NOTE

NANOTECHNOLOGY: WHEN MAKING SOMETHING SMALLER IS NONOBVIOUS

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I. INTRODUCTION

On December 3, 2003, President Bush signed the 21st Century Nanotechnology Research and Development Act (the "Nanotechnology Act"),[1] authorizing approximately $3.7 billion in federal funding for nanotechnology research and development over the next four years.[2] The signing of the bill makes nanotechnology the highest federally funded basic science and

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[1] 15 U.S.C. §§ 7501-09 (2000).

[2] 15 U.S.C. § 7505 (2000) (authorizing $3,678,863,000 in federal funding over the 2005-2008 fiscal years).

technology effort since the "Space Race."[3] The Nanotechnology Act defines "nanotechnology" as "the science and technology that will enable one to understand, measure, manipulate, and manufacture at the atomic, molecular, and supramolecular levels."[4] The prefix "nano" in the word nanotechnology means one billionth.[5] Nanotechnology thus deals with various structures of matter having dimensions on the order of a billionth of a meter.[6] A nanometer is approximately the length of three to six atoms placed side by side;[7] or alternatively, the width of a single strand of DNA.[8] To put this into perspective, the human hair is roughly between 50,000 and 100,000 nanometers in diameter.[9]

The Committee on Technology referred to the science of nanotechnology as the next industrial revolution.[10] Nanotechnology is not just the study of small things; it is research and development "aimed at creating materials, devices, and systems with fundamentally new molecular organization, properties, and functions."[11] Nanotechnology promises many innovative inventions, including the ability to self-replicate so that machines can assemble identical copies of themselves,[12] storing the information which all of mankind has ever recorded on just thirty-five sheets of paper,[13] or manufacturing "nanobots" that

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[3] Charles Choi, *Analysis: Nano bill not just a grand gesture; it promises real results* (Dec. 5, 2003) (quoting F. Mark Modzelewski, executive director of the NanoBusiness Alliance in New York), *available at* http://www.nanospace.org/new_page_44.htm, (referring to the competition between the United States and the Soviet Union for space exploration superiority during the 1950s and 1960s). *See also* Steven Garber & Roger Launius, *A Brief History of NASA*, National Aeronautics and Space Administration, http://www.hq.nasa.gov/office/pao/History/factsheet.htm (last visited Nov. 6, 2005).

[4] 15 U.S.C. § 7509 (2000).

[5] THE WORLD BOOK DICTIONARY 1380 (Clarence L. Barnhart & Robert K. Barnhart eds., World Book, Inc. 1992).

[6] CHARLES P. POOLE, JR. & FRANK J. OWENS, INTRODUCTION TO NANOTECHNOLOGY 1 (John Wiley & Sons, Inc. 2003).

[7] CENTER FOR RESPONSIBLE NANOTECHNOLOGY, C-R-NANOTECHNOLOGY GLOSSARY, *available at* http://www.crnano.org/crnglossary.htm (last visited Nov. 6, 2005).

[8] *Id.*

[9] *Id.*

[10] INTERAGENCY WORKING GROUP ON NANOSCIENCE, ENG'G AND TECH., COMM. ON TECH., *National Nanotechnology Initiative: Leading to the Next Industrial Revolution* 16 (Feb. 2000) http://www.ostp.gov/NSTC/html/iwgn/iwgn.fy01budsuppl/nni.pdf [hereinafter *Nanotechnology Initiative Report*].

[11] 15 U.S.C. § 7509 (2000) (defining nanotechnology within the Nanotechnology Act).

[12] *See* K. Eric Drexler, *Engines of Creation, The Coming Era of Nanotechnology* 19 (Anchor Books 1986), *available at* http://www.foresight.org/EOC/Engines.pdf.

[13] Richard P. Feynman, There's Plenty of Room at the Bottom: An Invitation to Enter a New Field of Physics, Address at the Annual Meeting of the American Physical Society at the California Institute of Technology (Dec. 29, 1959), *available at* http://www.zyvex.com/

selectively infiltrate and target cancer cells or viruses within the human body, selectively incapacitating the targets with therapeutics stored within the nanodevice.[14]

Nanoscience will inevitably "change the nature of almost every human-made object in the next century" and will redefine our interaction with the world around us.[15] These potentially revolutionary innovations explain why scientists and industry leaders associate nanotechnology with the next industrial revolution, and not just another step in technological progress. According to Mike Honda, California House Representative and co-drafter of the original Nanotechnology Act, "the worldwide market for nanotechnology products and services could reach $1 trillion by 2015."[16] For the first time in recent history, however, the United States is not at the forefront of this emerging technological field.[17] As of 2001, over thirty countries had already initiated their own national nanotechnology programs.[18] The nanotechnology race is thus well underway, and the first to secure the relevant intellectual property rights will be in the best position to reap the greatest rewards.

Nanotechnology-related patents are not expected to encounter the wholesale confusion associated with the early prosecution of claims for business methods,[19] biotechnology,[20] and computer software technology,[21] which the U.S. Patent and Trademark Office (the "USPTO") initially held as non-patentable subject matter.[22] With respect to nanotechnology, patent

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nanotech/feynman.html.

[14] C. A. Haberzettl, *Nanomedicine: Destination or Journey?*, 13 NANOTECHNOLOGY R9, R9 (2002).

[15] *See Nanotechnology Initiative Report*, *supra* note 10, at 16; *see also* David Pogue, *Explaining Nanotechnology*, N.Y. TIMES (Feb. 3, 2005) (quoting Steve Jurvetson, managing director of a Silicon Valley venture-capital firm that invests heavily in nanotech companies, as saying that nanotechnology will be more important than the Industrial Revolution itself), *available at* http://www.nytimes.com/2005/02/03/technology/circuits/03POGUE-EMAIL.html.

[16] *See* R. Colin Johnson, *Nanotech R&D Act Becomes Law*, EE TIMES (Dec. 3, 2003), *available at* http://www.eetimes.com/story/OEG20031203S0025.

[17] *See* Pogue, *supra* note 15 (noting that the European Union and Japan have already invested more in the development of nanotechnology than the United States).

[18] M. C. ROCO, *International Strategy for Nanotechnology Research and Development*, NATI'L SCI. FOUND., Aug. 28, 2001, at 1.

[19] Iona Niven Kaiser, *Nanotechnology Patents: Will Small-Scale Science Pose Big Challenges for Applicants and the Patent Office?*, PATENT STRATEGY & MGMT., July 6, 2004, at 1.

[20] *See id.*

[21] *See* Barry Newberger, *Intellectual Property and Nanotechnology*, 11 TEX. INTELL. PROP. L.J. 649, 654 (2003) (presentation transcript).

[22] *See* Kaiser, *supra* note 19, at 1; *see also* Newberger, *supra* note 21, at 654.

applications concern "products in the traditional sense, items of manufacture, and processes of manufacturing nanotech-based materials."[23] Indeed, the fundamental science of nanotechnology embraces the combined elements of well-developed arts, such as chemistry, physics, electronics, material science, and mechanical engineering, to which nanotechnology seems "readily integrable into the scope of traditional patent protection."[24] It is this view of nanotechnology that has led some to conclude that there are no doctrinal issues that need to be worked through.[25] Nevertheless, the prosecution of nanotechnology-related patent claims is sure to raise unique problems.[26] As technology continues to become increasingly more complex, we need to reexamine the rationale behind prior developed legal doctrine as applied to today's technology.

