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Contribution and Citation Impact of Materials Science Research in India, 2001-10

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ABSTRACT

The paper analyses quantitatively the Indian research in Materials Science during 2001-2010 on several parameters including publication growth and rank, country-wise contribution, material-wise contribution, share of international collaborative linkages and leading collaborating countries, most productive Indian institutions and authors, and characteristics of high cited papers.

Keywords: Scientometric, global publication share, India publication output

1. INTRODUCTION

Materials are the basic substances. They can be natural like wood or human-made like plastic. Material scientists create and combine materials in new ways; their numbers is almost very large. There are now about 30,000 different known-materials. Materials Science covers a huge range of activities and touches upon different fields including chemistry, biology, applied physics, chemical, mechanical, civil and electrical engineering, etc.[1] Materials Science is an interdisciplinary field where scientists conduct a systematic investigation of each material, in terms of its structure, properties, processing, and performance. The research often leads to new applications of known materials and the creation of new materials with desired properties. The basis of Materials Science involves relating the desired properties and relative performance of a material in a certain application to the structure of the atoms and phases in that material through characterisation. The major determinants of the structure of a material and thus of its properties are its constituent chemical elements and the way in which it has been processed into its final form. These characteristics, taken together and related through the laws of thermodynamics, govern a material's microstructure, and thus its properties[2]. Materials Science is one of the oldest forms of applied science and engineering. In the history of human civilisation, different eras have often been retrospectively identified according to an advance in the human ability to work with a new type of material. Examples are the Stone Age, Bronze Age, and Iron Age. A major breakthrough in the understanding of materials occurred in the late nineteenth century, when Willard Gibbs demonstrated that thermodynamics relating to atomic structure in various phases are related to the physical properties of a material. Many important elements of modern Materials Science have resulted from the space race. In particular, the understanding and engineering of metallic alloys, ceramics, and other materials were useful for the construction of space vehicles, space suits, and so forth, and the new knowledge was found valuable for various consumer and industrial applications as well. Materials Science has laid the physical foundations of 21st century civilisation, and will continue to be centrally important in the quest for finding technological solutions toward sustainable development in the face of environmental degradation and the continued buildup of greenhouse gases due to the burning of carbon-based fuels[3].

In the past, only a few scientometric studies have been conducted in this area. Among these studies, one of the earliest studies was conducted by Kochhar[4], *et al.* on the analysis of research output from Indian institutions in seven categories of materials, namely, metals and alloys, aluminum, ceramics, composites, glass, polymers and wood during 1980-89 as per the database developed by INSDOC under a funded project from TIFAC. Mohan[5] *et al.*

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analysed 2587 international collaborative papers from Indian scientists during 1995-99, as covered in *Materials Science Citation Index*. It analysed the nature of collaboration and the countries of collaboration along with the areas of subject emphasis. Walke[6] *et al.* made a quantitative assessment of Indian Materials Science output (9545 papers) during 1993-2001 using *Web of Science* database. It analysed growth, size of publications output and research quality, media of communication, strong and weak areas of research, nature of collaboration and institutional productivity. Kshitij & Sinha[7] dealt with Indian materials production and trade, R&D strategy and knowledge generation (research output) in universities and research institutes and extent of international collaboration in publications by different type of materials. Bakshi[8] attempts to provide a broad picture of priority areas in Materials Science research and identification of leading institutions in India. Kademani[9], *et al.* analysed 14849 Indian publications in Materials Science during 1999-2008 using Scopus database. It analysed India's publications growth, citation impact, international collaborative papers share, leading institutions and authors, etc. Adams & Pendlebury[10] examine the origin and nature of Materials Science field, review its growth globally and identified the key players and also looks selectively at some of its current diversity in terms of hot topics.

2. OBJECTIVES

The main purpose of this study is to analyse the research performance of India in Materials Science as reflected in its publications output during 2001-10. The objectives are to study: (i) Indian research output, its growth, rank and global publications share; (ii) Patterns of international collaboration and identify the major collaborative partners; (iii) Contribution by different types of materials and their citation impact; (iv) Publications productivity and citation impact of leading institutions and authors; and (v) Characteristics of its high cited papers.

