

Scientometric study of global electron probe microanalysis literature

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ABSTRACT

This paper attempts to highlight the quantitative and qualitative growth and development of the literature on electron probe microanalysis in terms of publication output as per Web of Science (1992–2013) database. A total of 6853 publications and 60,958 citations to these publications were received. The average number of publications published per year was 311.50. The highest number of publications (436) was published in 2013. The highest number of citations (4266) was received in 2004. The average citations per publication were 8.90 and the average impact factor per publication was 1.44. The collaboration trend is toward multi-authored publications. Majority of the countries prefer to work in a large group in this field. Japan topped the list with 1674 publications followed by People's Republic of China with 1390 publications, USA with 538 publications, Germany with 499 publications, France with 460 publications, the South Korea with 405 publications, and India with 379 publications. The highest number of publications was published in Materials Sciences with 2763 publications, followed by Chemical Sciences with 1529 and Engineering Sciences. The highly productive institutions were: Chinese Academy of Sciences People's Republic of China followed by Tohoku University, Japan, Shandong University, People's Republic of China, University of Antwerp, Belgium and University of Tokyo, Japan.

Keywords: Degree of collaboration, electron probe micro analysis, highly productive institutions, publication productivity

INTRODUCTION

Electron probe microanalysis (EPMA) has developed over the past 20 years into a generally accepted analytical method. The basis of this powerful micro-analytical technique is simple: Electrons emitted from a hot filament are accelerated and focused onto a sample surface. Inelastic scattering in the target material leads to the ionization and to the emission of X-rays, characteristic of the elemental composition. The X-rays emerging from the sample are analyzed in appropriate spectrometers and the measured intensities are then related to the composition of the sample.^[1]

Today many problems in surface analysis can be solved, which were beyond our capabilities 20 years ago. Ideally materials research should be supported by the full range of these complementary techniques. Unfortunately, this is rarely the case, in view of the large capital investment required for the acquisition of the instrumentation.

Publication and citation counting techniques have been used in the assessment of scientific activity for at least 50 years. During the half-century of this activity, the main thrust of interest seems to flow along the two connected but parallel paths: The bibliometric path of publication and citation counts as tools for the librarian and an evaluative path using the same tools to illuminate the mosaic of scientific activity.^[2] Research publications are clearly one of the quantitative measures for the basic research activity in a country. It must be added, however, that what excites the common man, as well as the scientific community, are the peaks of the scientific and technological achievement, not just the statistics on publications. There are also other kinds of research and technology development-mission

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Access this article online

Quick Response Code:	
	Website: www.jscires.org
	DOI: 10.4103/2320-0057.167251

oriented, industry-oriented, country-specific, etc., progress in these cannot be obviously measured by counting only the number of publications.^[3] Many scientometric studies have appeared in the literature to focus on the performance of science in various domains.^[4-9] Statistical distribution patterns of published literature on instrumental analytical techniques (1981–1984) has been carried out using Analytical Abstracts.^[10] Scientometric studies are useful in ascertaining which methods have been most employed for various analytical determinations as well as predicting which methods will continue to be used in the immediate future and which appear to be losing favor with the analytical community.^[11]

Objectives

The main objective of the study is to present the growth of EPMA related literature published during 1992–2013 (22 years) as per the Web of Science (WoS) database and make the quantitative and qualitative assessment by the way of analyzing various features of research output which includes the growth of publications and citations, country-wise distribution of publications and citations, subject-wise distribution of publications and citations, highly productive institutions, and highly preferred journals.

MATERIALS AND METHODS

Data were collected from WoS for the period 1992–2013. By using suitable search strategy, records pertaining to “Electron Probe Micro Analysis” in the “Topic field” (electron probe microanalysis or electron probe microanalyzer or EPMA) were downloaded. A total of 6853 publications were retrieved and 60,958 citations to these publications were received. Further, all the bibliographic details were transferred to spreadsheet application. The data were analyzed as per objectives of the study. Journal Citation Report-2012 was used to collect the information related to journal impact factor (IF).

Degree of collaboration is the ratio of the number of collaborative research papers during a certain period of time. As per the formula given by Subramanyam,^[12] for determining the degree of collaboration in a discipline, the value of collaboration will be between 0 and 1.

