

TRANSACTIONS OF THE INDIAN CERAMIC SOCIETY: A BIBLIOMETRIC STUDY

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ABSTRACT

In this study an attempt is made to investigate the scholarly communications in Transactions of the Indian Ceramic Society journal during 2000-2011 and to study its publication trends. For the analysis of the study 12 volumes containing 48 issues have been taken up for evaluation. It is observed that, contributions of articles to each volume is not consistent and on an average 26 articles have been published in each volume. Two authored articles are found to be the highest followed by three and four authored articles. The average degree of collaboration is 0.876. In total 8536 citations have been appended to 308 articles during the period 2000-2011. Journals (80.51%) are the major source of information used by authors followed by books (10.72%). During the period 108 citations have been taken from the source journal. Number of articles written in national collaboration is 77 (25%) whereas that of written in international collaboration is only 10 (3.25%).

Keywords: Bibliometric study; Degree of collaboration; Citation analysis; Keyword analysis; National collaboration; International collaboration; Geographical distribution

1. INTRODUCTION

Bibliometrics is a set of methods used to study or measure texts and information. Citation analysis and content analysis are commonly used bibliometric methods. In fact, many research fields use bibliometric methods to explore the impact of their overall research, the impact of a set of researchers, or the impact of a particular paper. It is now used in quantitative research assessment exercises of academic output which is starting to threaten practice based research. The term was coined by Alan Pritchard in a paper published in 1969, titled *Statistical Bibliography or Bibliometrics?* He defined the term as "the application of mathematics and statistical methods to books and other media of communication" ("Bibliometrics, n.d."). Bibliometrics is a type of research method used in library and information sciences. It is an emerging area of research in this field. The quantitative analysis and statistics to describe patterns of publication within a given field of body of literature are utilized. The main derivatives of bibliometrics are: publication counts, citation counts, co-citation analysis, co-word analysis, scientific 'mapping'. But there are no limitations in assigning parameters in bibliometrics (Thanuskodi, 2010).

'Transactions of the Indian Ceramic Society' has a great impact in the field of glass and ceramics as this is the only publication in this specialized field in India. Bibliometrics studies are used to identify the pattern of publication, authorship and citation analysis with the hope that such regularities can give an insight into the dynamics of the area under consideration. No bibliometrics or scientometric studies have been done on the journal. This consequently sheds more light on the knowledge of the structure of subject literature and better organization of information resources which can ultimately be effectively used.

Bibliometric analysis related to authorship pattern, citation pattern, degree of collaboration, average length of articles, geographical distribution of authorship, bibliographical distribution of citation and keyword analysis are critically and exhaustively studied. In this study, a new parameter, citation pattern within the source journal, is added.

2. REVIEW OF RELATED RESEARCH

Ramesh and Nagaraju (2000) did citation analysis of the 'Indian Journal of Information, Library and Society' for the period 1995-1999. In 138 citing articles had 901 citations. Nearly 89% of citations belonged to books and Journals, while nearly 11% of citations belonged to reports, conference proceedings, seminars and other sources. This article described about types of documents cited, ranking of authors, ranking of titles, bibliographic coupling, co-citations and ranking of journals.

Vijay (2005) performed bibliometric study of 'Research publication trends among Indian food scientists and technologists'. The paper highlighted the collaborative research and authorship trend in the area of food science and technology in India. The degree of collaboration was 0.91 which indicated towards the high degree of team research in this discipline. Productivity constituted 36. pattern of authors showed that single author constituted only 8.57% and two authors 94%. He also showed average number of authors per paper.

Jena (2006) in his bibliometric analysis of the journal 'Indian journal of Fibre and Textile Research' showed that 507 articles published during 1996-2004. There were 8114 citations in which 73.92% was journals, 11.61% was books. In authorship pattern, out of 507 articles, three authored articles are highest in number (34.12%), two authored articles were 28.60 % followed by multi-authored articles of 22.88 %. The average length of article was 6.45 pages. In geographic distribution of contributions it was shown that the highest contributors were from India (85.87%) and the foreign contributors were less than 2%. Apart from these, year-wise distribution of publication and subject trend of articles were also discussed.

Patra, et al (2006) analysed growth pattern, core journals and authors' distribution in the field of bibliometrics using data from 'Library and Information Science Abstracts' for the period 1967-2004. Lotka's law was used to identify authors' productivity pattern. Bradford's law of scattering was used to identify core journals. They identified 12 most productive authors with more than 20 publications in that field. The study revealed that 3,996 articles of Indian authors were published in 281 journals.

Pillai (2007) examined authorship patterns in Physics literature on 'Citations in doctoral theses of the Indian Institute of Science'. The paper dealt with 11412 journal citations and 1328 book citations from 71 doctoral theses in Physics during 1999-2003. In authorship pattern it was shown that single author contributed 20.40% and two authors contributed 27.62% of articles. The

mean value of degree of collaboration is 0.80.

Barrois, et al (2008) in their 'Bibliometric study of psychological research on tourism' analysed the evolution of psychological study of tourism and its impact in science during the period 1990-2005. Based on Web of Science, total 572 papers dealt with the psychological study of tourism during the period. The data showed that 40.73% of the articles had been signed by a single author, 53.34% had two or three and only 5.94% more than three authors. The most productive country was the USA, accounting for 26.75% of articles, followed by the UK 14.51%, Australia 11.54%. Citation pattern was evaluated with Bradford's law of scattering.

Nazim and Ahmad (2008) performed a bibliometric analysis on 'nanotechnology research' of 2675 articles during the period 1991-2006. The aim was to offer an overview of research trends in this field and characterize its most important aspects. Total 2675 articles for the period and 167 articles were published every year. Single author contributed 17.20% articles while 38.13% articles have two or three authors. Lotka's Law was applied to count the frequency of publication. Bardford's Law of scattering was applied to identity the core journals in this field.