3. METHODOLOGY AND SOURCE OF DATA

The study used *Scopus* database (http://www.scopus.com) to extract relevant data on Materials Science research in India and other most productive countries for the past ten years (2001-10). Scopus is the international multidisciplinary database indexing 18000 peer-reviewed journals (including 1800 open access journals), besides more than 500 international seminar/conference proceedings, 400 trade publications and 300 book series. In this analysis, all types of items included in the database are covered. A three-year citation window has been used for counting the citations received and to access the impact of Indian research output. The main search strategy string used for generating Indian publications output in medicine was as follows: "affil(India) and pubyear aft 2000 and pubyear bef 2011 and (limit-to (subjarea, "mate")). For generating research output on different types of materials, research strategies were developed which primarily used materials name in title, abstract and keywords. For calculating the total international collaborative papers in Materials Science, a separate search strategy, which combines India's collaboration with 140 countries, was prepared and this strategy was combined with the main string and search strategy to generate India's total collaborative papers. For analysing institutional, authors' and journals' output, separate search strategies were evolved and these strategies were combined with the main search strategy to generate the desired output.

4. ANALYSIS

4.1 Global Publication Share and Rank of Top 20 Countries

India ranks 8th among the top 20 countries in Materials Science, with its global publication share of 3.87 per cent computed on cumulative publications output during the period 2001-10. Overall the global publication shares of the top 20 countries in Materials Science ranged from 0.98 per cent to 18.27 per cent. China tops the list with global publication share of 18.27 per cent, followed by United States with 13.50 per cent share. Japan ranks third followed by Germany, France, South Korea and United Kingdom (their global publication share ranging from 4.24 % cent to 9.41 %). India, Russia, Italy, Canada, Taiwan and Spain take up the 8th to 13th positions (their global publications share ranging from 2.23 % to 3.87 %). The countries that rank between 14th and 20th positions are Poland, Australia, Brazil, Netherlands, Switzerland, Sweden and Singapore with their global publications share ranging from 0.98 per cent to 1.69 per cent during 2001-10 (Table 1). The developed countries that have shown decline in their global publications share from 2001-05 to 2006-10 are: Japan by 1.92 per cent, followed by Russia (1.76 %), Germany (0.60 %), UK (0.24 %), France (0.19 %), Sweden (0.14 %) and Poland (0.0.11 %). In contrast, the developed countries that have shown increase in their publications share from 2001-05 to 2006-10 are: USA by 0.33 per cent, followed by Canada (0.29 %), Australia (0.22 %), Spain and Switzerland (0.16 % each), Italy (0.07 %) and Netherlands (0.02 %) (Table 1). Most of the developing countries on the other hand have shown rise in their global publications share include China, South Korea, India, Taiwan, Singapore, and Brazil from 2001-05 to 2006-10. China has shown the most significant rise in its publications share from 12.13 per cent to 22.13 per cent, followed by South Korea from 3.64 per cent to 4.83 per cent and their world ranking improved from 2nd to 1st and from 8th to 5th. The shift in India's global publication share from 3.25 per cent to 4.26 per cent also improved its world ranking from 9th to 7th during the corresponding years (Table 1).

Table 1. Publication productivity and world share of top 20 countries in Material Science, 2001-10

Country	Number of papers			% share of papers			Rank of countries		
	01-05	06-10	01-10	01-05	06-10	01-10	01-05	06-10	01-10
China	66808	193435	260243	12.13	22.13	18.27	2	1	1
USA	73205	119158	192363	13.30	13.63	13.50	1	2	2
Japan	58312	75788	134100	10.59	8.67	9.41	3	3	3
Germany	38762	56320	95082	7.04	6.44	6.67	4	4	4
France	26835	40887	67722	4.87	4.68	4.75	5	6	5
South Korea	20053	42226	62279	3.64	4.83	4.37	8	5	6
UK	24165	36254	60419	4.39	4.15	4.24	7	8	7
India	17869	37214	55083	3.25	4.26	3.87	9	7	8
Russia	26804	27215	54019	4.87	3.11	3.79	6	9	9
Italy	13712	22384	36096	2.49	2.56	2.53	10	11	10
Canada	11974	21538	33512	2.17	2.46	2.35	11	12	11
Taiwan	10103	23108	33211	1.84	2.64	2.33	13	10	12
Spain	11722	19999	31721	2.13	2.29	2.23	12	13	13
Poland	9688	14456	24144	1.76	1.65	1.69	14	14	14
Australia	7708	14200	21908	1.40	1.62	1.54	15	15	15
Brazil	7074	11940	19014	1.28	1.37	1.33	16	16	16
Netherlands	6396	10291	16687	1.16	1.18	1.17	17	17	17
Switzerland	5380	9974	15354	0.98	1.14	1.08	19	18	18
Sweden	6279	8745	15024	1.14	1.00	1.05	18	20	19
Singapore	5000	8911	13911	0.91	1.02	0.98	20	19	20
World	550541	874153	1424694	100.00	100.00	100.00			

