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Measurement of Brazilian Technological Innovations in Nanotechnology

Medición de innovaciones tecnológicas en nanotecnología brasileña

Mensuração das inovações tecnológicas brasileiras em nanotecnologia

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Abstract

In the last decades, we have observed the growth of competitiveness and with this the need arises for the development of new technologies. Hence arises nanotechnology, which is a science that encompasses different areas, performing the manipulation of atoms and molecules. However, with the emergence of different technologies in nano, it is necessary to use the technological mapping to measure the production of these technologies that are being inserted in the market. This article seeks to map the technological innovations related to nanotechnology at the National Institute of Industrial Property (INPI). The methodology used was to the exploratory research through the documentary analysis through the search in the INPI database. As a result, the information obtained shows that there are a significant number of patents on nanotechnology innovations, but there is still a need for new technologies to expand in this area. It can be observed that there is little participation of Universities in the nano deposits, which shows the need of expansion of innovations in nano also in the Universities, and not only by companies. Therefore, innovations in nanotechnology can contribute to the growth of research on atom manipulation and extend the studies in its application in medicine.

Keywords: Tecnologic Innovation; Nanotechnology; Patents; Technology.

Resumen

En las últimas décadas, se observa el crecimiento de la competitividad y con ello viene la necesidad de desarrollar nuevas tecnologías. De ahí la nanotecnología, que es una ciencia que involucra a diferentes áreas, por lo que la manipulación de átomos y moléculas. Sin embargo, con la aparición de diferentes tecnologías de nano, debe utilizar la tecnología de mapas para medir la producción de estas tecnologías que se introduzca en el mercado. En este artículo se pretende llevar a cabo un mapeo de la innovación tecnológica relacionada con la nanotecnología en el Instituto Nacional de la Propiedad Industrial (INPI). La metodología utilizada fue la investigación exploratoria a través del análisis de los documentos mediante la búsqueda en la base de datos del INPI. Como resultado, la información obtenida muestra que hay un número significativo de patentes en las innovaciones en nanotecnología, más todavía hay una necesidad de expansión de las nuevas tecnologías en esta área. Se puede observar que hay muy poca participación de las universidades en los depósitos nano, lo que demuestra la necesidad de ampliar las innovaciones en nano también en las universidades, no sólo por las empresas. Por lo tanto, las innovaciones en nanotecnología pueden contribuir al crecimiento de la investigación en la manipulación de átomos y ampliar los estudios en su aplicación en la medicina.

Palabras clave: Innovación Tecnológica; Nanotecnología; Patente; Tecnología.

Resumo

Nas últimas décadas, observamos o crescimento da competitividade e com isso surge a necessidade do desenvolvimento de novas tecnologias. Daí surge a nanotecnologia, que é uma ciência que engloba diferentes áreas, realizando a manipulação de átomos e moléculas. No entanto, com o surgimento de diferentes tecnologias em nano, é preciso utilizar do mapeamento tecnológico para mensurar a produção dessas tecnologias que estão sendo inseridas no mercado. O presente artigo busca realizar um mapeamento das inovações tecnológicas relacionadas a nanotecnologia junto ao Instituto Nacional de Propriedade Industrial (INPI). A metodologia utilizada foi à pesquisa exploratória através da análise documental por meio da busca na base de dados do INPI. Como resultado, as informações obtidas mostram que há um número significante de patentes sobre inovações em nanotecnologia, mais que ainda há uma necessidade de expansão de novas tecnologias sobre essa área. Pode-se observar que há pouca participação de Universidades nos depósitos de nano, o que mostra a necessidade de expansão de inovações em nano também nas Universidades, e não apenas por empresas. Portanto, as inovações em nanotecnologia podem contribuir para o crescimento das pesquisas em manipulação de átomos e ampliar os estudos em sua aplicação na medicina.

Palavras-Chave: Inovação Tecnológica; Nanotecnologia; Patentes; Mapeamento.

Introduction

The changes that have been taking place in recent decades bring to light the growth of technologies being developed for the market. Hence arises the need of studies of technological prospecting as a tool to aid in the decision-making process.

