

Polymer Science research in India: A Scientometrics Study

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ABSTRACT

Polymer Science & Technology is a leading field in material science. India has a good no. of institutions carrying research in Polymer Science, including IIT, NIT and institutes of national importance. Measuring the research productivity of the institutions, country is carried out by means of Scientometrics study. Evaluation of scientific research through Scientometrics is a well-accepted and recognised process worldwide. The Web of Science, Google Scholar, and Scopus international database are comprehensive in measuring the research publications in all kinds of the universe of knowledge. The present paper attempts to assess the Scientific research output of India in Polymer Science. The total no. of research publications in Polymer Science during 2010-2020 is found to be 25044. The highest relative growth rate is 13.49 in 2014, followed by 11.68 in 2013.

KEYWORDS: Scientometrics, Polymer Science, India.

INTRODUCTION

The field of Polymer Science and Technology has shown remarkable growth in recent years, by advancements in synthetic polymers, plastics, elastomers, and their applications across industries. Polymer science is a multidisciplinary field encompasses aspects of chemistry, physics, and engineering, which contribute significantly to material science. The study of polymers not only focuses on their chemical synthesis and physical properties but also extends to the characterization of their structural and functional attributes. These contributions have made Polymer Science an essential area of research, particularly in addressing challenges related to sustainability, energy efficiency, and innovative materials.

India has emerged as a prominent player in the field of Polymer Science and Technology, showcasing considerable advancements in research output over the years. As a country striving to become a global leader in science and technology, understanding its contribution to this field is crucial for academic, industrial, and policymaking stakeholders.

OBJECTIVES OF THE STUDY

- To measure the research publications in Polymer Science in India at World Level
- To measure the institution wise research output in polymer science
- To quantify the subject wise research output in polymer science
- To assess the year wise research productivity in polymer science

SCOPE OF THE STUDY

The study will cover all the research publications in Polymer Sciences in India and the study will assess research publications published during 2000-2019.

METHODOLOGY

The Scientometric study uses different set of citation databases like Scopus, Web of Science etc. Also, there are various software developed to assess the Scientometric indicators of research institutions and publications. In the present study, the data was collected from Web of Science in the field of Polymer Science published during 2000 to 2019. The necessary statistical tools and software was used to carry out Scientometrics study. The Bibioshyn software is used to assess the research productivity in the field of Polymer Science in India.

Country wise Research Publications in Polymer Science

The country wise research publications in Polymer Science published during 2010 to 2020 is shown in the following table.

Table No.1 Country wise Research Publications in Polymer Science.

Rank	2010		2011		2012		2013		2014		2015	
	Country	No. of pub	Country	No. of pub	Country	No. of pub	Country	No. of pub	Country	No. of pub	Country	No. of pub
1	China	5563	China	6111	China	6122	China	6363	China	6686	China	6587
2	USA	3734	USA	3651	USA	3664	USA	3394	USA	3708	USA	3434
3	Germany	1663	Germany	1765	India	1746	India	1950	India	2213	India	2285
4	India	1580	Japan	1687	Germany	1663	Germany	1638	Germany	1815	Germany	1663
5	Japan	1550	India	1628	Japan	1652	Japan	1631	Japan	1629	Japan	1580
6	France	914	France	986	South Korea	1030	France	1025	France	1011	France	1021

7	South Korea	911	South Korea	967	France	948	South Korea	995	South Korea	988	South Korea	991
8	UK	687	UK	801	UK	747	Iran	736	UK	799	UK	771
9	Canada	612	Russia	741	Russia	745	Russia	650	Iran	760	Russia	757
10	Spain	547	Spain	627	Iran	692	UK	626	Russia	718	Iran	703
Rank	2016		2017		2018		2019		2020			
	Country	No. of pub										
1	China	7115	China	8272	China	9697	China	11897	China	10544		
2	USA	4863	USA	3643	USA	3284	USA	3219	India	3075		
3	India	2385	India	2551	India	2766	India	2865	USA	2891		
4	Germany	1881	Germany	1765	Germany	1649	Germany	1593	Germany	1357		
5	Japan	1604	Japan	1501	Japan	1498	Iran	1508	Iran	1331		
6	France	1158	South Korea	1070	Iran	1254	Japan	1479	Japan	1247		
7	UK	1032	France	974	South Korea	1229	South Korea	1242	South Korea	975		
8	South Korea	1020	Iran	961	Russia	958	France	1029	France	974		
9	Iran	991	Russia	949	France	933	Russia	934	Russia	854		
10	Russia	956	UK	889	UK	786	UK	826	UK			

DATA ANALYSIS AND INTERPRETATIONS

Global Trends in Publications (2010–2020) China shows a strong upward trend from 5,563 (2010) to over 10,500 (2020), indicating rapid research output growth. USA is relatively stable but slightly declining, from 3,734 (2010) to around 2,891 (2020). India emerges strongly, moving from below 2,000 publications (2010) to more than 2,000 (2020), surpassing Germany and USA in some years. Germany and Japan remain stable but show slower growth compared to China and India.

