The Mapping of Nanoparticles Literature over the Years

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Abstract— Intense scientific interest has arisen in the area of nanoparticle research owing to a broad spectrum of possible applications in optical, biomedical, and electronic fields. Nanoparticles are atomic or molecular aggregates with at least one dimension between 1 and 100 nm [1]. In the present study, we used bibliometrics and data mining to understand the pattern of research in the area of nanoparticles based on two criterions namely chronological growth and country-wise distribution. The data for this study has been obtained from Scopus multidisciplinary database for a period during 1978-2014. All this was analyzed statistically. We have comprehensively resorted to tabulating and network mapping.

Key words: Nanoparticles, molecular aggregates, tabulating and network mapping

I. INTRODUCTION

Nanoparticles are atomic or molecular aggregates with at least one dimension between 1 and 100 nm [1, 2, 3]. The activity of nanoparticles varies depending on their size or shape and their chemical composition. They are of many types for example natural, incidental and engineered. There have been a large number of studies on nanoparticles in recent years due to the advent of nanotechnology in recent years. Though nanoparticles are very small they can have a huge impact on global weather. It can lead to negative change in the atmospheric composition locally, regionally, and also globally. Serious problems can be caused by these atmospheric aerosols such as reduced visibility, acidic deposition and cooling the planet by reflecting sunlight back to space. There may be direct emission of these atmospheric particles but majority of these are formed in the atmosphere by transformation of gaseous emissions such as sulphur oxides, nitrogen oxides, and volatile organic substances. Accumulation of NPs in the environment may alter dust cloud formation, ozone depletion, environmental hydroxyl radical concentration, or stratospheric temperature change [4, 5, 6].

This study is an attempt to make the quantitative study of research output on Nanoparticles. Data of this study is obtained from Scopus [7] online database and analyzed with different viewpoints. In particular, the study was limited to the following objectives:

1) To examine the chronological growth of literature on Nanoparticles.
2) To identify the main countries publishing in this area.

II. MATERIALS AND METHODS

The data for this study has been obtained from Scopus multidisciplinary database for a period during 1978-2014. The authors wish to clarify that chronological patterns have been deduced only for the past 20 years as the authors felt that this is the window that has maximum growth in the literature and can indicate the changes and patterns very well. Data was analyzed as per the objectives of this study in Microsoft Excel 2013[10].Also, fifteen countries having the maximum research output in this field have been chosen to compare results effectively.

III. RESULTS AND DISCUSSION

1) Year-Wise Growth of Nanoparticles Literature

2014	40210
2013	36658
2012	32331
2011	29058
2010	23543
2009	19392
2008	17001
2007	14433
2006	10750
2005	9016
2004	5914
2003	4050
2002	3131
2001	2240

2000	1663
1999	1395
1998	1006
1997	721
1996	469
1995	301

Table 1: No. of publications chronologically in the last decade

The data taken here is for the number of publications over the last 20 years. At this stage it is important to understand that nanoparticles come broadly under the field of nanotechnology but initially they were studied under the field of Interface and colloid science that had existed for nearly a century before they became associated with nanotechnology [8].As can be seen there is a steep rise in the number of publications in this area in the last decade. This can be attributed to the rise in interest in the field of nanotechnology owing to its wide applications in optical, biomedical and material science. It should be kept in mind that nanoparticles are essentially very small pieces of material that measure no more than an atom or two. They are small enough that they can interact easily on the same level with microscopic pathogens such as bacteria or viruses. The reason or their versatility is the fact that they can literally be particles from any substance so they are used in many types of technological applications, from delicate electronics to revolutionary medical procedures [9].