Kumar, et al (2008) did a scientometric analysis of 3976 articles published in 'Pramana – Journal of Physics' during 1982-2006. Authorship pattern showed that two authors contributed 31.24 % followed by single authors 30.03%. Out of 73 countries contributed during the period, around three fourth of the total affiliations were from India. Keyword analysis made focus on cosmology, supersymmetry, chaos, quantum chromodynamics. Collaboration rate of published papers was 0.70. It also focused on impact factor, institutional collaboration of authors and referencing pattern.

Abdulah and Rahman (2009) did a bibliometric study of 'Journal Syariah' for the period 1993-2000. Total 285 articles were published during the period. Citation analysis showed that 98.6% articles referred to books and only 39.3% articles were in journals. The paper discussed about distribution and lengths of articles by year and the average number of pages per article. Citation analysis showed that book contributed 98.6%, journal contributed 39.3% citations. Apart from these, subject area of articles, quantitative growth of subject and most prolific contributors were discussed.

Nattar (2009) did a scientometric analysis of 'Indian journal of Physics' of 829 articles during 2004-2008. He observed the distribution of contributions volume-wise and year-wise. It showed that out of 829 contributors, single author contributed 12.42% and two authors contributed 33.17% articles. Degree of collaboration was 0.781 indicating dominance of collaborative research. Geographical distribution of contributions depicted that 91.64% articles were from India and rest were from Bangladesh, Egypt, Iran and Japan. From citation analysis it was shown that journal contributed 65.66% and book 24.50%.

Thanuskodi (2010) aimed at analyzing the research output performance of 'Journal of Social Sciences' for 2003-2007. Out of 273 contributions, two authors contributed 44.33% followed by single author with 30.40%. In total 2172 citations, journal contributed 55.98%, followed by book 21.08%. Geographical distribution of contributions showed that 78.39% contributions were from abroad and only 21.615% were from India. Apart from these, length of articles, year-wise distribution of articles, subject-wise distribution of articles was also discussed.

Singh, et al (2011) did a bibliometric analysis of 'DESIDOC Bulletin of Information Technology' for the period 1992-2002. The study revealed that out of 145 publications, 66.90% articles published by single author and 21.38% by two authors. Geographical distribution of contributors showed that 88.28% were from India and the rest were from USA, UK, Australia and South Africa. Institution-wise distribution of contributors revealed that research organizations contributed 46.21% articles, followed by university/college with 31.72%.

Thanuskodi (2011) presented a bibliometric analysis of the journal 'Library Herald' for the period 2006 to 2010. The result showed that out of 138 articles, published contributions, 52.17% contributed by single author and 38.40% by two authors. From geographical distribution it was shown that Indian contributions were 89.85% and foreign contributions were 10.15%. Journal contributed the maximum 32.42% citations followed by conference proceedings with 24.41%. Institution-wise contribution showed that universities contributed 27.54% and colleges 19.56%, research institutes 21.01% of articles.

Jena, et al (2012) attempted to measure the publication traits of 'Annals of Library and Information Studies' from 2001 to 2010. Examining 36 issues, they got finding of: average citations per article 16, average page per article 8. From citation analysis it was shown that journal contributed 57.4%, followed by books with 15.51%. They also analysed that degree of collaboration was 0.676 and half life period of document citation was 11 years. Out of 476 contributors, Indian contribution was 95.38%. It was also shown that the average citations per article is 16 and the average number of pages per article is 8.

3. SOURCE JOURNAL

'Transactions of the Indian Ceramic Society' is the most important journal in India in the field of glass and ceramics published by the Indian Ceramic Society, Kolkata since 1941. Each issue of this journal covers original research papers, topical reviews, opinions and achievements and industry profiles. It is published quarterly, instead of bimonthly since 2000. The journal has established itself as a leading technical journal in India in the field of glass, ceramics, refractories and its related fields.

The journal has been selected for coverage in Thomson Reuters products since Vol. 66 No. 1, 2007 and it is being indexed and abstracted in Science Citation Index Expanded. And now, it is jointly published online by Taylor & Francis group from volume 71, No.1, 2012.

4. OBJECTIVES OF THE STUDY

The following objectives have been formulated for the present study:

- To examine the authorship pattern of the contributions
- To indicate volume-wise geographical distribution of contributions
- To find out research productivity count of the contributions both at national and international level
- To investigate the citation pattern of the contributions
- To find out the citation pattern within the source journal
- To study the number of pages used in different volumes
- To find out the most used keywords

5. SCOPE OF THE STUDY

An attempt has been made to analyse 308 research articles published in 48 issues of 12 volumes of the journal 'Transactions of the Indian Ceramic Society' (2000-2011) in the field of synthesis, bulk production of glass and ceramic materials and their chemical, mechanical, optical, electronic and spectroscopic and other properties.

6. METHODOLOGY

Out of 72 volumes of the journal Transactions of the Indian Ceramic Society published so far, only 12 volumes (Vol. 59 – Vol.70) have been taken up for study. For this purpose, details of each published article such as, title of the paper, number of authors, keywords, affiliation of the authors, number of citations and their forms, etc. were recorded in separate cards and then compiled, tabulated manually and finally analysed for making observation.

7. ANALYSIS OF THE STUDY

Only 12 volumes from 2000 to 2011 have been chosen for study. It is very difficult to mention the most effective period of examination. The Ceramic Society changed its periodicity from bimonthly (6 issues/year) to quarterly (4 issues/year) from 2000. Implementation of internet was gradually increasing in India at that time. In its 66th volume in 2007 the journal has been selected for indexing and abstracting in Science Citation Index of Thompson Reuters products. So a comparison can be done between non-SCI period (2000-2006) and SCI period (2007-2011) of the journal volumes.

