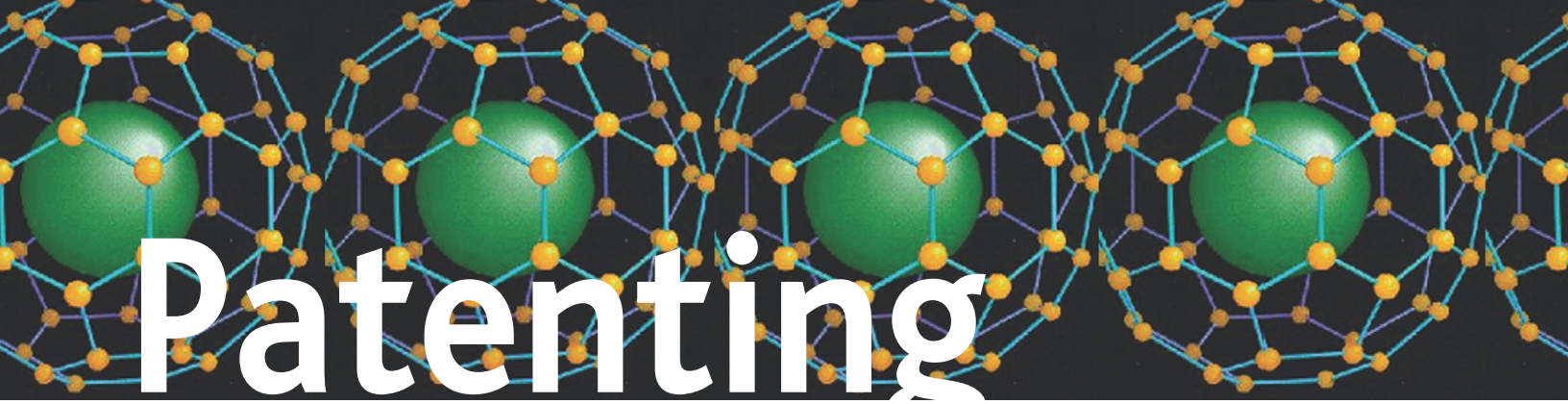

# Patenting nanotechnology

by Ronald A. Bleeker, Louis M. Troilo, and Dominic P. Ciminello

The rapid growth of nanotechnology has been accompanied by an inevitable interest in obtaining patent protection. This article describes the basic requirements and procedures of patent law (primarily in the US), as well as some of the unique legal issues that may be faced by those seeking to obtain patents for their nanotechnology inventions[1].

**Nanotechnology – broadly defined here as research and development at the atomic or molecular scale (1-100 nm) – is one of today's fastest growing technologies. The ability to design materials at this level is leading to novel products with wide-ranging applications (Figs. 1 and 2). As with any developing field of science, nanotechnology presents the scientific community with a host of technical challenges, but also presents inventors with new hurdles when trying to patent their inventions[2].**

The multidisciplinary combination of chemistry, physics, electronics, and engineering often associated with nanotechnology in particular, creates problems for patent agencies, such as the US Patent and Trademark Office ('the Patent Office'). Not only does this union of technologies require the Patent Office to decide on the best way to classify and examine these patent applications, but it also requires finding examiners capable of understanding such inventions. The following article is intended to describe the patent process briefly and to make nanotechnology inventors aware of some of the unique issues associated with protecting their intellectual property.

## US patent law

In essence, a patent is a bargain between an inventor and a government[3]. An inventor agrees to disclose his invention to the public, who presumably will benefit from the new knowledge and perhaps be encouraged to make improvements. In return, the government grants the inventor the right to exclude others from using the invention for a

Finnegan, Henderson, Farabow, Garrett & Dunner, L.L.P.
1300 I Street, NW
Washington, DC 20005-3315, USA
E-mail: ronald.bleeker@finnegan.com



ISSN:1369 7021 © Elsevier Ltd 2004

limited time, usually 20 years from the date of filing the patent application.

