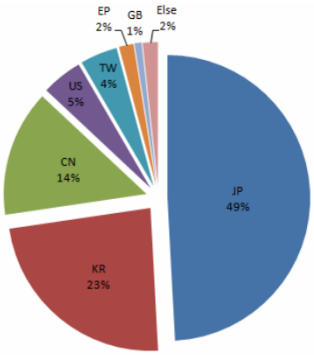

Fig. 10. The percent of patent numbers related to dye-sensitized solar cells by country.

As can be seen from Fig. 9, Fig. 10, the number of patents related to DSSC mainly applied by Japan, Korea, China, US, and Taiwan.

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4. Case study

(2)Results and analysis

c. Where is China in the emerging technology domain

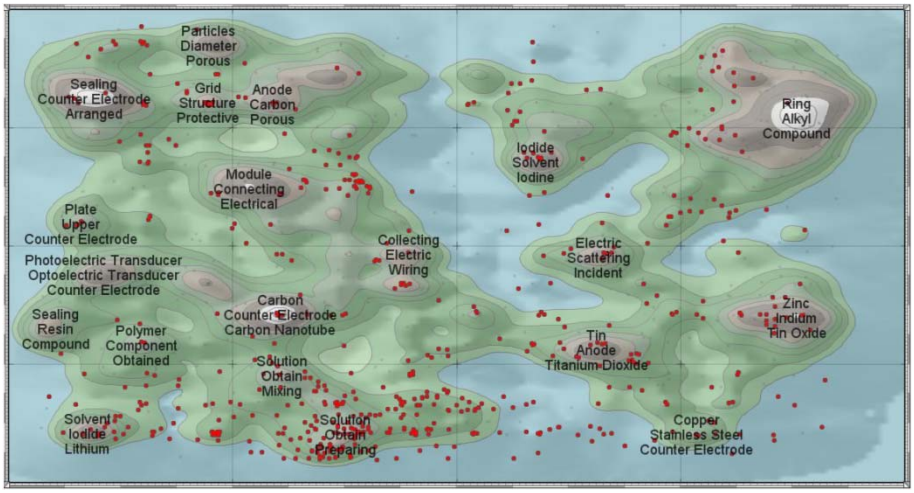

Fig. 11 Patent map for DSSC and China's focus (red color showing China's patents)