4.2 India's Publication Growth Rate in World

The developed and developing countries differ significantly in their annual average publication growth rate in Materials Science during 2001-10. Whereas the developed countries have comparatively slower annual average growth rate (ranging from 2.94 % to 13.69 %). The developing countries on the other hand have shown significantly faster annual average growth rates (10.55 % to 21.39 %) as seen from annual research output data on papers published by developed and developing countries during 2001-10 (Table 2).

4.3 India Publications Output

India's annual publications grew from 2949 publications in 2001 to 9909 publications in 2010, witnessing an annual average growth rate (AAGR) of 14.59 per cent.Its cumulative publications output increased from 17869 during 2001-05 to 37214 publications during 2006-10, witnessing a growth rate of 108.26 per cent (Table 3).

4.4. Status of India's International Collaboration

India's share of international collaborative papers was 20.22 per cent in its cumulative national publications output in Materials Science during 2001-10. India witnessed increase in its national share of international collaborative papers from 18.55 per cent during 2001-05 to 21.02 per cent during 2006-10 (Table 3).

Table 2. Annual average growth rate of different countries

Country	AAGR	Country	AAGR
World	8.24	Canada	11.45
China	21.39	Taiwan	14.84
USA	11.77	Spain	9.75
Japan	5.03	Poland	8.25
Germany	8.11	Australia	12.71
France	8.15	Brazil	10.55
South Korea	14.05	Netherlands	9.02
UK	7.72	Switzerland	13.69
India	14.59	Sweden	6.48
Russia	2.94	Singapore	12.66
Italy	9.95		

Table 3. Indian research output

Year	TP	ICP	% ICP
2001	2949	443	15.02
2002	3223	507	15.73
2003	3520	744	21.14
2004	3812	781	20.49
2005	4365	840	19.24
2006	5394	1024	18.98
2007	5950	1105	18.57
2008	7036	1357	19.29
2009	8925	2015	22.58
2010	9909	2321	23.42
2001-05	17869	3315	18.55
2006-10	37214	7822	21.02
2001-10	55083	11137	20.22

TP=Total papers; ICP=International collaborative papers.

Among the top 20 collaborating countries with India, the leading ones from the developed countries that had significant collaboration with India are United States with 22.07 per cent international collaborative publications share, followed by Germany (16.26 %), Japan (11.20 %), UK (7.97 %), France (7.50 %), Italy (4.0 per cent).

Among the top 20 collaborating countries with India, the leading ones from the developing countries that had significant collaboration with India are South Korea with 10.16 per cent followed by Taiwan (4.18 %), Malaysia (4.04 %), Singapore (2.10 %), China (2.10 %) and Brazil (1.51 %) during 2001-10 (Table 4).

India witnessed both rise and fall in the share of international collaborative papers with different countries from 2001-05 to 2006-10. Among developed countries, it had witnessed the largest decrease (4.03 %) with Japan, followed by Germany (3.52 %), USA (3.32 %), Netherlands (0.75 %), UK (0.68 %), Canada (0.37 %), etc. as against increase with countries such as Poland (0.68 %), France (0.67 %), etc.

India witnessed increase in the share of international collaborative papers with most of the developing countries, with maximum increase with South Korea (5.53 %), followed by Malaysia (4.16 %), China (0.89 %), Brazil (0.30 %), and Singapore (0.03 %) as against decrease with Taiwan by 2.09 % (Table 4).

