Broad Claiming in Nanotechnology Patents: Is Litigation Inevitable?

SEAN O'NEILL,[*] KIRK HERMANN,[**]
MARLENE KLEIN,[***] JEFF LANDES[****] and RAJ BAWA[*****]

ABSTRACT

Nanotechnology is expected to faciliate great advances in energy, materials and medicine. Inventors, corporations, and governments are staking their claims to the rapidly-growing body of nanotechnology intellectual property. Patents are issuing with far-reaching rights, leading some to question the validity and scope of these patents. Concerns are arising on potentially overlapping patent claims in some sectors of nanotechnology. Contributing to the problem of patent overlap is the use of broad terms in the claims of nanotechnology patents. Clarification as to the meaning of the claim terms is sometimes available in the specification portion of the patent. The prosecution history of the patent application may also clarify the meaning of nanotechnology claim terms. The USPTO's recent creation of a new art classification system for nanotechnology and the development of standardized nanotechnology terminology is reducing the ambiguity regarding claim terms and thereby eliminating some of the uncertainty regarding ownership rights to nanotechnology.

---

[*] Sean O'Neill is an intellectual property attorney at the firm of Stetina Brunda Garred & Brucker P.C. located in Aliso Viejo, California. His practice focuses on patent prosecution and litigation of mechanical, biomedical and telecommunications inventions and counseling on patent strategies for start-ups and established companies. He can be reached at soneill@stetinalaw.com.

[**] Kirk Hermann is an intellectual property attorney at the firm of Shimokaji & Associates located in Irvine, California. His practice covers all aspects of intellectual property law and focuses on electrical, optical, and software patent prosecution and litigation. He can be reached at khermann@shimokaji.com.

[***] Marlene Klein is a Senior Patent Attorney at Canon U.S.A. located in Irvine, California. Her practice covers all aspects of intellectual property law, primarily focusing on patent prosecution and corporate contracts. She can be reached at marlene.klein@cda.canon.com.

[****] Jeff Landes is Patent Counsel at a pharmaceutical company in San Diego, CA. His practice focuses on all aspects of intellectual property law relating to pharmaceutical development and commercialization. He can be reached at jlandes@san.rr.com.

[*****] Dr. Raj Bawa, a microbiologist and biochemist, is president of Bawa Biotechnology Consulting, LLC, based in Ashburn, Virginia and Schenectady, New York. The firm specializes in all aspects of biotechnology, pharmaceutical, nanotechnology and chemical patent prosecution and patent searching. Dr. Bawa is a registered patent agent and holds a faculty position at Rensselaer Polytechnic Institute in Troy, New York where he also serves as advisor to the Office of Technology Commercialization. He can be reached at bawabio@aol.com.

I. INTRODUCTION

There is enormous excitement surrounding the multidisciplinary field of nanotechnology. Nanotechnology continues to open up novel vistas of innovation ranging from the discovery of emergent properties arising at the quantum level to the finding of new wonder structures such as nanotubes, quantum dots and diamondoids. Public and private entities across the globe are convinced of nanotechnology's potential and are staking their claims. International rivalries are growing, political alliances are forming and battle lines are being drawn.

According to a recent report, governments, corporations and venture capitalists spent almost 10 billion U.S. dollars on nanotechnology R&D globally in 2006.[1] This report predicts that by 2014, 2.6 trillion U.S. dollars in global manufactured goods (about 15% of the total global output) may include nanotechnology in one form or another. Even at the time of this writing, it is estimated that there are more than 300 nanotechnology-based consumer products in the marketplace.[2]

II. GROWING UNCERTAINTY REGARDING OWNERSHIP RIGHTS TO NANOTECHNOLOGY

As scientists sort out and document the results of their research, corporate entities continue to seek and carve out far-reaching patent rights in what is now a full scale patent "land grab."[3]

As this trend unfolds, uncertainty is growing amongst researchers, developers, policy-makers and investors regarding who really owns what particular swath of technology in the rapidly-expanding body of nanotechnology intellectual property.[4] Some fear that the far-reaching patent rights provided by early nanotechnology patents clearly overlap. Commentators, ranging from university experts to government agencies, blame this trend of uncertainty and patent overlaps on problems at the U.S. Patent & Trademark Office (USPTO), including a delay in implementing nanotechnology training for examiners.[5] They further point to the granting of patents of questionable validity and scope, as well as a growing backlog of unexamined patent applications and increasingly lengthy periods for patent pendency as exacerbating this uncertainty.[5, 6] Add to this backdrop the limited number of judicial opinions on patents involving

---

[1] *See* Lux Research, Inc., *Key Findings*, THE NANOTECH REPORT (4th Ed. 2006), a*vailable at* http://www.luxresearchinc.com/reference.html (last visited Feb. 15, 2007).

