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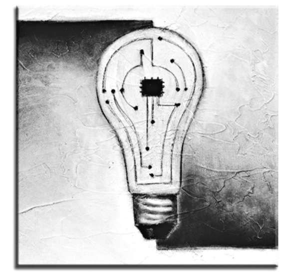
Patenting Nanotechnology: A Unique Challenge to IP Bar



TECH TODAY

BY M. VERONICA MULLALLY AND DAVID R. WINN

Nanotechnology is an umbrella term that describes a rapidly evolving interdisciplinary field of technology based on manipulation of matter at a sub-micron scale.

Governments throughout the world have recognized the critical importance of nanotechnology for the future of medicine and industry and have made significant amounts of money available for such research.

Most recently, on Dec. 3, 2003, the 21st Century Nanotechnology Research and Development Act was signed into law by President George W. Bush. This legislation dedicates $3.7 billion for nanotechnology research and development for the years 2005 through 2008 for five of the 16 agencies comprising the existing National Nanotechnology Initiative (NNI): the National Science Foundation, the Department of Energy, the National Aeronautics and Space Administration, the National Institute of Standards and Technology, and the Environmental Protection Agency.

The United States is already leading the way with U.S. companies holding eight times the number of patents in nanotechnology as are assigned to companies in any other country. Similar to biotechnology in the 1980s, nanotechnology is growing at a rapid pace, generating new ideas, products and processes. Patent protection is central to these research and development activities as nanotech companies (many of them start-ups) compete to control whole areas of nanotechnology by acquiring broad basic patents.

For most start-up companies, patents represent the essential value of the company and are critical to attracting investment and generating licensing revenue. They will also be critical to a successful exit strategy as established companies seek to move into the field once it becomes commercially viable.

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What Is Nanotechnology?

Nanotechnology embraces objects, mechanisms, assemblies, and systems based on size scales smaller than the micrometer/micron and larger than 1 nanometer (nm) or about 10 atomic diameters. Some points of reference for this scale are a human hair, which is about 80,000nm in diameter, and a red blood cell, which is about 1000nm.

The prototype, and perhaps the ultimate, nanotechnology system is found in nature: a virus or a living cell. A cell uses energy and forces, senses its environment, modifies its environment, communicates by chemical or even light messengers, moves about, reproduces, and manufactures (antibodies, hormones etc.) all by sub-cellular structures, mechanisms and macro chemicals the scale of 1nm to 100nm. Living cells do all of this in an assembly of several microns in size. The dream of nanotechnologists is to create mechanisms and processes on the scale of a single cell.

Areas of Development

Nanotechnology can be divided into two main areas of development: exploitation of the quantum properties of matter manipulated on the nanoscale, and exploitation of the physical attributes of nanoscale particles.

The 100nm threshold delineates where the laws of classical Newtonian physics of objects taper off and quantum mechanics phases in, i.e. the wavelike properties of objects become as or more important than their particle nature. When the wavelengths of energy/forces of the particle itself begin to compete with the size of the particle, its physical properties are affected.

The wavelength nature of an object scales inversely with its mass or energy (and hence size) and so a nanoparticle, as contrasted with a much larger object such as a person, can have wavelengths associated with it that are much more comparable to its own size.

The resulting quantum effects can modify many of a nanoscale object's physical properties, including density, thermal and electrical conductivity, chemical reactivity, optical properties (reflectance, scattering, absorption, emission, luminescence), magnetic properties, and tensile and compressive strength.

The nanoscale particle is also important for its size alone. Because the ratio of surface area/volume (mass) of an object varies inversely with its diameter, the surface area becomes much more important when objects are at sub-micron scales.

The surface area for a given mass of material divided into 10nm particles is 1,000 times that of the same mass divided into 10 micron particles. Thus, surface-related properties can be different on a nanoscale: The surface energies between nanoparticles and their surroundings become comparably larger and chemistry and particle-surface forces are much greater than with micron and larger systems.

Surface reactions such as catalysis, or coatings (including functionalization for specific chemical reactivity such as hydrophilic or protein selectivity), or sintering become easier because a large fraction if not all of the molecules in the nanoparticle are part of the surface, and hence have access to "the outside environment." Objects can become stronger in relation to their own size, similar to why a flea can jump 50 times its own height whereas an elephant cannot.

A nanofiber or particle is concomitantly stronger per mass. The nanoscale also enables "self-assembly," where chemical or biological processes are sufficiently large compared with the nanoscale to be able to reproduce a monotonous array of features or structures.

The ability to use and exploit the newly discovered properties of matter at the nanoscale offers a wealth of new opportunities and challenges in a diverse range of technologies.

Present areas of nanotechnology development include:

- Biomedical technology, examples of which include drug delivery methods, such as nano-coated medical devices or functionalized nanoparticles; genomics and proteomics; in-vivo diagnostics, such as protein-tagged or functionalized nanoparticles to increase contrast/resolution in medical imaging;
- Nanoelectronics and nanophotonics, which yield faster, lower-power devices, and lower costs by higher yields per wafer, and unique properties. Silicon, carbon nanotube, SiGe and other semiconductor nanoelectronics include lithography on a scale approaching 10nm, nanodots, nanotubes, nanowires and nanochannels, with applications for field-emission displays, field-effect transistors, nanolasers, ultra-high density data storage, including magnetic or phase change memory (MRAM, R-RAM) and atomic scale or molecular switchable memories;
- Micro/Nano Electrical Mechanical Systems (M/NEMS), in which nanomatchining is wedded to electronics and/or optics and/or fluidics (which can include biomedical devices). Examples include nanowire chemical sensors, resonators, accelerometers, micro-fuel cells, microlenses, optical coatings, and many applications in optics/detectors, fluidics, sensors, and data acquisition for lab-on-chip systems;
- Industrial uses of nanomaterials utilize the core nanotechnologies of nanopowders, nanofunctionalization, nanoporosity, self-assembly, and nano-super-lattice crystals in plastics, textiles and fibers, construction, paper, metals and alloys, paints and coatings, cosmetics, and chemicals, with applications ranging from thermal insulating, bacteria and abrasion resistance to sunblock.