Acknowledging the potential for nanotechnology-specific issues, the USPTO formed a Nanotechnology Customer Partnership initiative (the "NCP"), intended as an open forum to "share ideas, experiences, and insight between [the nanotechnology scientific community] and the USPTO."[27] The first meeting of the NCP occurred on Sept. 11, 2003.[28] Among the issues discussed was whether the miniaturization of known existing patented products to the nano-scale, standing alone, would satisfy the nonobvious patentability requirement.[29] At this meeting, the USPTO suggested that these subsequent nano-scaled versions are *not* nonobvious from their prior macro-scaled counterparts, and thus they are nonpatentable based alone on their reduction in size to the nano-scale.[30]

This Note sets out to examine the generally accepted doctrine relied upon by the USPTO that a mere change in size does not constitute invention, and to discuss whether that doctrine is applicable to developments in nanotechnology.

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[23] Newberger, *supra* note 21, at 654.

[24] Kaiser, *supra* note 19, at 1.

[25] Newberger, s*upra* note 21, at 649.

[26] Kaiser, *supra* note 19, at 1; Vivek Koppikar *et al*., *Current Trends in Nanotech Patents: A View From Inside the Patent Office*, 1 NANOTECH. L. & BUS. 1, 4 (2004) ("There are some relatively unique situations faced by applicants who file nanotechnology patents.").

[27] UNITED STATES PATENT AND TRADEMARK OFFICE, Nanotechnology Partnership Meeting (Sept. 11, 2003), http://www.uspto.gov/web/patents/nanotech/meet091103.htm.

[28] *Id.*

[29] *See* Koppikar, *supra* note 26, at 5. Section 103 of the Patent Act states:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

35 U.S.C. § 103(a) (2000) (emphasis added).

[30] *See* Koppikar, *supra* note 26, at 5.

First, this Note reviews the existing precedent and its treatment of inherent properties. The Note then focuses generally on why the macro-scale prior art should not per se encompass nano-scale versions. This will lead into a discussion of the Doctrine of Equivalents and its corollary, the Reverse Doctrine of Equivalents, and how these doctrines preserve the legal principles that abstract ideas and functions of the prior art are not patentable. The Note then turns to how Congress' enactment of 35 U.S.C. § 112 embodies these principles, and how this statute can be used properly to limit the claims of the prior art in relation to subsequent nano-scale inventions. The Note then reexamines the prior precedent establishing the rule that size limitations are nonpatentable, and suggests that the rationale behind the precedent is inapplicable to nanotechnology. It then proposes that a determination of nonobviousness be made in light of the written description and enablement requirements of the prior art, and that nano-scale versions are in fact nonobvious when the prior art references fail to enable a person having ordinary skill in the art (a "PHOSITA") to be in possession of the nano-scale version. Finally, the Note recommends that the USPTO reorganize its current structure to handle adequately a nonobviousness determination in view of a PHOSITA in the field of nanotechnology, rather than rely on a per se rule that a change in size, standing alone, is obvious.

II. THE CURRENT LAW

A. Changes in Size

The USPTO, in a presentation at the September 11 NCP meeting, suggested that miniaturization down to the nano-scale, standing alone, is *not* patentable.[31] The USPTO official cited *In re Rose*[32] in making the argument that claim limitations relating to the size of a claimed object are not sufficient to distinguish patentability over prior art.[33] This view is entirely consistent with the existing federal case law on the matter.[34]

Indeed, as early as 1928, the legal principle was well established that a "mere difference in dimension cannot add novelty" to a claimed new product.[35] Courts have since consistently held that the mere scaling of a prior art, capable

[31] *Id.* (emphasis added).

[32] 220 F.2d 459 (C.C.P.A. 1955) (determining the patentability of a claimed lumber package invention "of appreciable size and weight requiring handling by a lift truck" in light of prior art lumber packages that could be lifted by hand); *see also* Koppikar, *supra* note 26, at 5.

[33] *In re* Rose, 220 F.2d at 463 (holding that "differences in degree and/or size [are] not patentable distinctions").

[34] *See id.*; *see also infra* notes 35, 37-38 and accompanying text.

[35] King Ventilating Co. v. St. James Ventilating Co., 26 F.2d 357, 359 (8th Cir. 1928).

of being scaled,[36] would not establish patentability in a claim over that prior art.[37] Recently, the United States Court of Appeals for the Federal Circuit ("the Federal Circuit") held that when the only difference between the prior art and its claims was a recitation of relative dimensions of the claimed device, and a device having the claimed relative dimensions would not "exhibit qualitatively different phenomena" from the prior art, the claimed invention was not patentably distinct from the prior art.[38]

B. New and Improved Properties

The question as to whether a nano-scale version of an existing prior art reference is patentable under the current law seems to turn on whether the nano-scaled version exhibits "qualitatively different phenomena" than that of its macro-scaled counterpart.[39] But what amounts to "qualitatively different phenomena" rendering a subsequent nano-scaled version nonobvious? What if the nano-scaled version discovers new and improved characteristics over that of the prior art? Can the nano-scaled version then be patented?

The existing case law weighs against patentability. The mere recitation of a *newly discovered* function or property "inherently possessed by things in the prior art" does not distinguish the claimed product patentable over the prior art.[40] The Federal Circuit has ruled as recently as 1997 that it is a "well settled rule that the mere recognition of latent properties in the prior art does not render non-obvious an otherwise known invention."[41]

What, then, are the inherent properties of existing prior art in which to determine "qualitatively different phenomena" exhibited by the nano-scaled version? The law of inherency protects the natural flowing consequences of

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[36] While this paper focuses on whether or not the nano-product itself is patentable, there is little doubt that a new *process* created to make an existing product at the nano-scale, previously unattainable at that scale, is patentable. Veronica Mullally & David R. Winn, *Patenting Nanotechnology: A Unique Challenge to the IP Bar*, N.Y. L.J., July 6, 2004, at t2.

[37] *In re* Rinehart, 531 F.2d 1048, 1053 (C.C.P.A. 1976); *see also* U.S. Indus., Inc., v. Norton Co., 210 U.S.P.Q. 94, 104 (N.D.N.Y. 1980) (holding that "mere changes of proportions of a known composition with a resultant increase in strength, size, etc., is generally deemed insufficient to constitute patentability, such changes, though useful, being only of degree rather than kind.").

[38] Gardner v. TEC Sys., Inc., 725 F.2d 1338, 1346 (Fed. Cir. 1984).

[39] *See id*. at 1345-46 (noting that dimensional limitations do not inherently distinguish the subsequent version from the prior art).

[40] *In re* Oelrich, 666 F.2d 578, 580-81 (C.C.P.A. 1981) (holding that finding a new use for an old device does not entitle one to a patent over the prior art).