7.1 Volume-wise distribution of contribution

Table-1 shows the volume-wise distribution of articles in the journal. It is shown that there is no uniformity in total contributions in each volume. It is assumed that each issue is published with the readily available articles in that period and this is varied from 19 to 32. It is evident here that after volume 62 in 2003, there is a gradual decrease in contributions and it is again increased from volume 69 in 2010. Perhaps, this is because the journal is being indexed in the Journal Citation Reports of Thomson Reuters and its impact factor is gradually increasing. Out of a total of 308 articles, the maximum numbers of articles are in 2001 and 2003 contributing 32 articles each, which is 10.39% to the total contributions. On the other hand, only 19 articles have been published in 2008 and in 2009 which is 6.17% of the total publications.

Considering issue-wise distribution of contributions, it exhibits that the highest 11 articles were published in July-Sept issue of volume 69 and the lowest 3 articles were published in January-March issue of volume 66.

Table-1 Distribution of Contributions (Volume-wise)

Year	Vol. No.	No. of Issues	No. of Contributions	% of Articles	No. of Articles/ Issue
2000	59	4	24	7.79	6.00
2001	60	4	32	10.39	8.00
2002	61	4	30	9.74	7.50

2003	62	4	32	10.39	8.00
2004	63	4	29	9.42	7.25
2005	64	4	24	7.79	6.00
2006	65	4	23	7.47	5.75
2007	66	4	21	6.82	5.25
2008	67	4	19	6.17	4.75
2009	68	4	19	6.17	4.75
2010	69	4	26	8.44	6.5
2011	70	4	29	9.42	7.25
	Total	48	308	100	

7.2 Authorship pattern

The authorship pattern analysis exhibits the types of research. It is found from Table-2 that out of total 308 articles, two authored articles (88 nos.) are the highest in number (28.57%). The three authored articles (81 nos.) are 26.30% followed by single authored and four authored articles of 17.20% and 13.30% respectively. Regarding single author contributions, volume 62 and 65 has the highest 6 publications each. Regarding two author contributions, volume 59 and 61 depicts the highest 11 publications each.

It is found from the volume-wise contributions that volumes 59, 67, 68, 69 and 70 contain only one single authored article each. Volume 64 contains 4 single authored articles. Volume 60, 61, 63 and 66 each have 5 single authored articles and volume 62 and 65 each have 6 single authored articles. Finally, it should be said that out of 308 articles, 41 articles are single authored and 267 are multi-authored. The increase in multi-authorships indicates research-based work. This research work may be done by the students with their research guides or a collaborative research work of sponsored projects. So multi-authorship is inevitable in a research oriented work and that reflects in the present journal analysis also.

Table-2 Authorship patterns of contributions

No. of Authors	No. of Contributions	Total no. of Authorship	% of Authorship
Single Authors	41	41	13.31
Two Authors	88	176	28.57
Three Authors	81	243	26.30
Four Authors	53	212	27.21
Five Authors	29	145	9.42
Six Authors	8	48	2.60
Seven Authors	5	35	1.62
Eight Authors	1	8	0.32
Nine Authors	1	9	0.32
Ten Authors	1	10	0.32

7.3 Degree of collaboration

The degree of collaboration varies from one discipline to another. It is generally high in the intensely collaborative scientific and technical fields, but low in the humanities. The formula given by K Subramanyam (Subramanyam, 1983) is useful for determining the degree of

collaboration in quantitative terms. The mathematical deduction of the formula is:

$$C = \frac{Nm}{Nm + Ns}$$

where, C = degree of collaboration in a discipline

Nm = number of multi-authored research papers

Ns = number of single authored research papers

In the present study, Nm = 267 and Ns = 41, Thus, C = 0.867

So the degree of collaboration of this journal as a whole is 0.846 and that of various years has been presented in the Table-3. It is shown that the degree of collaboration in 2000 is 0.958 and then decreases gradually up to 2003 (value is 0.813). It further increases to 0.833 in 2005. In 2006, its value is 0.739 and after that the value is gradually increasing and finally its value is reached to 0.966. The more the value of multi-authored research papers (Nm) increases, more will be the value of C. In the present study, the average value of C is 0.867 and it tends to 1. This indicates the trend towards collaborative research.

Table – 3 Degree of collaboration

Year	Single authors	Multi authors	Degree of collaboration
2000	1	23	0.958
2001	5	27	0.844
2002	5	25	0.833
2003	6	26	0.813
2004	5	24	0.828
2005	4	20	0.833
2006	6	17	0.739
2007	5	16	0.762
2008	1	18	0.947
2009	1	18	0.947
2010	1	25	0.962
2011	1	28	0.966

7.4 Citation or reference pattern of articles

References are used in all academic fields in order to acknowledge previous research, to develop the arguments made, and to frame the context in which research is situated. A citation is a reference to any item (book, journal article, dissertation, archival manuscript, etc.) which clearly identifies the source in which the full-text of the item is to be found. A citation provides sufficient information to acknowledge the author and locate the item.

It is a bibliometric technique in which works cited in publications are examined to determine patterns of scholarly communication, for example, the comparative importance of books versus journals, or of current versus retrospective sources, in one or more academic disciplines. The citations in research papers, theses, and dissertations are also examined by librarians for purposes

of collection evaluation and development (Panchesnikov, 2007).

Table-4 gives citation pattern of articles. The table shows year-wise distribution of citations, average citation/article and average citation/journal issue. It is shown that there are total 8536 citations distributed among 48 journal issues having 308 articles. It is evident from the table that there is a variation in citation numbers from year to year. The highest number of average citations per article is 48.16 in 2009 and the lowest number is 15.75 in 2001. Again, the highest average citation per journal issue is 292.75 in 2010 and the lowest average citation per journal issue is 104.75 in 2000.

