The Intricates of Patent in Nanotechnology

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Abstract

The fusion of many disciplines with nanotechnology, resulting in the creation of nanoparticles having special features that set them apart from their macro-level counterparts. The quick discovery, distribution, and delivery of technical solutions are fueling economic growth and development as a result of rising worldwide investments in nanotechnology. However, nanotechnology patenting is still in its infancy in developing nations like India and confronts a number of difficulties, such as patentability requirements, cross-disciplinary methods, a lack of competence, wide claims, and concerns with patent infringement. This paper is an attempt to highlight that the legal system be changed so that advances in nanotechnology can be protected by intellectual property rights.

Introduction

Nanotechnology, which combines various scientific disciplines, plays a crucial role in developing nanoparticles that exhibit unique properties distinct from the same material at a macro level. With increasing global investments in nanotechnology, the discovery, diffusion, and implementation of technological solutions are progressing rapidly, contributing to economic growth and development. This emerging technology has two main application approaches: the top-down approach involves manipulating matter at the nanoscale to serve a specific purpose, while the bottom-up approach gathers elements at the nanoscale to create mechanisms or materials.

The majority (84%) of nanotechnology patents have been granted by the USPTO, EPO, and JPO, indicating their dominance in this field. In contrast, in developing countries like India, nanotechnology patenting is still in its early stages and faces numerous challenges in gaining expertise and handling nano-patent applications. These challenges include defining the patentability criteria of nanotechnology inventions, adopting a cross-disciplinary approach to nanoscience, addressing issues related to expertise in handling nano-patent applications, dealing with broad claims, and resolving multiple nano-patent infringement suits. The paper aims to illustrate the evolving patent landscape in nanotechnology by exploring the international patent classification system, searching for nanotechnology prior art, and developing search strategies.

Nanotechnology Research and Applications

Nanotechnology, a burgeoning field in modern human civilization, has pervaded every aspect of our lives. The concept of nanoscience and technology was initially proposed by physicist Richard Feynman in 1960. Later, in 1974, Prof. Taniguchi coined the term "Nanotechnology" to describe the manipulation and control of atoms and molecules. Due to its complexities, the development and deployment of nanotechnology require careful consideration by stakeholders. Many countries are investing heavily in research and development in this area, indicating its promising potential.

Nanoscience is expected to revolutionize products and processes, potentially surpassing the impact of silicon chips in the field of information technology. However, despite its tremendous outcomes and ongoing research, uncertainties remain about the consequences of nanotechnology on the environment and wealth. The far-reaching effects of nanoscience on human health and the environment, particularly when exposed to nanoparticles, are still not fully understood. Therefore, a programmatic approach with partnerships in research and development is essential to explore and test nanotechnology's transformative applications in healthcare, environment, energy resources, and information technology. It is crucial to foster conscientious communication between stakeholders and citizens to ensure responsible development and utilization of this highly innovative science.

Nanoscience refers to the study of materials at the atomic and molecular levels, where the resulting properties differ significantly from those at larger scales. According to the US National Nanotechnology Initiative, nanotechnology involves understanding and controlling matter within the range of approximately 1 to 100 nanometres. At this scale, unique phenomena enable novel applications, encompassing nanoscale science, engineering, and technology. Nanotechnology involves tasks such as imaging, measuring, modeling, and manipulating matter at this length scale. Materials at the nanoscale exhibit extraordinary physical, chemical, and biological properties, measuring one billionth of a meter. These exceptional properties open up new possibilities for nanotechnology to address critical development challenges effectively. Following are a few areas and the applications currently

- **Agriculture and Food Security**

Nanotechnology is being utilized in food technologies to create nanofood, which involves nanoparticles employed during cultivation, production, processing, and packaging. By using certain biological molecules in innovative ways, this approach enhances production and processing while providing nutritional benefits. Scientists apply enzyme interactions, nanocapsules for delivering agrichemicals, nanosensors for monitoring soil conditions, nanochips for identification purposes, and nanoparticles for DNA delivery in genetic engineering to improve agricultural productivity.

- **Energy**

Nanotechnology plays a crucial role in enhancing the efficiency of both conventional and non- conventional energy sources. It achieves this by using nanocoated resistant drill probes, which extend the lifespan and efficiency of fuels, resulting in cost savings. Nano optimized membranes effectively extract excess carbon dioxide from the atmosphere, storing it for power generation and other eco-friendly purposes. Moreover, nano-structured semiconductors contribute to increasing the efficiency of automobiles and electronics. The development of lithium-ion batteries with nanotechnology has significantly improved the performance of electric vehicles due to their high heat resistance. Additionally, zeolites, nano porous materials used in industries, aid in water adsorption and heat storage.

- **Graphene Nanotechnology**

Graphene shows great promise in applications such as solar cells, lithium-ion batteries, fuel cells, and supercapacitors. Nanomaterials incorporating Graphene significantly enhance energy capacity, storage, and catalytic reactions.