4. Case study

(2)Results and analysis

c. Where is China in the emerging technology domain

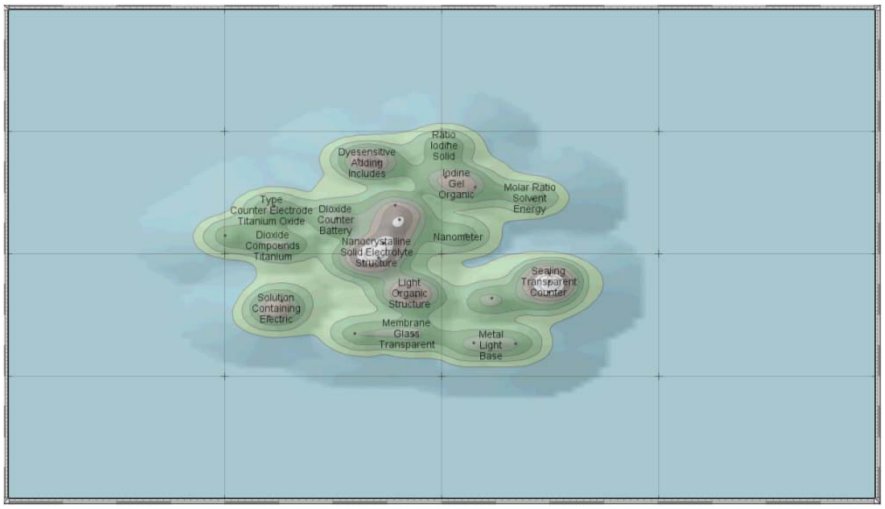

Fig. 12 Patent map for China's DSSC from 2004 to 2007

4. Case study

(2)Results and analysis

c. Where is China in the emerging technology domain

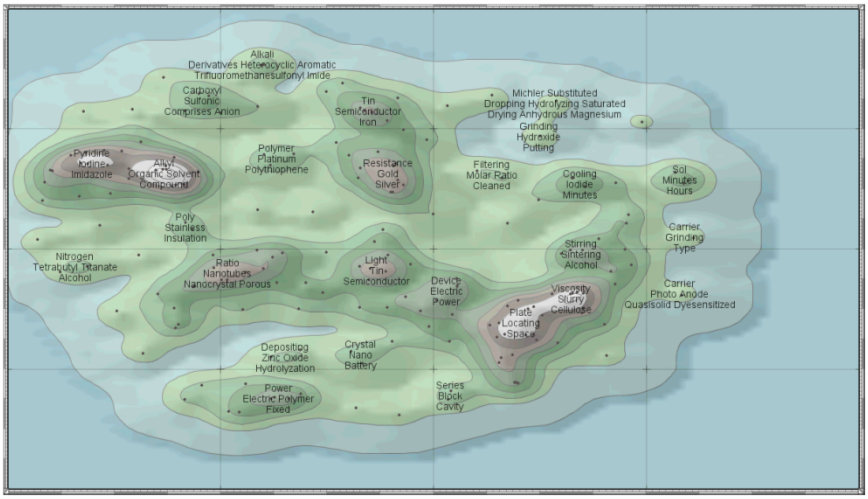

Fig. 13 Patent map for China's DSSC from 2004 to 2010

4. Case study

(2)Results and analysis

c. Where is China in the emerging technology domain

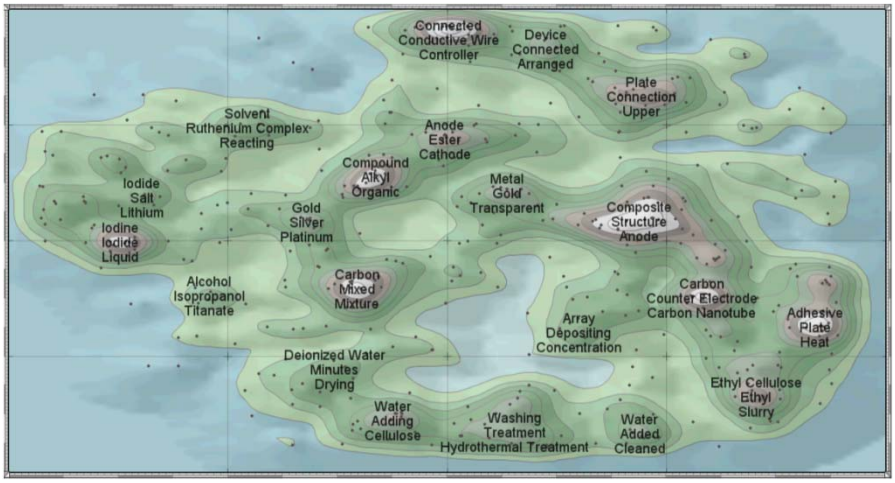

Fig. 14 Patent map for China's DSSC from 2004 to 2013

4. Case study

(2)Results and analysis

c. Where is China in the emerging technology domain

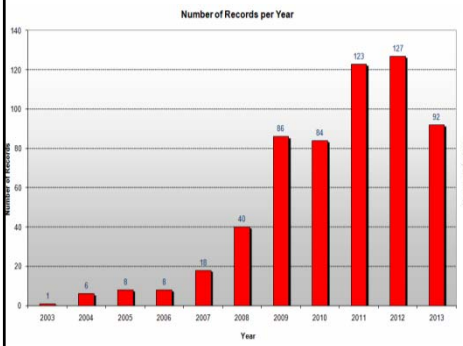

Fig. 15. Annual number of China's patents related to dye-sensitized solar cells

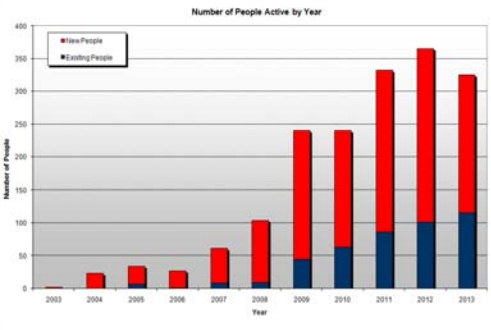

Fig. 16. Annual number of Chinese people active related to dye-sensitized solar cells.