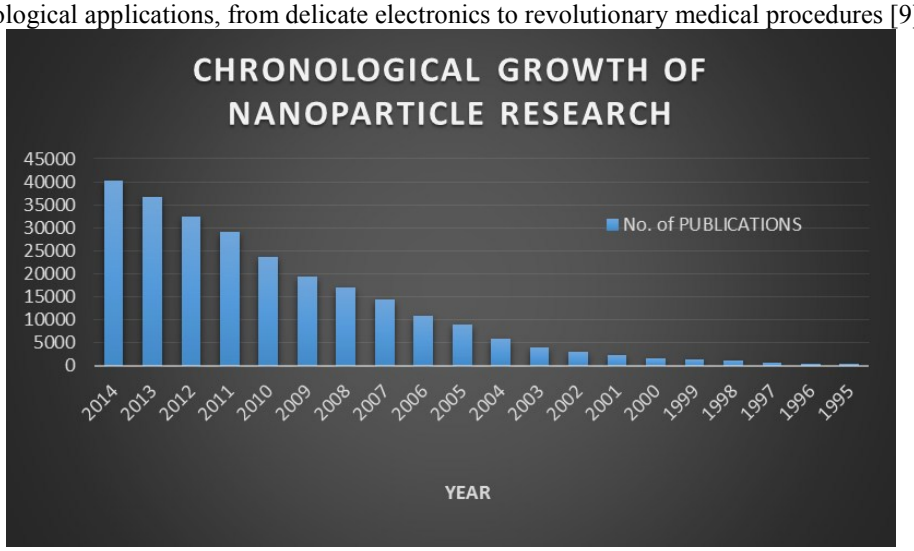

Fig. 1: Graphical overview of no. of publications in the last decade

2) Distribution in terms of Countries

As can be seen from the data that China tops the list and has also defeated the leading research country in Nanotechnology i.e. United States of America. India ranks third in the list but the percentage share of India is very less than China and USA. Its only 8% which is one-thirds as of china (24%) and very less than USA which at 22%.

COUNTRY	**No. of PUBLICATIONS**
China	58311
United States	52322
India	19119
Germany	16176
Japan	15890
South Korea	14229
France	11764
United Kingdom	9284
Iran	8064
Spain	7531
Italy	7450
Russian Federation	7229
Taiwan	7045
Canada	5696

Table 2: Prominent Countries in the area of nanoparticles

It is to be borne in mind that we have only compared the first fifteen countries out of the data for 142 countries which included one publication each from countries like Bermuda and Lesotho. It would not have been practical to include all

such countries. Since the purpose of this study was to identify leading countries in the nanoparticles research area therefore only top 15 countries were subjected to the said analysis. India is followed by Germany which is followed by Japan. Authors would like to emphasize that number of publications are in no way indicative of the quality of research in that area. It is only giving us the patterns in the area of nanoparticle research and outlines the major players in the field.

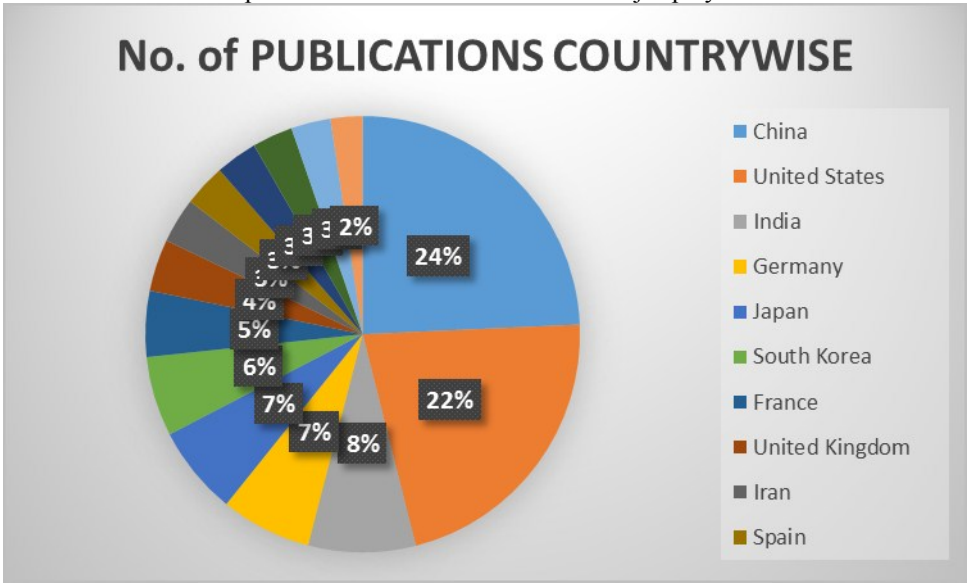

Fig. 2: Prominent Countries in the area of nanoparticles

ACKNOWLEDGEMENTS

The authors are thankful to University of Delhi for providing with excellent library infrastructure and facilities.

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