RESULTS AND DISCUSSION

Year-wise Distribution of Publications and Citations

A total of 6853 publications were retrieved and 60,958 citations to these publications were received. The average

number of publications published per year was 311.50. The highest number of publications (436) was in 2013. The highest number of citations (4266) was received in 2004. The overall average citations per publication (ACP) were 8.90. There is a declining trend of citations in recent years mainly because the older publications tend to receive more citations than younger publications as they require more time to be noticed by the researchers and to find the context and relevance to the cite^[13] and the average IF (AIF) per publication was 1.44. Figure 1 provides the year-wise growth of publications, citations, and average citations per publication on EPMA. It is observed from the Table 1 that the highest growth rate 28.97 was observed in 1996 followed by 23.16 in 2004, 17.32 in 1995 and 12.96 in 2006. An exponential growth of publications was observed which indicates the continuous ongoing research in the field.

Degree of Collaboration

The extent of collaboration can be measured with the help of multi-authored papers. To measure the collaborative research pattern, a simple indicator called degree of collaboration is used. The number of single authored and multi-authored publications is calculated and is applied to the formula: $C = \text{TMAP}/\text{TP}$.

Where:

C = Degree of collaboration

TMAP = Total number of multi-authored publications (6525)

TP = Total number of publications during a certain period of time (6853)

Here:

$$C = 6525/6853 = 0.95$$

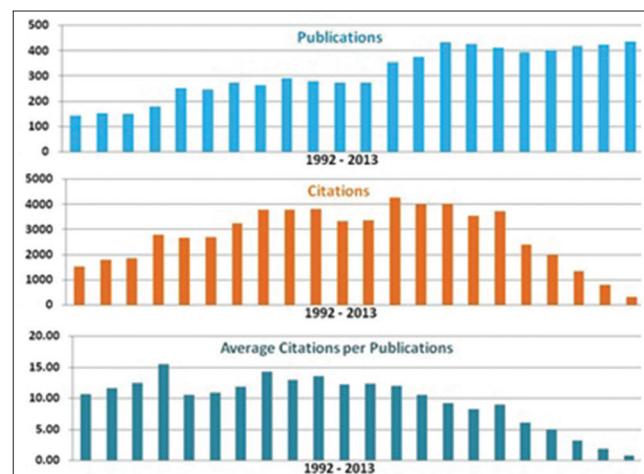


Figure 1: Year-wise distribution of publications, citations, and average citations per publications

Hence, the degree of collaboration of publications on EPMA's authors is 0.95. This indicates that there was more number of collaborative publications (95.21%) than single authored publications (4.79%).

Country-wise Share

There were a total of 94 countries involved in research on EPMA. Japan topped the list with 1674 publications, 9.35 ACP and 1.36 AIF followed by the People's Republic of China with 1390 publications, 5.73 ACP and 1.21 AIF, the USA with 538 publications, 15.36 ACP and 1.88 AIF, Germany with 499 publications, 10.76 ACP and 1.52 AIF, France with 460 publications, 11.61 ACP and 1.76 AIF, the South Korea with 405 publications, 8.75 ACP and 1.72 AIF, India with 379 publications, 7.73 ACP and 1.50 AIF, England with 248 publications, 13.53 ACP and 1.64 AIF, Taiwan with 240 publications, 9.64 ACP and 1.76 AIF, Italy with 186 publications, 11.37 ACP and 1.66 AIF, Canada with 178 publications, 12.24 ACP and 1.56 AIF, Austria with 171 publications, 9.05 ACP and 1.53 AIF, Australia with 169 publications, 9.69 ACP and 1.80 AIF, Belgium with 168 publications, 13.20 ACP and 2.17 AIF, Russia

with 132 publications, 5.61 ACP and 1.27 AIF, Poland with 91 publications, 7.25 ACP and 1.82 AIF, the Netherlands with 89 publications, 11.74 ACP and 1.44 AIF, Spain with 85 publications, 8.21 ACP and 1.67 AIF, Switzerland with 77 publications, 13.99 ACP and 2.07 AIF, Argentina with 58 publications, 7.57 ACP and 2.12 AIF, Brazil with 56 publications, 9.30 ACP and 1.93 AIF, Sweden with 56 publications, 14.57 ACP and 1.89 AIF, Portugal with 54 publications, 8.19 ACP and 1.86 AIF, Czech Republic with 53 publications, 9.81 ACP and 1.55 AIF, and Hungary with 52 publications, 13.33 ACP and 2.46 AIF. Figure 2 gives countries-wise share of publications on EPMA. Table 2 provides the publications and citations and their citation impact of different countries under two broad period blocks (≥ 50 publications).

