Indian Journal of Information Sources and Services
ISSN: 2231-6094 (P) Vol.9 No.1, 2019, pp.111-116

DOI: https://doi.org/10.51983/ijiss.2019.9.1.583

Global Publication Productivity in Materials Science Research: A Scientometric Analysis

Thuraiyappah Pratheepan
Uva Wellassa University, Badulla, Sri Lanka
E-Mail: pratheepan12345@gmail.com
(Received 17 January 2019; Accepted 21 February 2019; Available online 28 February 2019)

Abstract - **This paper examines the world research profile and growing trend of publications on Materials Science for fifteen years spanning 2002-2016 based on the data retrieved from ISI Thomson Reuters Web of Science by using various statistical tools and techniques used in the emerging field of Scientometrics. The study uses Science Citation Index of ISI Thomson Reuters Web of Science for the period from 2002 to 2016 (for a period of fifteen years) of top fifteen countries in the field of Materials Science. The indicators used in this study are Relative Growth Rate (RGR), Doubling Time (Dt.), Activity Index (AI), Publication Efficiency Index (PEI), Relative Comparative Advantage for Publication (RCAP). The findings of the study reveal that the percentage share of Materials Science publications of the World is 5.61 out of the total scientific publications of the World; the study indicates that China topped the table with 2,87,736 publications, followed by the USA (2,17,422); there is an exponential growth of publication for the world (R^2 = 0.967) in Materials Science field; the Annual Growth Rate (RGR) is highest for Iran (through it ranked fifteenth in terms of publications), i.e. 27.00; Activity Index is more than one for nine countries which indicates that the research efforts of these countries correspond to the worlds average; It is evident from the study that the USA (1.48), England (1.19), Australia (1.14), Germany (1.09) and France (1.07) have more than one PEI which clearly indicates that there is an impact of publications in Materials Science by these countries is more than the research effort devoted during 2002 to 2016; China topped the list with the highest mean value of Relative Comparative Advantage for Publication (RCAP) i.e. 2.23. RCAP value of China, South Korea, Taiwan, India, Iran, Japan, Russia and France are more than one. The data indicate that these countries are specialised in the field of Materials Science.**
Keywords: **Activity Index, Materials Science, Publication Efficiency Index, Relative Comparative Advantage for Publication, Relative Growth Rate, Scientometrics**

I. INTRODUCTION

Monitoring and evaluating the various facets of the scientific enterprise is a necessary and integral part of the science policy. The developments in the R & D activities presuppose the knowledge of the activities and performance of the innovation system. The developments of new indicators on Science, Technology and Innovation (STI) have grown substantially at the global level during the last two decades.

However, the analysis of data is the most skilled task in the research process. It calls for the researchers' own judgment and skill. Analysis means the critical examination of the assembled and grouped data for studying the characteristics of the subject under study and determining the patterns of relationships among the variables relating to it. Both the quantitative and qualitative methods are used to achieve this. However, the Science research most often requires quantitative analysis involving the application of various statistical techniques. Scientometrics is one of the techniques which is a set of mathematical and statistical methods used to analyze and measure the quantity and quality of books, articles and other forms of publications. It is considered as a recognized exercise to measure the research output in terms of publications. Hence the present study is conducted on the Scientometric analysis of Materials Science research.

Materials Science is an inter disciplinary field involving the properties of matter and its applications to various areas of Science and Engineering. This scientific field investigates the relationship between the structure of Materials at Atomic or Molecular scales and their macroscopic properties. It incorporates elements of applied Physics and Chemistry. In recent years, Materials Science has become a major field of research as it is focused on Nanoscience and Nanotechnology. Materials used in High-Tec applications are usually designed for the maximum performance and normally expensive e.g. Titanium alloys for supersonic airplanes, Magnetic alloys for computer disks, special ceramics for the heat shield of the space shuttle, etc. There is a lot of research conducted worldwide in Materials Science. There is a necessity of quantifying the research conducted in the field of Materials Science by applying various Scientometrics indicators along with newly introduced and practiced indices, indicators.