In addition, the current world market scenario is focused on competitiveness (Almeida, Santos, Wartha & Silva, 2015), which makes the technological mapping necessary to verify the development of nanotechnology technologies.

Furthermore, nanotechnology involves a set of techniques used to manipulate atom by atom, aiming at the creation of new structures at nanoscale (Berger Filho, 2009), allowing advances in areas that, even if they are not new, begin to be reinvented (Eugénio & Fatal, 2010).

In this context, the present research aims at mapping the Brazilian technological innovations related to nanotechnology to the National Institute of Industrial Property (INPI).

Literature Review

In Brazil, universities, research institutions and companies seek to demonstrate the potential they have for the technological development of their products, services and advances in their research, but it is still necessary to seek knowledge in innovation.

In addition, firms are concerned with their ability to innovate, particularly in relation to their competitors, because they believe that their future may depend on innovation (Fagerberg, Martin & Andersen, 2013).

With regard to innovation, it is understood that the transformations in the innovation process over the last two decades show that it is increasingly dependent on interactive processes of an explicitly social nature, with a growing interaction between the different phases of this process (Cassiolato & Lastres, 2000).

In relation to the innovative scenario in Brazil, studies in nanotechnology have been gaining space, and this science is related to the manipulation of atoms and molecules to perform processes, construction of living things or beings, that is, it seeks to rearrange matter on the scale Of atoms, which involves a more elemental structural form of anything or any living being (Guazzelli & Perez, 2009).

Nanotechnology produces results in the areas of pharmaceutics and biotechnology, which involve the development of nanocarriers, which are used in cosmetics and associated with drugs, such as some antitumor chemotherapeutics (Zanetti-Ramos & Creczynski-Pasa, 2008).

Nanosciences and nanotechnologies (N & N), which can contribute to the development of industries such as pharmaceuticals, electronics, automobile and textiles, among others (Fernandes & Filgueiras, 2008).

In turn, nanotechnology encompasses five areas: minerals and agribusiness; Medical and health devices; Energy and environment; Materials and manufacturing; Electronics, information and communication (Cuadros, Méndez & Portero, 2009).

In Brazil, in 2004, the Ministry of Science and Technology launched the Pluriannual Plan (2004-2007), the program "Development of Nanoscience and Nanotechnology" and in 2005 was launching the National Nanotechnology Program that enabled the expansion of the number of initiatives in this area. Theme (Plentz & Fazzio, 2013).

It is important to emphasize that the estimate of professionals working in the field of nanotechnology, which this sector can move around the world, by 2018, an amount of U$ 1 trillion. And in Brazil it is expected to have 1% of all this market, which would generate business around U$ 11 billion (Duarte, 2015).

It is understood that nanotechnology can bring advances in technologies that manipulate materials, being able to explore different areas of different knowledge, generating innovation that can be used to improve areas such as health, providing technologies for treatment and diagnosis of diseases.

Methodology

It is an exploratory, descriptive quantitative approach, conducted through data datawarehousing at the National Institute of Industrial Property (INPI). For this purpose, the keyword "nano" was used in the database, and in return, 207 patents on innovations in nanotechnology were obtained for analysis.

Analyzing the evolution since the year 1993, there was the first deposit in the base of the INPI until the present day, verifying the quantity of patent deposits and the number of companies and universities that deposited innovations in nanotechnology.