[2] *See* Project on Emerging Nanotechnologies, *The nanotechnology consumer products inventory* (2006), *available at* www.nanotechproject.org/consumerproducts (last visited Feb. 15, 2007).

[3] *See, e.g.*, JOHN C. MILLER, ET AL., THE HANDBOOK OF NANOTECHNOLOGY BUSINESS, POLICY, AND INTELLECTUAL PROPERTY LAW (Wiley 2005); Drew Harris, et al., *Strategies for Resolving Patent Disputes Over Nanoparticle Drug Delivery Systems*, 1 NANOTECH L. & BUS. 373 (2004); Raj Bawa, *Will the Nanomedicine "Patent Land Grab" Thwart Commercialization?* 1 NANOMEDICINE: NANOTECH., BIO. AND MED., 346, 346-350 (2005); Mark Van Lente, *Building the New World of Nanotechnology*, 38 CASE W. RES. J. INT. LAW 173, 173-215 (2006).

[4] *See* Lux Research, Inc., and Foley and Lardner LLP, *Nanotech IP Battles Worth Fighting*, (2006).

[5] *See* Vivik Koppikar, et al., *Current Trends in Nanotech Patents: A View From Inside the Patent Office*, 1 NANOTECH L. & BUS. 27 (2004); Bawa, *supra* note 3; Van Lente, *supra* note 3; Raj Bawa, *Editorial - Patents and Nanomedicine*, NANOMEDICINE: NANOTECH., BIO. AND MED. (2007) (in press); Raj Bawa, *Nanotechnology Patenting in the US*, 1 NANOTECH L. & BUS., 31, 31-50 (2004); Raj Bawa, *Patenting Nanomedicine: A Catalyst for Commercialization?* 5 SMALL TIMES 16 (2005); AK Mittal, LD Kootz, *Improvements Needed to Better Manage Patent Office Automation and Address Workforce Challenges*, Report GAO-05-1008T, United States Accountability Office (2005).

[6] *See, e.g.*, John Miller and Drew Harris, *The Carbon Nanotube Patent Landscape*, 3 NANOTECH L. & BUS. 427 (2006) (identifying images of carbon nanotubes from the 1970s and 1980s to raise questions of validity related to patents held by IBM and NEC).

nanotechnology[7] and a lack of standardized terminology,[8] and you have a patent landscape that is almost impossible to navigate in certain nanotechnology sectors.

This patent "land grab" mentality is also fueled by the relative lack of products and processes in the marketplace which compels companies to demonstrate confidence by generating intellectual property in order to convince venture capitalists to invest. In this regard, some companies are compelled to claim as much IP as possible in their patent application out of fear that their competitors will beat them to the punch.

III. COLLABORATION IN THE NANOTECHNOLOGY COMMUNITY TO SOLVE THE PROBLEM

Efforts are underway to address many of these problems. Recently, along with the above-mentioned nanotechnology-related training of examiners, the USPTO also created a separate art classification for nanotechnology patents.[9] The creation of Class 977 along with 263 new categories (i.e., sub-classes) provides a place for organizing most nanotechnology-related subject matter and assists examiners in classifying new disclosures and patents. Class 977 therefore aids in the search and examination of nanotechnology-related patent applications. In addition, the creation of Class 977, although based on the stricter NNI definition of nanotechnology, provides a much-needed tool by which attorneys and inventors can locate U.S. nanotechnology patent documents.

Additionally, experts in the field are collaborating to devise a first standard of nanotechnology nomenclature.[10] The development of a glossary of nanotechnology terms is occurring in the public sector (e.g., USPTO) as well as in the private sector (e.g., Institute of Nanotechnology).[11]

Still, uncertainty regarding the nanotechnology patent landscape and the validity of numerous issued patents remains the norm.[12] This is largely due to the nature of the nanotechnology patent "land grab" with its concomitant use of very broad claim language. Prominent examples include the far reaching claim language directed towards patents involving various types of nanoparticles and nanostructures.