II. OBJECTIVES OF THE STUDY

The main objective of the present study is to provide the growth of literature on Materials Science research for the period from 2002 to 2016. The specific objectives of the study are to:

1. Identify the annual growth of publications in the field of Materials Science at the global level;
2. Study the Relative Growth Rate (RGR) and Doubling Time (Dt.) in the field of Materials Science.
3. Find out the research performance of highly productive countries in the field of Materials Science;

4. Use indices like Activity Index (AI), Publication Efficiency Index (PEI), and Relative Comparative Advantage for Publication (RCAP).

III. METHODOLOGY

The data on Materials Science research has been collected from the Science Citation Index of ISI Thomson Reuters' Web of Science. The string used to retrieve the data on Materials Science Research is as follows:

SU= (Materials Science) AND PY= (2002-2016)

The ISI Web of Science is an integrated, Web based platform designed to support all levels of scientific and scholarly research within the academic, corporate, government or non-profit organizations. The data collected then is fed into MS-Excel and put into tabular forms.

IV. DATA ANALYSIS AND INTERPRETATION

A. Distribution of Publications: Scientific Vs. Materials Science

The table I depicts the status of Scientific Publications and that of Materials Science publications of the World.

The study reveals that the percentage share of Materials Science publications of the World is 5.61 out of the total scientific publications of the world. The worlds Materials Science publications are 12, 42,775.

TABLE I DISTRIBUTION OF PUBLICATIONS: SCIENTIFIC VS. MATERIALS SCIENCE

Year	Scientific Publications (World)	Percentage (%)	Materials Science Publications (World)	Percentage (%)
2002	1034960	4.67	51021	4.11
2003	1082219	4.88	53690	4.32
2004	1170092	5.28	61179	4.92
2005	1240004	5.60	62981	5.07
2006	1295368	5.84	67492	5.43
2007	1360669	6.14	71007	5.71
2008	1412111	6.37	75368	6.06
2009	1481516	6.68	78861	6.35
2010	1515982	6.84	80199	6.45
2011	1596237	7.20	88723	7.14
2012	1678782	7.57	92804	7.47
2013	1769840	7.99	103137	8.30
2014	1816832	8.20	112171	9.03
2015	1837430	8.29	119577	9.62
2016	1871884	8.45	124565	10.02
	2,21,63,926	100	12,42,775	100
Percentage Share of Materials Science Publication (World)		5.61		

The study reveals the research output of top fifteen countries in Materials Science. The study indicates that China topped the study with 2,87,736 publications, followed by the USA with 2,17,422 publications, Japan with 1,02,696 publications, Germany with 84,076 publications, South Korea with 80,078 publications ranked second to fifth respectively. India ranked sixth in the study with 65,234 publications. Among the top fifteen highly productive countries, eight countries belong to the developed countries and seven are developing countries.

The contribution in Materials Science publications from the developing countries is enormous. The average publication per year is the highest for China (19,182 publications) and the lowest for Iran (145 publications). India's contribution to the Materials Science discipline from 2002 to 2016 is 5.25%.

The RGR is the increase in number of articles/ pages/ reports/ patents per unit of time. This definition is taken from the study of growth analysis of individual plants and successfully applied in the field of Botany (Hunt, 1978) which in turn had its origin from the study of the rate of interest in the financial investments by Blackman (1919). The RGR and Doubling time of publications in Materials Science are presented in table II.