[41] *In re* Geisler, 116 F.3d 1465, 1468 (Fed. Cir. 1997) (holding the counterintuitive discovery that a thinner layer of a known substance was more durable than the claimed thicknesses in the prior art was merely the recognition of a latent property, i.e. wearability, possessed by the prior art).

practicing the prior art, even if those consequences are unknown.[42] In other words, inherency does not require a PHOSITA to have prior knowledge, recognition, or appreciation of the inherent characteristic or property for the claimed invention to be deemed anticipated by the prior art.[43] In 2003, the Federal Circuit reaffirmed this legal doctrine of inherency in *Schering Corp. v. Geneva Pharmaceuticals, Inc.*,[44] holding that "precedent does not require a [PHOSITA] to recognize the inherent characteristic in the prior art that anticipates the claimed invention."[45] Thus, "inherency operates to anticipate entire inventions as well as single limitations within an invention."[46]

Although *Schering* involved a pharmaceutical compound, its application should extend to nanotechnology.[47] After *Schering*, the inherent properties of a prior art should include any and all properties and characteristics that necessarily exist in that prior art at the nano-scale. Thus, the patentability of a nano-scaled claimed invention may turn on whether the nano-level properties of a prior art are inherent to that art, or whether the new or improved properties result when the prior art is miniaturized to the nano-scale.[48] Therefore, it is quite likely that the nano-scale properties of the claimed invention will be found to be inherent to the macro-scale prior art.[49] A patent application for the claimed nano-scaled invention, containing claims to newly discovered properties found at the nano-scale, might not pass an inherent-anticipation challenge. Thus, prior art that was previously known to exist and function only at the macro-scale may nevertheless inherently anticipate their nano-scaled counterparts exhibiting new and improved properties.

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[42] *See In re* Wiseman, 596 F.2d 1019, 1023 (C.C.P.A. 1979) (holding that the fact that the inherent function of the prior art device was unknown does not permit an applicant from obtaining a patent on that device by claiming the unknown function).

[43] The United States Court of Appeals for the Federal Circuit has explained that:

> Inherency is not necessarily coterminous with the knowledge of those of ordinary skill in the art. Artisans of ordinary skill may not recognize the inherent characteristics or functioning of the prior art. However, the discovery of a previously unappreciated property of a prior art composition, or of a scientific explanation for the prior art's functioning, does not render the old composition patentably new to the discoverer.

Atlas Powder Co. v. IRECO Inc., 190 F.3d 1342, 1347 (Fed. Cir. 1999).

[44] 339 F.3d 1373 (Fed. Cir. 2003).

[45] *Schering*, 339 F.3d at 1378.

[46] *Id*. at 1380.

[47] Robert A. Matthews, Jr. & Louis M. Troilo, Schering Corp. v. Geneva Pharmaceuticals, Inc.*: Just How Far Can Inherent Anticipation Extend?*, 20 SANTA CLARA COMPUTER & HIGH TECH. L.J. 779, 794 (2004) (suggesting the court's holding could be applied to other technologies).

[48] *See supra* notes 38-41 and accompanying text.

[49] Matthews, *supra* note 4747, at 795.

C. Overcoming Inherent Anticipation Through Unexpected Results

Parallel to the legal doctrine that a change in size is not patentable[50] and the doctrine of inherency[51] is the well-established exception that one can rebut a finding of obviousness through a showing of "unexpected results."[52] "Unexpected results" are those that show the claimed invention exhibiting some "superior property or advantage" that a PHOSITA would have found "surprising or unexpected."[53] The basic principle behind this rule is straightforward. Although the presumption exists that similar compositions have similar properties, those compositions that would have been surprising to a PHOSITA would not have been obvious.[54] The unexpected result principle has been applied most often to less predictable fields, where minor changes in a prior art yield substantially different results.[55] This rationale would hold true in the field of nanotechnology.[56] Thus, the applicant of a nano-scaled invention could rebut a finding of inherent anticipation through a showing of "unexpected results."

Nevertheless, "it is well settled that unexpected results must be established by factual evidence."[57] Consequently, because what amounts to "unexpected

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[50] *See supra* notes 31-38 and accompanying text.

[51] *See supra* notes 40-46 and accompanying text.

[52] *In re* Rose, 220 F.2d 459, 464 (C.C.P.A. 1955); *see also In re* Soni, 54 F.3d 746, 750 (Fed. Cir. 1995) (holding that "[o]ne way for a patent applicant to rebut a prima facie case of obviousness is to make a showing of unexpected results.").

[53] *In re* Soni, 54 F.3d at 750.

[54] *Id.*

[55] *Id.* (referring to the applicability of this doctrine to the field of chemistry).

[56] In most cases, nanotechnology involves much more than making a prior art smaller and results in unexpected characteristics:

> For example, quantum dots are three-dimensionally constrained semiconductor nanostructures, typically between one nanometer and 100 nanometers in diameter that have properties that are different from conventional size semiconductors. Quantum dots behave like a single gigantic atom in many of their characteristics. They have remarkable optical and transport properties that are based upon quantum effects.
>
> For instance, when the electron-hole pairs in the core of a quantum dot are excited with a beam of light, they re-emit light [fluoresce] with a narrow and symmetric emission spectrum that depends directly on the size of the crystal. This means quantum dots can be fine-tuned to emit light at a variety of wavelengths simply by altering the size of the core. A three nanometer particle made from cadmium selenide, for example, radiates green light at 520 nanometers, while a slightly larger 5.5 nanometer particle of the same material radiates red light at 630 nanometers.
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> Indeed, quantum dots are not merely smaller versions of standard semiconductors; they have unexpected characteristics that are highly sought after in certain industries and their use will lead to many commercially successful applications.

Michael P. Williams, *Questions Abound About Patents and Nanotechnology*, N.Y. L.J., Sept. 15, 2003, t7.

[57] *In re* De Blauwe, 736 F.2d 699, 705 (Fed. Cir. 1984).

results" is inherently uncertain; costly litigation to settle the matter is inevitable. The Federal Circuit has held that the "[m]ere improvement in properties does not always suffice to show unexpected results," but rather an applicant can establish "unexpected results" through a demonstration of "substantially improved results" by the applicant.[58] The dissent in *In re Soni* criticized the uncertainty in applying the majority's definition of "unexpected results" in asserting that "perhaps the majority means to say, more generally, that [USPTO] examiners, Board Members, and Federal Circuit judges will know 'substantial' improvements when they see them."[59]

In re Geisler[60] highlights the inherent uncertainty regarding a determination of "unexpected results." The prior art patent in *In re Geisler* provided that, "in general, for suitable protection the thickness of the protective layer *should not be less than* [100 angstroms]."[61] The discovery underlying the claimed invention, according to the applicant, was that for at least down to a thickness of fifty angstroms, a reduction of the prior art's thickness made the prior art more wear resistant, and thus a counter intuitive and "unexpected result."[62] Judge Bryson (who along with Judge Lourie formed the majority in *In re Soni*) wrote for the majority in *In re Geisler*, holding that just because the inventor of the prior art made an assumption contrary to the actually discovered inherent properties of the prior art does not prove that a PHOSITA would regard those discovered results as unexpected.[63] The court further stated that the contested 26% greater wear resistance at the reduced thickness result "does not constitute proof of 'substantially improved results' comparable to the fifty-fold improvement in tensile strength for the composition that was at issue in *Soni*."[64]

In re Soni and *In re Geisler*, taken together, do not necessarily clarify an "unexpected results" determination. One reading of the two cases may be that "unexpected results" lie somewhere between a counter intuitive 26% increase in durability from a 50% reduction of the prior art's thickness and a fifty-fold increase in tensile strength from a mere 37% increase in molecular weight. The only certain conclusion, however, is that a finding of "unexpected results" is determined on a case-by-case basis and only future litigation, or legislative action, will resolve the issue. Furthermore, prior art, previously known to exist

[58] *In re* Soni, 54 F.3d at 751 (finding "substantially improved results" for claimed invention that had a fifty-fold increase in tensile strength from only a 37 percent increase in molecular weight compared to the prior art).