4.5 Type of Material

In terms of types of material, the maximum output (25786 papers, 46.81 % share) of India was in the area of polymers during 2001-10, followed by composite (10298 papers, 18.70 %), alloys (9588 papers, 17.41 %), coatings/film (7271 papers, 13.20 %), optical material (5024 papers, 9.12 %), ceramics (4086 papers, 7.42 %), semi-conducting materials (3314 papers, 6.02 %), liquid crystals (2417 papers, 4.39 %), electronic materials (2000 papers, 3.63 %), biomaterials (735 papers, 1.33 %) and photonic materials (231 papers, 0.42 %). In terms of citation impact, the maximum citation impact of 6.28 was achieved by biomaterials, followed by electronic materials (5.05), polymers (4.75), etc., during 2001-10 (Table 5).

4.6 Indian Most Productive Organisations in Materials Science

The top 40 most productive Indian institutions involved in Materials Science research have published 170 and more papers each during 2001-10. The publications profile of these 40 Indian institutions along with their research output, citations received and *h*-index values are presented in Table 8. These 40 Indian institutions involved in Materials Science research together have contributed 65.59 per cent share (with 36130 papers) in the cumulative publications output of India in Materials

Table 4. India's collaborative papers with different countries, 2001-10

S. No.	Collaborating country	India's collaborative papers with different countries			Share of India's collaborative papers with different countries (%)		
		2001-05	2006-10	2001-10	2001-05	2006-10	2001-10
1	USA	809	1649	2458	24.40	21.08	22.07
2	Germany	621	1190	1811	18.73	15.21	16.26
3	Japan	465	782	1247	14.03	10.00	11.20
4	South Korea	208	923	1131	6.27	11.80	10.16
5	UK	280	608	888	8.45	7.77	7.97
6	France	233	602	835	7.03	7.70	7.50
7	Taiwan	187	278	465	5.64	3.55	4.18
8	Malaysia	37	413	450	1.12	5.28	4.04
9	Italy	134	312	446	4.04	3.99	4.00
10	Canada	107	224	331	3.23	2.86	2.97
11	Spain	67	210	277	2.02	2.68	2.49
12	Australia	87	183	270	2.62	2.34	2.42
13	Singapore	69	165	234	2.08	2.11	2.10
14	China	49	185	234	1.48	2.37	2.10
15	Switzerland	62	135	197	1.87	1.73	1.77
16	Brazil	43	125	168	1.30	1.60	1.51
17	Poland	31	127	158	0.94	1.62	1.42
18	Netherlands	64	92	156	1.93	1.18	1.40
19	Sweden	32	117	149	0.97	1.50	1.34
20	Russia	32	90	122	0.97	1.15	1.10
	Total	**3315**	**7822**	**11137**	**100.00**	**100.00**	**100.00**

Table 5. Research output and citation impact of India and CSIR in different types of materials, 2001-10

Material type	India			
	TP	TC	Citation	Impact
Polymer	25786	122483	4.75	
Composite	10298	39356	3.82	
Alloys	9588	29965	3.13	
Coatings/films	7271	28847	3.97	
Optical material	5024	21699	4.32	
Ceramics	4086	12474	3.05	
Semi-conducting material	3314	13879	4.19	
Liquid crystal	2417	10167	4.21	
Electronic material	2000	10091	5.05	
Biomaterial	735	4616	6.28	
Photonic material	231	1003	4.34	

TP=Total papers; ICP=International collaborative papers

Science, with an average of 903.25 papers per institution. Only 13 Indian institutions have registered higher publications share than the group average. These are Indian Institute of Science (IISc), Bangalore with 2798 papers, followed by Indian Institute of Technology (IIT), Kharagpur (2723 papers); Bhabha Atomic Research Centre (BARC), Mumbai (2195 papers); IIT, Delhi (2018 papers); IIT, Madras (1744 papers), IIT, Kanpur (1547 papers); IIT, Bombay (1426 papers); National Chemical Laboratory (NCL), Pune (1258 papers); Indira Gandhi Center for Atomic Energy, Kalpakkam (1225 papers); etc.The average citation per paper registered by the total papers of these 40 Indian institutions is 3.90 during 2001-10. Only 11 Indian institutions have registered higher impact than the group average. The highest impact of 8.61 citations per paper was scored by the Jawaharlal Nehru Centre for Advanced Research (JNCAR), Bangalore, followed by Indian Institute of Chemical Technology (IICT), Hyderabad (6.87); NCL, Pune (6.29); Indian Association for Cultivation of Science, Kolkata (5.30) (Table 6).