TABLE II RELATIVE GROWTH RATE (RGR) AND DOUBLING TIME (DT.) OF MATERIALS SCIENCE RESEARCH

Years	Materials Science Publications	Cumulative No. of Publications	w1	w2	RGR (w2-w1)	Dt.
2002	51021	51021		10.84		
2003	53690	104711	10.84	11.56	0.72	0.96
2004	61179	165890	11.56	12.02	0.46	1.51
2005	62981	228871	12.02	12.34	0.32	2.15
2006	67492	296363	12.34	12.60	0.26	2.68
2007	71007	367370	12.60	12.82	0.21	3.23
2008	75368	442738	12.82	13.00	0.19	3.71
2009	78861	521599	13.00	13.17	0.16	4.23
2010	80199	601798	13.17	13.31	0.14	4.84
2011	88723	690521	13.31	13.45	0.14	5.04
2012	92804	783325	13.45	13.57	0.13	5.50
2013	103137	886462	13.57	13.70	0.12	5.60
2014	112171	998633	13.70	13.82	0.12	5.82
2015	119577	1118210	13.82	13.93	0.11	6.13
2016	124565	1242775	13.93	14.03	0.11	6.56
Total	1242775				3.19	57.95
				Mean	0.21	3.86

*RGR = Relative Growth Rate, Dt. = Doubling Time

It is noticed that the RGR of Publications decreased from 0.72 in 2003 to 0.11 in 2016. The mean RGR for fifteen years period is 0.21. If the number of articles or pages of a particular subject field doubles during a given period than the difference between the logarithms of numbers at the beginning and end of the period must be logarithms of number 2.

If the natural logarithm is used this difference has a value of 0.693. Thus the corresponding doubling time for each specific period of interval and for research output can be calculated.

The corresponding Doubling time for different years gradually increased from 0.96 (2003) to 6.56 (2016). The mean Doubling time for the selected period (2002 to 2016) is 3.86.

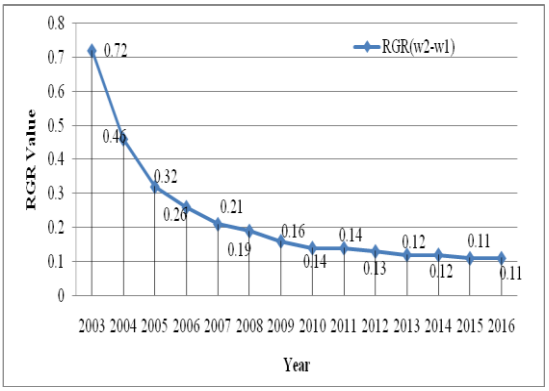

Fig. 1 Relative Growth Rate (RGR)

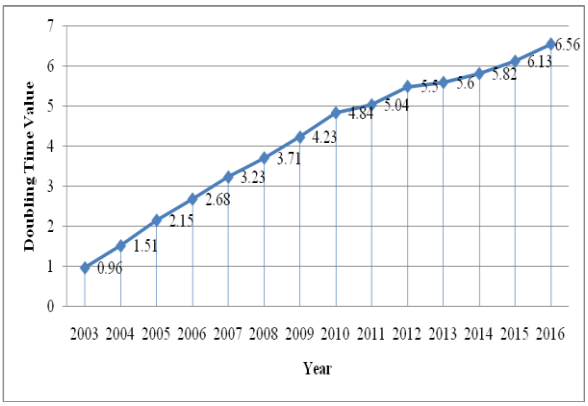

Fig. 2 Doubling Time (Dt.)

The quality of the publications depends upon the number of citations received by the paper, country or an author. The study also provides the number of citations received by the top fifteen countries in Materials Science.

The USA topped the list with 59,08,925 citations, followed by China with 43,82,100 citations, Germany with 16,78,324 citations, Japan with 16,72,247 citations and South Korea with 12,16,964 citations ranked second to fifth respectively.

India ranked eighth with 8,47,613 citations to its credit. The Average citations per year is the highest for the USA with 3,93,928 citations and the lowest for Iran with 15,692 citations.