[59] *Id*. at 755.

[60] 116 F.3d 1465 (Fed. Cir. 1997).

[61] *Id*. at 1468 (emphasis added).

[62] *Id*.

[63] *Id.* at 1470.

[64] *Id*.

and function only at the macro-scale, will frequently inherently anticipate their subsequent nano-scaled counterparts. As a result, owners of the prior art reference who likely never contemplated a nano-scaled version of their prior art will experience windfall profits and rights that they did not anticipate when applying for their patents.

Applying the "unexpected results" principle and case law to nanotechnology, the question remains whether a reduction in size of a macro-scaled prior art to a nano-scaled version is patentable. The USPTO, at the first NCP meeting, relied in part on *In re Rose* to suggest that miniaturization down to the nano-scale, standing alone, is insufficient to render the nano-scaled version nonobvious from the prior art.[65] To overcome this nonobviousness rejection under current legal doctrine, the applicant for the nano-scaled version would have to make a showing of "unexpected results" concerning the nano-scaled version's new and improved properties.[66] A finding of "unexpected results," however, is determined on a case-by-case basis and is dependent on the inherently uncertain, subjective view of examiners and federal judges.[67] The patentability of nano-scaled versions of existing macro-scaled prior art should depend on legal principles, however, not outdated precedent and litigation over "unexpected results."

III. PROPOSAL

A. Prior Art Should Not Monopolize Nano-Scaled Counterparts

Granting patent holders of macro-scaled prior art a monopoly over subsequently developed nano-scaled counterparts does not further the patent system's underlying function of promoting scientific progress.[68] The USPTO issues patents that effectively convey limited monopolies to inventors over their inventions as an incentive to invent and disclose their scientific progress to the public.[69] With nanotechnology only now beginning to emerge, inventors of macro-scaled prior art rarely, if ever, contemplated nano-scaled versions of their inventions. Consequently, inventors of the macro-scaled prior art never needed the added incentive of a monopoly over nano-scaled versions to invent the prior art they had already invented. Rather, it is today's scientific community that needs the incentive to research and develop the emerging field of nanotechnology. Granting prior art patent holders a monopoly over newly

[65] *See supra* notes 31-38 and accompanying text.

[66] *See supra* notes 51-56 and accompanying text.

[67] *See supra* notes 57-64 and accompanying text.

[68] U.S. CONST. art. I, § 8, cl. 8 (granting Congress the power "[t]o *promote the Progress* of Science and *useful Arts*, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries) (emphasis added).

[69] *Id*.

developed nano-scaled inventions would therefore not only create unfair windfall gains for the prior art patent holder, but would simultaneously reduce the incentive for today's scientific community to experiment and exploit this new area of science.

Substantial and fundamental differences exist between the world of nanotechnology and the traditional macro-technology world.[70] Matter behaves uniquely when reduced to the nano-level.[71] For example, when a nano-scale invention is reduced beyond a critical size, its electron structure, conductivity, reactivity, melting temperature, mechanical properties, etc., are all different than that of its macro-level prior art counterpart.[72] Furthermore, nano-scale interactions become dominated by quantum mechanical effects that are too weak to notice on the prior art at the macro-level.[73] Based on the striking physical transformation that occurs when a prior art crosses from the macro-scale to the nano-scale, "the nano-scale is not just another step toward miniaturization, but a qualitatively new scale."[74] When viewed in this light, it becomes apparent that macro-scaled prior art, at the time of its invention, was likely never intended for applications at the nano-scale. Even if the inventor of the prior art did envision its use at the nano-scale, the inventor likely perceived it as nothing more than an abstract idea for its use, and thus it did not reach the threshold of an actual invention at the time.

As the patent system has long recognized, abstract ideas are not patentable.[75] This doctrine originated as early as 1854 in *O'Reilly v. Morse*,[76] involving Samuel Morse's patent on the telegraph. The USPTO originally granted Morse a broad patent covering *any* invention using electro-magnetism developed "for marking or printing intelligible characters, signs, or letters, at any distances."[77]

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[70] The fundamental physics and chemistry changes when the dimensions of a solid are in the nanometer range. POOLE & OWENS, *supra* note 6, at 5. In fact, the driving force behind nanotechnology is the recognition that nanostructured materials have chemistry and physics different from those of bulk materials. *Id.* at 6.

[71] *See* POOLE & OWENS, *supra* note 6, at 72.

[72] *Id.* at xi.

[73] *See id*. at 226.

[74] NAT'L SCI. FOUND., SOCIETAL IMPLICATIONS OF NANOSCIENCE AND NANOTECH. 1 (Mihail C. Roco & Sims Bainbridge eds., 2001), http://www.wtec.org/loyola/nano/NSET.Societal. Implications/nanosi.pdf. *See also* POOLE & OWENS, *supra* note 6, at 226 (describing the sudden, dramatic change in properties as the size of a material drops below 100 nanometers).

[75] Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1642 (2003).

[76] 56 U.S. 62 (1854).

[77] *Id.* at 112. Morse's eighth claim read as follows:

> Eighth. I do not propose to limit myself to the specific machinery or parts of machinery described in the foregoing specification and claims; the essence of my invention being

The Supreme Court, however, denied Morse such broad patent protection because he claimed the exclusive right to an invention "which he has not described and indeed had not invented, and therefore could not describe when he obtained his patent."[78] The Supreme Court recognized that granting a patent over yet *undiscovered applications* of the invention would "shut[] the door against inventions of other persons" and reward the prior art patentee the new discoveries of properties of the invention that future scientists may bring to light.[79] To hold otherwise would deny the public the benefit of such discoveries without the permission of the original patentee whose prior art failed to implement the newly discovered benefit.[80]

Four decades later, the Supreme Court revisited this concept in *Westinghouse v. Boyden Power Brake Co.*,[81] where the Court distinguished between the "letter" and "spirit" of a patent.[82] The court reasoned that a claimed invention is patentable over prior art, even though the claimed invention reads literally upon the claims of the prior art, when the claimed invention is so far removed in principle from the prior art that it reaches the same end result through substantially different means.[83] The court held that if this were not the case, the rule that the *function* of an invention cannot be patented would have no practical value.[84]

The doctrine that abstract ideas and the function of an invention cannot be patented prevents patents from covering entire new fields of science, and

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> the use of the motive power of the electric or galvanic current, which I call electro-magnetism, however developed for marking or printing intelligible characters, signs, or letters, at any distances, being a new application of that power of which I claim to be the first inventor or discoverer.