The power of the US government to grant patents originates in the US Constitution (Article 1, §8). The Supreme Court has described the goals of the patent system as follows:

> First, patent law seeks to foster and reward invention. Second, it promotes disclosure of inventions to stimulate further innovation and to permit the public to practice the invention once the patent expires. Third, the stringent requirements for patent protection seek to assure that ideas in the public domain remain there for the free use of the public[4].

In the US (as in Europe, Japan, and other major economies), patents are 'examined' to determine whether the claimed invention meets certain statutory requirements. The US patent system does not reward every advance in technology, but only those that meet certain standards of utility, novelty, and nonobviousness. So, to satisfy the requirement of utility, a patent must be obtained on a new and useful process, machine, chemical composition, or improvement thereof.

A patentable invention must also be novel. For instance, an inventor may not obtain a US patent on an invention if it was known or used by others in the US, or described in a printed publication, journal article, etc., in any country before the inventor files an application. US patent law allows an inventor a one-year grace period to file an application following public use, sale, or offer for sale of the invention. (Note that this one-year grace period does not exist in many countries outside the US. Rather, 'absolute novelty' is the standard.) Accordingly, any one of a public disclosure, sale, or offer for sale before filing a patent application may completely preclude patent rights outside the US, even if US rights are not immediately affected.

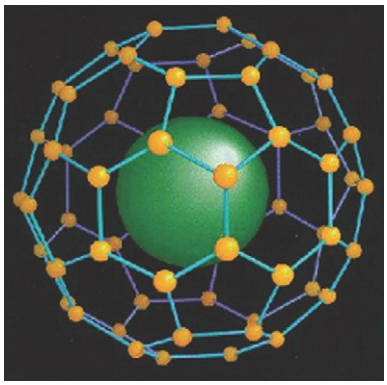

*Fig. 1 The structure of a $C_{60}$ fullerene or 'buckyball' with a central metal atom. (Reprinted with the permission of Rice University.)*

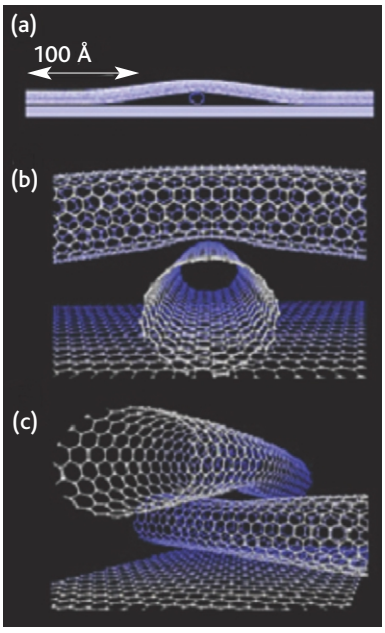


*Fig. 2 Research on the structure and properties of carbon nanotubes could lead to their use in nanoelectronic devices. (Courtesy of IBM.)*

The invention sought to be patented must also be 'nonobvious' in view of the prior knowledge that was available at the time of the invention. The Patent Office makes this determination by viewing all of the prior art through the eyes of a person who is familiar with the field of technology to which the invention pertains at the time the invention was made. This hypothetical person is referred to as 'one of ordinary skill in the art'. For example, if at the time the inventor created his invention, one of ordinary skill in the art could have used information from prior patents, articles, publications, or other publicly available sources, alone or in combination, to develop the same idea that the inventor is trying to patent, the Patent Office will not issue a patent. It will assert that the invention is 'obvious in view of the prior art'.

In addition to the requirements of utility, novelty, and nonobviousness, a full disclosure of the invention is also required. In other words, an inventor must provide a description that is sufficiently detailed to teach one skilled in the art how to make or practice the invention. The patent must also claim the invention with sufficient particularity that one skilled in the art (including competitors) will

understand the limits of the invention. Finally, the patent must include a description of the 'best mode' known to the inventor for practicing the invention. The foregoing disclosure requirements are usually judged in view of the predictability of the technology. In new and emerging fields, such as nanotechnology, a heightened level of disclosure is often required, as the operability of the claimed invention may be called into question. A deficiency in any of these core disclosure requirements can be fatal to the patentability of the underlying patent, even if it is otherwise deemed to have utility, novelty, and nonobviousness.