IV. AN ACCURATE ASSESSMENT OF THE SCOPE OF CLAIM COVERAGE IS ESSENTIAL

What is occurring is that patentees who are trying to protect inventions regarding specific types of nanotechnology discoveries are not using specific terminology in their patent claims. Instead, their claims include broad terms such as "nanoparticles" and/or "nanostructures." In some cases, the specific types of nanostructure and/or nanoparticles (e.g., quantum dots, nanotubes, nanowires, nanocups, nanocones,

---

[7] *See* Andrew S. Baluch, et al., *In re Kumar: The First Nanotech Patent Case in the Federal Circuit,* 2 NANOTECH L. & BUS. 342 (2005).

[8] *See* Charles Q. Choi, *Nano World: Nano Patents in Conflict*, (2005), *available at* http://tech.monstersandcritics.com/columns/article_6611.php/Nano_World_Nano_Patents_in_Conflict (last visited Feb. 15, 2007); Bawa, *supra* note 5, at 102.

[9] *See* Blaise Mouttet, *Nanotech and The U.S. Patent & Trademark Office: The Birth of A Patent Class*, 2 NANOTECH L. & BUS. 260 (2005).

[10] *See* American National Standards Institute, *New Standard Terminology for Nanotechnology,* (2006), *available at* http://www.ansi.org/standards_activities/standards_boards_panels/nsp/overview.aspx?menuid=3 (last visited Feb. 15, 2007).

[11] *See* Institute of Nanotechnology, *Glossary of Terms,* (2006), *available at* http://www.nano.org.uk/nano/glossary.htm (last visited Feb. 15, 2007).

[12] *See* Ruben Serrato, et al., *The Nanotech Intellectual Property Landscape,* 2 NANOTECH L. & BUS. 150 (2005).

nanoliposomes, nanoshells, nanocrystals, etc.) are ambiguously described in the "written description" section of the patent.

In drafting patent applications, the patent agent/attorney enjoys the freedom to act as their own lexicographer, which means that they can define and use claim terms in any way they choose. However, employing special or non-standard terms in the claims comes with the obvious risk that a court may construe such terms with a meaning that was unintended by the applicant. Unless the special claim terms are clearly defined in the specification, a court may apply an ordinary meaning such as the dictionary definition of the term. This unintended construction of the claim term may harm the patent owner such as in cases where a court finds non-infringement of the patent by a competitor's product.

Because an accurate reading on the scope and breadth of individual patents is required to provide effective counseling to clients on various IP issues such as infringement avoidance or in preparation for licensing negotiations, the focus of this article is to address the efficacy of this approach to patenting nanostructure discoveries.

The United States Patent Act at 35 U.S.C. § 112 states that the *quid pro quo* for receiving a 20-year monopoly on the invention claimed in a patent is the requirement that disclosure of the invention to the general public is full and complete. 35 U.S.C. § 112, first paragraph, is recited as follows:

> The specification shall contain a written description of the invention and of the manner and process of making and using it, in such full, clear, concise, and exact terms so as to enable any person skilled in the art to which it pertains, or with which it is most clearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Thus, § 112, first paragraph, contains three distinct requirements for patentability: (1) a complete written description[13]—setting forth the full and complete details of making and using the invention; (2) enablement[14]—the specification must teach one skilled in the art how to make and use the full scope of the invention without undue experimentation and (3) best mode[15]—of carrying out the claimed invention known at the time of filing for a patent needs to be set forth. Although patents are presumed valid upon issuance, a violation of any of these three requirements is grounds for a finding of invalidity of an issued patent by a court in an infringement suit, or by the USPTO such as in a reexamination proceeding.