Id.

[78] *Id*. at 113.

[79] *Id.*

[80] *See id*.

[81] 170 U.S. 537 (1898).

[82] *See id*. at 568.

[83] *See id*. The Court stated:

> But even if it be conceded that the Boyden device corresponds with the letter of the Westinghouse claims, that does not settle conclusively the question of infringement. We have repeatedly held that a charge of infringement is sometimes made out, though the letter of the claims be avoided. The converse is equally true. The patentee may bring the defendant within the letter of his claims, but if the latter has so far changed the principle of the device that the claims of the patent, literally construed, have ceased to represent his actual invention, he is as little subject to be adjudged an infringer as one who has violated the letter of a statute has to be convicted, when he has done nothing in conflict with its spirit and intent.

Id. at 568.

[84] *See id*. at 569 (emphasis added).

instead limits patents to particular implementations.[85] Patenting abstract ideas or functions of an invention, rather than limiting the scope to the actual implementation of that concept at the time the patent is granted, allows the patentee to "engross a vast, unknown, and perhaps unknowable area."[86] Such a patent grants power to the prior art to block scientific development in a new scientific field without conferring any additional benefit to society.[87] The basic quid pro quo contemplated in the Constitution for granting a patent monopoly is the benefit derived by the public from an invention with actual utility.[88] Therefore, the scope of a prior art's patent should be limited to the actual implementation of that benefit and should not be read to include future benefits derived through subsequent scientific development.

In many instances, the specifications and claims of a traditional patented product will not make mention of limiting size or scale of the invention because prior to nanotechnology, scale was not an issue.[89] Therefore, in examining prior art in reference to a nano-scaled patent application, the USPTO examiner will have to infer the dimensional limitations of the prior art's claims. Reading such claims without reference to size limitations to include nano-scaled counterparts would in effect expand that prior art's patent to include abstract ideas at the time the patent was granted. In doing so, the USPTO would be ignoring the well-established precedent that abstract ideas are not patentable.[90] The effect of such interpretations is to allow prior art, which has already been granted a monopoly in exchange for some useful utility received by the public, to stifle development of nano-applications of that art, from which the public has yet to receive any benefit.

Titanium dioxide provides a useful example for illustrating this point.[91] Titanium dioxide is the pigment commonly used in white paint.[92] Recent scientific advances have produced nano-scale titanium dioxide, which, unlike its traditional macro-scale counterpart, is invisible because at the nano-scale it does not scatter visible light.[93] While conventional titanium dioxide used in white paint would not make a great sunscreen (unless you wanted to paint your body white), its nano-scaled counterpart is an ideal invisible sunscreen.[94] The

[85] Burk & Lemley, *supra* note 75, at 1643.

[86] Brenner v. Manson, 383 U.S. 519, 534 (1966).

[87] *Id.*

[88] *Id.*; *see also supra* notes 68-69 and accompanying text.

[89] *See supra* notes 31-38 and accompanying text.

[90] *See supra* note 75 and accompanying text.

[91] Assume for illustrative purposes that titanium dioxide is an artificially created compound to which the patent does not claim size limitations and has yet to expire.

[92] Newberger, *supra* note 21, at 652.

[93] *Id.*

[94] *Id.* (noting that while maintaining its property to scatter UV radiation, nano-scaled

patent on titanium dioxide conferred to society the benefit of a superior white paint over that of the prior art of the time,[95] in exchange for a limited monopoly over the invention. But should this patent cover newly discovered nano-scaled applications? The argument could be made that the invisible characteristic of titanium dioxide at the nano-scale is an inherent property of the prior art, and thus the prior art inherently anticipates the nano-scaled counterpart.[96] But the benefit to society for the monopoly granted to the prior art was that of a *superior white paint*. At the time of the invention, nano-scaled titanium dioxide was unattainable and thus never anticipated for applications that were unsuitable for prior art in its macro-scale state. Thus, interpreting the prior art's patent to cover its nano-scaled counterpart would grant the patentee a windfall from which society never benefited. This example demonstrates that allowing a macro-scale patent to cover nano-scale functions would drastically decrease incentives to discover new applications of prior art at the nano-scale.

Of course, the *process* used to make nano-scale titanium dioxide would likely be a separately-patentable process.[97] However, if the nano-scale titanium dioxide is covered by the macro-scale patent, the nano-scale titanium dioxide produced through that process patent would nevertheless infringe the prior patent.[98] As a result, in order to lawfully sell the nano-scale titanium dioxide, the nano-scale inventor would be forced to license the sale of the nano-scale titanium dioxide from the macro-scale patentee.[99] This situation reduces the incentive for the American science community to develop nanotechnology, and creates a windfall gain for the prior art patentee at the expense of society.[100]

B. Looking to Other Legal Doctrine to Resolve the Issue

The doctrine of equivalents evolved in order to prevent an infringer from misappropriating the benefit of an invention through unimportant and insubstantial changes and substitutions in the existing pioneering patent which, although adding no additional value to the prior art, would be enough to take the "new" invention outside the literal scope of the prior art's claim and thus

titanium dioxide is invisible compared to white at its macro-scale).

[95] In fact, titanium dioxide used in white paints produced the strongest, most brilliant white available to artists in the entire history of art. INSTITUTE FOR DYNAMIC EDUCATIONAL ADVANCEMENT, TITANIUM DIOXIDE WHITES: OVERVIEW, http://webexhibits.org/pigments/indiv/overview/tiwhite.html (last visited Nov. 5, 2005).

[96] *See supra* notes 40-4949 and accompanying text.

[97] *See supra* note 36 and accompanying text.

[98] JANICE M. MUELLER, AN INTRODUCTION TO PATENT LAW 15-16 (Erwin Chemerinsky et al. eds., Aspen Publishers 2003) (explaining the effects of blocking patents).

[99] *Id.* at 16.

[100] *See id.* (noting that if the two parties are unable to negotiate an agreement to cross-license, society is harmed because no one receives the benefit of the improvement).

outside the reach of patent law.[101] The theory behind this doctrine is that "if two devices do the same work in substantially the same way, and accomplish substantially the same result, they are the same, even though they differ in name, form, or shape."[102] Thus, a pioneer patentee may invoke the doctrine of equivalents and proceed against the producer of a subsequent device in an infringement action if that device "performs substantially the same function in substantially the same way to obtain the same result."[103]

The "wholesome realism" which drives the doctrine of equivalents, however, is not always applied in favor of a pioneer patentee and is sometimes used in certain situations against the pioneer patentee to compel an equitable excuse of literal infringement.[104] In what is now referred to as the reverse doctrine of equivalents, the Supreme Court articulated that "where a device is so far changed in principle from a patented article that it performs the same or a similar function in a substantially different way, but nevertheless falls within the literal words of the claim, the doctrine of equivalents may be used to restrict the claim and defeat the patentee's action for infringement."[105] Thus, the reverse doctrine of equivalents prevents the "unwarranted extension of the claims beyond a fair scope of" the pioneer patentee's invention[106] and serves as a "vital release valve, preventing [pioneer] patent owners from stifling radical improvements."[107] Put differently, the reverse doctrine of equivalents embodies the doctrine that a patentee cannot patent abstract ideas or the function of an invention.[108] The doctrine restricts the claims of the pioneering patent so as not to cover subsequent inventions that perform the same function in substantially different ways, despite falling within the literal scope of the pioneer patent's claims.[109] Therefore, the reverse doctrine of equivalents eliminates both the windfall gains to the pioneer patentee and the subsequent inventor's disincentive to invest in nano-scale applications of existing prior art that would be created if the nano-scale version of the prior art were blocked by

[101] Graver Tank & Mfg. Co. v. Linde Air Prods. Co., 339 U.S. 605, 607-08 (1950).