TABLE III RGR, AGR, & DT OF TOP FIFTEEN COUNTRIES IN MATERIALS SCIENCE RESEARCH

Country	ACP	RGR	DT	AGR	Percentage Share of the total Scientific Publications	Materials Science Publications rank out of the total Science Publications
China	15.23	0.27	2.85	14.79	12.485	4
USA	27.18	0.21	3.96	5.63	3.391	13
Japan	16.28	0.18	5.54	-0.36	7.421	4
Germany	19.96	0.20	4.25	3.84	5.329	6
South Korea	15.20	0.23	3.50	9.19	12.304	4
India	12.99	0.24	3.24	10.24	9.702	4
France	18.20	0.19	4.41	2.91	5.691	4
England	21.70	0.19	4.36	3.90	3.586	11
Italy	17.25	0.21	3.95	5.95	3.649	10
Taiwan	15.09	0.23	3.91	6.82	9.935	4
Spain	17.52	0.21	3.82	5.85	4.513	6
Canada	19.62	0.22	3.89	6.57	3.432	10
Russia	8.00	0.18	4.67	3.53	6.778	3
Australia	20.95	0.23	3.25	9.87	3.926	9
Iran	10.82	0.35	2.11	27.00	8.453	4

*ACP=Average Citation per Paper, RGR=Relative Growth Rate, AGR=Annual Growth Rate, DT=Doubling Time

The table III reveals the RGR, AGR, DT and ACP of the top fifteen countries in Materials Science. The Average Citation per Paper is highest for USA (27.18 ACP), England (21.70 ACP), Australia (20.95 ACP), Germany (19.96 ACP) and Canada (19.62 ACP) respectively. The RGR is the lowest for Japan and Russia (0.18) and the highest for Iran (0.35). The Doubling time of Japan is highest (5.51) and lowest for Iran (2.11). However, the Annual Growth rate (AGR) is the highest for Iran, i.e. 27.00 and the lowest for Japan (-0.36). It is also observed from the table that the percentage share of the total scientific publications is the highest for China (12.485%), followed by South Korea (12.304%) and the lowest for the USA (3.391 %).

The data also reveals that China topped the table with the 12.485 % share of Materials Science publications out of the total scientific publications of the country and the priority area of research, followed by South Korea with 12.304 % and the fourth priority subject of research out of the other scientific research areas. India with the share of 9.702 % and the fourth priority areas of research in India. Though the USA and England have the highest scores of ACP but the least in share of percentage (USA 3.391%, England 3.586%) out of their total scientific publications. The Activity Index (AI) is being used to compare a country's publication output with the world research output, the AI suggested by Frame (1977) and elaborated by Schubert and Braun (1986). This indicator can be used to characterize the relative research effort of a country to a particular subject discipline (Hu and Rousseau, 2009; Chen and Guan, 2011). AI is a relative performance indicator, which takes into account the effect of the publication performance of a country in a particular subject to the world performance. If AI=1, which indicates that the country's research efforts in a field corresponds precisely to the world's average. If AI>1, it means the county employs more strength than the world average. The table 4 depicts the Activity Index of top fifteen countries in Materials Science. Among the top fifteen countries, nine countries' AI is more than 1 which indicates that nine countries (Japan 1.093, Russia 1.043, France 1.035, England 1.031, USA 1.008, Germany 1.006, Italy 1.004, Taiwan 1.003, and Canada 1.003) research efforts correspond to the world's average. The AI of Spain, South Korea, India and China (0.996, 0.973, 0.957, and 0.951) are between 0.951 and 0.996. The AI is high in the initial years from 2002 to 2016 for Japan, Russia, France, England, the USA, Germany and Italy. For other countries the Activity Index (AI) is fluctuating year by year.