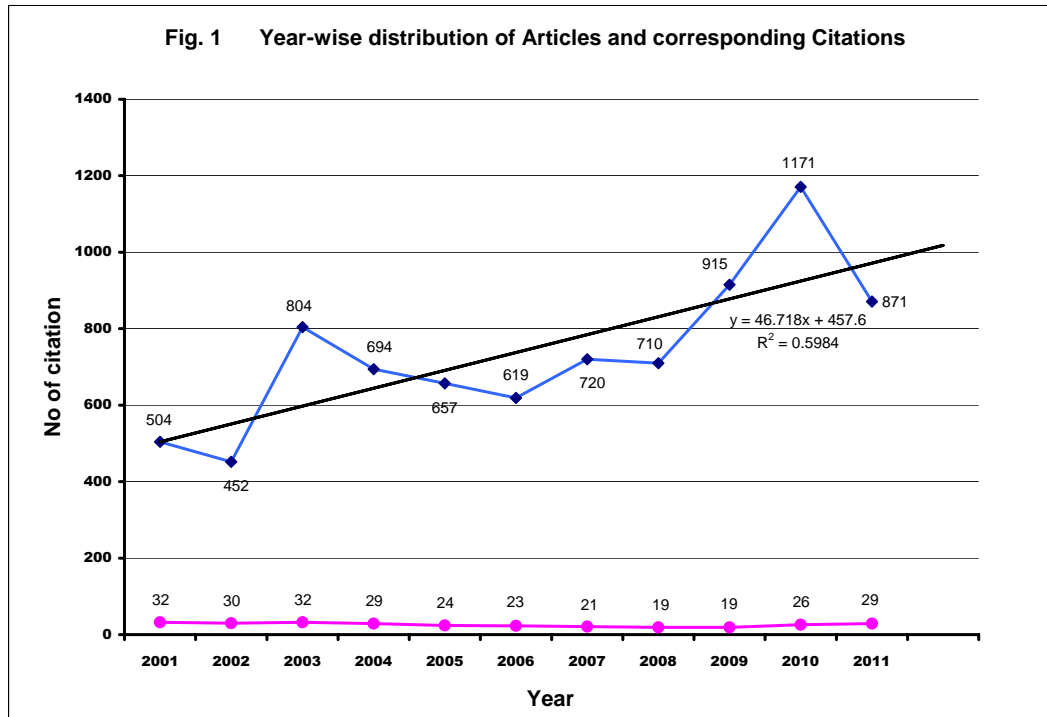
Table-4 Citation pattern of articles

Year	No. of Articles	No. of Citations	Average Citation/ Article	Average Citation/ Journal Issue
2000	24	419	17.46	104.75
2001	32	504	15.75	126.00
2002	30	452	15.07	113.00
2003	32	804	25.13	201.00
2004	29	694	23.93	173.50
2005	24	657	27.38	164.25
2006	23	619	26.91	154.75
2007	21	720	34.29	180.00
2008	19	710	37.37	177.50
2009	19	915	48.16	228.75
2010	26	1171	45.04	292.75
2011	29	871	30.03	217.75

Fig.1 shows year-wise distribution of articles and their corresponding citations. From the distribution of articles curve it is evident that the number of articles published in each volume remains almost constant.

The journal is being covered by Thompson Reuters products and indexed by Science Citation Index Expanded from 2007. So the value as well as prestige of journal has simultaneously been increased from 2007. For that reason, the citation pattern before 2007 i.e., from 2000 to 2006 and after 2006 i.e., from 2007 to 2011 has been compared taking 2006 as a base year.

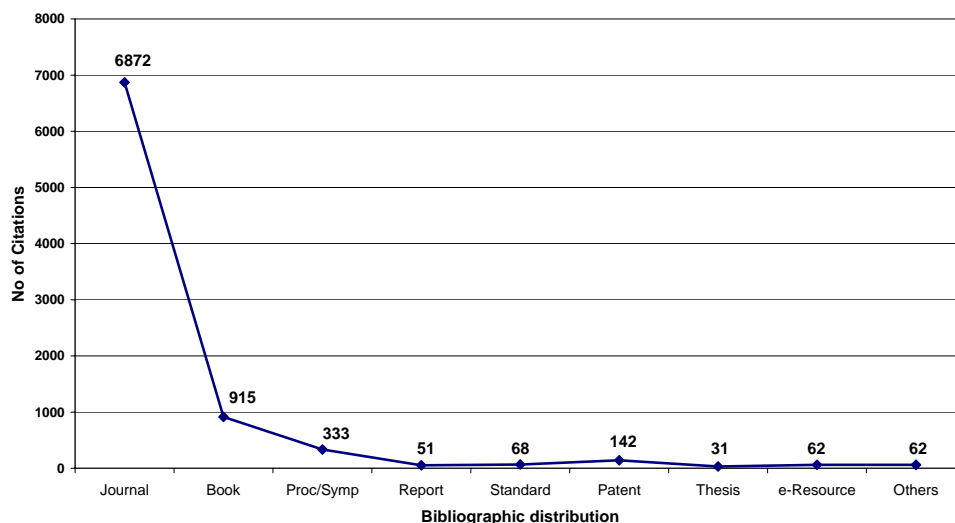
It is shown that there is a little increase in number of citations during 2000 to 2006 (average 592.71). But during 2007 to 2011 there is a sharp increase in number of citations (average 877.4). The number of use of e-resource is 18 in the first case and that of second case is 31. This increase is due to availability of electronic resources mainly, open access journal articles, archival articles, free US patents. So we may mark 2006 as a year after which citations is gradually increasing. The straight line shows the linear regression line or trendline of the citations where correlation coefficient, $R^2 = 0.5984$ and the regression equation $y = 46.718x + 457.6$.