During 1992–2002 it is observed that the world average growth of publications on EPMA was 36.51%, whereas the countries such as the Netherlands (56.18%), Japan (46.95%), England (45.16%), Germany (44.09%), Sweden (42.86%), Hungary (42.31%), Argentina (41.38%), Austria (40.35%), Belgium (39.88%), Russia (38.64%), USA (37.73%), and France (36.74%) had more than the world average.

During 2003–2013 it is observed that the world average growth of publications on EPMA was 63.41%, whereas the countries such as the South Korea (81.98%), Australia (79.88%), Peoples Republic of China (79.57%), India (78.1%), Canada (75.84%), Spain (71.76%), Czech Republic (71.7%), Poland (70.33%), Switzerland (70.13%), Brazil (69.64%), Taiwan (69.58%), Portugal (68.52%), and Italy (67.2%) had more than the world average. During this period, the countries appeared are altogether new which showed the interest in research in the field.

Top Countries in Different Subject Areas

Japan had the highest number of publications in six subject areas: Biological Sciences, Chemical Sciences,

Table 1: Year-wise growth of literature on EPMA

Year	TP	Percentage of TP	GR	TC	Percentage of TC	ACP	AIF
1992	143	2.09	-	1529	2.51	10.69	1.00
1993	153	2.23	6.54	1789	2.93	11.69	1.24
1994	148	2.16	-3.38	1844	3.03	12.46	1.08
1995	179	2.61	17.32	2775	4.55	15.50	1.19
1996	252	3.68	28.97	2667	4.38	10.58	1.19
1997	246	3.59	-2.44	2688	4.41	10.93	1.13
1998	274	4.00	10.22	3246	5.32	11.85	1.13
1999	264	3.85	-3.79	3786	6.21	14.34	1.35
2000	292	4.26	9.59	3780	6.20	12.95	1.18
2001	279	4.07	-4.66	3800	6.23	13.62	1.54
2002	272	3.97	-2.57	3336	5.47	12.26	1.50
2003	272	3.97	0.00	3358	5.51	12.35	1.43
2004	354	5.17	23.16	4266	7.00	12.05	1.54
2005	376	5.49	5.85	3981	6.53	10.59	1.43
2006	432	6.30	12.96	3989	6.54	9.23	1.65
2007	428	6.25	-0.93	3543	5.81	8.28	1.45
2008	412	6.01	-3.88	3713	6.09	9.01	1.66
2009	395	5.76	-4.30	2400	3.94	6.08	1.60
2010	403	5.88	1.99	1993	3.27	4.95	1.58
2011	419	6.11	3.82	1338	2.19	3.19	1.45
2012	424	6.19	1.18	809	1.33	1.91	1.48
2013	436	6.36	2.75	328	0.54	0.75	1.76
Total	6853	100.00	-	60,958	100.00	8.90	1.44

TP=Total publications, GR=Growth rate of publications, ACP=Average citations per publication, AIF=Average impact factor per publication, EPMA=Electron probe micro analysis, TC=Total number of citations

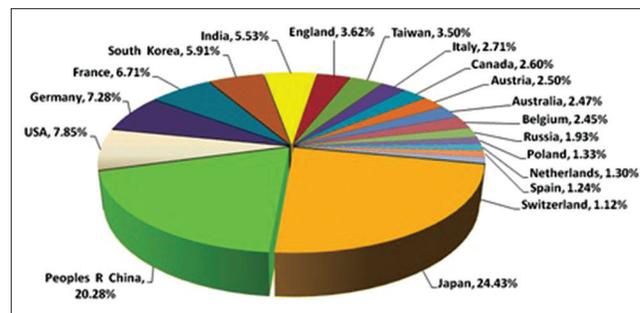


Figure 2: Countries-wise share of publications on electron probe microanalysis

Table 2: Distribution of publications and citations and their citation impact of different countries under two broad period blocks (≥ 50 publications)