Growth Rates in research shows that China is nearly doubled its output between 2010–2020 (~90% growth). India grew significantly (more than 20%–30% in later years, especially after 2016). USA gradual decline, possibly due to stabilization in research funding or changes in publication patterns. Germany & Japan have minimal growth, indicating mature but stable research ecosystems.

FINDINGS

China’s dominance: Significant investment in R&D and higher education is reflected in publication volume.

India’s rise: Increasing research funding and academic expansion.

USA & Europe: Shift towards quality or high-impact publications rather than volume.

Implications: Collaboration with China and India is becoming increasingly important for global research impact.

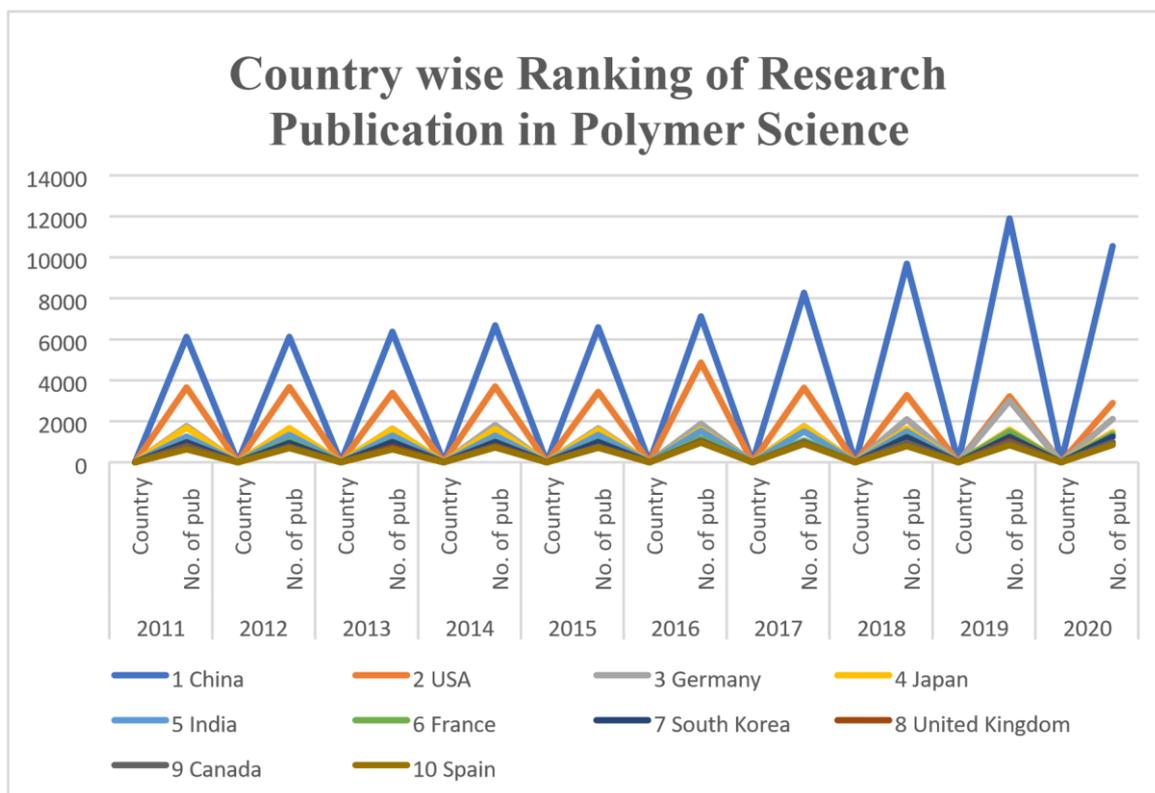


Fig.No.1

Relative Growth Rate of Research Publications of India in Polymer Science:

Relative Growth Rate (RGR):

Relative Growth Rate measures the increase in research output (e.g., publications, citations) per unit of time relative to the size of output in the previous period. Relative growth rate (RGR) shows the research productivity of the researchers in subsequent year.