Results and Discussion

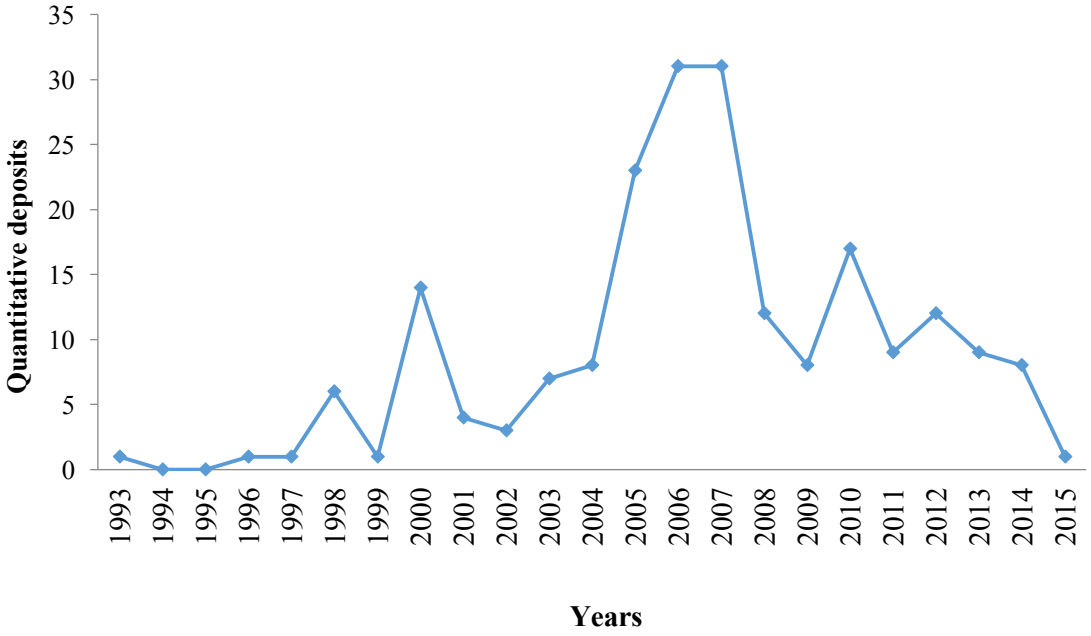
Figure 1 shows the annual evolution of patent deposits, in which it was verified that the first deposit occurred in 1993 at the INPI base, noting that this analysis was based only on the use of the nano keyword. It is also observed that in the 90's there were few deposits aimed at nano research.

However, this production of patents has been increasing, and in 2000 there was a substantial increase in deposits, with fifteen occurring, and in 2005, 2006 and 2007 they obtained a larger quantity of deposits, with twenty-three, thirty-one and thirty-one, But that number declined in 2008 decreasing to only twelve and in 2014 only 6. The year 2015 showed only one patent deposit.

It is important to emphasize that in the beginning of 2000 Brazil already invested in nanotechnology, since in this respective year the initiatives of this area began by the Ministry of Science and Technology and Innovation (MCTI), as well as in 2003, through an ordinance, a Group was created In order to develop the Nanotechnology Program under the Pluriannual Plan (2004-2007), which shows that in the national scenario the search for the development of nanotechnology research was beginning (Zanetti-Ramos & Creczynski-Pasa, 2008).

This nanotechnology program, launched in 2005, increased MCT's investment in nanotechnology and made it possible to increase the number of initiatives in this area (Plentz & Fazzio, 2013), which also explains the fact that 2006 and 2007 had Number of patent deposits. In addition, Foundation for Research Support of the State of São Paulo (FAPESP) has also opened calls for nanotechnology projects in these years.

Figure 1 - Annual evolution of patent deposits in INPI



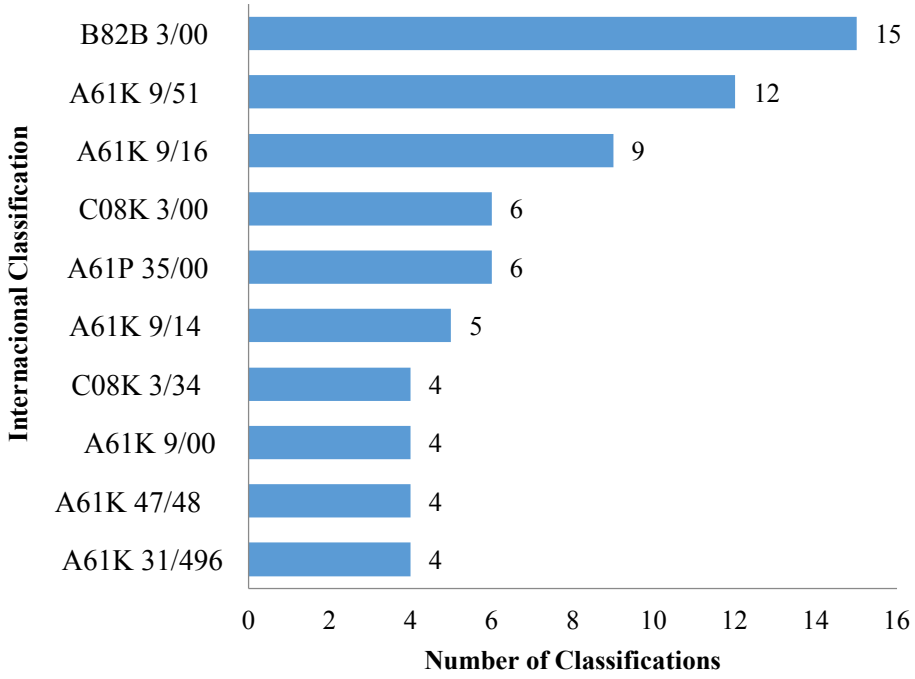
Source: Based on data collection in the INPI (2016)