V. THE ROLE OF THE COURTS IN DETERMINING CLAIM SCOPE OF NANOTECHNOLOGY PATENTS

Patents that have been deemed to comply with § 112 by the USPTO are frequently subjected to claim interpretation by a court to determine their true scope. In a claim interpretation hearing, more commonly known as a "Markman" hearing, a court will delineate the meaning of claim language. Typically in these court proceedings, a judge, who is most likely a layperson with regard to the claimed technology, makes a determination as to the claim scope. To do so, the judge first reviews the claim terms for their intended meaning. In *Phillips v. AWH Corp*., the Court of Appeals for the Federal Circuit, the circuit to which all district court patent cases are appealed, stated that claim terms are given the meaning they have to one of ordinary skill in the art.[16]

---

[13] *See* Laurie A. Axford, *Patent Drafting Considerations for Nanotechnology Inventions*, 3 NANOTECH L. & BUS. 305 (2006).

[14] *See* Melissa D. Schwaller and Gaurav Goel, *Getting Smaller: What Will Enablement of Nanotechnology Require?* 3 NANOTECH L. & BUS. 145 (2006).

[15] *See* Matthew J. Dowd, et al., *Nanotechnology and the Best Mode,* 2 NANOTECH L. & BUS. 238 (2005).

[16] *See* Phillips v. AWH Corp., 415 F.3d 1303 (Fed. Cir. 2005).

Although terms of art undergo constant refinement in emerging technologies such as nanotechnology, claim terms should be construed by first referring to intrinsic evidence, as reaffirmed by the *Phillips* Court.[17] Intrinsic evidence includes the claims, the specification and the prosecution history of a patent application. If the meaning of a claim term is still unclear after referring to intrinsic evidence, then extrinsic evidence may be consulted, for example, by referring to dictionaries and to relevant technical treatises.

Courts sometimes employ the doctrine of claim differentiation for clarifying the scope of coverage provided by a patent claim. Under this doctrine, the use of different terms in different claims of the same patent results in the claims having differing scopes of coverage.[18] Although not a hard and fast rule that is applied in every case, the doctrine prohibits the broadening of a claim beyond that which is disclosed in the specification but also prohibits the narrowing of broad claims by incorporating limitations of narrower claims.[19] Perhaps most informative with respect to construing claims, the *Phillips* Court noted that the specification "is always highly relevant to the claim construction analysis. Usually, it is dispositive; it is the single best guide to the meaning of a disputed term."[20]

VI. "NANOSTRUCTURE" CLAIM CONSTRUCTION EXAMPLES

1. U.S. Patent No. 7,068,898

Applying the above discussion regarding claim construction to U.S. Patent No. 7,068,898 (hereinafter "the '898 Nanosys patent"), entitled "Nanocomposites," issued on June 27, 2006 to Nanosys, Inc., Claim 1 recites the following (with emphasis added):

> 1. A composite material, comprising: a matrix; and *one or more nanostructures*, the one or more nanostructures each comprising a core and at least one shell, the core comprising a first semiconducting material having a conduction band and a valence band, the shell comprising a second semiconducting material having a conduction band and a valence band, and the first and second materials having a type II band offset.

Dependent Claim 6 of the '898 Nanosys patent further narrows the nanostructure limitation of Claim 1 by reciting specific classes of nanostructures:

> 6. A composite material as in claim 1, wherein the one or more nanostructures comprise one or more of: *nanocrystals, nanowires, branched nanowires, or nanotetrapods*.

At first glance, Claim 1 of the '898 Nanosys patent appears to broadly cover *all* composite materials comprising a matrix and nanostructures. As mentioned in the discussion above, the doctrine of claim differentiation cannot be used to narrow the scope of coverage of Claim 1 by incorporating the "nanostructure" limitations recited in Claim 6. However, clarification as to the meaning of the

---

17 *Id*. at 1313.
18 *See* Clearstream Wastewater Systems, Inc., v. Hydro-Action, Inc., 206 F.3d 1440 (Fed. Cir. 2000).
19 *See id.*
20 Phillips, 415 F.3d at 1315.