7.5 Bibliographical distribution of citations

Bibliographical distribution of citations is broadly divided into the following categories: journal, book, proceedings/conference/workshop/seminar, report, standard, patent, thesis, e-resource and others. Fig. 2 shows that journals are cited predominantly in all volumes followed by books. Journal citations are 6872 (80.51% of the total citations), whereas book constitutes 915 citations (10.72%) only. Percentage of rest of the other citations is as follows: proceedings 3.90%, reports 0.60%, standards 0.80%, patents 1.67%, thesis 0.36%, e-resource 0.73% and others 0.73%. It is also found that use of electronic resources started from volume 62 in 2002. So in applied research, the main source of information is journal, the source of nascent thought.

Fig. 2 Bibliographic distribution of Citation



7.6 Citation pattern within the source journal

Table-5 shows the citation pattern within the source journal. It is found that a measurable number of citations have been taken from the source journal. The highest number is 22 in 2001 followed by 21 in 2004 and 19 in 2002. The highest percentage of citation within the source journal is 4.365 in 2001 followed by 4.204 in 2002. In total, out of 108 citations to articles published in the journal (1.27% of total citations) within the source journal, 64 (0.75% of the total citations) are self citations by authors citing previous articles published by them in the journal.

Table-5 Citation within the source journal

Year	Total no. of Citations	No. of citations within source journal	No. of self citations within source journal	% of citation within source journal
2000	419	4	4	0.955
2001	504	22	9	4.365
2002	452	19	7	4.204
2003	804	6	5	0.746
2004	694	21	15	3.026
2005	657	4	3	0.609
2006	619	5	5	0.808
2007	720	6	3	0.833
2008	710	5	4	0.704
2009	915	11	5	1.197
2010	1171	4	2	0.342
2011	871	2	2	0.230
Total	8536	108	64	

7.7 Length of articles

Table-6 shows the distribution of articles according to page numbers and the average length of articles. It is seen from the table that out of 308 articles, 154 articles (50.00%) cover 1-5 pages, 122 articles (39.61%) cover 6-10 pages, 17 articles (5.52%) cover 11-15 pages, 10 articles (2.25%) cover 16-20 pages and only 5 articles (1.62%) cover 21-25 pages.

Table-7 shows that average length of article is 6.63 pages. Further, it is observed that average length of article varies from a minimum of 4.58 pages to maximum 9.21 pages.

Table-6 Distribution of articles according to number of pages

Vol No / Pages	1-5	6-10	11-15	16-20	21-25	Total
59	19	4	1			24
60	23	9				32
61	19	11				30

62	22	6	3	1		32
63	15	13			1	29
64	6	15	2		1	24
65	9	9	2	3		23
66	9	9	2	1		21
67	5	9	3	1	1	19
68	8	8		2	1	19
69	8	13	3	1	1	26
70	11	16	1	1		29
Total Articles	154	122	17	10	5	308
Total %	50.00	39.61	5.52	2.25	1.62	100

Table-7 Average length of articles

Year	Vol. No.	No. of Articles	Total Pages	Average Page/ Article
2000	59	24	110	4.58
2001	60	32	151	4.72
2002	61	30	149	4.97
2003	62	32	184	5.75
2004	63	29	176	6.07
2005	64	24	174	7.25
2006	65	23	175	7.61
2007	66	21	152	7.24
2008	67	19	175	9.21
2009	68	19	149	7.84
2010	69	26	206	7.92
2011	70	29	184	6.34

7.8 Geographical distribution of contributors

Table-8 shows the geographical distribution of authorship in different institutes. It is shown that Central Glass & Ceramic Research Institute (CG&CRI), Kolkata contributes the maximum, 59 articles, followed by Bhabha Atomic Research Centre (BARC), Mumbai institutes 20 articles. Other important contributors are as follows: CG&CRI, Naroda Centre, Gujarat 16; Anna University, Chennai 15; Government College of Engineering & Ceramic Technology (formerly College of Ceramic Technology), Kolkata 11; Benaras Hindu University, UP 10; National Institute for Interdisciplinary Science and Technology (formerly Regional Research Laboratory), Thiruvananthapuram, Kerala 8.

CG&CRI, Kolkata published the maximum 59 articles. This is because CG&CRI is the only research institute in India related to glass, ceramics, refractories and its related areas and 'Transaction of the Indian Ceramic Society' is the only journal in India publishing the same type of articles. So there is a natural affinity of the scientists of CG&CRI to publish their research output to this journal. On the other hand, both the institutes Indian Ceramic Society and CG&CRI situated in the same geographical region Kolkata.

Table-8 Affiliations of authors of the articles

Rank	Institution/Organization	Occurrence
1	CG & CRI, Kolkata, W.B.	59
2	Bhaba Atomic Research Centre, Mumbai, Maharashtra	20
3	CG & CRI, Naroda, Gujarat	16
4	Anna University, Chennai, Tamil Nadu	15
5	College of Ceramic Technology, WB	11
6	Benaras Hindu University, UP	10
7	National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram, Kerala	8
8	University of Calcutta, W.B.	7
=8	Indian Institute of Technology, Kharagpur, W.B.	7
9	Defence Metallurgical Research Laboratory, A.P.	6
=9	Institute of Minerals and Materials Technology, Bhubaneswar, Orissa	6
=9	Jadavpur University, Kolkata, W.B.	6
=9	Steel Authority of India Ltd, Ranchi, Jharkhand	6
10	Indian Association for the Cultivation of Science, W.B	5
=10	National Aerospace Laboratories, Bangalore, Karnataka	5
=10	Bengal Engineering and Science University, WB	5
=10	National Research Centre, Dokki, Egypt	5
=10	CG&CRI, Khurja, UP	5
=10	Thapar University, Punjab	5
11	Bangalore University, Bangalore, Karnataka	4
=11	Bharat Heavy Electricals Ltd, Bangalore, Karnataka	4
12	IIT, Mumbai, Maharashtra	3
=12	IIT, Kanpur, UP	3
=12	IIT Madras, Tamil Nadu	3
=12	Indian Institute of Science, Bangalore, Karnataka	3
=12	Indira Gandhi Centre for Atomic Research, AP	3
=12	Sharif University of Technology, Iran	3
=12	Sri Venkateswara University, AP	3
=12	The Indian Ceramic Society, WB	3
=12	Universiti Teknologi Petronas, Malaysia	3
=12	University of Hyderabad, AP	3
13	Answer Technology Inc, USA	2
=13	Central Building Research Institute, Uttranchal	2
=13	H&R Johnson (India) Ltd, Mumbai, Maharashtra	2
=13	IFGL Refractories Ltd, Kolkata, WB	2
=13	International Advanced Research Centre for Powder Metallurgy & New Materials, Hyderabad, AP	2
=13	Islamic Azad University, Iran	2
=13	Jeyraj Annapackium College for Women, Tamil Nadu	2
=13	Kakatiya Institute of Technology & Science, AP	2
=13	Natasha Ceramic Services, WB	2