The average *h*-index value of these 40 Indian most productive institutions was 27.90 during 2001-10. The 19 Indian institutions have scored higher *h*-index value than group's average of 27.77. The highest *h*-index value (54) was achieved by IISc, Bangalore, followed by NCL, Pune (48); JNCAR, Bangalore (41); IIT, Kharagpur (39); IIT, Delhi (37); Indian Association for Cultivation of Science, Kolkata (36); IICT, Hyderabad (35); IIT, Kanpur (34); etc. (Table 6).

The average share of the international collaborative papers of the top 40 Indian most productive institutions was 21.06 per cent during 2001-10. The 14 Indian institutions have scored higher *h*-index value than group's average of 21.16 per cent. The highest international collaborative papers share (78.32 %) was achieved by Mangalore University, followed by Tata Institute of Fundamental Research, Mumbai (40.30 %); University of Mysore (40.28 %); Sri Venkateshwar University, Tirupati (31.94 %); Mahatma Gandhi University, Kottyam (31.94 %), University of Hyderabad (29.06 %); Indian Association for Cultivation of Science, Kolkata (27.90 %); University of Calcutta (26.64 %); IIT, Bombay (26.02 %); Jadavpur University, Kolkata (25.52 %); IIT, Kanpur (25.08 %); University of Pune (24.83 %); Jawaharlal Nehru Centre for Advanced Research, Bangalore (24.57 %) and Anna University, Chennai (22.96 %) (Table 6).

4.7 Top Authors Productivity and Impact

Fifteen authors having been identified as most productive who have published 119 and above papers in materials research during 2001-10. These 15 authors together contributed 2516 papers with an average of 167.73 papers per author and account for 4.57 per cent share in the cumulative publications output of India during 2001-10. Seven authors have published higher number of papers than the group average (167.73). These are: Baldev Raj with 238 papers, followed by A.K. Tyagi (236 papers), R.N.P. Choudhary (203 papers), D.K. Avasthi (189 papers), B.T. Gowda (187 papers), A.K. Bhowmick (186 papers) and S.A. Thomas (175 papers). Considering the quality/impact of papers, these authors have received a total of 12740 citations for 2516 papers with an average of 5.06 citations per paper. Six authors have registered higher impact than the average impact of papers of all authors (5.06). These are: C.N.R. Rao with 16.52 citations per paper, C.D. Lokhande (7.03 citations per paper), A.K. Bhowmick (7.02 citations per paper), T.M. Aminabhavi (6.09 citations per paper), M.T. Sebastian (6.05 citations per paper) and B. Basu (5.63 citations per paper). Measuring the performance of these authors on the basis of *h*-index, eight authors have achieved the higher *h*-index value than the group average of 18.13. These authors are C.N.R. Rao with *h*-index of 33, followed by S.A. Thomas (26), A.K. Bhowmick (24), T.M. Aminabhavi (23), C.D. Lokhande (22), M.T. Subastian (19), B. Basu (19), and Baldev Raj (19) (Table 7).

4.8 Research Communication in High Productive Journals

The 15 most productive Indian and foreign journals publishing Indian research papers in Materials Science together contributed 13079 papers, which accounts for 23.74 per cent of the total output of India during 2001-10. The cumulative publications output share of these 15 most productive journals showed a decrease in India's publications output from 24.63 per cent during 2001-05 to 23.32 per cent during 2006-10.

5. HIGH CITED PAPERS

The characteristics of top 109 most cited papers of India in Materials Science were also evaluated. The 100 most high-cited papers have received citations (since

Table 6. Productivity and impact of 25 major Indian institutions in Materials Sciences, 2001-10