[102] Machine Co. v. Murphy, 97 U.S. 120, 125 (1878).

[103] *Graver Tank*, 339 U.S. at 608 (citing Sanitary Refrigerator Co. v. Winters, 280 U.S. 30, 42 (1929)).

[104] *Id.* at 608-09.

[105] *Id.* (citing Westinghouse v. Boyden Power Co., 170 U.S. 537, 568 (1898)).

[106] Scripps Clinic & Research Found. v. Genentech, Inc., 927 F.2d 1565, 1581 (Fed. Cir. 1991) (suggesting application of the reverse doctrine of equivalents on remand where the defendant produced similar biological materials by a radically new biotechnological process); *see also* Texas Instruments, Inc. v. U.S. Int'l Trade Comm'n, 846 F.2d 1369, 1372 (Fed. Cir. 1988) (noting that the reverse doctrine of equivalents is invoked when claims are written more broadly than the disclosure warrants).

[107] Burk, *supra* note 75, at 1657-58.

[108] *See supra* notes 75-84 and accompanying text.

[109] *See Graver Tank*, 339 U.S. at 608-09.

the pioneering patent.

Courts equitably apply the reverse doctrine of equivalents based upon underlying questions of fact[110] when, despite literally infringing the prior art's claim(s), the subsequent invention is so "substantially different" from the prior art that it is no longer the same invention.[111] Therefore, in order to invoke the reverse doctrine of equivalents, the nano-scaled invention must first show that the subsequent invention literally infringes the pioneering patent's claims.

Literal infringement occurs where the subsequent invention falls precisely within the express boundaries of the prior patent's claims.[112] While the Supreme Court has called literal infringement "a dull and very rare type of infringement,"[113] in practice, literal infringement is quite common due to the uncertainty of claim interpretations which define the literal scope of the claim.[114] With regards to nanotechnology, the uncertainty as to the literal scope of the prior art's claims is amplified. Since the claims of the prior art will rarely define the limiting size or scale of the invention,[115] subsequent nano-scaled inventions will likely fall within the scope of the prior art's claims that are devoid of any mention of scale and thus literally infringe the prior macro-scale patent. This concern drives the question of whether the nano-scaled inventions themselves are patentable over their existing macro-scaled counterparts based on the reduction of size alone.

The second requirement of the reverse doctrine of equivalents is that the subsequent invention must be "sufficiently different," or nonequivalent, from the prior art.[116] While rare, instances of nonequivalence do occur.[117] One such

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[110] *See* Amgen, Inc. v. Hoechst Marion Roussel, Inc., 314 F.3d 1313, 1351 (Fed. Cir. 2003) (citing *Scripps Clinic & Research Found.*, 927 F.2d 1565, 1581 (Fed. Cir. 1991)).

[111] *Texas Instruments*, 846 F.2d at 1371-72 (stressing that in order to invoke the reverse doctrine of equivalents, the subsequent invention must both literally infringe the prior art's claim and be sufficiently different from the prior art).

[112] MUELLER, *supra* note 98, at 237; *see also Graver Tank*, 339 U.S. at 607.

[113] *Graver Tank*, 339 U.S. at 607.

[114] MUELLER, *supra* note 98, at 238; *see generally* UNIVERSITY OF HOUSTON LAW CENTER INSTITUTE FOR INTELLECTUAL PROPERTY AND INFORMATION LAW, PATSTATS: U.S. PATENT LITIGATION STATISTICS, *available at* http://www.patstats.org/editors_page.html (last visited Nov. 5, 2005) (concluding that claim interpretation "[i]s an important contested point in nearly all infringement decisions and some validity rulings").

[115] *See supra* note 89 and accompanying text.

[116] *Texas Instruments*, 846 F.2d at 1371.

[117] *See* Gardner v. Ford Motor Co., 17 U.S.P.Q.2d 1177, 1186 (W.D. Wash. 1990) (holding that "the accused . . . systems are so far removed in principle, structure and operation from the claimed systems that, even if one or more claims could be read by happenstance to cover an accused . . . system, such claim still would not be infringed"). *See also* Monsanto Co. v. Mycogen Plant Science, Inc., 61 F. Supp. 2d 133 (D. Del. 1999) (overturning, for lack of sufficient evidentiary basis, a jury verdict that found that a subsequent invention fell literally

instance is the case of *Leesona Corp. v. United States*,[118] involving the alleged infringement of a patented battery electrode structure by that of a subsequently-developed battery. The prior art's patent specification disclosed an electrode which included a micro-porous metal layer for controlling bubble pressure, with the pore size of the layer ranging from one to fifty microns in diameter.[119] The claim in issue, claim 12, called for this metal layer to be "porous," "self-sustaining," and "of uniform and controlled porosity."[120] The Court of Claims determined that the corresponding metal layer of the subsequent battery was in fact "porous and self-sustaining and . . . could be said to have a uniform and controlled porosity,"[121] and, as thus interpreted, literally infringed the terms of the prior patent's claim.[122]

However, the court continued its analysis, and, relying on *Westinghouse v. Boyden Power Brake Co.*,[123] determined that "more than a literal response to the terms of the claims must be shown to make out a case of infringement."[124] The court interpreted the scope of the claim at issue in light of the patent specification and concluded that "the limitation in claim twelve of a 'porous self-sustaining metal layer of uniform and controlled porosity' *must* be restricted to porosities in the microporous range."[125] Consequently, because the porous layer of the subsequent battery was a conventional expanded metal screen with openings far greater than fifty microns and was not intended to perform the same function as the microporous metal layer of the patented

within a prior patent claim but nevertheless did not infringe under the reverse doctrine of equivalents); Precision Metal Fabricators Inc. v. Jetstream Sys. Co., 6 U.S.P.Q.2d 1704, 1708 (N.D. Cal. 1988) (holding that the defendant's "machines do not operate on the same principle as plaintiff's patented inventions. Whatever similarities exist are incidental and do not enhance the operation of defendants' machines . . . . This appears to be a case where defendants are not gaining the benefit of plaintiff's patents, but their equipment could fall within the literal language of the patents."); FMC Corp. v. Hennessy Indus. Inc., 2 U.S.P.Q.2d 1479, 1488 (N.D. Ill. 1986) (holding that there "was not an infringement within the scope of claim 5 as it was not within the scope of the invention claimed even if it was within the literal language of claim 5"); Brenner v. Recognition Equip. Inc., 593 F. Supp. 1275, 1278 (S.D.N.Y. 1984) (holding that "[i]t is fundamental that the language of patent claims cannot be stretched to include products and processes essentially unlike those described by the patent. Thus, even assuming *arguendo* that the literal language of plaintiffs' claims can be said to read upon REI's systems, those systems do not infringe because they accomplish the coding and sorting functions in a substantially different manner.").