=13	National Centre for Radiation Research and Technology, Egypt	2
=13	National Institute of Technology, Durgapur, WB	2
=13	Ramaiah Institute of Technology, Karnataka	2
=13	Regional Engineering College, Rourkela, Orissa	2
=13	SRM University, Tamil Nadu	2
=13	The Pennsylvania State University, USA	2
=13	University of Dayton Research Institute, USA	2
=13	University of Pune, Maharashtra	2
=13	University of Tehran, Iran	2
14	Adiyaman University, Turkey	1
=14	Advanced Materials and Process Research Institute, Bhopal, MP	1
=14	Advanced Surface Technologies, Haryana	1
=14	Alfred University, USA	1
=14	Allied Ceramics Pvt Ltd, Kolkata, WB	1
=14	Ambrose Alli University, Nigeria	1
=14	Amirkabir University of Technology, Iran	1
=14	Appler Associates, USA	1
=14	ARC International, Hyderabad, AP	1
=14	Arts-Glacierhi, New Delhi	1
=14	Bangladesh Council of Scientific & Industrial Research, Bangladesh	1
=14	Ben-Gurion University of the Negev, Israel	1
=14	Bharat Refractories Ltd, Jharkhand	1
=14	Bar-Ilan University, Israel	1
=14	Carborundum Universal Ltd, Tamil Nadu	1
=14	Catacel Corporation, Ohio, USA	1
=14	Catholic University of America, USA	1
=14	Center for Materials for Electronics Tehchnology, Maharashtra	1
=14	Central Mechanical Engineering Research Institute, WB	1
=14	Centre for the Development of Glass Industry, UP	1
=14	Corning Incorporated, USA	1
=14	Cosmo Ferrites Ltdm Himachal Pradesh	1
=14	Dalmia Institute of Scientific and Industrial Research, Orissa	1
=14	Defence Research and Development Organization, New Delhi	1
=14	DDU Gorakhpur University, UP	1
=14	Dept Od Science & Technology, WB	1
=14	Dr ambedkar institute of technology, Karnataka	1
=14	Ducom Instruments Pvt Ltd, Karnataka	1
=14	Durgapur Steel Plant, WB	1
=14	Ecole Nationale des Ingenieurs de Sfax, Tunisie	1
=14	Faculte des Sciences de Sfax, Tunisie	1

=14	Forensic Science Laboraty, Bangalore, Karnataka	1
=14	Gujarat Glass Ltd, Gujarat	1
=14	Haldia Institute of Technology, WB	1
=14	Heritage Institute of Technology, Kolkata, WB	1
=14	HKBK College of Engineering, Karnataka	1
=14	Hokkaido University, Japan	1
=14	Imam Khomeini International University, Iran	1
=14	Indian School of Mines, Bihar	1
=14	INSA de Lyon, France	1
=14	Institute de Recherches sur la Catalyse-CNRS, France	1
=14	Institute for Colorants, Paint and Coatings, Iran	1
=14	Institute Superieur des Beaux Arts de Sousse, Tunisie	1
=14	Institute for Materails & Processes in Energy Systems (IWV2), Germany	1
=14	Jnanganga Gulbarga University, Karnataka	1
=14	Katholieke Universiteit Leuven, Belgium	1
=14	Kennametal Widia India Ltd, Bangalore, Karnataka	1
=14	Kyushu University, Japan	1
=14	LSU School of Density, USA	1
=14	LTMG Hoptital, Mumbai, Maharashtra	1
=14	Maharani Lakshmi Ammanni College for Women, Tumkur, Karnataka	1
=14	Material and Energy Research Center, Iran	1
=14	MS University of Baroda, Baroda, Gujarat	1
	Mustafa Kemal University, Turkey	1
=14	Nagoya Institute of Technology, Japan	1
=14	National Council for Cement & Building Materials, Haryana	1
=13	National Institute of Advanced Industrial Science & Technology, Japan	1
=13	National Institute of Foundry & Forge Technology, Jharkhand	1
=14	National Institute of Technology, Rourkela, Orissa	1
=14	National Metallurgical Laboratory, Jharkhand	1
=14	National Physical Laboratory, New Delhi	1
=14	Naval Materials Research Laboratory, Maharashtra	1
=14	Netaji Subhas Engineering College, WB	1
=14	New Horizon College of Engineering, Bangalore, Karnataka	1
=14	Nimra Cerglass Technics Pvt Ltd, AP	1
=14	North University of China, China	1
=14	Osaka Prefecture University, Japan	1
=14	Osmania Univeristy, Andhra Pradesh	1
=14	Petroleum Conservation Research Association, New Delhi	1
=14	Prof Emeritus of Kyiti University, Japan	1