"nanostructure" term in Claim 1 is available by referring to a "Definitions" section which the patentees included in the specification of the '898 Nanosys patent and which is recited as follows (emphasis added):

> "*A 'nanostructure' is a structure having at least one region or characteristic dimension with a dimension of less than about 500 nm*, e.g., less than about 200 nm, less than about 100 nm, less than about 50 nm, or even less than about 20 nm. Typically, the region or characteristic dimension will be along the smallest axis of the structure. *Examples of such structures include nanowires, nanorods, nanotubes, branched nanowires, nanotetrapods, tripods, bipods, nanocrystals, nanodots, quantum dots, nanoparticles, and the like.* Nanostructures can be substantially homogeneous in material properties, or in certain embodiments can be heterogeneous (e.g. heterostructures). The nanostructures can be fabricated from essentially any convenient material or materials. The nanostructures can comprise 'pure' materials, substantially pure materials, doped materials and the like, and can include insulators, conductors, and semiconductors. A nanostructure can optionally comprise one or more surface ligands (e.g., surfactants)."
>
> "A *'nanoparticle' is any nanostructure having an aspect ratio less than about 1.5*. Nanoparticles can be of any shape, and include, for example, nanocrystals, substantially spherical particles (having an aspect ratio of about 0.9 to about 1.2), and irregularly shaped particles. Nanoparticles can be amorphous, crystalline, partially crystalline, polycrystalline, or otherwise. Nanoparticles can be substantially homogeneous in material properties, or in certain embodiments can be heterogeneous (e.g., heterostructures). The nanoparticles can be fabricated from essentially any convenient material or materials. The nanoparticles can comprise 'pure' materials, substantially pure materials, doped materials and the like, and can include insulators, conductors, and semiconductors."

As can be seen, the "Definitions" section further limits the size and configuration of "nanostructure" covered in Claim 1. Under the description provided above, Claim 1 only covers composites having "nanostructure" that have at least one dimension of less than 500 nm and which are exemplified in configurations including nanowires, nanorods, nanotubes, branched nanowires, nanotetrapods, tripods, bipods, nanocrystals, nanodots and quantum dots as well as nanoparticles having an aspect ratio less than about 1.5. Further limitations on the configuration of "nanostructure" taught in the '898 Nanosys patent include limitations on the material composition and arrangement of the nanostructure. Therefore, what might initially appear to be an overly-broad claim element in Claim 1 may, in reality, provide a much narrower scope of coverage to the independent claim.

The prosecution history of the '898 Nanosys patent provides further clarification to the meaning of the term "nanostructure" wherein the Examiner, in the first Office Action, issued a prior art rejection against Claim 1 citing a reference that disclosed a particular type of nanowire. The prosecution history indicates that the patentee overcame the rejection by pointing out that the cited reference disclosed only *longitudinal heterostructure nanowires* and failed to disclose either core-shell nanostructures or composites.

The Examiner essentially reiterated the patentee's arguments in the "Reasons for Allowance" section of the Notice of Allowance for the '898 Nanosys patent. In this regard, the prosecution history could be interpreted as further clarifying (and narrowing) the meaning of the term "nanostructure" to specifically

exclude longitudinal heterostructure nanowires from Claim 1 even though "heterostructures" are specifically recited in the "Definitions" section of the specification of the '898 Nanosys patent.

2. U.S. Patent 7,101,761

In another example, the above-described methodology is applied to U.S. Patent No. 7,101,761 (hereinafter "the '761 Intel patent") entitled "Method of Fabricating Semiconductor Devices with Replacement, Coaxial Gate Structure," issued on September 5, 2006 to Intel Corporation, wherein Claim 1 recites the term "nanostructure" as follows (emphasis added):

> 1. A method comprising:
>
> providing a *nanostructure* covered on a substrate;
>
> oxidizing a first portion of the nanostructure to define a sacrificial layer between the substrate and a second portion of the nanostructure;
>
> forming a first support structure over the nanostructure;
>
> forming a second support structure over the nanostructure; and
>
> removing the sacrificial layer from the nanostructure such that second portion of the nanostructure is suspended a distance from a surface of the substrate between the first and second support structure.

Dependent Claims 5 and 7 of the '761 Intel patent limit the nanostructure term of Claim 1 as follows:

> 5. The method of claim 1, wherein the nanostructure comprises a *nanowire* structure.
>
> 7. The method of claim 1, wherein the nanostructure comprises a *nanotube* structure.