4. Case study

(2)Results and analysis

c. Where is China in the emerging technology domain

- As can be seen from Fig.15, the number of China's annual patents on dye-sensitized solar cells increased constantly since 2003.
- As can be seen from Fig.16, many new researchers in China have studied dye-sensitized solar cells technology.
- Besides, Fig.13 and Fig.14 indicate that large numbers of new technology terms appeared in China after 2010.
- These show that the research and development field of dye-sensitized solar cells in China has been very active in recent years.

5. Conclusions and Discussion

•This paper proposes a framework that integrates patent map with experts' intelligence, attempts to identify emerging technologies, map the development of the emerging technologies, and find China's status in the emerging technologies domain.

•The solar cells technology was employed as a case study, through which the proposed framework has been proven to be valid and flexible.

•Some key findings and contributions are listed as follows:

(1)The framework provides a tool for identifying and mapping emerging technologies.

5. Conclusions and Discussion

(2) Dye-sensitized solar cells is one emerging technology among solar cells technology domain in recent years.

(3)The research and development on dye-sensitized solar cells technology has been very active in recent years, and also in China.

- The results of this paper could be interesting to technology experts, business managers, and policy makers. And this paper could shed light on the emerging technology studies and relevant policy analysis.

Acknowledgement

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6. References

[1] Rifkin, J.; "The Third Industrial Revolution: How Lateral Power is Transforming Energy, the Economy, and the World," New York: Palgrave Macmillan, 2011.
[2] CIEDS, "A report on the development of Chinese strategic emerging industries (Chinese)," Chinese Institute for Engineering Development Strategies, Science China Press, Beijing, 2013.
[3] Huang, L., Li, X., Lu, W.; "Research on Emerging Technology Selection and Assessment by Technology Foresight and Fuzzy Consistent Matrix," Foresight, Vol. 2, pp. 77 – 89, 2010.
[4] Japan Institute of Invention and Innovation, "Introduction to patent map analysis", 2011.
[5] Jun, S., Lee, S. J.; "Emerging technology forecasting using new patent information analysis," International Journal of Software Engineering and Its Applications, Vol. 6, pp. 107-114, 2012.
[6] Kim, Y. G., Suh, J. H., Park., S. C.; "Visualization of patent analysis for emerging technology," Expert Systems with Applications, Vol. 34, pp. 1804-1812, 2008.
[7] Lee, S., Lee,S., Seol, H., Park,Y.; "Using patent information for designing new product and technology: keyword based technology roadmapping," R&D Management, Vol. 38, pp. 169-188, 2008.
[8] Yoon, B., Park,Y.; "A text-mining-based patent network: analytical tool for high-technology trend," The Journal of High Technology Management Research, Vol. 15, pp. 37–50, 2004.
[9] Yoon, J., Kim, K.; "TrendPerceptor: A property-function based technology intelligence system for identifying technology trends from patents," Expert Systems with Applications, Vol. 39, pp. 2927–2938, 2012.
[10] Lee, S., Toon, B., Park, Y.; "An approach to discovering new technology opportunities: Keywords-based patent map approach," Technovation, Vol. 29, pp. 481-497, 2009.
[11] Chang, P. L, Wu C. C, Leu H. J.; "Using patent analyses to monitor the technological trends in an emerging field of technology: a case of carbon nanotube field emission display," Scientometrics, Vol. 82, pp. 5-19, 2010.
[12] Yoon J, Park H, Kim K.; "Identifying technological competition trends for R&D planning using dynamic patent maps: SAO-based content analysis," Scientometrics, Vol. 94, pp. 313-331, 2013.
[13] Daim, T. U., Rueda, G., Martin, H., Gerdsri, P.; "Forecasting emerging technologies: Use of bibliometrics and patent analysis," Technological Forecasting and Social Change, Vol. 73, pp. 981-1012, 2006.
[14] Thomson Innovation, "ThemeScape" Retried 3-26-2014 World Wide Web, http://www.thomsoninnovation.com/tip-innovation/support/help/themescape.htm.