=14	PSG College of Technology, Tamil Nadu	1
=14	Punjab Engineering College, Punjab	1
=14	Research Institute for Humanity and Nature, Japan	1
=14	Rourkela Steel Plant, Orissa	1
=14	Shahid bahonar University, Iran	1
=14	Siddaganga Institute of Technology, Tumkur, Karnataka	1
=14	Silpa-Sadana, Visva-Bharati, WB	1
=14	Tata Consultancy Services, Pune, Maharashtra	1
=14	Tata Refractories, Orissa	1
=14	Tata Research Development and Design Centre, Pune, Maharashtra	1
=14	Tata Steel, Jharkhand	1
=14	Technical University Freiberg, Germany	1
=14	Thapar Institute of Engineering and Technology, Punjab	1
=14	The Chatterjee Group, Kolkata, WB	1
=14	Tsinghua University, Beijing, China	1
=14	The Energy and Resources Institute, Karnataka	1
=14	Tata Institute of Fundamental Research, Mumbai, Maharashtra	1
=14	The Queen's University, UK	1
=14	Tokyo Institute of Technology, Japan	1
=14	Tumkur University, Karnataka	1
=14	University of Adiyaman, Turkey	1
=14	University of Burdwan, WB	1
=14	University of Cadiz, Spain	1
=14	University of Cukurova, Turkey	1
=14	University of Kalyani, WB	1
=14	University of Keele, UK	1
=14	University of Leeds, UK	1
=14	University of Northern British Columbia, Canada	1
=14	University of Seville, Spain	1
=14	WB University of Animal and Fisheries Sciences, WB	1
=14	Wuhan University of Science and Technology, China	1

Fig. 3 shows the distribution pattern of contributions within different states in India. Out of 268 Indian contributions, West Bengal contributes 108 (40.30%), followed by Maharashtra supplies 29 (10.82%), and Tamil Nadu 21 (7.84%) and Uttar Pradesh 19 (7.09%). And the rest of the states contribute as Gujarat and Karnataka 17 each, Andhra Pradesh 16, Orissa and Jharkhand 10 each, Kerala 9, Punjab 6 and Haryana, New Delhi and Uttaranchal each contribute 2 articles.

Fig. 3 Geographical distribution of contributions in India

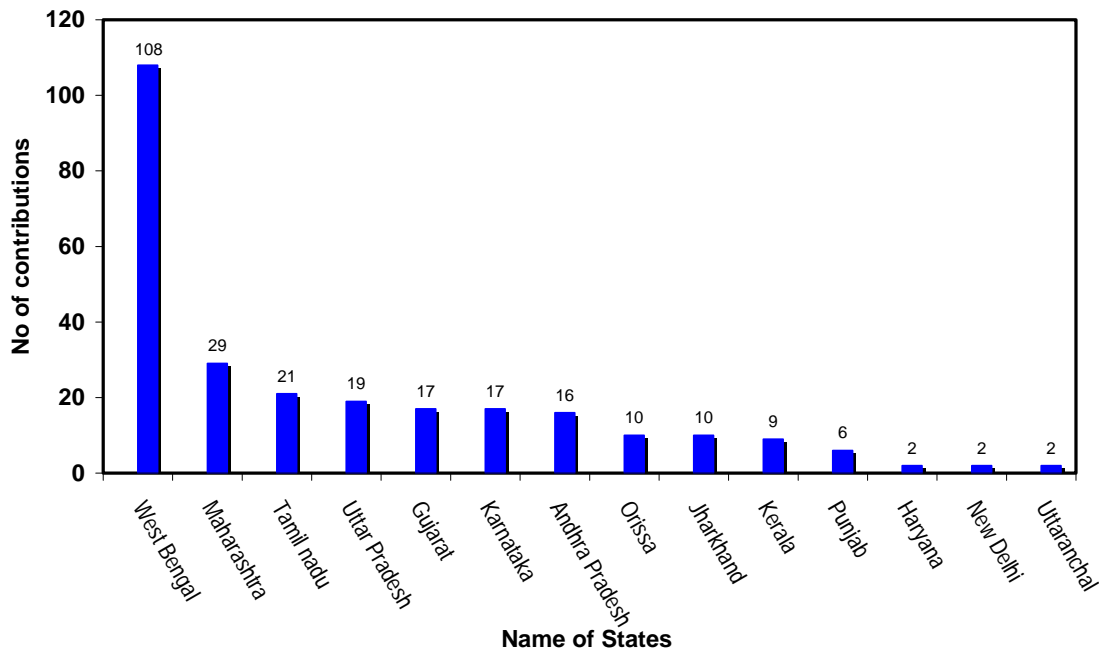
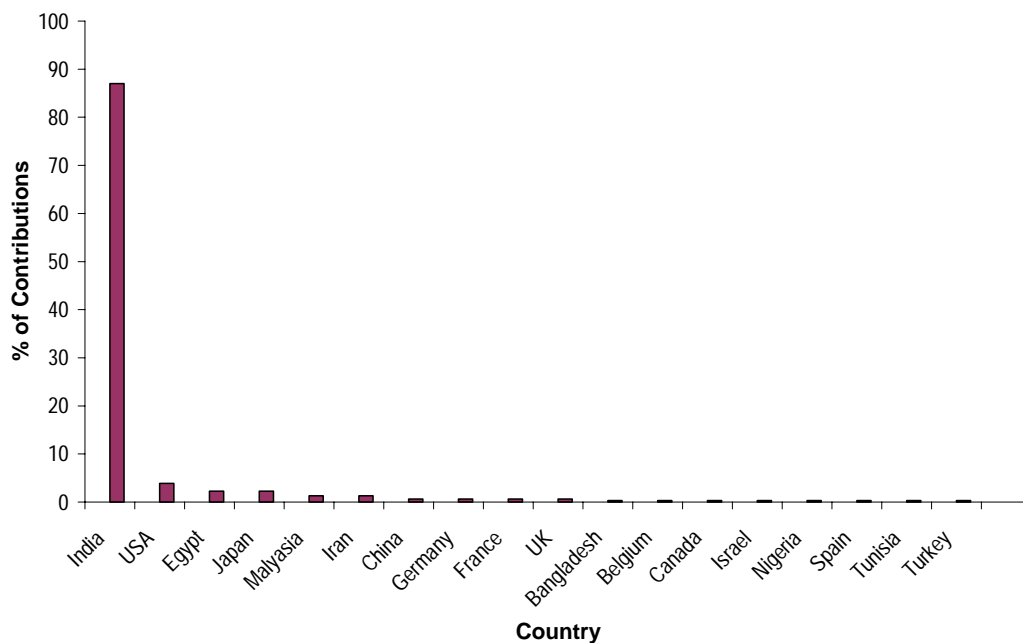


