Authorship and Collaboration Trends of Materials science

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Abstract

The aim of this study is to analyze the authorship and collaboration trends in the research field of Materials Science based on the SCOPUS database for the period of 15 years from 2003 to 2018. Results show that multi authored papers (91%) predominate single authored papers (9%). The degree of collaboration in the field of Material Science is 0.63. This study supports the fact that scientific research is collaboration in nature.

Keywords

Bibliometrics, Material Science, Authorship Pattern.

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INTRODUCTION

Research collaboration has become a norm in the field of pure and applied sciences. Co-authorship varies from one subject to another. Authorship studies provide valuable information concerning characteristics of authors, their collaboration, assessing and monitoring research activities among others. Some specific areas in studying authorship are discovering changing patterns in the area of authorship, etc. Collaboration among scientists implies that they are working together and pursuing a common scientific goal. Material Science includes the study of the relationship between the synthesis, processing, structure, properties and performance of materials which will enable us to engineer the function. The properties might be mechanical, electrical, magnetic or optical, electronics, communications, medicine, transportation, manufacturing, recreation, energy and environment.. The aim of the present study is to analyze the authorship trends and collaboration pattern and most productive authors in the field of Material Science research during 2003-2018.

METHODOLOGY

The bibliographic records related to the material science have been retrieved and downloaded from the SCOPUS (Elsevier) Database. The following keyword has been used in the combined fields of Title, Abstract and Keyword to extract records: *Material Science*. The search yields 27952 records and exported to MS-Excel for further analysis. The following bibliometric tools have been employed.

COLLABORATIVE CO-EFFICIENT

The strength of collaboration among the authors can be measured with following formula suggested by Ajiferuke, Burrel and Tauge (1988).

$$CC = 1 - \left(\sum_{j=1}^{k} \frac{i}{j} \cdot \frac{Fj}{N}\right)$$

Where

Fj= the number of articles with "j" author

J= articles (one author, two authors, three authors…)

N= the whole number of authors in an article.

Co-Authorship Index

To examine the changing pattern of co-authorship, the following formula suggested by Garg and Padhi (2003) is used.

$$CAI = \frac{Nij/Nio}{Noj/Noo} \times 100$$

Where,

CAI = Co-Authorship Index

Nij = Number of papers having j authors in block i

Nio = Total output of block i

Noj = Number of papers having j authors for all blocks

Noo = Total number of papers for all authors and all blocks

J = 1,2,3,4 e" 5

CAI = 100 implies that co-authorship to the world average, CAI>100 reflects higher than average effort and CAI<100 reflects lower than average effort in a particular block for a particular type of authorship.

Scl[2] tool

The sci[2] tool is used to generate a map of co-authorship network map among the authors of material science research. To construct the visualization map, the following steps were taken.

Step 1 - Load CSV file was selected
Step 2 - Extract co-author network was selected (file format: SCOPUS)
Step 3 – Network Analysis Tool kit was selected
Step 4 – Extract K-core was selected (Unweight and Directed)
Step 5 – GUESS was selected and default random layout used.

RESULTS

Authorship Pattern

The distribution of contributions according to number of authors is shown in Table. It is evident that above 90% of total research output is collaborative research by two or more authors. The range of authors per article is between 1 and 27. It is found that 0.17% (48) of articles is by anonymous authors. Only 9.2% (2568) of total research output is by single authors.

Table 1: Authorship Pattern

S. No	No. of Authors	No. of Articles	%
1	Single	2568	9.19
2	Two	5415	19.37
3	Three	6814	24.38
4	Four	5875	21.02
5	Five	3688	13.19
6	Six	2037	7.29
7	Seven	831	2.97
8	Eight	315	1.13
9	More than Eight	361	1.29
10	Anonymous	48	0.17
	Total	**27952**	**100**

COLLABORATIVE CO-EFFICIENT

To examine the strength of collaboration among the authors, the entire data has been divided into single, two, three, four and more than four authored articles. It is calculated by making use of Collaborative Co-efficient (CC) and presented in Table 2. It is observed from the Table 2 that the value of CC is increased from 0.53 in 2003 to 0.66 in 2017 with an average of 0.63. Further, the value collaborative coefficient is greater than 0.5 for all the years.