[118] 530 F.2d 896 (Ct. Cl. 1976).

[119] U.S. Patent No. 3,438,815 (issued Apr. 15, 1969).

[120] *Id.*; Leesona Corp. v. United States, 530 F.2d at 905-06.

[121] *Leesona*, 530 F.2d at 906.

[122] *See id.*

[123] *See supra* notes 81-84 and accompanying text.

[124] *Leesona*, 530 F.2d at 906.

[125] *Id.* at 912 (emphasis added).

battery, the court concluded that the subsequent battery had nothing of a similar nature to the prior art.[126] Therefore, the court held that "[s]ince the [subsequent] metal layer does not perform substantially the same function in substantially the same way for substantially the same purpose as the patented micro-porous metal layer, there is no infringement."[127]

This case illustrates how courts may apply the reverse doctrine of equivalents to cases alleging infringement of a macro-scaled patented invention by its subsequent nano-scaled version. The doctrine's general emphasis on the subsequent invention's principles of operation applies effectively to the area of nanotechnology. At the nano-scale, matter behaves qualitatively differently than it does at its macro-state,[128] and thus nano-scaled inventions must function on entirely different principles of operation than their traditional macro-scaled counterparts.[129] Therefore, the same rationale that the court applied in *Leesona Corp. v. United States* to limit the scope of the claim to porosities in the microporous range could be applied to infringement cases involving nano-scaled inventions to limit the scope of the prior macro-scaled patent to those dimensions either explicitly or implicitly contained within the patent description.[130]

While the reverse doctrine of equivalents may present a solution to the problem of overly broad patent claims blocking the use of subsequently created nano-scaled versions of the prior art, the doctrine acts only as a defense to a charge of literal infringement.[131] Hence, one can not directly rely on the reverse doctrine of equivalents as a basis for determining whether the nano-scaled version itself is patentable based on size alone. To determine the patentability of the nano-scaled invention itself, we need to examine how the principles underlying the reverse doctrine of equivalents are embodied in the initial patent requirements placed on the prior art before being granted a patent.

C. Interpreting the Prior Art's Claims in Accordance with 35 U.S.C. § 112

The justification for the doctrine of equivalents is based in equity. It would be "unfair" to the prior art's inventor to deprive her of the benefits of her invention when someone later in time makes, uses, or sells a product or process, that – although not literally infringing the prior patent – is

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[126] *See id.* at 905-06.

[127] *Id.* at 906.

[128] *See supra* notes 71-74 and accompanying text.

[129] *See* POOLE & OWENS, *supra* note 6, at xi.

[130] *See* Robert P. Merges & Richard R. Nelson, *On the Complex Economics of Patent Scope*, 90 COLUM. L. REV. 839, 860-68 (1990) (advocating the reverse doctrine of equivalents as a mechanism to limit a prior art's patent scope in light of significant technological improvements by a subsequent invention).

[131] MUELLER, *supra* note 98, at 245.

substantially the same invention.[132] This justification raises the question as to why the patentee did not originally claim the subsequent invention that the patentee is now seeking to cover through the doctrine of equivalents. The answer illustrates the proper limitations of the prior art's claims with respect to the patentability of subsequent nano-scaled inventions.

The primary use of the doctrine of equivalents is to expand the scope of patent claims to cover any variation in the patented invention that a PHOSITA would regard as "interchangeable" with the specified claimed invention.[133] For example, in *Perkin-Elmer Corp. v. Westinghouse Electric Corp.*,[134] the prior art patentee asserted that with regards to connecting two components of the invention together, the method specified in the claim as "tap coupling" is interchangeable with the accused method of "loop coupling" to those skilled in the art.[135] The "interchangeable" argument amounts to the position that, although the patent claimed tap coupling, and although the disclosure taught tap coupling in order to enable a PHOSITA to make or use the invention, the patent *enabled* those skilled in the art to make or use the invention with loop coupling as well. Therefore, the subsequent invention derives directly from the prior patent and its disclosure without further innovation, and is thus "equivalent" to the prior art.

A corollary of the "interchangeability test" above is to use the doctrine of equivalents to expand the scope of claims to cover subsequent variations of the patented invention made possible through the use of technological innovations occurring after the patent was filed.[136] The doctrine of equivalents applies to these "new technology" cases when subsequent technological innovations

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[132] *See supra* notes 101-103 and accompanying text.

[133] Thomas & Betts Corp. v. Litton Sys., 720 F.2d 1572, 1579 (Fed. Cir. 1983) (noting that "the test of equivalency extends beyond what is literally stated in a patentee's specification to be equivalent and encompasses *any* element which one of ordinary skill in the art would perceive as interchangeable with the claimed element"); *see also Graver Tank*, 339 U.S. at 609 (noting that "an important factor [in determining equivalents] is whether persons reasonably skilled in the art would have known of the interchangeability of an ingredient not contained in the patent with one that was").

[134] 822 F.2d 1528 (Fed. Cir. 1987).

[135] *Id*. at 1531.

[136] *See* Hughes Aircraft Co. v. United States, 717 F.2d 1351, 1366 (Fed. Cir. 1983) (holding that devices changing the patented invention with advances developed subsequent to the patent could infringe under the doctrine of equivalents); *see also* Pennwalt Corp. v. Durand-Wayland, Inc., 833 F.2d 931, 941-41 n.4 (Fed. Cir. 1987) (noting that "[i]t is clear that an equivalent can be found in technology known at the time of the invention, as well as in subsequently developed technology") (Bennett, J., dissenting); *see also* Texas Instruments, Inc. v. U.S. Int'l Trade Comm'n, 805 F.2d 1558, 1563 (Fed. Cir. 1986) (noting that "equivalence is determined as of the time infringement takes place"). *See, e.g.*, Atlas Powder Co. v. E. I. Du Pont de Nemours & Co., 750 F.2d 1569 (Fed. Cir. 1984).

allow the use of new technology to replace certain elements of the prior art's claims without substantially changing the prior patented invention.[137]

For example, suppose that after filing of the patent at issue in *Perkin-Elmer Corp. v. Westinghouse Electric Corp.*, someone invented a new technological innovation in coupling that replaced the old "tap coupling" method specified in the patent's claim. Suppose that the new inventor calls this new technology "knock-coupling." Suppose further that "knock-coupling" performs the same function and causes the components joined by this method to operate in substantially the same way as the old "tap coupling" method. The only difference between the two is that "knock-coupling" costs half as much in manufacturing costs as "tap coupling" and has thus replaced "tap coupling" within the industry. In this example, the patentee would invoke the doctrine of equivalents, arguing that the subsequent invention is "equivalent" to the prior art as a whole because the prior patent also *enables*, through the use of later developed technology, a PHOSITA to make or use the invention with "knock-coupling." The rationale for broadening the scope of the prior patent's claims to cover the new technology of "knock-coupling" is the same rationale for broadening the scope to cover the "interchangeable" elements at the time the patent was filed in the first example (i.e. loop coupling).