Finally, it is important to emphasize the role of patent claims. These act like fences in the lush fields of emerging technology. They stake out and define the scope and extent of the inventor's rights. That is, the claims define the legal 'metes and bounds' of the inventor's rights and shape the boundary of the inventor's right to exclude. It is important, however, to understand that while a patent gives you the right to stop others from practicing your invention, it does not necessarily give you the right to make or use the invention yourself (e.g. others may have a broader patent that dominates yours).

## Patent issues in nanotechnology

As in the biotechnology and e-commerce booms of the past two decades, patents will shape the emerging landscape of the nanotechnology industry in important ways. The US patent system has generally proved very adaptable to new technologies[5]. However, the inherent nature of nanotechnology will raise some new and unique intellectual property issues that the Patent Office and patent practitioners will have to address. Inventors should be aware of these issues, and how the Patent Office is likely to address them.

## Dealing with a multidisciplinary field

By its very nature, nanotechnology is a multidisciplinary area of science. As such, its inventions are based on a wide spectrum of technologies including materials science, electronics, physics, chemistry, and biology. While this diversity may foster creative new approaches to the technical hurdles posed at the nanoscale, it also creates some significant difficulties in patent examination, classification, and analysis.

For example, the broad definition of 'nanotechnology' leads to challenges in classifying new inventions for Patent Office purposes. On one hand, an application may use other terms, such as 'microscale' or 'quantum dot', to describe a nanotechnology invention. On the other hand, an applicant may incorrectly describe his invention as 'nanotechnology', perhaps seeking to capitalize on the positive press associated with this term, or use terms like 'nano-second' that arise in other contexts. Inventors and examiners must, therefore, be particularly cautious when searching for prior art in this area – 'nano' alone is not a good search term.

A second problem relates to where nanotechnology patents will be examined within the Patent Office. In the 1980s and 1990s, judicial decisions in the US cleared the way for inventors to patent inventions in the expanding areas of biotechnology and Internet business methods. Inventors sprinted to the Patent Office, overwhelming it with new applications. The Patent Office recognized the importance of these new technologies and eventually responded to the surge in applications by establishing two new groups solely devoted to examining Internet business methods and biotechnology inventions. To date, however, the Patent Office has declined to do the same for nanotechnology. According to the Patent Office, this is because nanotechnology broadly cuts across all technologies, so that having one group dedicated to it would present difficulties in examination and classification. However, the Patent Office remains open on this issue and has indicated that it will revisit this decision if a sufficient 'critical mass' of nanotechnology applications is received. A recent survey[6], using one definition of nanotechnology, found that the number of nanotechnology patents issued by the Patent Office rose from 538 in 1976 to 6425 in 2002 (Fig. 3, Table 1).

The multidisciplinary nature of nanotechnology places an increased burden on patent examiners, who understandably do not have a wealth of experience in this new area. Indeed, the small pool of nanotechnology engineers and scientists who become patent examiners limits the ability of the Patent Office to recruit examiners with appropriate technical backgrounds. However, a group dedicated to examining nanotechnology inventions might result in better trained examiners, even if they were not initially schooled in the field, and a better product from the Patent Office.

If examiners are unfamiliar with or untrained in nanotechnology, applications are more likely either to be rejected improperly because the examiner mistakenly

concludes that the application is not novel, or else they may issue overly broad claims. In either case, the nanotechnology industry and public will suffer. For example, if an application is improperly denied, the applicants might have to file costly petitions to the Patent Office and, possibly, even the courts to have the decision reviewed. Overly broad patents may be of poor 'quality' in that they are more vulnerable to successful challenges based on prior art not considered by the Patent Office. Conversely, the issue of an overly broad patent may serve to improperly exclude competitors from entering the market, thus giving a single company far too much control over a particular part of a technological field. Obviously, this will discourage innovation, and thus frustrate the purpose of the patent system[7].