It shows how fast a research field (or author’s output) is growing compared to its existing size.

$$\text{Formula} \quad \text{RGR} = \frac{\ln W_2 - \ln W_1}{t_2 - t_1}$$

Where:

W1= cumulative number of publications at the beginning (time t1)

W2 = cumulative number of publications at the end (time t2)

\ln = natural logarithm

Interpretation

Higher RGR → rapid increase in publications.

Lower RGR → slower growth.

When RGR tends to zero → growth is stabilizing (field is maturing).

Doubling Time (DT):

Doubling Time is the time required for the cumulative number of publications (or citations) to become double. It is derived from RGR and shows the sustainability of growth.

Formula

$$DT = 0.693 / RGR$$

Where 0.693 is the natural log of 2.

Interpretation

Short DT → publications double quickly (fast-growing research area).

Long DT → slow doubling (mature or saturated field).

DT and RGR are inversely related: as RGR increases, DT decreases.

The following table shows the research growth rate of research publications in India from 2010 to 2020.

Table No.2 Relative Growth Rate of Research Publications in Polymer Science

Year	Articles	Percentage	RGR
2010	1580	6.31	0
2011	1628	6.50	3.04
2012	1746	6.97	7.25
2013	1950	7.79	11.68
2014	2213	8.84	13.49
2015	2285	9.12	3.25
2016	2385	9.52	4.38
2017	2551	10.19	6.96
2018	2766	11.04	8.43
2019	2865	11.44	3.58
2020	3075	12.28	7.33

DATA ANALYSIS AND INTERPRETATIONS

Initial Growth Phase observed in 2010–2014. Rapid increase in publications with high RGR and low DT.

Maturity Phase observed after 2015. After 2015, Growth rate slows down with RGR decreases and DT increases.

This pattern is typical of research fields: emergence → expansion → maturity.

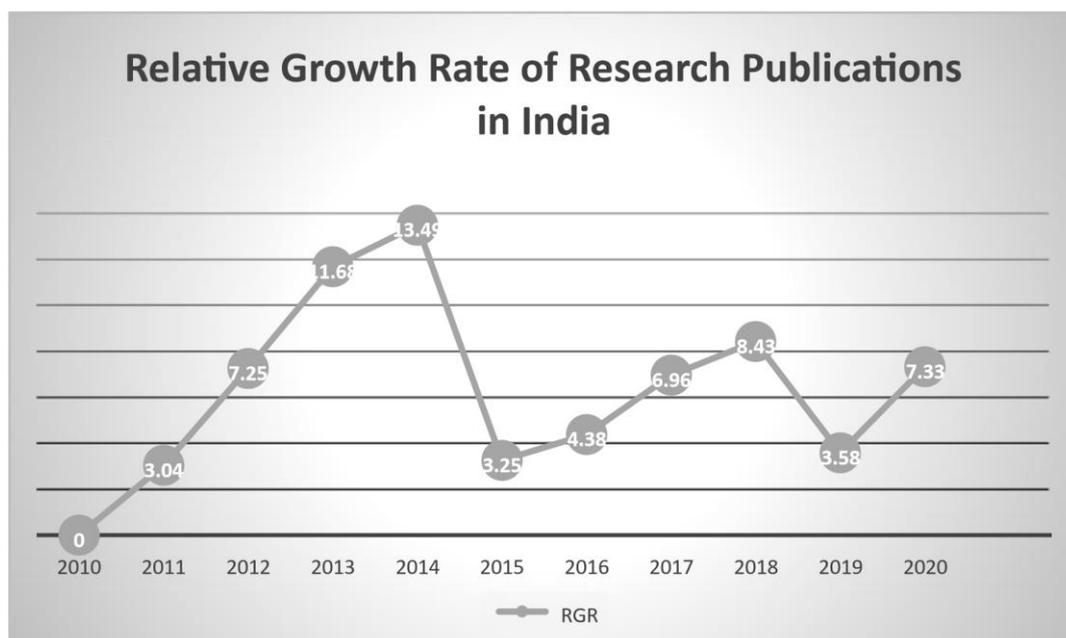


Fig.2

Subject wise research Publications:

Polymer Science is an applied subject having more specializations in the subject. The research publications in top fifty top subjects are analysed. The subject wise research publications are analysed as below.