- **Space**

Nano censors have proven valuable in propulsion systems, using accelerated nanoparticles as propellant to provide thrust for launching masses. China's development of anti-satellite weapon countermeasures involves this advanced nanotechnology.

- **Nanomedicine**

Nanomedicines have revolutionized healthcare and pharmaceuticals. These nanodevices and nanostructures operate at the molecular level, enabling groundbreaking advancements in diagnostics and therapeutics. For instance, nanotechnology facilitates the visualization of individual cells in cancer cases and the delivery of nanorobots to reverse malignant changes. Biomedical research benefits from nanoscience through high-profile imaging of internal organs and the development of anti-cancer drugs.

- **Environment**

Nanoscience's potential impact on the environment and climate protection includes preserving natural resources, conserving water, and reducing greenhouse gas concentrations. Nanomaterials exhibit eco-friendly properties, making them suitable for battery recycling using Zinc Oxide nanoparticles instead of Zinc and Manganese Dioxide, cleaning up radioactive messes with titanate nanofibers, and addressing oil spills. Nanoflakes made with Graphene at the nanoscale are also used to treat water impurities.

- **Fisheries and Aquaculture**

Nanoparticles have been shown to enhance the growth of young carp and sturgeon, resulting ina 30% and 24% faster growth rate, respectively. Research also indicates that nanoscale delivery of nutraceuticals improves the growth and performance of fish and shellfish, making it a promising area of aquaculture research. Nano delivery systems for nutraceuticals can reduce wastage and increase the economic viability of aquaculture practices.

Radio frequency ID (RFID) tags, incorporating nanoscale components, can be used to track and monitor fish, including their metabolism, swimming patterns, and feeding behavior. Nano- barcodes, composed of metallic stripes with nanoparticles, offer a way to encode information and monitor the source and delivery status of aqua products, ensuring better quality and traceability. Nanotechnology also plays a role in water filtration and remediation, with nano- enabled technologies capable of removing contaminants from water, such as ammonia, nitrites, nitrates, and harmful compounds. Additionally, nanoscale powder made from iron can effectively clean up contaminants, making way for nano-aquaculture.

Nanotechnology devices, like Nano Check by Altair Nanotechnologies, are used for water cleaning in swimming pools and fishponds, preventing algae growth and removing heavy metals. Such devices are being tested for their effect on fish and potential impacts on human health and the environment. In the field of fishing, nanotechnology is utilized in fishing lures. Nano-coated lures, painted to reflect light in multiple directions, significantly increase the chances of catching fish compared to conventional lures.

Intellectual Property Rights in Nanotechnology

The emerging field of nanotechnology is witnessing a surge in research applications, technological advancements, and commercialization, which underscores the need for its exploration and recognition under intellectual property (IP). Governments, large companies, national laboratories, and universities are actively seeking to patent their nanotechnology innovations. However, adapting IP rights to nanoscience and technology poses significant challenges and broader issues. Nanotechnology inventions in various sectors like medicine, environment, construction, health, electronics, and information technology have brought about revolutionary changes in economic growth and development, expanding the scope of intellectual property law.

Patents require disclosure to enable the public to understand how an invention works. However, with nanotech inventions dealing with the nanoscale level, classification becomes challenging. Nanoscience involves an unprecedented amalgamation of various scientific disciplines, making the identification of "non-obvious" characteristics difficult. Patent examiners and officials in patent offices need expertise in fields like biology, chemistry, engineering, and physics to adequately assess nanotechnology patents.

Other issues in granting IP protection to nanotechnology include overlapping patents leading to multiple infringement suits, lack of guidelines under TRIPS agreement for nanotechnology patents, and utility requirements. As nanotechnology has a direct impact on regional economies, it becomes a public policy issue that requires careful assessment of its impacts. Developing a separate class and legal provisions for nanotech patents, combining patents with trade secrets and other IP licenses, has proven beneficial in providing strong IP protection for nanotechnology and serving the public interest.

However, there are concerns about large-scale nanotech patent litigation due to the potential formation of patent thickets and overlapping claims, leading to conflicts in granting patents. To address these challenges, the IP regime needs to be equipped to handle nanotechnology's legal complexities and infrastructure. Intellectual Property Rights should be tailored to nanotechnology innovations in a way that serves public interest and does not hinder further research and development in the field.

Nanotechnology is still in its early stages and has a long way to go in developing nano-scale materials and machines made to atomic specifications. It is a multidisciplinary discipline encompassing chemistry, physics, biology, computer science, and engineering. The impact of nanotechnology on various aspects of life is profound, ranging from clean and abundant energy to pollution-free and cost-effective production of high-quality materials, cancer drugs, and more. Protecting intellectual property of nanotechnology inventions is crucial as it incentivizes

innovation in the field by granting inventors the prospect of monopoly profits and rewards for successful investments in research and development activities.