Countries	1992-2002				2003-2013				Grand total of TP	Grand total of TC
	TP	Percentage of TP	TC	Percentage of TC	TP	Percentage of TP	TC	Percentage of TC		
World	2502	36.51	31,240	51.25	4351	63.49	29,718	48.75	6853	60,958
Japan	786	46.95	9290	59.33	888	53.05	6368	40.67	1674	15,658
Peoples Republic of China	284	20.43	2540	31.88	1106	79.57	5428	68.12	1390	7968
Germany	220	44.09	3100	57.72	279	55.91	2271	42.28	499	5371
USA	203	37.73	4023	48.67	335	62.27	4243	51.33	538	8266
France	169	36.74	2663	49.86	291	63.26	2678	50.14	460	5341
England	112	45.16	2097	62.50	136	54.84	1258	37.50	248	3355
India	83	21.90	797	27.22	296	78.10	2131	72.78	379	2928
South Korea	73	18.02	1336	37.69	332	81.98	2209	62.31	405	3545
Taiwan	73	30.42	881	38.09	167	69.58	1432	61.91	240	2313
Austria	69	40.35	868	56.07	102	59.65	680	43.93	171	1548
Belgium	67	39.88	1234	55.64	101	60.12	984	44.36	168	2218
Italy	61	32.80	946	44.75	125	67.20	1168	55.25	186	2114
Russia	51	38.64	334	45.07	81	61.36	407	54.93	132	741
Netherlands	50	56.18	702	67.18	39	43.82	343	32.82	89	1045
Canada	43	24.16	689	31.62	135	75.84	1490	68.38	178	2179
Australia	34	20.12	294	17.96	135	79.88	1343	82.04	169	1637
Poland	27	29.67	297	45.00	64	70.33	363	55.00	91	660
Argentina	24	41.38	232	52.85	34	58.62	207	47.15	58	439
Spain	24	28.24	457	65.47	61	71.76	241	34.53	85	698
Sweden	24	42.86	420	51.47	32	57.14	396	48.53	56	816
Switzerland	23	29.87	576	53.48	54	70.13	501	46.52	77	1077
Hungary	22	42.31	343	49.49	30	57.69	350	50.51	52	693
Brazil	17	30.36	245	47.02	39	69.64	276	52.98	56	521
Portugal	17	31.48	226	51.13	37	68.52	216	48.87	54	442
Czech Republic	15	28.30	239	45.96	38	71.70	281	54.04	53	520

TP=Total publications, TC=Total number of citations

Earth and Environmental Sciences, Engineering Sciences, Medical Sciences and Physical Sciences. Table 3 provides the distribution of publications and citations of top five countries in various subject areas.

Subject-wise Distribution of Publications and Citations

All the publications were broadly classified into eight subject categories based on WoS subject categories. Materials Sciences accounted for the highest number of publications (2763, 40.32%) followed by the Chemical Sciences with 1529 (22.31%) publications, Engineering Sciences with 928 (13.54%) publications, the Earth and Environmental Sciences with 636 (9.28%) publications, Physical Sciences with 538 (7.85%) publications, Multidisciplinary Sciences with 194 (2.83%) publications, Biological Sciences with 144 (2.1%) publications and Medical Sciences with 121 (1.77%) publications. Table 4 provides subject-wise distribution of publications and citations as per two broad period blocks.

The application of EPMA during 1992–2002 was the highest in the field Physical Sciences (46.47%) followed by Chemical Sciences (40.94%), Engineering Sciences (39.66%), Biological Sciences (39.58%) and Materials Sciences (35.5%). It is observed that there is a shift in application of EPMA in various fields during 2003–2013. The highest percentage (81.96) of publications was in Multidisciplinary Sciences followed by the Earth and Environmental Sciences (77.20%), Medical Sciences (66.94%), Materials Sciences (64.50%), Biological Sciences (60.42%), and Engineering Sciences (60.34%). This trend indicates the priorities of research in different time period.