Even if the Patent Office establishes a dedicated nanotechnology examining group, giving greater consistency in the standards that must be met to obtain a patent, inventors need to actively assist their patent counsel in prosecuting their application claims. For example, because the Patent Office does not currently classify nanotechnology patents in a single area, US examiners may not be aware of potentially relevant prior art from other areas[8]. As it would be both more efficient and less costly to distinguish such art in the Patent Office (rather than in a court), inventors will benefit by quickly bringing such literature to the attention of the attorney handling their applications. In addition, US law requires inventors to disclose all information that might be relevant to the Patent Office in determining patentability.

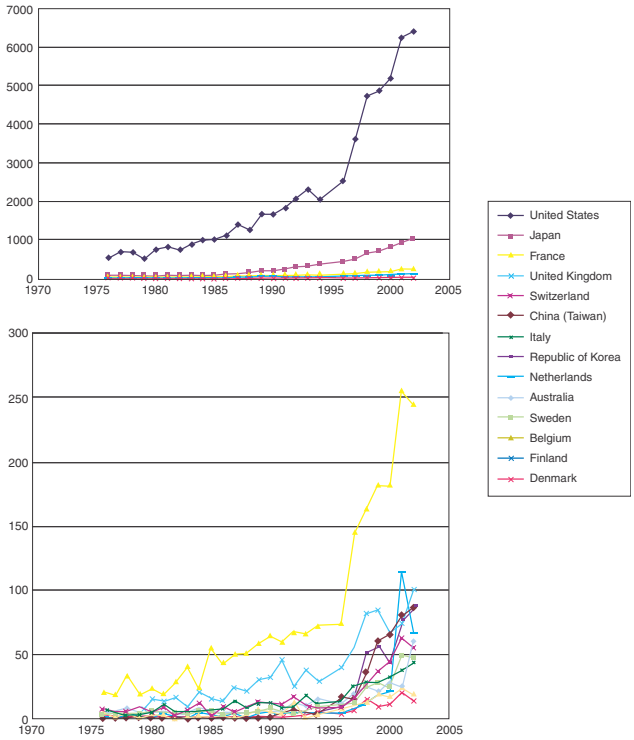


*Fig. 3 The number of nanotechnology patents per year for the 14 leading countries[6].*


This 'duty of disclosure' is taken very seriously by the Patent Office and the courts. Failure to disclose such information is another ground on which US patents can be lost. Recently, proposals have been made by the Patent Office and the Federal Trade Commission to introduce an 'opposition'

**Table 1** *Analysis of owners of nanotechnology patents (1976-2002)[6].*

| Rank | Assignee name | Number of patents | Average patent age |
|---|---|---|---|
| 1 | International Business Machines Corporation (IBM) | 2092 | 6.6 |
| 2 | Xerox Corporation | 1039 | 7.1 |
| 3 | Minnesota Mining and Manufacturing Company (3M) | 809 | 6.9 |
| 4 | Micron Technology, Inc. | 781 | 1.9 |
| 5 | Eastman Kodak Company | 738 | 9.3 |
| 6 | Motorola, Inc. | 705 | 7.1 |
| 7 | Texas Instruments, Inc. | 694 | 6.9 |
| 8 | NEC Corporation | 608 | 3.7 |
| 9 | The Regents of the University of California | 540 | 3 |
| 10 | The United States of America as represented by the Secretary of the Navy | 525 | 10 |
| 11 | Canon Kabushiki Kaisha | 505 | 5 |
| 12 | Advanced Micro Devices, Inc. | 502 | 3.3 |
| 13 | General Electric Company | 491 | 11 |
| 14 | Hitachi, Ltd. | 462 | 5.7 |
| 15 | Hewlett-Packard Company | 434 | 7.7 |
| 16 | Kabushiki Kaisha Toshiba | 412 | 4.6 |
| 17 | E. I. DuPont de Nemours and Company | 362 | 11 |
| 18 | Lucent Technologies, Inc. | 341 | 2.8 |
| 19 | Intel Corporation | 341 | 4.6 |
| 20 | The Dow Chemical Company | 322 | 10 |

system in the US Patent Office, similar to that already used in the European and Japanese Patent Offices. This would allow interested third parties to bring prior art to the attention of the Patent Office and permit an *inter partes* proceeding in the Patent Office to determine validity[9].