Dynamics of Nanotechnology Patenting-Indian Perspective

It is widely assumed that nanotechnology research is costly and that the field will be dominated by corporate giants, leading to monopolization. Analyzing the global patent landscape of nanotechnology reveals intense competition for patenting, necessitating harmonization of international intellectual property regulations. India, as a representative of developing countries, faces the challenge of creating a suitable IP regime for nanotechnology. A study of Indian patents in nanotechnology between 1990-2007 shows a significant increase in the number of patents, with government organizations like DRDO, CSIR, and DAE, alongside private firms and academic institutions, actively contributing to nanotechnology developments.

The patentability criteria for nanotechnology inventions include novelty, non-obviousness, and industrial application. However, nanotech inventions, involving a wide range of applications and overlapping with multiple disciplines, can be challenging to assess for non-obviousness. Additionally, nanotechnology research often leads to evolving utilities that may be difficult to define at the time of conception. The novelty requirement is met by searching for prior art records, including foreign and national patents. Compulsory licensing provisions can helpovercome patenting problems, promoting fair negotiations and public good.

The enablement clause, experimental use clause, and the disclosure standard should be strengthened to ensure the ultimate beneficiary of patents is the public. Nanotechnology patents face obstacles due to broad claims, cross-sectoral applications, and links to various technological disciplines. Ethical and moral grounds also pose challenges, and nanotoxicology concerns may hinder patentability. Policies and initiatives such as the "Nanomission" highlight India's efforts in marketizing nanoproducts and addressing consumer needs. However, India's patent law needs to evolve to accommodate nanotechnology innovations effectively.

Trends in Nanotechnology patents: USPTO, EPO, JPO

Nanotechnology is a rapidly evolving field that involves manipulating matter at the nanoscale, promising revolutionary advancements. Data from the OECD in June 2008 showed that the majority of nanotechnology patents were dominated by companies and academic institutions from the United States, Europe, and Japan. Patent applications for nanoscience and technology have been steadily increasing, particularly in Singapore, Japan, the United States, Israel, and

Ireland. The United States, European Union, and Japan collectively hold 84% of nanotechnology patents. Notably, the USPTO leads in nanotech patents, with a significant number of grants in recent years.

- **USPTO Nanotechnology patents and initiatives:**

A report by Mcdemott Will & Emery states that US-based inventors contribute 54% of nanotechnology-related patents. The USPTO has established a cross-reference class 977 for nanotechnology, aiding patent examination and further classification. However, nanotech patent searches can be challenging due to its broad coverage and the need for subject area expertise. While nanotechnology patenting is on the rise, its full potential is yet to be realized, and commercialization remains in the early stages. The lack of a robust classification system and focused command over nanoscience pose hurdles to accommodating nanotechnology inventions.

- **EPO Nanotechnology Patents:**

EPO defines a nanostructure as an atomically precise arrangement of matter formed solely from atoms or molecules, and nano-inventions granted by EPO include various technologies such as scanning probe microscopes, nanotubes, and nanoimprint lithography. EPO has a unique tag, "Y01N," for nanotech inventions, which facilitates interdisciplinary searches. Nanotech patent applications at EPO must prove novelty and non-obviousness, demonstrating technical advantages over prior art. Infringement actions against nanotech patents can be complex, particularly during commercialization.

In **Smith Kline Beecham Biologicals v. Wyeth Holdings corporation,** EPO granted patent toa Hepatitis B vaccine which used lipids measuring 60-120 nano metres. It was found that the patent had novelty in comparison to a prior patent obtained by a similar vaccine which use 80- 500 nano metres lipids molecules. Because the smaller particles in the objected case imparted unique immune responses. In addition to novelty, the patent application must prove the non-obviousness of invention. In the above cited case, the inventive step or non-obviousness was found because of its unexpectedly improved impact in providing immunisation against Hepatitis B

- **JPO Nanotechnology Patents:**

Japan prioritized the nanotechnology sector in 2001, leading to substantial investments and a significant number of nanotech patents. However, nanotech patents account for only 1% of the total patent applications at JPO. A proactive approach is needed for dealing with nanotech patent applications due to their interdisciplinary nature and diverse applications. Patent examiners should be trained with expertise in nanotechnology to effectively evaluate patent applications.

Conclusion

Nanotechnology innovations encounter challenges during the patent examination process due to difficulties in applying patentability criteria. These challenges arise from the multidisciplinary nature of nanoscience, leading to overlapping patents and the presence of larger-scale devices in prior art. Determining the scope of claims also becomes ambiguous, making it hard to assess their narrowness or broadness. In response, USPTO and EPO have introduced separate classes, such as Class 977, to accommodate nanotechnology patents, resulting in numerous nanopatents being granted. However, this has led to overlapping patents and an increase in patent infringement suits. India, on the other hand, lacks a nanotechnology patent classification system, making the legal landscape for nanotech inventions even more complex. This places a burden on patent examiners, potentially resulting in lower-quality patents.

The convergence of benefits and disadvantages in nano patenting presents challenges and opportunities for investors. Nanotechnology raises issues regarding intellectual property protection and non-commercial laws, as it must navigate criteria related to novelty, inventive step, industrial application capability, and eligibility under Section 3 of the Patents Act, 1970in India.

End Notes

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