Highly Productive Institutions

Table 5 provides the highly productive institutions on EPMA based on the number of publications. The list also provides the average number of publications, total number of citations, average citations per publication,

Table 3: Distribution of publications and citations of top five countries in various subject areas

Subjects	Country	TP	TC	ACP	TIF	AIF
Biological Sciences	Japan	38	424	11.16	74.83	1.97
	France	25	462	18.48	43.83	1.75
	USA	21	275	13.10	50.27	2.39
	Germany	14	122	8.71	46.08	3.29
	England	9	152	16.89	22.68	2.52
Chemical Sciences	Japan	336	3547	10.56	634.05	1.89
	Peoples Republic of China	246	1691	6.87	488.17	1.98
	Germany	167	1624	9.72	238.91	1.43
	France	134	1398	10.43	289.08	2.16
	South Korea	106	1366	12.89	324.77	3.06
Earth and Environmental Sciences	Japan	110	1452	13.20	264.3	2.40
	USA	94	1900	20.21	221.01	2.35
	Germany	73	1242	17.01	175.11	2.40
	Peoples Republic of China	71	663	9.34	116.4	1.64
	France	64	1177	18.39	144.88	2.26
Engineering Sciences	Japan	262	2855	10.90	302.12	1.15
	Peoples Republic of China	171	1105	6.46	160.97	0.94
	USA	91	1553	17.07	138.48	1.52
	South Korea	81	891	11.00	117.54	1.45
	Taiwan	69	758	10.99	106.86	1.55
Material Sciences	Peoples Republic of China	768	3638	4.74	719.97	0.94
	Japan	676	4561	6.75	678.3	1.00
	India	188	1362	7.24	224.88	1.20
	USA	157	1434	9.13	215.2	1.37
	Germany	155	1472	9.50	170.06	1.10
Medical Sciences	Japan	64	404	6.31	111.18	1.74
	USA	20	254	12.70	63.68	3.18
	Australia	12	131	10.92	26	2.17
	Germany	8	134	16.75	17.55	2.19
	South Korea	5	15	3.00	8.02	1.60
Multidisciplinary Sciences	Peoples Republic of China	57	446	7.82	104.54	1.83
	Japan	33	714	21.64	62.75	1.90
	India	32	416	13.00	53.07	1.66
	USA	20	241	12.05	34.06	1.70
	South Korea	15	179	11.93	23.9	1.59
Physical Sciences	Japan	155	1701	10.97	144.83	0.93
	Peoples Republic of China	65	358	5.51	68.64	1.06
	USA	40	823	20.58	55.33	1.38
	France	37	216	5.84	32.81	0.89
	Germany	37	339	9.16	56.77	1.53

TP=Total publications, ACP=Average citations per publication, AIF=Average impact factor per publication TC=Total number of citations, TIF=Total impact factor

h-index,^[14] and AIF per publication of 22 institutions with publications ≥ 50 .

Chinese Academy of Sciences, Peoples Republic of China with published highest (256, 3.74%) number of publications and 7.71 average citations per publications followed by Tohoku University, Japan with 186 (2.71%) publications and

8.66 average citations per publication, Shandong University, Peoples Republic of China with 115 (1.68%) publications and 7.43 average citations per publication, University of Antwerp, Belgium with 111 (1.62%) publications and 14.41 average citations per publication and University of Tokyo, Japan with 107 (1.56%) publications and 10.35 average citations per publication.

Table 4: Subject-wise distribution of publications and citations under two broad period blocks

Subjects	1992-2002				2003-2013				Grand total of TP	Grand total of TC
	TP	Percentage of TP	TC	Percentage of TC	TP	Percentage of TP	TC	Percentage of TC		
Materials Sciences	981	35.50	9815	52.15	1782	64.50	9004	47.85	2763	18,819
Chemical Sciences	626	40.94	8448	53.94	903	59.06	7215	46.06	1529	15,663
Engineering Sciences	368	39.66	5537	63.37	560	60.34	3201	36.63	928	8738
Earth and Environmental Sciences	145	22.80	2838	36.43	491	77.20	4953	63.57	636	7791
Physical Sciences	250	46.47	2484	53.62	288	53.53	2149	46.38	538	4633
Multidisciplinary Sciences	35	18.04	681	28.64	159	81.96	1697	71.36	194	2378
Biological Sciences	57	39.58	948	52.87	87	60.42	845	47.13	144	1793
Medical Sciences	40	33.06	489	42.78	81	66.94	654	57.22	121	1143
Total of TP and TC	2502	36.51	31,240	51.25	4351	63.49	29,718	48.75	6853	60,958