The PEI indicator is another derivative of the above mentioned Activity Index (Price, 1981), and was used by Garg and Padhi (2001) and Guan and Ma (2004) in their studies as a measure of research quality. The PEI is an indicator that defines if the impact of research output by the top performing countries in scientific publications and citations. IF PEI>1, it indicates that the impact of publications in a given field by a particular country is more than the research effort devoted to it during the period considered. It is evident from the table 5 that USA (1.48), England (1.19), Australia (1.14), Germany (1.09) and France (1.07) have more than 1 PEI which clearly indicates that there is an impact of publications in Materials Science by these countries is more than the research effort devoted during 2002 to 2016. The PEI of France (0.99), Spain (0.96) and Italy (0.94) are nearer to one which also corresponds to the world's average. The PEI is least for Russia (0.44) and Iran (0.59). The PEI is always above 1 for all the years for the USA, England and Australia (except 2003 year).

TABLE IV ACTIVITY INDEX (AI) OF TOP FIFTEEN COUNTRIES IN MATERIALS SCIENCE

Year	Japan	Russia	France	England	USA	Germany	Italy	Taiwan	Canada	Spain	South Korea	India	China	Australia	Iran
2002	1.71	1.54	1.34	1.33	1.03	1.28	1.09	0.77	0.9	1.08	0.75	0.69	0.46	0.76	0.13
2003	1.67	1.42	1.19	1.27	1.04	1.15	1.07	0.87	0.93	0.93	0.78	0.72	0.54	0.73	0.2
2004	1.54	1.39	1.17	1.2	1.03	1.17	1.15	0.91	0.96	0.99	0.91	0.68	0.55	0.76	0.22
2005	1.39	1.16	1.1	1.1	1.02	1.1	0.94	0.91	1.07	0.91	0.95	0.75	0.69	0.76	0.25
2006	1.35	1.12	1.08	1.07	1.01	1.01	0.88	1.22	1.1	0.96	1	0.79	0.71	0.8	0.37
2007	1.25	1.03	1.07	1.05	1.05	1.07	0.99	1.04	1.06	1	0.82	0.91	0.78	0.79	0.47
2008	1.08	0.96	1.12	1	1	0.97	0.98	1.1	1.04	0.96	0.89	0.96	0.86	0.86	0.63
2009	1.04	0.91	1.04	1.01	1.01	0.98	0.95	1.17	1.07	0.98	0.95	1.05	0.92	0.9	0.97
2010	0.92	0.81	1	0.98	1.06	1	1.02	1.17	1.07	1.01	1.01	1.07	0.93	1.02	1.15
2011	0.89	0.84	0.99	0.93	1.03	1.04	1.03	1.19	1.02	1.02	1.1	1.05	1	1.01	1.22
2012	0.79	0.82	0.95	0.91	1.01	0.96	0.96	1.06	1	1.07	1.1	1.05	1.08	1.09	1.33
2013	0.77	0.8	0.94	0.89	0.96	0.93	1.03	1.09	0.96	1.01	1.1	1.15	1.16	1.13	1.41
2014	0.71	0.85	0.85	0.86	0.96	0.92	0.99	0.97	0.97	1.03	1.09	1.14	1.29	1.19	1.43
2015	0.64	1.01	0.85	0.92	0.96	0.91	0.97	0.82	0.96	0.99	1.06	1.15	1.39	1.22	1.48
2016	0.65	0.99	0.83	0.95	0.95	0.9	1.01	0.76	0.94	1	1.08	1.19	1.43	1.25	1.67
AI	1.093	1.043	1.035	1.031	1.008	1.026	1.004	1.003	1.003	0.996	0.973	0.957	0.951	0.919	0.862