Along with novel products and processes that are otherwise impossible, nanotechnology promises superior versions of current products, produced at lower costs, with less waste and pollution.

Patenting Nanotechnology

Almost 3,000 patents were issued between 1996 and 2002 with the term "nano" in the patent.

Today, the rapid pace of research and development continues, and valid enforceable patents are likely to be the only thing between success and failure for start-up nanotech companies.

The interdisciplinary convergence of physics, chemistry, biotechnology, electronics and medicine that is nanotechnology has resulted in inventions that can involve multiple disciplines. Just as it did with the advent of biotechnology, the U.S. Patent and Trademark Office is facing multiple problems in dealing with patent applications that claim inventions in this field.

One difficulty is in locating examiners with sufficient knowledge and experience of the technology to examine applications. Together with the mounting workload caused by ever more applications of ever increasing complexity from other technologies, the shortage of examiners with appropriate experience means that applications for patents in nanotechnology will likely take longer to prosecute. Delays in obtaining issued patents may impact the pace of the industry's growth, particularly the ability to secure funds for further research and development or commercialization of products.

Another problem common to obtaining patents in an emerging technology is the risk that overbroad patents may be granted. Such patents could impede growth and innovation.

In the early days of biotechnology, inexperienced examiners granted overly broad patents that risked bringing the entire industry to a standstill. Subsequent industry protests led to the establishment of the biotechnology examination unit in 1988. A similar risk exists today for the nanotechnology industry.

However, nanotechnology presents a unique challenge. Because of its cross-disciplinary nature, nanotechnology may not be as conducive to compartmentalization as biotechnology or business methods, which also has a special examination group. Perhaps conscious of this difference, the Patent Office has invited nanotechnologists to educate examiners on the technology, and in September 2003, the first Nanotechnology Customer Partnership Meeting was held at the Patent Office.

Currently, nanotechnology applications are examined throughout the different art units of the Patent Office. The agency has seven different technology centers, from biotechnology to chemicals and materials. Applications are routed to the various centers based on the subject matter claimed.

Because there is no specialized nanotechnology center, there is a risk that similar interdisciplinary nanotechnology applications could be sent to examiners in different arts. For example, examiners in semiconductors or biotechnology may not necessarily search for prior art in the other areas and thus may not find art that might be highly relevant.

There is also a risk that examiners inexperienced in nanotechnology could issue patents having overlooked art or having misunderstood the prior art they did locate. The issuance of questionable patents would be problematic for the industry in years to come.

It would be beneficial if nanotechnologists assisted the Patent Office in educating examiners and in developing guidelines for examining nanotechnology patent applications. Any inference of uncertainty as to the strength of patents and the attendant risk of expensive patent litigation may give potential nanotechnology investors pause and may unnecessarily slow the growth of this promising field.

As a practical matter, it would be helpful if nanotechnology inventors paid particular attention to drafting patent applications using well-recognized terms, submitted extensive prior art, and utilized every opportunity for an interview during prosecution to further educate the examiner.

A fundamental issue in patenting nanotechnology is related to whether the nanoproduct is novel just because it is smaller or whether, in light of patents that contain generic claims that cover the traditional product concept, it is obvious and therefore not patentable.

When size alone creates a new heretofore unknown property, an invention may be present. Yet, in many cases, the nanoproduct itself may not be patentable, whereas the process involved in making it is still patentable.

In addition to the manufacturing process, the tools involved in making the nano-product and the uses of the nanoproduct may also be patentable. Thus, although a known chemical composition may not be patentable over prior art, the nanotechnology process to make it more cheaply in quantity and its new applications may be.

While it may be several more years before a body of case law related to nanotechnology patents is developed, it is possible to speculate that in this area of law, like the technology itself, there may be some novelty. For instance, nanotechnology may be where the Reverse Doctrine of Equivalents could finally find application. (*Tate Access Floors, Inc. v. Interface Architectural Resources, Inc.*, 279 F.3d 1357, 1368 (2002) (the court has never affirmed non-infringement on the basis of the Reverse Doctrine of Equivalents).)

The Reverse Doctrine of Equivalents applies as a defense to patent infringement "where a device is so far changed in principle from a patented article that it performs the same or similar function in a substantially different way, but nevertheless falls within the literal words of the claim."

Given the unusual properties of nanomaterials and nanoprocesses, it is likely that there will be instances where nanotechnology is used to perform a similar function but does so in a substantially different way. In sum, small things may make big differences and avoid prior art.

Conclusion

Just as nanotechnology is proving an exciting area for scientists and industrialists, it is also likely to be an exciting area for patent prosecutors and patent litigators, since intellectual property rights are the key to obtaining investment and commercial success in nanotechnology.

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