TP=Total publications, TC=Total number of citations

Table 5: Highly productive institutions (≥ 50 publications) in EPMA research

Rank by TP	Institutes	TP	TC	ACP	h-index	AIF
1	Chinese Academy of Sciences, Peoples Republic of China	256	1973	7.71	22	1.49
2	Tohoku University, Japan	186	1610	8.66	18	1.41
3	Shandong University, Peoples Republic of China	115	855	7.43	17	1.38
4	University of Antwerp, Belgium	111	1599	14.41	22	2.55
5	University of Tokyo, Japan	107	1107	10.35	17	1.44
6	Osaka University, Japan	90	892	9.91	18	1.53
6	University of Vienna, Austria	90	617	6.86	13	1.73
7	Harbin Institute of Technology, Peoples Republic of China	89	611	6.87	14	1.10
8	Dalian University of Technology, Peoples Republic of China	88	461	5.24	13	1.24
9	Hokkaido University, Japan	79	834	10.56	13	1.43
10	Wuhan University of Technology, Peoples Republic of China	75	328	4.37	10	0.85
11	Kyoto University, Japan	71	1228	17.30	18	1.84
12	National Institute of Materials Science, Japan	67	431	6.43	11	2.06
13	National Taiwan University, Taiwan	62	577	9.31	13	1.71
13	Russian Academy of Sciences, Russia	62	439	7.08	9	1.27
14	Tokyo Institute of Technology, Japan	59	761	12.90	17	2.01
15	Kyushu University, Japan	58	492	8.48	12	1.40
16	Bhabha Atomic Research Center, India	57	419	7.35	11	1.31
17	Sungkyunkwan University, South Korea	56	460	8.21	11	1.23
18	National Tsing Hua University, Taiwan	55	683	12.42	17	1.78
19	Northeastern University China, Peoples Republic of China	53	214	4.04	7	0.95
20	University of Science Technology Beijing, Peoples Republic of China	52	106	2.04	6	0.72

TP=Total number of publications, TC=Total number of citations, ACP=Average citations per publication, AIF=Average impact factor per publication, EPMA=Electron probe micro analysis

Citation Analysis of Electron Probe Microanalysis Articles

A total of 60,958 citations were received to 6853 publications which is an average of 8.90 citations per publications over a period of 22 years. Among the EPMA research publications, “The THEMIS Mission” was the most frequently cited publication, having 333 citations since it was first published in 2008. This publication was published in the Space Science Reviews, Vol. 141: p. 5-34 (with an IF of 5.52). It is observed that the highest

share of publications (52.63%) was in citation range from 1 to 10 and received 23.76% share of citations. Table 6 provides the publications and citations as per citations range.

Journals Preferred for Publication by the Scientists

The distribution of EPMA related publications were spread over 892 journals across the world. The leading journals preferred by the scientists were: Journal of Alloys and Compounds with 212 publications which received

1974 citations, Surface and Coatings Technology with 129 publications which received 2071 citations, Materials Science and Engineering-A 126 publications which received 1915 citations, Mikrochimica Acta with 109 publications which received 477 citations and the Journal of the Japan Institute of Metals with 108 publications which received 354 citations [Table 7].

Quality of Research Output

Out of 6853 publications, 6111 publications were published in the journals and out of 6111 publications around 86.96% (5314) of the total publications were published in the journals with IFs ranging from 00.01 to 35.75 and received 89.65% (54,044) citations and 13.04% (797) publications published in the journals having without

Table 6: Distribution of publications and citations as per citations range

Citation range	TP	TC	Share of publications	Share of citations
More than 100	49	7030	0.72	11.53
51-100	139	9274	2.03	15.21
31-50	238	9270	3.47	15.21
11-30	1195	20,900	17.44	34.29
1-10	3607	14,484	52.63	23.76
0	1625	0	23.71	0.00
Total	6853	60,958	100.00	100.00

TP=Total number of publications, TC=Total number of citations

IF. Table 8 gives the distribution of publications and citations according to IF range of journal publications. It is revealed from the table that the highest number of publications (1972, 32.27%) appeared in 238 journals having IF range from 1.01 to ≥ 2.00 and received 19,726 (32.72%) citations with 10.00 average citation per publication.