With respect to the CIP code, it can be seen from Figure 2 that the most present classifications in the results found were B82B 3/00, A61K 9/51, with only those that appeared more than once in the survey. In Table 1 all meanings of the IPCs highlighted in Figure 2 can be visualized.

It is also noted that of the eight large sections hat highlight the classifications A, B, C, D, E, F, G and H, the area that was most present in the patent deposits was section A and C. Section A represents human needs and C represents chemistry and metallurgy. It is important to verify in which section the patents analyzed are classified, since it is the section that indicates the field of action of the patent (Perucchi & Mueller, 2014).

Furthermore, in the case of this survey of the 531 classifications found through the analysis of patent deposits, 184 are related to section A, about 35% of CIPs and 200 are section C, involving 38% of CIPs, since in a patent more than one rating. It was also observed that most of the classifications that had more emphasis in the research are related to the subclass A61K, that involves the preparations for medical, dental or hygienic purposes, being important to emphasize that this research involves the use of nanotechnology in medical treatments, being That an example of technology in this area is carbon nanotubes.

Figure 2 - Number of patents per international classification code in INPI



Source: Based on data collection in the INPI (2016)

Table 1 - International Patent Classifications found at INPI

Classification Code	All rights reserved
B82B 3/00	Manufacture or treatment of nano structures formed by individual manipulation of atoms, molecules, or limited groups of atoms or molecules as discrete units
A61K 9/51	Nanocapsules
A61K 9/16	Agglomerates; Sprinkles; Microgranules
C08K 3/00	Use of inorganic ingredients
A61P 35/00	Antineoplastic agents
A61K 9/14	In particulate form, e.g. ex. post
C08K 3/34	Silicon-containing compounds
A61K 9/00	Medicinal preparations characterized by special physical forms
A61K 47/48	The non-active ingredient being chemically bound to the active ingredient, e.g. ex. Conjugated polymeric drugs

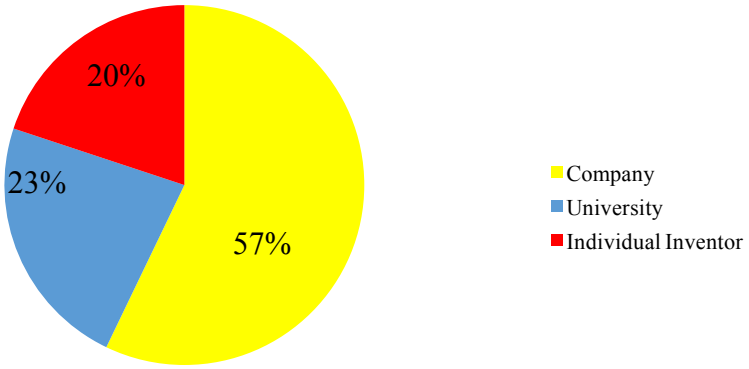
A61K 31/496	Non-condensed piperazines containing additional heterocyclic rings, e.g. ex. Rifampin, thiothixene

Source: Based on data collection in the INPI, 2016

The Figure 3 shows the profile of the depositors, in which it was observed that the majority of these, 57%, are companies, 23% are universities and 20% is made up of individual inventors.