## Smaller can be patentable

Under US case law, an invention may not be patentable where the sole element of novelty is a difference in size, since a mere change in size may be viewed as 'obvious'. In fact, patents have been refused even in situations where the change in form, proportion, or size brought about better results than the previous invention. Such situations may be common in nanotechnology patents.

However, where the invention is not merely the reduction in size, but rather is the solution of new problems caused by reduction in size, inventors should direct their claims to the solution. In many inventions, decrease in size to the nanoscale requires the solution of new problems that did not exist at the macroscale. For example, quantum effects that are not significant at the macroscale can significantly affect the operation of a mechanical or electronic device at the nanoscale. Solving such problems may require the development of new manufacturing methods or materials, some of which should be patentable. By drafting patent applications presenting the invention as a solution to these new problems at the nanoscale, inventors will not only have a better chance of obtaining a patent, but may obtain a more diverse patent portfolio.

For example, if an inventor develops a nanoscale signal emitter, but finds through experimentation that he first has to overcome quantum mechanical problems to deliver power to the emitter, he could focus his claims on the solution to that problem. Rather than merely claiming the nanoscale signal emitter, for example, the inventor may be able to claim the new power supply and the process of transmitting power to the signal emitter. Similarly, a nanoscale lever in a microelectromechanical system may be an obvious mechanical part (just smaller), but overcoming problems of 'stiction' that do not arise at the macroscale may represent a patentable invention. New and emerging technologies are ripe with serendipitous solutions, and inventors should be aware of the potential in patenting such solutions.

US case law also prohibits a composition of matter patent, where the applicant is merely seeking to patent a new use for a known, existing material. However, the issue of patentability of inventions comprising known materials often turns on whether new and/or improved properties result when the known material is manipulated at the nanoscale. By showing that properties are unique to the nanomaterial and not present at the macroscale, inventors are more likely to have a patent granted.

## Conclusion

Nanotechnology's youth and its multidisciplinary nature combine to raise new technical and legal issues for patent systems around the world. While the art of protecting intellectual property associated with nanotechnology inventions is also still young, the patent system has a history of adaptability to new technologies. As the different areas of nanotechnology develop, so will the patent system. In the meantime, inventors need to stay abreast of the current rules of the patent system in their own country and in others, and be actively involved as they and their attorneys prosecute their applications in order to assure that their ideas are properly protected. MT


REFERENCES

1. The views expressed in this article are those of the authors and do not necessarily reflect the views of Finnegan, Henderson, Farabow, Garrett, and Dunner L.L.P. or its clients.
2. While there are other methods of protecting intellectual property (e.g. trade secrets), this article focuses on protecting an inventor's ideas through patents.
3. While patents are traditionally granted by national governments, some multinational arrangements exist (e.g. Eurasia, Africa). The European Patent Convention provides for central examination and issue of patents, but enforcement depends on perfecting national rights. The proposed Community Patent, however, would be enforceable throughout the European Union.
4. *Aronson v. Quick Point Pencil Co.*, 440 US 257, 262 (1979)
5. This has also been generally true of other major patent systems, although issues have arisen with patents relating to drugs, biotechnology, and computer software.
6. Huang, Z., *et al.*, *J. Nanoparticle Res.* (2003) **5** (3-4), 333
7. Cockburn, I. M., *et al.*, Patent Quality. In *Patents in the Knowledge-Based Economy*, Cohen, W. M., and Merrill, S. A. (eds.), National Academies Press (2003); King, J. L., Patent Examination Procedures and Patent Quality, *ibid.*
8. However, the US Patent Office is developing a supplemental cross-reference system for classifying nanotechnology inventions and a separate collection of nanotechnology art. See Salotto, J., *Nanotechnology and Classification*, USPTO Customer Conference on Nanotechnology (Sept. 11, 2003)
9. USPTO 21st Century Strategic Plan; Graham, S. J. H., *et al.*, Patent Quality Control. In *Patents in the Knowledge-Based Economy*, Cohen, W. M., and Merrill, S. A. (eds.), National Academies Press (2003); Levin, J., and Levin, R., Benefits and Costs of an Opposition Process, *ibid.*