Fig. 4 exhibits the geographical distribution of contributions at international level. Out of total 308 contributions, Indian contribution is 268 (87.01%), followed by USA 12 (3.9%). Other contributors have the percentage as Egypt and Japan 2.27 each, Malaysia and Iran have 1.30 each. Apart from that China, Germany France and UK have 2 contributions each and Bangladesh, Belgium, Canada, Israel, Nigeria, Spain, Tunisia and Turkey have 1 contribution each.

Fig. 4 Geographical distribution of contributions in international level



7.9 National and international collaboration

Trend of modern scientific research is collaborative in nature. Collaboration may be within different institutions of any country (national collaboration) or may be within different institutions of two or more countries (international collaboration). The journal *Transactions of the Indian Ceramic Society* has also these features. The number of papers written in national collaboration is 77 (25%) and that of written in international collaboration is 10 (3.25%).

7.10 Keyword analysis

Keyword is closely linked to, or describes or defines, a particular subject. They are central to a subject matter. It is a term that captures the essence of the topic of a document. A keyword is an index entry that identifies a specific record or document. So keyword analysis of the journal represents overall picture of the articles published during the period.

Keywords are taken mainly from the title and sometimes from abstract and also from author keyword where it is available. The most used keywords are given in Table-9. The keyword 'Composites' is associated with 30 articles, followed by Glass related with 22 articles, 'Alumina' with 20, 'Sol-gel process' with 18 articles each, 'Refractories' with 11 articles, 'Tiles' with 11 articles and 'Cement' with 10 articles. It is found that most of the research articles are 'nano' related, viz. nanocomposite, nanopowder, nanosolution, nanoparticle, nanoclay, etc.

Table-9 Most used keywords

Rank	Keyword	No. of articles associated with
1	Composite	30
2	Glass	22
3	Alumina	20
4	Sol-gel Process	18
5	Refractories	11
=5	Tile	11
6	Cement	10
7	Titania	7
8	Ferroelectric ceramic	6
=8	Ferrite	6
9	Bioceramic	5
=9	Ceramic fiber/ whisker	5
=9	Clay	5
=9	Silicon carbide	5
10	Dielectric ceramic	4
=10	Ceramic foam/membrane	4
=10	Glass ceramic	4
=10	Sensor	4
=10	Silica	4
=10	Traditional ceramic	4
=10	Brick	4
11	Corderite	3

=11	Crockery	3
=11	Kiln	3
=11	Sintering	3
=11	SOFC	3
=11	YAG	3

8. FINDINGS

From the above study, the following findings can be drawn:

- There is no consistency in numbers of publishing articles from 2000 to 2011. It varies from 19 to 32.
- Authorship pattern shows that double authorship occupies the first position 28.57% followed by triple authorship occupies 26.30%. The single authorship acquires 13.31%. So there is a consistency in authorship.
- Contribution of CG&CRI, Kolkata scientists is the maximum. Out of 308 papers, CG&CRI, Kolkata contributes 50 articles. On the other hand, CG&CRI, Kolkata, Naroda and Khurja as a whole contribute 80 papers which is 25.97 % of the total contributions.
- Citation analysis reveals that the authors are mostly dependent on journals, the source of nascent thoughts. Out of 8536 citations, 80.51% is journals. It is also very clear that there is a gradual increase in using e-resource as a source of information.
- There is a gradual increase in citation numbers after 2006 due to easy availability of journal articles and patents on the net.
- During the period, 108 citations have been taken from the source journal, *Transactions of the Indian Ceramic Society*, out of which, the number of self-citation is 64.
- The degree of collaboration in *Transactions of the Indian Ceramic Society* is 0.867 which clearly indicates its dominance upon individual contribution.
- From the geographical distribution of contributions, it is evident that West Bengal supplies highest contributors (40.32%) followed by Maharashtra (10.82%) and in international level, Indian contribution is 87.01% and foreign contribution is 12.99%.
- From the keyword analysis, it is found that 8.77% articles are related with *composite*, 7.47% deals with *glass and* 5.84% is *alumina* and *alumina castables* related articles.
- 25% articles (77 nos.) are written with national collaboration whereas only 3.25% (10 nos.) articles are written with international collaboration.

10. CONCLUSION

Transactions of the Indian Ceramic Society is a reputed journal in the field of glass and ceramics and it is the only publication of its kind and level in India. Bibliometric analysis shows that most of the contributions are collaborative in nature. Increase in multiple authorship and collaboration between researchers is the indication of growing professionalism in different fields. Double-authored contributions occupy the first position (28.57%) to the total contributions published within this period (2000-2011). Regarding source materials, journal places the first position and e-resource gradually plays an important role. A good number of articles are written by the authors of international institutions. Geographical distribution of contributions in international level shows that among 15 countries, India has the priority for research compared to other countries. A remarkable attribute of this study is that, this journal really includes fruitful research for the researcher.

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