

Bibliometric analysis on scientific productivity of NIMTE, CAS

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Abstract—The methods of bibliometric analysis and knowledge mapping were used to investigate the scientific productivity of Ningbo Institute of Material Technology & Engineering based on the SCI, EI, ISTP articles as well as patents application from been found in Chinese Academy of Sciences. The papers number, co-authors, subjects, clusters, collaboration, cited authors, co-words and time cited were analyzed respectively on the published papers and applied patents. The knowledge map and bibliometric analysis results make out that this new established institute achieved great academic successes on materials research, and at the same time they kept ahead in five fields of materials science and technology through patents group application.

Keywords- scientific productivity; NIMTE; coauthorship; knowledge mapping; bibliometrics analysis.

I. INTRODUCTION

Materials science is one of the three most important fundamental disciplines which deals with fundamental properties and characteristics of materials (Callister WD 2003). And material scientists investigate the relationship between the structure of materials at atomic or molecular scales and their macroscopic properties which incorporates elements of applied physics and chemistry (Bhadresh H.K.D.H 1999). In recent years, as the term of nanotechnology approaching every one of us, materials science has been propelled to the forefront so the first institute of material science and engineering of Chinese Academy of Sciences (CAS) was found in Ningbo at 2006 to pull off the material research of China. The Ningbo Institute of Material Technology and Engineering (NIMTE) carry out extensive research and commercial activities in the novel material discovery and manufacture. As time went by, the scientific productivity of NIMTE have grown much bigger from been established. So this article made the bibliometric analysis and knowledge map on scientific productivity of NIMTE in order to observe its scientific development in the research field of materials.

In recent years, bibliometrics has been used as a method to analyze the distribution and characteristics of publications using mathematics and statistical methods making a quantitative analysis. Bibliometrics is a quantitative treatment of the properties of recorded disburse and behavior appertaining (Schneider JW 2004). As scientists in material science have too many choices of journals to read and refer; therefore, the evaluation of the performance of each journal was deemed necessary to indicate the impact and

contribution of each one in its research field. One common way of conducting bibliometric research is to use the Web of Science (WOS) database to analyze their citing and cited relations. And China intellectual properties database as well as its analysis software of patents helps us to get the relations among patents of NIMTE.

In this study, the main data source of analysis was derived from the WOS (including SCI & ISTP) database of the Institute for Scientific Information (ISI, Philadelphia, PA, USA) and Engineering Village (EI) database. The retrieve word was the name of the institute, the retrieve time period starts from 2006 to 2010 and the retrieve time is September 1st, 2010. The total effective number of the thesis involved is 428. For the patent documents, Thomson Data Analyzer (TDA) was also used to data mining and analysis.

II. DATA AND METHODS

This study is based on the analysis of the articles form of scientific productivity of NIMTE, CAS. The statistic analysis tool is TDA and the visualization tool knowledge mapping. Other analysis was performed by MS Office Excel 2007.

A. Data Retrieved

The data source came from WOS and EI, and the publish time span is from 2006 to 2010, updating in July 30, 2010. Data in this study was required on Sept 1st, 2010 using the Address= “Ningbo Inst Mat Technol & Engn” selecting “all the years”. Totally 231 articles are got from the database as SCI-Expand and 27 articles as ISTP, which called Conference Proceedings Citation Index-Science (CPCI-S) now. For EI part, we turned to expert search of EI-compendex database using author affiliation retriever in all forms of NIMTE stored in Engineering Village Database and got 169 articles at last. Because of the limitation of the retrieval time, the data in 2010 is partial.

The number of the papers of NIMTE covered by three major retrieval systems grown smoothly (only ISTP decreased in 2009). The average thesis growth rate of SCI was higher than that of EI, suggesting that the most researchers tended to submit their thesis to the journals covered by SCI and it is likely they paid more attention on basic than engineering research.

Figure 1 shows the number of SCI & ISTP articles acquired from WOS database and EI papers during the period of 2006 to 2010. The total number of WOS articles from 2006 to 2009 is 428. From been established, the number of articles increased obviously and the average increase rate is about 93% from the year 2006 to 2009.

III. RESULT ANALYSIS

A. Papers analysis

Usually, more than one research field was held in most institutes majoring in science & technology all over the world. NIMTE have six business units such as polymers and composites, magnetic materials and advanced devices, surface engineering & remanufacturing, functional materials and nanodevices, fuel cell & energy technology and fibers.

From figure 3 we can conclude that most published papers concentrated on materials, physics and chemistry science of common subject catalogue. That is because most NIMTE researchers' education background involved in the above branch of learning so they are more familiar with them.