Though Claim 1 of the '761 Intel patent appears to broadly cover various types of nanostructures, under the doctrine of claim differentiation, the limitations of nanowire and nanotube recited in Claims 5 and 7 cannot be read into Claim 1 to narrow its scope. However, further clarification as to the meaning of the "nanostructure" term of Claim 1 may be found by referring to the specification wherein the patentees included the following paragraph (emphasis added) that sheds light on the breadth of the "nanostructure" term:

> As used herein, the term nanostructure refers to *any structure having a diameter less than about 50 nm, such as a nanowire or a nanotube*. The term nanowire is used herein to describe *any nanowires, including silicon nanowires*. The term nanotube is used herein to describe *any nanotubes, including single-walled or multiple-walled carbon nanotubes*.

Although the remainder of the written description of the '761 Intel patent defines no other specific types of nanostructures other than those mentioned above (i.e., nanowires, nanotubes), it would appear that the term "nanostructure" as recited in Claim 1 broadly includes "any structure having a diameter less

than about 50 nm." The prosecution history of the '761 Intel patent provides no further clarification on the type of nanostructure that is recited in Claim 1. It is unknown whether a court or the USPTO would broadly construe "nanostructure" to include *any* structure falling within the geometrical range described in the written description.

3. U.S. Patent 6,940,086

In a further example, U.S. Patent No. 6,940,086 entitled "Tin Oxide Nanostructures" and issued on September 6, 2006 to Georgia Tech Research Corp. (hereinafter "the '086 Georgia Tech patent") was noted by one commentator as being one of the ten broadest U.S. patents pertaining to nanostructures.[21] Claim 1 of the '086 Georgia Tech patent is broadly recited as follows (emphasis added):

> 1. A *nanostructure*, comprising a *tin oxide (SnO_2) nanowire*.

As can be seen, Claim 1 itself limits the nanostructure to a specific type (e.g., SnO_2 nanowire). However, dependent Claim 2 recites a further geometric limitation to the SnO_2 nanowire of Claim 1:

> 2. The nanostructure of claim 1, wherein *the SnO_2 nanowire is substantially rectangular.*

Clarification as to any additional types of SnO_2 nanowires that may be included in Claim 1 is found in the specification of the patent (emphasis added):

> The *cross-sectional shape of the nanowires can vary from virtually circular to the larger rectangle-like structure . . . .*

Under the doctrine of claim differentiation, the *rectangular* geometrical limitation of dependent Claim 2 cannot properly be read into independent Claim 1 to narrow its scope. However, as described in the specification, the SnO_2 nanowire may be construed to include circular cross-sectional shapes. Further limitations on the configuration of SnO_2 nanowire taught in the '086 Georgia Tech patent include the material composition and arrangement of the nanostructure. Many of these alternative configurations appear to be covered by the remaining claims of the '086 Georgia Tech patent. In this regard, as noted by at least one commentator, the '086 Georgia Tech patent appears to broadly claim a variety of tin oxide nanostructure configurations.[22]

---

[21] *See* Blaise Mouttet, *Top Ten Broadest US Patents for Nanostructures*, September 17, 2006, *available at* http://tinytechip.blogspot.com/2006/09/top-ten-broadest-us-patents-for.html (last visited Feb. 15, 2007).

[22] *See id.*

4. U.S. Patent 5,424,054

Also included in the list of the ten broadest U.S. patents for nanostructures are two patents issued to IBM, namely, U.S. Patent Nos. 5,424,054 and 6,843,850 (hereinafter "the '054 IBM patent" and "the '850 IBM patent").[23] The '054 IBM patent has a relatively early priority date of May 21, 1993 and includes Claim 3, one of two independent claims:

> 3. A hollow carbon fiber having a wall consisting essentially of a single layer of carbon atoms.

Claim 3 does not have any claims depending therefrom. However, it may also be noted that Claim 3 includes the transitional phrase "consisting essentially of." Although the phrase "consisting of" is a closed term in claim drafting language meaning that additional elements are excluded from the limitation, the phrase "consisting essentially of" has been interpreted to provide that additional elements *may* be included if such additional elements do not "materially" affect the novel characteristics of the product (i.e., hollow carbon fiber) defined by the claim. As applied to the '054 IBM patent, this transitional phrase would appear to further broaden the scope of coverage of Claim 3.