Table 2: Collaborative Co-efficient vs. Year

S. No	Year	No. of Authors						Total	CC
		Anon.	Single	Two	Three	Four	>Four		
1	2003	5	204	209	206	149	178	951	0.53
2	2004	1	159	215	240	168	163	946	0.55
3	2005	2	149	240	245	209	172	1017	0.57
4	2006	4	171	235	281	192	204	1087	0.57
5	2007	3	154	247	284	199	257	1144	0.59
6	2008	6	126	238	298	249	280	1197	0.61
7	2009	16	161	288	359	282	361	1467	0.61
8	2010	2	148	293	312	281	430	1466	0.62
9	2011	0	127	301	333	322	419	1502	0.63
10	2012	0	92	244	351	273	405	1365	0.65
11	2013	5	157	436	564	505	556	2223	0.64

12	2014	2	247	705	911	764	945	3574	0.64
13	2015	2	252	682	906	821	932	3595	0.64
14	2016	0	231	666	898	854	996	3645	0.65
15	2017	0	190	416	626	607	934	2773	0.66
	Total	**48**	**2568**	**5415**	**6814**	**5875**	**7232**	**27952**	**0.63**

CO-AUTHORSHIP INDEX

To analyze the pattern of co-authorship, the entire data has been divided into single, two, three, four and more than four authored articles by number of authors and three block period. Accordingly, Co-Authorship Index (CAI) is calculated and presented in Table 3. It is found that the CAI for single, two and three authored articles is decreased where it is increased for four and more than four authored articles from first block period to last block period. It indicates that research in Material science is marching towards collaborative research team consists of more than three authors.

Table 3: Co-Authorship Index Vs. Five Year Blocks

S. No	Five Year Plan	No. of Authors					Total
		1	**2**	**3**	**4**	**>4**	
1	2008-2010	837(177)	1146(115)	1256(175)	917(85)	974(73)	5145
2	2011-2013	654(102)	1364(101)	1653(97)	1407(96)	1895(105)	6997
3	2014-2017	1077(74)	2905(95)	3905(101)	3551(107)	4363(107)	15810
	Total	**2568**	**5415**	**6814**	**5875**	**7232**	**27952**
( ) indicates CAI							

TOP TEN AUTHORS

Table 4 provides the rank list of the top ten authors in the field. The top ten authors published between 128 and 309 papers during the study period. These authors were from China (7), the United States (1), Japan (1) and France (1). Binder was the most prolific author, with 309 papers followed by Kolb HC (287) and Lutz (275).

Table 4 Ranking of Authors

S. No	Details of Author / Year / Journal	Records	%
1	Binder WH, 2007, MACROMOL RAPID COMM, V28, P15, DOI 10.1002/marc.200600625	309	1.2
2	Kolb HC, 2001, ANGEW CHEM INT EDIT, V40, P2004, DOI 10.1002/1521-3773(20010601)40:11<2004::AID-ANIE2004>3.0.CO;2-5	287	1.1
3	Lutz JF, 2007, ANGEW CHEM INT EDIT, V46, P1018, DOI 10.1002/anie.200604050	275	1.1
4	Novoselov KS, 2004, SCIENCE, V306, P666, DOI 10.1126/science.1102896	256	1.0
5	Perdew JP, 1996, PHYS REV LETT, V77, P3865, DOI 10.1103/PhysRevLett.77.3865	234	0.9
6	Rostovtsev VV, 2002, ANGEW CHEM INT EDIT, V41, P2596, DOI 10.1002/1521-3773(20020715)41:14<2596::AID-ANIE2596>3.0.CO;2-4	215	0.9
7	IIJIMA S, 1991, NATURE, V354, P56, DOI 10.1038/354056a0	206	0.8
8	Geim AK, 2007, NAT MATER, V6, P183, DOI 10.1038/nmat1849	187	0.7
9	Tornoe CW, 2002, J ORG CHEM, V67, P3057, DOI 10.1021/jo011148j	157	0.6
10	KROTO HW, 1985, NATURE, V318, P162, DOI 10.1038/318162a0	128	0.5

CONCLUSION

The study of authorship and collaboration trends in the field of material science research has been carried our and the following observations are made from the analyses. About 90% of total research output is collaborative nature by two or more authors. The Collaborative Co-efficient for 2003 is 0.53 which increased gradually to 0.66 and 2017 with an average of 0.63. The value of Co-Authorship Index for more than 4 authored papers is increasing trend which indicates that the research in material science is marching towards all possible edges. Out of 32950 total authors (0.6%) having 20 or more co-author links during the study period.

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