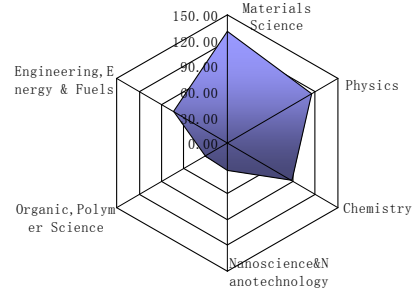


Figure 3. Distribution of the Research Subjects

International cooperation is an important component of S&T research activities and it has played an important role in promoting S&T advancement of an institute (Jesper W.S 2004). International cooperation is instrumental for research program to get timely information about the material technology development trend in the world.

NIMTE has paid much attention to communicate with international fellows and have already achieved great successes. NIMTE involved in diverse international activities, such as cooperation with U.S.A, Japan and Australia organizations. Actively communicating with world-famous institutes helps NIMTE expanding its S&T influence in the world. Figure 4 was come from the NIMTE homepage showing their contact with the outside research organizations.



Figure 4. Cooperation between NIMTE and the Outside Organizations

From figure 5, through SCI article co-authorship we can also find that the authors from NIMTE have frequent connection with the top research organizations in turn from USA, Japan and Australia etc. This kind of collaboration led demotic research in CAS catching up with the world research level rapidly and will exceed them soon.

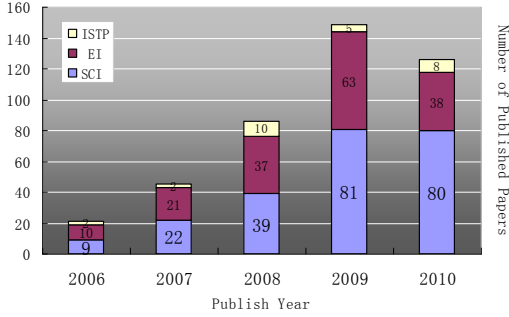


Figure 1. Number of Articles during the period 2006-2010

The patents date was collected from China intellectual properties net using the CNIPR software to analyze. The retrieve word was designed as applicants = Ningbo Institute of Material Technology and Engineering in Chinese form. Totally 123 patents were got from the patents database of State Intellectual Property Office of the P.R.C among the year 2005 to 2010.

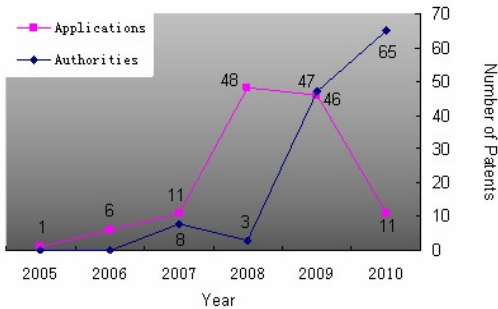


Figure 2. Number of Patents during the period 2005 to 2010

NIMTE seeks to realize its industrialization of scientific and technological achievements by its authorized patents. So the specialists in materials research and engineering devoted themselves to diverse needs of industry ranging from research and development programs. It can be seen from figure 2 that the patents application increased sharply after 2007 and the authorized patents also rose greatly after 2008. Nearly 50 patents were applied or authorized recently.

B. Bibliometric analysis methods

In the Bibliometrics study, the subjects, collaboration, time cited, co-words, cluster analysis of the papers and patents were deeply examined. It is called co-author when multi-writers appeared simultaneously in one paper, this reflects the collaboration between research institutes in different regions or countries (Courtial J.P 1994). The higher the strength of it, the closer relationship is among them. Co-words means the phenomenon that two or more words occur simultaneously in one article or the field of keywords, the times of which is called the frequency or strength of co-words (Kathleen F 2002). In this study, co-author and co-word analysis were used to analyze the collaboration between NIMTE and other research organizations.

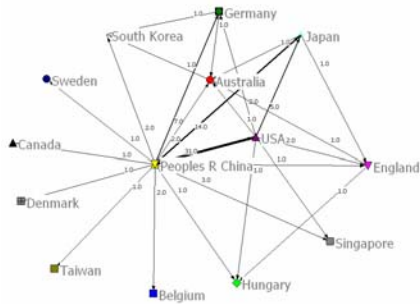


Figure 5. Collaboration frequency and relationship map

The dates in table I showed that which famous experts were being followed and cited by NIMTE authors, For example, INOUE A who came from Kyushu University in Japan, is one of the authorities been cited by many scientists in magnetic material research of the material field.