In referring to the specification for clarification on the scope of coverage of Claim 3, no alternative embodiments of the hollow carbon fiber are described. However, the specification includes the following sections (emphasis added) which further define the invention:

> The present invention relates to carbon fibers having a wall comprising a *single layer of carbon atoms*. The present invention also relates to a process for making carbon fibers (tubes) having a wall comprising a single layer of carbon atoms.
>
> The carbon fibers of the present invention have a wall comprising a single atomic layer of carbon atoms. The thickness of the wall of the fiber is a *single carbon atom thick and the carbon atoms of the wall are bonded together*. The fiber is hollow and the wall is optimally cylindrically shaped and has a cross-sectional diameter generally less than about 3.5 nm preferably less than about 2 nm and more preferably less than about 1.5 nm; preferably a diameter of about 1 nm to about 2 nm. The fibers generally have a length greater than about 50 nm preferably greater than 100 nm, most preferably greater than about 1000 nm.

As noted above, the specification of the '054 IBM patent describes carbon fiber using the transitional phrase "comprising." This transitional phrase provides even broader coverage than the phrase "consisting essentially of" described above. However, in order to overcome prior art cited during prosecution of a patent application, patentees often narrow the claim scope by revising the transitional phrase. In this regard, it is possible that the patentees amended the transitional phrase in Claim 3 from "comprising" to "consisting essentially of" in order to overcome prior art cited thereagainst. Even with such a narrowing amendment, Claim 3 of the '054 IBM patent appears to very broadly cover a tubular carbon fiber.[24]

---

[23] *See id*.
[24] *See id*.

5. U.S. Patent 6,843,850

The '850 IBM patent includes Claim 1, which is recited as follows (emphasis added):

> 1. A *single-walled nanotube* that has been manufactured in the absence of a catalyst.

Claim 2 is the sole dependent claim of Claim 1 and further limits the process for forming the single-walled nanotube and is recited as follows:

> 2. The single-walled nanotube according to claim 1 having been annealed substantially inert atmosphere at a temperature of at least about 1350 degrees Celsius.

In referring to the specification of the '850 IBM patent, the process for forming the single-walled nanotube is described as starting with a silicon carbide semiconductor wafer. Annealing of the silicon face of the semiconductor wafer in a vacuum is indicated as inducing the formation (i.e., via rolling up) of the single-walled nanotube. Due to the minimal number of steps recited in Claim 1, it appears that the '850 IBM patent broadly covers all single-walled nanotubes formed without a catalyst.

VII. BROAD SPECTRUM OF UNCERTAINTY REGARDING THE SCOPE OF CLAIM COVERAGE FOR NANOTECHNOLOGY PATENTS

As can be seen, for nanotechnology patents that use broad claim terms, the spectrum of uncertainty regarding the scope of coverage is fairly broad. In some patents, such as in the '898 Nanosys patent, what initially appears to be a broad claim element in Claim 1 may, in reality, provide a much narrower scope of coverage after referring to the specification and reviewing the prosecution history. In the other cases, the '054 and '850 IBM patents appear to very broadly claim the rights to "single-walled carbon fibers" (i.e., the '054 IBM patent) and "single-walled nanotubes" (i.e., the '850 IBM patent).

As is apparent by reference to the above, the appropriate meaning of the claim terms is best ascertained by referring to the intrinsic evidence and, more specifically, referring to the specification as the "single best guide" as noted in *Phillips*.[25] In this regard, the specification allows patent practitioners (i.e., patent agents and patent attorneys) to obtain a better idea of the scope of coverage of nanotech patents in order to effectively counsel clients on various IP matters.

For nanotechnology patents lacking a clear definition of claim terms in the specification, or where neither claim differentiation nor the prosecution history further clarifies the claim term meanings, uncertainty may persist as to who owns what in the nanotechnology world. As a general strategy to avoid downstream problems, it is suggested that applicants file patent applications that are not unduly broad in scope.[26]

---

[25] *See* Phillips, 415 F.3d at 1315.

[26] *See* Sarah Lacy, *Patently Confusing*, (2005), *available at* http://www.businessweek.com/the_thread/dealflow/archives/2005/04/patently_confus.html (citing a report by Lux Research and the law firm of Foley & Larder LLP) (Last visited Feb. 15, 2007).