*AI=Activity Index

TABLE V PUBLICATION EFFICIENCY INDEX (PEI) OF TOP FIFTEEN COUNTRIES IN MATERIALS SCIENCE

Year	USA	England	Australia	Germany	Canada	France	Spain	Italy	Japan	China	South Korea	Taiwan	India	Iran	Russia
2002	1.50	1.05	1.06	0.98	1.22	0.95	0.89	0.83	0.83	0.80	0.86	0.94	0.83	0.65	0.38
2003	1.57	1.03	0.96	1.06	0.99	0.99	1.03	0.89	0.72	0.77	0.85	0.82	0.83	1.01	0.41
2004	1.56	1.07	1.18	1.01	1.20	0.94	0.84	0.79	0.76	0.78	0.79	0.92	0.85	0.74	0.43
2005	1.44	1.11	1.10	1.12	1.13	1.04	1.01	1.05	0.83	0.77	0.75	0.91	0.82	0.82	0.36
2006	1.49	1.21	1.18	1.09	1.19	1.03	0.96	0.95	0.77	0.82	0.73	0.70	0.79	0.71	0.42
2007	1.44	1.40	1.18	1.06	1.09	0.93	1.02	0.84	0.73	0.84	0.84	0.75	0.75	0.80	0.46
2008	1.50	1.15	1.43	1.03	1.00	0.94	0.91	0.87	0.75	0.88	0.82	0.72	0.75	0.77	0.39
2009	1.42	1.14	1.32	1.12	1.02	0.95	0.90	0.96	0.80	0.90	0.83	0.80	0.75	0.73	0.39
2010	1.46	1.06	1.17	1.05	0.93	0.88	0.92	0.96	0.81	0.94	0.88	0.69	0.65	0.73	0.38
2011	1.41	1.07	1.26	0.99	1.05	0.87	0.97	0.91	0.81	0.99	0.85	0.73	0.71	0.70	0.38
2012	1.36	1.02	1.25	0.98	0.90	0.87	0.92	0.93	0.78	1.03	0.89	0.85	0.69	0.63	0.39
2013	1.35	1.13	1.18	0.97	0.92	0.88	0.93	0.97	0.76	1.03	0.90	0.73	0.73	0.66	0.48
2014	1.30	1.19	1.21	1.01	0.93	0.81	0.94	0.98	0.77	1.05	0.90	0.77	0.67	0.68	0.52
2015	1.24	1.09	1.31	1.04	0.94	0.81	0.98	1.08	0.81	1.04	0.92	0.71	0.68	0.73	0.49
2016	1.21	1.09	1.31	1.00	0.96	0.84	0.96	1.02	0.84	1.05	0.86	0.75	0.71	0.92	0.53
PEI (Value)	1.48	1.19	1.14	1.09	1.07	0.99	0.96	0.94	0.89	0.832	0.830	0.82	0.71	0.59	0.44

*PEI=Publication Efficiency Index

V. FINDINGS AND CONCLUSION

The present study highlights the key issues of Materials Science research development as reflected in Web of Science database for the period from 2002 to 2016. It is observed from the study that the percentage share of materials Science publications of the world is 5.61 out of the total scientific publications of the world. The contribution in materials science publications from the developing countries is enormous. China topped the table with 2,87,736 publications, followed by the USA with 2,17,422 publications. The Relative Growth Rate (RGR) of publications decreased from 0.72 in 2003 to 0.11 in 2016. The mean RGR for fifteen years' period is 0.21. The corresponding doubling time for different years gradually increased from 0.96 (2003) to 6.56 (2016). The Average Citations per Paper is highest for USA (27.18), followed by England (21.70).

The Activity Index (AI) of nine countries, i.e. Japan (1.093), Russia (1.043), France (1.035), England (1.031), the USA (1.008), Germany (1.006), Italy (1.004), Taiwan (1.003) and Canada (1.003) is more than one. The Publication Efficiency Index (PEI) is more than one for the USA (1.48), England (1.19), Australia (1.14), Germany (1.09) and France (1.07). The study also indicates that China topped the list with the highest mean value of Relative Comparative Advantage for Publication (RCAP), i.e. 2.23, followed by South Korea (2.19).

Scientometrics is one of the techniques which are a set of mathematical and statistical methods used to analyze and measure the quantity and quality of books, articles and other forms of publications. Predominantly, the Scientometric indicators help organizations / governments to make decisions, framing the policy, appointments, promotions and funding. However, these indicators also used as measuring techniques for the research and detect the misallocation / misappropriation. Such studies will enable the authorities of the organization / institutions to provide adequate facilities to assess the research activities in a systematic manner.