TABLE I. AUTHORS CITED BY NIMTE ARTICLES

SCI Cited Authors	Time	ISTP Cited Authors	Time
INOUE A	37	INOUE A	18
KRESSE G	31	SHEN BL	5
LI Y	30	YU XZ	5
ZHANG ZF	29	BITOH T	4
CHEN L	22	POON SJ	4
WANG XP	21	IMAFUKU M	4
LI YW	18	PONNAMBALAM V	4
PERDEW JP	17	TAKENAKA T	4
WANG J	17	CHINH NQ	4
LI RW	14	IWAHASHI Y	4
SAKAI Y	14	XU C	4
ZHOU CG	13	LU ZP	3
GEORGES S	13	HADJIPANAYIS GC	3
LIU JJ	13	HU FX	3
FUJIEDA S	12	LI HX	3
ZHANG HW	12	YAN A	3
BLOCH PE	11	ZHANG HW	3
WEN WJ	11	CHEN X	3
DELLEY B	10	CHEN ZM	3
HU FX	10	CHENG YC	3
MARREROLOPEZ D	10	KRESSE G	3

There are 231 SCI articles published from 2006 to 2010, among which many thesis were cited by other papers. A pie picture was made after mathematical statistics, showing in figure 6 that 1 to 5 time cited articles take part in 37%, 6 to 10 is 3%, 11 to 15 is 3%. It is significant that the most cited article was cited 35 times, which published in LANGMUIR, 23 (19): 9802-9807 on SEP 11 2007, and this advanced work is mainly involve in silver hierarchical bowl-like array.

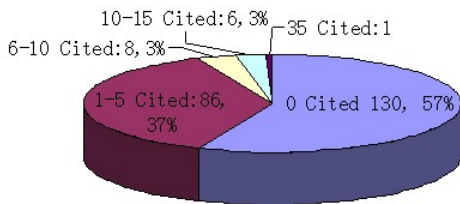


Figure 6. Number of SCI Articles Time Cited

Some experts of NIMTE published excellence work on SCI covered journals for many times since joining in the institute. Others published their papers in the journals included in EI, as they concern more about engineering problems in their research work.

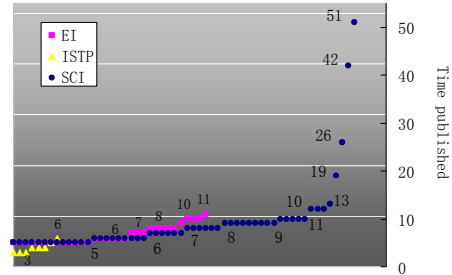


Figure 7. Number of Articles in SCI, ISTP, EI by NIMTE researchers

It can be seen that more than one scientist published over 20 SCI articles and over 10 EI articles from figure 7, which showed that some scholars' achievements were so fruitful and NIMTE attracts some hardworking leading experts since been established.

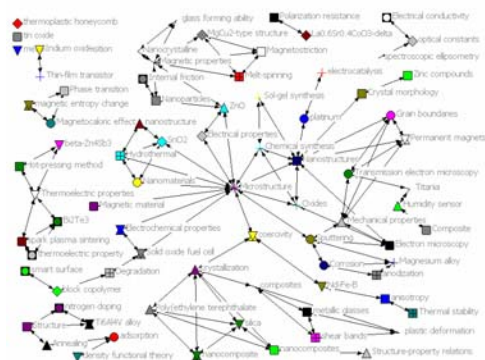


Figure 8. Clusters and Co-words Map of SCI Articles

Keywords are the main subject of one research paper concentrate on, and through which one could clearly understand the topic or main idea of the publications (Courtial J.P). By this kind of analysis it can be found that NIMTE dwelled on the microstructure & nanostructure materials these years, the ZnO and magnetic material (co-word: coercivity) will be likely to become the next hotspots the NIMTE scientists concentrate on.

B. Patents analysis

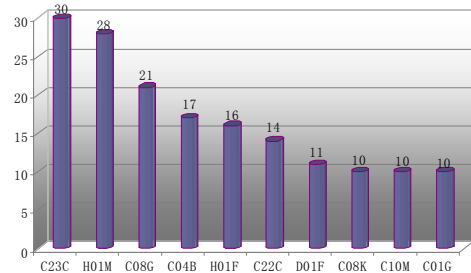


Figure 9. Distribution of the Research Subjects

Patents can reflect the timely scientific progress of a research organization, and authorized patents are more likely going into the business application. So the quantity of patent applied in certain technology filed proofs its scientific power and influence in the related research work.

From figure 9, it can be seen that the patent mainly concentrates in exploring the technology on “class C: Chemistry, Metallurgy” and “class H: Electricity” in international patent classification. The research field owning most patent distributed on coating technology (C23C), cell preparation (H01M) and organic polymer (C08G).

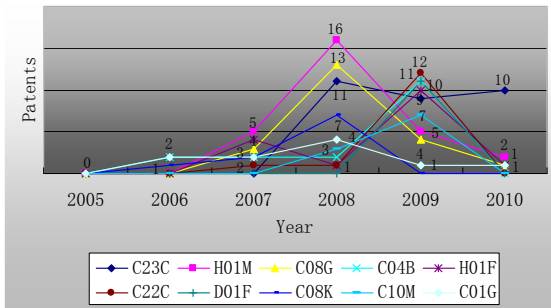


Figure 10. Distribution of Number of Patents during the period 2005-2010

Most patents of NIMTE were Exclusive Patents, which account for 94.7%, while only 5.3% of the patents were cooperated with its partners, which can be seen in table II.