VIII. RISKS OF CLAIMING BROADLY

By avoiding the temptation of claiming over broadly and receiving an issued patent that covers much more than the actual invention, applicants can reduce their risk of a negative claim interpretation and claim more narrowly. Furthermore, applicants can avoid the time and cost in defending later attempts at invalidation of overly-broad patents by the USPTO (e.g., in a reexamination proceeding) or by the courts (i.e., in litigation). It should be noted that the above-suggested strategy may, in some instances, be a moot point as potential disputes between overlapping nanotechnology patents will increasingly be handled with cross-licensing agreements. [27]

In addition, with focused claim drafting, start-ups may have an easier time of attracting investors who may be wary of broad patent claims that may overlap with a competitor's patent portfolio. The risk of becoming embroiled in a "cobweb" of nanotechnology patents may also be reduced. Furthermore, patent owners may find it easier to assure investors and acquiring companies of the defensibility and validity of their portfolios.

IX. STRATEGIES FOR PRESERVING NANOTECHNOLOGY IP

Other methods by which patentees can protect their nanotechnology IP include the practice of continuation filing available only in the United States and authorized under 35 U.S.C. § 120. In this strategy, applicants can file a continuation application or continuation-in-part (CIP) patent application based on a pending parent application which may later issue with relatively narrow claims. If a competitor produces a product that falls just outside the scope of coverage of the claims, the patentee can amend the claims of the continuation or CIP application such that the competitor's product infringes.

Although the availability of this tactic may come to a halt with the looming enactment of the new patent rules limiting patentees to a single continuation application, its use in current practice is proliferate across all technology sectors and is one of the most commonly used weapons in the arsenal of many patent practitioners.

A similar strategy may be applied in reissue practice as authorized under 35 U.S.C. § 251.[28] Under this rule, a patent owner may file a patent application seeking to enlarge the scope of the claims. However, broadening reissue applications must be filed within two years of the grant date of the parent application. Furthermore, as in continuation practice, the enlarged scope of the claims in the reissue application must be supported by the specification of the parent application.

Continuation application practice and the reissue strategy are powerful tools by which the owner of a nanotechnology patent can prevent competitors from designing around their patents. However, the availability of these strategies is dependent upon the breadth of the specification in covering alternative embodiments and features. In keeping with the above-noted suggestion of avoiding overly broad claims in nanotechnology patent applications, inventors and researchers are also encouraged to work closely with their patent agent/attorney in preparing a thorough specification that discloses all reasonable variations of their nanotech inventions.

---

[27] *See* Choi, *supra* note 8, at 103 (quoting Stephen Maebius, Chair of the Nanotech Industry Team at the law firm of Foley & Lardner LLP); Bawa, *supra* note 3, at 102; Bawa, *supra* note 5, at 102.

[28] *See* 35 U.S.C. § 251, last paragraph.

X. CONCLUSION

There is a great deal of excitement associated with what many speculate will be a boom in the multidisciplinary field of nanotechnology. In order to reduce uncertainty regarding the rights to nanotechnology inventions, patent applicants, and patent owners must resist the urge to claim overly broadly in the hope of getting a windfall of nanotechnology IP rights. Such attempts, in fact, may be responsible in part for creating uncertainty as to who owns what across the nanotechnology landscape.

Efforts are underway to reduce this uncertainty. In this regard, the USPTO's recent creation of a new nanotechnology classification system is an important step forward. Private entities have reduced the trend of uncertainty by developing a standardized nanotechnology glossary. Patent practitioners have also assisted in reducing uncertainty by including clear, well-established definitions of claim terms in the specification of their patents. Collectively, these efforts by public and private organizations will increase the likelihood that significant technologic advances across multiple scientific disciplines will continue to be proposed, validated, patented and commercialized with the subsequent nanotechnology boom leading to big payoffs—economically in the form of returns for investors as well as benefits to consumers in the form of improvements in energy, materials and medicine.

* * *

Note: This paper represents the current opinions of the authors which are likely to evolve. Furthermore, they should not be attributed, in whole or in part, to the organizations listed above, nor should they be considered as expressing an opinion with regard to the merits of any particular company or product discussed herein. Nothing contained herein is to be considered as the rendering of legal advice for specific patents or cases, and readers are responsible for obtaining such advice from their own competent legal counsel. This article is intended for educational and informational purposes only.