Analyzing these data, it was found that from the depository universities, the State University of Campinas (UNICAMP), an institution located in the State of São Paulo, was the one that deposited more patents, 6 in the INPI and the companies went to Unilever which presented 6 deposits.

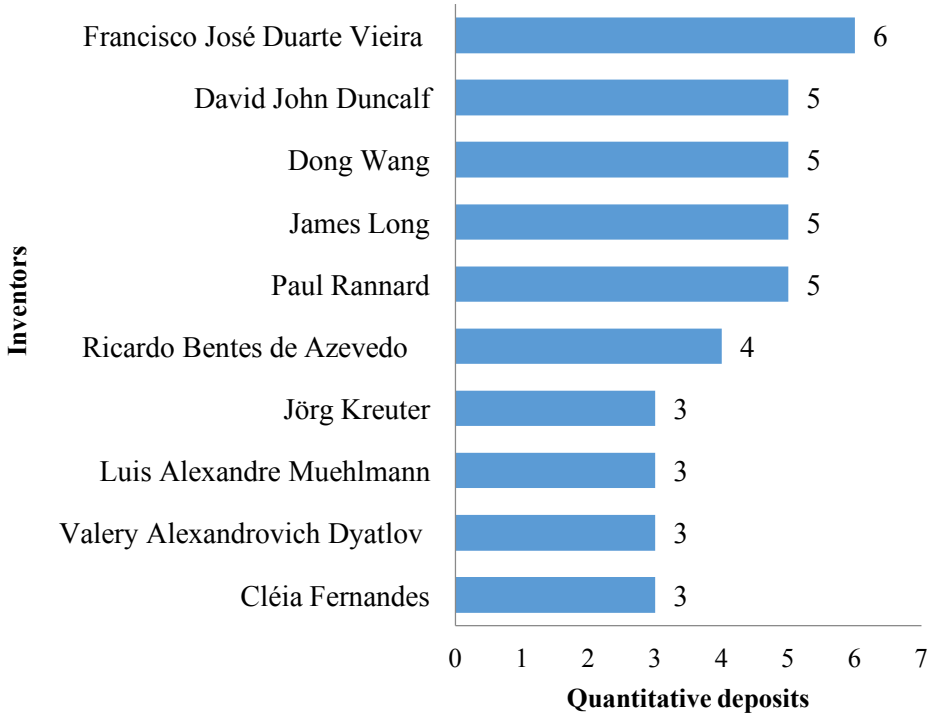
Figure 3 - Profile of the depositors in the INPI base



Source: Based on data collection in the INPI (2016)

In addition, the data in Figure 3 shows that it is necessary to encourage the partnership between universities and companies to stimulate the development of innovations in Brazil, since for Sant'Anna, Alencar & Ferreira (2013) the production of innovations in Brazil needs to improve, The Federal Government is developing and investing in some instruments to strengthen the country's innovative potential, such as FINEP's announcements.

Figure 4 - Patent Deposits of Inventors



Source: Based on data collection in the INPI (2016)

The Figure 4 highlights the inventors with the largest number of nanotechnology patent filings, in which the inventor Francisco José Duarte Vieira made six deposits. The others got five, four and three. About this inventor was not found information about his profession, only on the patents that deposited, and in all this appears as inventor and also as depositor, indicating that he is an individual inventor.

Conclusion

From the mapping carried out around nanotechnology, it is noted that after the 1990s, innovations in nano began to be more developed, covering more the manufacture or treatment of nano structures. However, it was from 2004 that it began to produce more number of nano technology, this can be explained of the fact that at that time the Nanoscience and Nanotechnology Development program was created, which sought to broaden the studies on this topic.

However, after the measurement of patents it was noticed that there was a predominance of deposits made by companies, bringing the need to encourage partnerships between companies and universities in order to explore and foster

technological development in different areas of knowledge, since Is an area that covers several areas of science and that can span several technological studies, with the application of nano in medicine.

In view of all the data found, it has been noticed that in Brazil technological innovations in nano have been growing over the years, and many of these innovations can be explored and commercialized in the market.

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