TABLE II. PANTENTS APPLICATION AND ITS COLLABORATION

Applicants	Exclusive Patents	Coauth or Patents	Cooperated Organization	Main organizations & times	
				Copartner	Times
Ningbo Institute of Material Technology and Engineering C.A.S	126	7	4	HKH National Engineering research center	8
				Ningbo Jinji Strong Magnetic Material Co., Ltd	2
				Central Iron & Steel Research Institute	2
				Guochuang high-voltage electric apparatus Co., Ltd	1

Top 10 patent applicators were arrowed in figure 11; most of them applied their patents in the year of 2008 and 2009, which illustrated that the core technology of NIMTE developed rapidly in a short period since established.

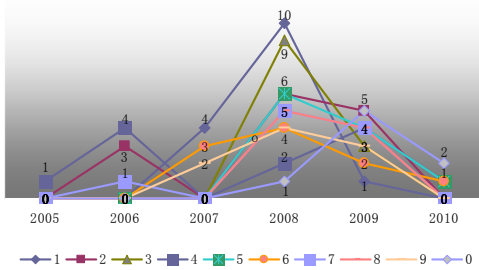


Figure 11. Distribution of Top 10 patents applicators from 2005 to 2010

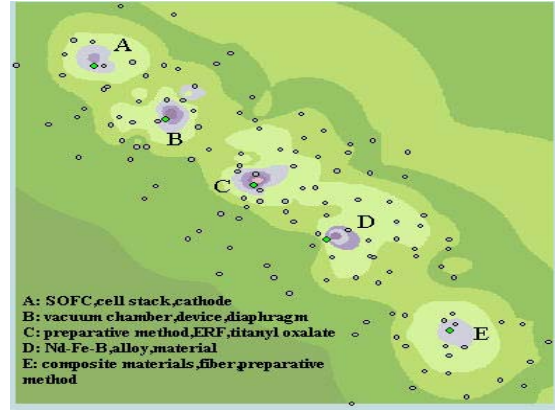


Figure 12. Clusters and Co-words Map of Patents

Clusters or co-words map of patents can show the core competency of an organization. Figure 12 was got from bibliometric analysis on the patents of NIMTE. A to E field (Solid Oxide Soft Cell or its stack & cathode, vacuum chamber or its device & diaphragm, preparative method or titanyl oxalate, Nd-Fe-B and its alloy material, composite materials such as fiber or its preparative method separately) are main technology domain completed by research teams of NIMTE, illustrating that these five fields of research subjects were formed in resent years as core patents technologies.

IV. CONCLUSION

In this paper, the bibliometric analysis and knowledge mapping were applied to research the scientific productivity of SCI, EI, ISTP articles and patents of NIMTE, CAS from 2006 to 2010. The published papers and applied patents grown rapidly during these years and the paper authors took extensively collaboration with many research organizations of the world. Some research subjects such as microstructure or nanostructure lead the main research field of NIMTE. The institute has already formed five patents group in past few years which can be illustrated from the knowledge map and bibliometric analysis results.

REFERENCES

- [1] EI: [http://www.engineeringvillage.com\(2010-9-1\)](http://www.engineeringvillage.com(2010-9-1))
- [2] Callister WD, “Materials Science and Engineering: An Introduction”, New York, 2003
- [3] Bhadesh H. K. D. H., “Neural Networks in Materials Science”, ISIJ International, Vol. 39, No. 10:966-979, 1999
- [4] Schneider, JW; Borlund, P “Introduction to Bibliometrics for Construction and Maintenance of Thesauri Methodical Considerations” J. Docu, 60 (5): 524-549 2004.
- [5] J.P.Courtial, “A Coword Analysis of Scientometrics” Academic Publishers B.V: 1994
- [6] Kathleen F. “Overvie of Knowledge Mapping” S&T Edu Lib, 2002
- [7] Jesper W.S; Pia Borlund, “Introduction to Bibliometrics for Construction and Maintenance of Thesauri”, J Docu Vol 60 No5: 524-549, 2004
- [8] SIPO: [http://www.sipo.gov.cn\(2010-9-1\)](http://www.sipo.gov.cn(2010-9-1))
- [9] Tsay M.Y; Yang Y.H, “Bibliometric Analysis of the Literature of Randomized Controlled trials” J Med Libr Assoc. 2005
- [10] WOS. [http://www.isiknowledge.com/wos\(2010-9-1\)](http://www.isiknowledge.com/wos(2010-9-1))