Table No.3 Subject wise research Publications

Sr. No.	Field of Study	No. of Publication	Percentage
1	Composite material	4718	20.81
2	Materials science	4629	20.42
3	Polymer	1106	4.88
4	Composite number	991	4.37
5	Nanocomposite	981	4.33
6	Ultimate tensile strength	858	3.78
7	Epoxy	555	2.45
8	Scanning electron microscope	492	2.17
9	Thermal stability	462	2.04
10	Dielectric	399	1.76
11	Fourier transform infrared spectroscopy	397	1.75
12	Flexural strength	388	1.71

13	Fiber	375	1.65
14	Chemical engineering	345	1.52
15	Thermogravimetric analysis	331	1.46
16	Carbon nanotube	276	1.22
17	Dynamic mechanical analysis	264	1.16
18	Natural rubber	252	1.11
19	Differential scanning calorimetry	224	0.99
20	Glass transition	218	0.96
21	Polypropylene	214	0.94
22	Nanoparticle	211	0.93
23	Graphene	210	0.93
24	Crystallinity	195	0.86
25	Polymer nanocomposite	168	0.74
26	Izod impact strength test	164	0.72
27	Fibre-reinforced plastic	161	0.71
28	Polyaniline	161	0.71
29	Ceramic	157	0.69
30	Coating	154	0.68
31	Engineering	153	0.67
32	Microstructure	148	0.65
33	Glass fiber	145	0.64
34	Polymer composites	143	0.63
35	Chemistry	142	0.63
36	Rheology	140	0.62
37	Nanotechnology	139	0.61
38	Dispersion (chemistry)	138	0.61

39	Conductivity	136	0.60
40	Oxide	132	0.58
41	Compressive strength	126	0.56
42	Copolymer	126	0.56
43	Elastomer	124	0.55
44	Thermal	123	0.54
45	Modulus	122	0.54
46	Polyester	118	0.52
47	Absorption of water	117	0.52
48	Surface modification	115	0.51
49	Tribology	115	0.51
50	Polymer blend	114	0.50

Data Analysis and Interpretations:

The top fifty subject are identified for the analysis of research publications. Composite material subject is trending in Polymer science having highest no. of research publications (20.81%) followed by Material Science (20.42%), Polymer (4.88%), Composite number (4.37%) and Nanocomposite (4.37 %).

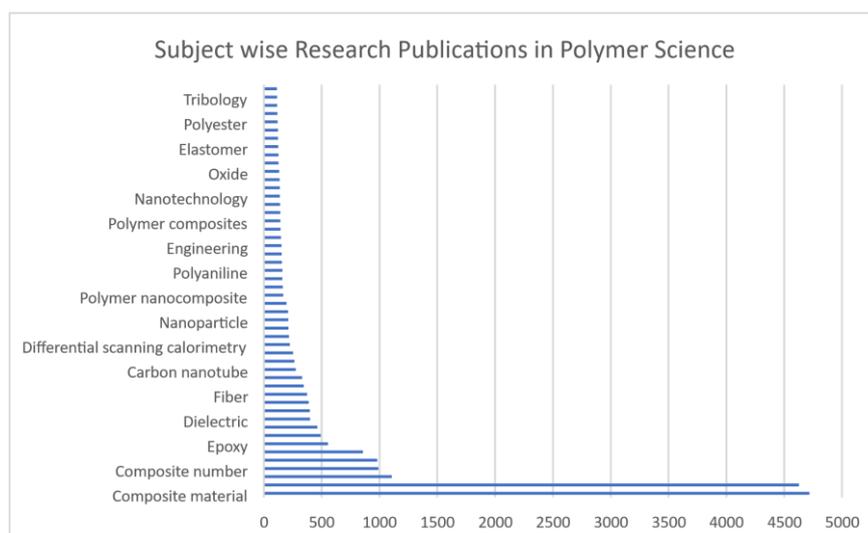


Fig.3

Institute wise Research Publications:

India has well established and renowned research institutions in Polymer Science. The following table depicts the institute wise research publications in Polymer Science.