REFERENCES

[1] Blackman, V. H. (1919). The Compound interest law and plant growth. *Annals of Botany*, *33*, 353-360.

[2] Braun, T., Schubert, A. P., & Zsindely, S. (1997). Nano science and nanotechnology on the balance. *Scientometrics*, *38*(2), 321-325.

[3] Chen, K. & Guan, J. (2011). A bibliometric investigation of research performance in emerging Nano biopharmaceuticals. *Journal of Informetrics*, *5*(2), 233-247.

[4] Frame, 1977. (1977). Mainstream research in Latin America and the Caribbean. *Interciencia*, *2*, 143-148.

[5] Garfield, E., & Pudovkina, A.I. (2003). From Materials Science to Nano-Ceramics: Citation analysis identifies the key journals and players. *Journal of Ceramic Processing Research*, *4*(4), 155-167.

[6] Garg, K. C., & Padhi, P. (2001). A study of collaboration in laser science and technology. *Scientometrics*, *51*(2), 415-427.

[7] Guan, J. C., & Ma, N. (2004). A comparative study of research performance in computer science. *Scientometrics*, *61*(3), 339-359.

[8] Hiremath, R.S., & Hadagali, G.S. (2014). A Scientometric Analysis of Global Research trends in Biomaterials. *International Journal of Digital Library Services*, *4*(4), 98-111.

[9] Ho, Y.S. (November, 2014). A bibliometric analysis of highly cited articles in Materials Science. *Current Science*, *107*(9), 1565-1572.

[10] Hu, X., & Rousseau, R. (2009). A comparative study of the difference in research performance in bio medical field among selected Western and Asian Countries. *Scientometrics*, *81*(2), 475-491.

[11] Hunt, R. (1978). Plant Growth Analysis: London: Edward Arnold. ISI highly cited researcher http://hcr.state of innovation. thomsonreuters.com/

[12] Kademani, B. S., Kumar, V., Sagar, A., & Kumar, A. (2006). World literature on Thorium research: a scientometric study based on Science Citation Index. *Scientometrics*, *69*(2), 347-364.

[13] Kademani, B. S., Sagar, A., & Bhanumurthy, K. (2011). Research and impact of materials science publications in India: 1999-2008. *Malaysian Journal of Library and Information Science*, *16*(2), 63-82.

[14] Kostoff, R. N., Koytcheff, R. G., & Lau Clifford, G. Y. (2007). Technical structure of the global nanoscience and nanotechnology literature. *Journal of Nanoparticle Research*, *9*, 701-724.

[15] Price, D.De.S. (1981). The analysis of Scientometric metrics for policy implications. *Scientometrics*, *3*, 47-54.

[16] Sagar, A., Kademani, B. S., Garg, R. G., & Kumar, V. (2010). Research trends in cobalt-60 in nuclear science and technology. *International Journal of Nuclear Knowledge Management*, *4*, 146-164.

[17] Schubert, A., & Braun, T. (1986). Relative indicators and relational charts for comparative assessment of publication output and citation impact. *Scientometrics*, *9*, 281-291.

[18] Sindagi, S., & Anandhalli, G. (2018). Scientometric analysis of Nanotechnology literature from 2000-2016 as reflected in Web of Science database. *International Journal of Creative Research Thoughts*, 764-773.

[19] Velmurugan, C. (2018). Mapping of Research Performance on Materials Science in India: A Study Based on Clarivate Analytics-Web of Science Database. International *Journal of Environmental Sciences & Natural Resources*, *15*(1), 1-12.

[20] Walke, R., & Dhawan, S.M. (2007). Materials Science Research in India: A Scientometric Analysis. *DESIDOC Bulletin of Information Technology*, *27*(1), 69-76.