Name	TP	TC	ACPP	*h*-index	HCP	%HCP	ICP	% ICP
IIS, Bangalore	2798	13597	4.86	54	13	0.46	702	25.09
IIT, Kharagpur	2723	10703	3.93	39	4	0.15	454	16.67
BARC, Mumbai	2195	7316	3.33	34	2	0.09	432	19.68
IIT, Delhi	2018	6536	3.24	37	3	0.15	339	16.8
IIT, Madras	1744	6629	3.8	33	2	0.11	308	17.66
IIT, Kanpur	1547	5886	3.8	34	2	0.13	388	25.08
IIT, Bombay	1426	5254	3.68	31	4	0.28	371	26.02
NCL-Pune	1258	7916	6.29	48	14	1.11	222	17.65
IGCAR, Kalpakkam	1225	3140	2.56	28	0	0	194	15.84
IACS, Kolkata	1165	6177	5.3	36	2	0.17	325	27.9
Anna University, Madras	1154	3632	3.15	31	2	0.17	265	22.96
Jadavpur University, Kolkata	1066	4146	3.89	31	1	0.09	272	25.52
NPL, Delhi	931	3285	3.53	25	0	0	193	20.73
IIT, Roorkee	879	3072	3.49	25	1	0.11	112	12.74
University of Delhi	810	2503	3.09	22	0	0	152	18.77
CECRI, Karaikudi	734	2904	3.96	30	0	0	133	18.12
DMRL-Hyderabad	664	2037	3.07	25	2	0.3	63	9.49
IICT, Hyderabad	658	4522	6.87	35	6	0.91	83	12.61
Cochin University of Science & Technology, Kochi	651	2196	3.37	28	0	0	120	18.43
Shivaji University, Kolhapur	622	3065	4.93	30	0	0	120	19.29
National Institute of Interdisciplinary Science &Technology, Thiruvanathapuram	609	3216	5.28	33	4	0.66	117	19.21
NML, Jamshedpur	607	1860	3.06	23	0	0	98	16.14
Jawahar Lal Nehru Centre for Advanced Research, Bangalore	582	5012	8.61	41	5	0.86	143	24.57
Banaras Hindu University, Varanasi	581	1724	2.97	21	0	0	107	18.42
Inter University Accelrator Centre, Delhi	547	1569	2.87	18	0	0	72	13.16
University of Madras	536	1506	2.81	22	1	0.19	83	15.49
Tata Institute of Fundamental Research, Mumbai	531	1618	3.05	22	1	0.19	214	40.3
University of Hyderabad	530	2563	4.84	26	3	0.57	154	29.06
CGCRI, Kolkata	505	1795	3.55	25	0	0	68	13.47
IIT, Guwhati	489	1828	3.74	21	0	0	52	10.63
Mangalore University	489	1208	2.47	15	0	0	383	78.32
Sri Venkateswar University, Tirupati	454	1699	3.74	22	0	0	145	31.94
University of Calcutta	443	1675	3.78	23	0	0	118	26.64
University of Pune	443	2006	4.53	26	1	0.23	110	24.83
CLRI, Madras	442	1168	2.64	19	0	0	41	9.28
University of Mysore	432	1066	2.47	18	0	0	174	40.28
Mahatma Gandhi University, Kottyam	431	1694	3.93	30	4	0.93	127	29.47
NIT, Thiruchirapally	423	1107	2.62	15	0	0	35	8.27

their publications till 1 October 20011) from 100 to 663 during 2001-10. These 109 high-cited papers have received 17356 citations, with an average of 159.22 citations per paper. Of these 109 papers, 81 appeared as articles, 26 as reviews and 2 as conference papers. Of these, 51 involve international collaboration (45 bilateral and 6 multilateral), 16 involve national collaboration and 42 papers zero collaboration. Among the 51 international collaborative papers, India is the lead author in 17 papers only. Of the 109 most cited papers, 1 paper is in citation range of 600-699, 3 papers in citations range of 400-499, 4 papers in citations range of 300-399, 13 papers in citation range of 200-299 and 88 papers in citations range of 100-199.