Table No. 4 Institute wise research Publications

Sr. No.	Institution Name	No. of Pub.	Percentage
1	Indian Institute of Technology Delhi	269	12.44
2	Indian Institute of Technology Kharagpur	250	11.56
3	Indian Institute of Science	207	9.57
4	Council of Scientific and Industrial Research	204	9.44
5	Mahatma Gandhi University	194	8.97
6	Anna University	148	6.85
7	VIT University	123	5.69
8	Central Institute of Plastics Engineering and Technology	116	5.37
9	Cochin University of Science and Technology	104	4.81
10	National Institute of Technology, Rourkela	103	4.76
11	Indian Institute of Technology Kanpur	96	4.44
12	Indian Institute of Technology Madras	92	4.26
13	Indian Institute of Technology Roorkee	90	4.16
14	Indian Institutes of Technology	88	4.07
15	Tezpur University	78	3.61
	Total	2162	100.00

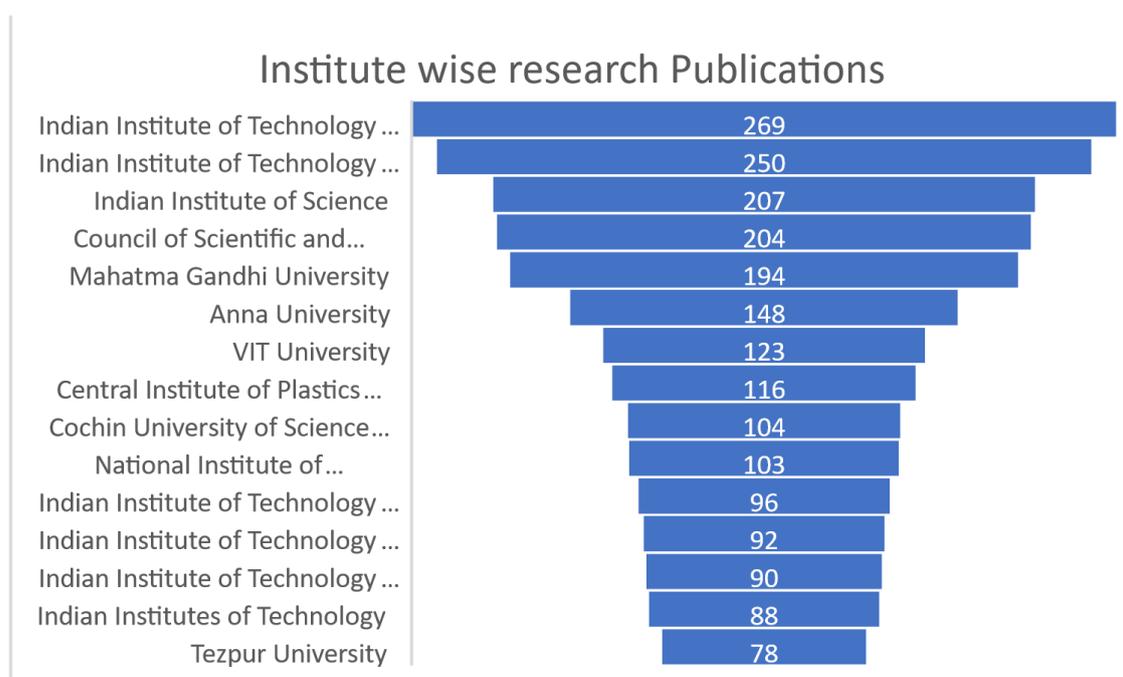


Fig.4

DATA ANALYSIS AND INTERPRETATIONS

The major contributions of institutions depicts that Indian Institute of Technology Delhi tops the list having 12.44 % research publications followed by Indian Institute of Technology Kharagpur (11.56 %), Indian Institute of Science (9.57%), Council of Scientific and Industrial Research (9.44%) and Mahatma Gandhi University (8.97%).

CONCLUSIONS

China shows a strong upward trend indicating rapid research output growth in Polymer Science while **USA** is relatively stable but slightly declining.

India emerges strongly, surpassing Germany and USA in some years. India stands 2nd rank in research Publications in Polymer Science.

Initial Growth Phase observed in rapid increase in publications with high RGR and low DT.

The top fifty subject are identified for the analysis of research publications. Composite material subject is trending in Polymer science having highest no. of research publications followed by Material Science, Polymer, Composite number and Nanocomposite.

The major contributions of institutions depict that Indian Institute of Technology Delhi tops the list followed by Indian Institute of Technology Kharagpur, Indian Institute of Science, Council of Scientific and Industrial Research and Mahatma Gandhi University.

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