CONCLUSION

A total of 6853 publications were published by the scientists in EPMA as per WoS during 1992–2013 which received 60,958 citations. The average number of publications per year was 311.50. The average number of citations per publication was 8.90. The highest number of publications (436) was published in 2013. The highest number of citations (4266) was received in 2004.

A total of 94 countries involved in research on EPMA. Japan topped the list with 1674 publications, 9.35 ACP and 1.36 AIF followed by the People's Republic of China with 1390 publications, 5.73 ACP and 1.21 AIF, USA with 538 publications, 15.36 ACP and 1.88 AIF, Germany with 499 publications, 10.76 ACP and 1.52 AIF, France with 460 publications, 11.61 ACP and 1.76 AIF, the South Korea with 405 publications, 8.75 ACP and 1.72 AIF, India with 379 publications, 7.73 ACP and 1.50 AIF and England with 248 publications. The highest number of publications

Table 7: Highly preferred journals by the scientists for publications (≥ 50 publications)

Rank by TP	Journals	IF-2012	TP	TC	ACP
1	Journal of Alloys and Compounds	2.39	212	1974	9.31
2	Surface and Coatings Technology	1.94	129	2071	16.05
3	Materials Science and Engineering-A	2.11	126	1915	15.20
4	Mikrochimica Acta	-	109	477	4.38
5	Journal of the Japan Institute of Metals	0.37	108	354	3.28
6	Intermetallics	1.86	102	1262	12.37
7	Journal of Nuclear Materials	1.21	100	917	9.17
8	Rare metal materials and engineering	0.16	89	123	1.38
9	Corrosion Science	3.62	88	1264	14.36
10	Journal of Materials Science	2.16	81	737	9.10
11	Journal of Crystal Growth	1.55	79	975	12.34
12	Applied Surface Science	2.11	74	737	9.96
13	Transactions of Nonferrous Metals Society of China	0.92	73	174	2.38
14	Metallurgical and Materials Transactions-A	1.63	71	850	11.97
15	Materials Science Forum	-	62	130	2.10
16	ISIJ International	1.15	61	402	6.59
17	Powder Metallurgy	0.58	60	70	1.17
18	Materials Transactions	0.59	57	300	5.26
19	X-Ray Spectrometry	1.55	53	379	7.15
20	Mikrochimica Acta	3.43	52	263	5.06

TP=Total number of publications, TC=Total number of citations, ACP=Average citations per publication, IF=Impact factors

Table 8: Distribution of publications and citations as per IF range

IF	Journals	TP	Percentage of TP	TC	Percentage of TC	ACP
0.01 - \geq 1.00	215	1304	21.34	4044	6.71	3.10
1.01 - \geq 2.00	238	1972	32.27	19,726	32.72	10.00
2.01 - \geq 3.00	159	1228	20.09	14,099	23.39	11.48
3.01 - \geq 4.00	82	577	9.44	9322	15.46	16.16
4.01 - \geq 5.00	19	111	1.82	2906	4.82	26.18
5.01 - \geq 6.00	16	70	1.15	1779	2.95	25.41
6.01 - \geq 35.75	15	52	0.85	2168	3.60	41.69
Without IF	148	797	13.04	6242	10.35	7.83
Total	892	6111	100.00	60,286	100.00	9.87

TP=Total number of publications, TC=Total number of citations, ACP=Average citations per publication, IF=Impact factors

was published in Materials Sciences followed by Chemical Sciences, Engineering Sciences, Earth and Environmental Sciences, Physical Sciences, Multidisciplinary Sciences, Biological Sciences and Medical Sciences.

Chinese Academy of Sciences, People's Republic of China with published highest (256) number of publications followed by Tohoku University, Japan with 186 publications, Shandong University, People's Republic of China with 115 publications, University of Antwerp, Belgium with 111 publications and University of Tokyo, Japan with 107 publications.

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How to cite this article: Sagar A, Kademani BS, Bhanumurthy K. Scientometric study of global electron probe microanalysis literature. *J Sci Res* 2015;4:96-103.

Source of Support: Nil, **Conflict of Interest:** None declared