The authors of these high cited papers are affiliated to 64 Indian institutions, including 15 papers from NCL, Pune, 13 papers from IISc, Bangalore; 7 papers from IICT, Hyderabad; 5 papers each from IIT, Mumbai; IIT Kharagpur and Jawaharlal Nehru Center for Advanced Scientific Research, Bangalore, 4 papers each from IIT, New Delhi; Mahatma Gandhi University, Kottayam; and

Table 7. Contribution and impact of most productive Indian authors in Material Science, 2001-10

Author name	Affiliation	TP	TC	ACPP	*h*-index
Baldev Raj	Indira Gandhi Centre for Atomic Research, Metalurgy and Materials Group, Kalpakam	238	735	3.09	19
A.K. Tyagi	Indira Gandhi Centre for Atomic Research, Surface and Nano Sc. Division, Kalpakam	236	1085	4.60	18
R.N.P. Choudhary	Indian Institute of Technology, Deptt. of Physics and Meterology, Kharagpur	203	644	3.17	15
D.K. Avasthi	Inter University Accelerator Centre India, Material Sc. Group, New Delhi	189	633	3.35	14
B.T. Gowda	Mangalore University, Deptt. of Chemistry, Mangalagangotri	187	557	2.98	10
A.K. Bhowmick	Indian Institute of Technology, Kharagpur	186	1306	7.02	24
S.A. Thomas	Mahatma Gandhi University, School of Chemical Sc., Kottayam	175	846	4.83	26
T.M. Aminabhavi	Karnatak University, Deptt. of Chemistry, Dharwad	159	969	6.09	23
C.N.R. Rao	Indian Institue of Science, Solid State & Structural Chemistry Unit, Bangalore	155	2561	16.52	33
B.S. Murthy	Indian Institute of Technology, Deptt. of Metallurgy and Material Engineering, Chennai	139	635	4.57	16
V. Raghavan	Indian Institute of Technology,Delhi	137	28	0.20	3
C.D. Lokhande	Shivaji University, Deptt. of Physics, Kolhapur	133	935	7.03	22
B. Basu	Indian Institue of Science, Materials Research Centre, Bangalore	131	737	5.63	19
D.K. Khanjilal	Inter University Accelerator Centre India, New Delhi	129	349	2.71	11
M.T. Sebastian	National Institue of Interdisciplinary Sc. & Technology, Thiruvananthapuram	119	720	6.05	19

Table 8. List of most productive journals publishing Indian papers in Material Science, 2001-10

Journals	Number of papers		
	2001-05	2006-10	2001-10
Journal of Applied Polymer Science	765	1174	1939
Journal of Alloys & Compounds	249	869	1118
Acta Crystallographica Section E. Structure Reports Online	0	1102	1102
Materials Letters	447	483	930
Bulletin of Material Science	477	431	908
Physica B.Condensed Matter	281	602	883
Materials Chemistry and Physics	359	479	838
Material Science and Engineering A	315	493	808
Journal of Physics Condensed Matter	241	515	756
Journal of Material Science	287	463	750
Polyhedron	192	470	662
Journal of Nanoscience and Nanotechnology	77	544	621
Applied Surface Science	174	447	621
Solid State Communications	239	373	612
Indian Journal of Engineering and Material Science	299	232	531
Total	4402	8677	13079
Total of the country	17869	37214	55083
Share of Top 15 journals in country (Total)	24.63	23.32	23.74

Regional Research Laboratory, Thiruvanathapuram; 3 papers each from IIT, Kanpur and University of Hyderabad; 2 papers each from Anna University, Chennai; BARC, Mumbai, Central Institute of Plastic Engineering & Technology, Bhubaneswar; Centre for Materials for Electronics Technology, Pune; Defence Materials Research Laboratory, Hyderabad; Government Autonomous Science College, Jabalpur; Indian Association for Cultivation of Science, Kolkata; Indian Institute of Technology, Chennai; International Advanced Research Center for Powder Metallurgy, Hyderabad; Revenshaw College, Cuttack; and 42 other Indian institutions with 1 paper each.

The 109 high-cited papers in Materials Science have appeared in 50 journals, including 9 papers each in *Progress in Polymer Science and Chemistry of Materials*, 8 papers in *NanoLetters*, 6 papers in *Macromolecules,* 5 papers in *Journal of Materials Chemistry*, 4 papers each in *Materials Chemistry and Physics, Industrial & Engineering Chemistry Research, Crystal Growth and Design, Composites Science and Technology and Acta*

Materialia, 3 papers each in *Journal of Membrane Science and Advanced Materials*, 2 papers each in *Surface & Coating Technology, Solar Energy Materials & Solar Cells, Progress in Materials Science, Polymer, Nanotechnology*, *Journal of Nanoscience and Nanotechnology*, *European Polymer Journal and Biomacromolecules*, and 30 journals with one paper each.

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