The competing reverse doctrine of equivalents limits the use of the doctrine of equivalents in "new technology" cases to expand the scope of the prior patent's claims. [138] It works to restrict broad claim language and preclude a finding of infringement when there is a showing that the accused device has "so far changed the principle of the [prior art]" that it does not embody the same or substantially the same device or combination of devices *described* within the prior patent.[139] The Federal Circuit held that "[a]pplication of the [reverse doctrine of equivalents] requires that facts specific to the accused device be determined and weighed against the equitable scope of the claims, which in turn is determined *in light of the [patent's] specification . . . .*"[140]

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[137] *See Hughes Aircraft*, 717 F.2d at 1365 (holding that the partial variation in technique, made possible by post-patent technology, does not allow the accused to escape the "web of infringement").

[138] *See supra* notes 104-127 and accompanying text for an overview of the reverse doctrine of equivalents and its application.

[139] *Westinghouse*, 170 U.S. at 568 (1898). *See also* Burr v. Duryee, 68 U.S. 531 (1863).

> That two machines produce the same effect will not justify the assertion that they are substantially the same, or that the devices used by one are, therefore, mere equivalents for those of the other. . . . If the invention of the patentee be a machine, it will be infringed by a machine which incorporates in its structure and operation the substance of the invention; that is, by an arrangement of mechanism which performs the same service or produces the same effect in the same way, or substantially the same way.

Burr, 68 U.S. at 572-73.

[140] *Scripps Clinic & Research Found.*, 927 F.2d at 1581 (emphasis added).

While the Federal Circuit has yet explicitly to affirm a decision finding non-infringement based on the reverse doctrine of equivalents,[141] the Federal Circuit has continued to follow the precedent established by the Supreme Court in the *Westinghouse*[142] and *Graver Tank*[143] decisions by affirming that the principles of the reverse doctrine of equivalents support a finding of non-infringement.[144]

The reason that the Federal Circuit has yet to resort to the reverse doctrine of equivalents in affirming a finding of non-infringement is that after the decision in *Graver Tank*, Congress enacted 35 U.S.C. § 112,[145] which

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[141] Tate Access Floors, Inc. v. Interface Architectural Res., Inc., 279 F.3d 1357, 1368 (Fed. Cir. 2002) (noting that "[n]ot once has [the Federal Circuit] affirmed a decision finding noninfringement based on the reverse doctrine of equivalents").

[142] *Westinghouse*, 170 U.S. 537. *See supra* notes 81-84.

[143] *Graver Tank*, 339 U.S. 605. *See supra* notes 104-105.

[144] *See* Amgen Inc. v. Hoechst Marion Roussel, Inc., 314 F.3d 1313, 1351 (Fed. Cir. 2003) (implying the doctrine is equitably applied based on the underlying questions of fact); *see also Scripps Clinic & Research Found.*, 927 F.2d at 1581 (noting that "the purpose of the 'reverse' doctrine is to prevent unwarranted extension of the claims beyond a fair scope of the patentee's invention. . ."); Smithkline Diagnostics, Inc. v. Helena Labs. Corp., 859 F.2d 878, 889 (Fed. Cir. 1988) (finding that the defendant could establish non-infringement by showing that his device performs a similar function in a substantially different way); SRI Int'l v. Matsushita Elec. Corp., 775 F.2d 1107, 1123 (Fed. Cir. 1985) (en banc) (noting that the "[a]vailability of the reverse doctrine of equivalents was set forth by the Supreme Court").

[145] Section 112 reads:

> 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 as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.
>
> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention. A claim may be written in independent or, if the nature of the case admits, in dependent or multiple dependent form.
>
> Subject to the following paragraph, a claim in dependent form shall contain a reference to a claim previously set forth and then specify a further limitation of the subject matter claimed. A claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers.
>
> A claim in multiple dependent form shall contain a reference, in the alternative only, to more than one claim previously set forth and then specify a further limitation of the subject matter claimed. A multiple dependent claim shall not serve as a basis for any other multiple dependent claim. A multiple dependent claim shall be construed to incorporate by reference all the limitations of the particular claim in relation to which it is being considered.
>
> An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in

"imposed requirements for the written description, enablement, definiteness, and means-plus-function claims that are co-extensive with the broadest possible reach of the reverse doctrine of equivalents."[146] The Federal Circuit has explained that both § 112 and the reverse doctrine of equivalents "spring from the same roots and very often take account of the same factors and considerations."[147] The Federal Circuit further stated that the *Graver Tank* concepts of equivalents are relevant in any equivalence determination under § 112, and that the underlying principles of the reverse doctrine of equivalents expressed in *Graver Tank* could be used in a § 112 analysis.[148] The Supreme Court affirmed this position in *Warner-Jenkinson Co. v. Hilton Davis Chem. Co.*,[149] holding that in accordance with the enactment of § 112, the "broad literal language of [patent] claims *must* be limited to only those means that are 'equivalent' to the *actual means shown in the patent specification*."[150] The Supreme Court referred to the limitations imposed by § 112 as "an application of the doctrine of equivalents in a restrictive role,"[151] i.e., the reverse doctrine of equivalents, which the Court previously "recognized . . . in *Graver Tank* itself."[152]

The enactment of 35 U.S.C. § 112, incorporating the underlying principles of the reverse doctrine of equivalents, can be interpreted as shifting the focus away from the subsequent invention towards a concentration on the prior art itself in cases involving a reverse doctrine of equivalents analysis. This distinction, while subtle, is the key to determining doctrinally whether the subsequent miniaturization of an existing patented product to the nano-scale, standing alone, can satisfy the nonobviousness patentability requirement.

The traditional reverse doctrine of equivalents focuses on the subsequent invention's characteristics to determine whether that invention should be equitably relieved from a finding of infringement when that device literally reads upon the claims of a prior art.[153] In contrast, a § 112 analysis focuses on the prior art and whether that patent's claims, when viewed in light of its § 112 specifications, should be equitably interpreted to cover the subsequent invention.[154] Because a § 112 analysis focuses on the prior art's patent

support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

35 U.S.C. § 112 (2000).

[146] *Tate Access Floors*, 279 F.3d at 1368.

[147] *Texas Instruments*, 846 F.2d 1369, 1372 (Fed. Cir. 1988) (Davis, J., concurring).

[148] *Id.*

[149] 520 U.S. 17 (1997).

[150] *Id*. at 28 (emphasis added).

[151] *Id.*

[152] *Id.*

[153] *See supra* notes 104-111 and accompanying text.

[154] *See generally* Warner-Jenkinson Co. v. Hilton Davis Chem. Co., 520 U.S. 17 (1996).

specifications, rather than the subsequent invention itself, courts can conduct a § 112 analysis to interpret the scope of a patent's claims prior to, and independent of, a suit brought against the subsequent invention for infringing *that* patent's claims.[155] Therefore, the patent specifications for the entire field of relevant prior art can be interpreted under a § 112 analysis by the USPTO to provide a basis for determining whether a subsequent nano-scaled miniaturization of an existing patented product satisfies the nonobviousness patentability requirement.

Interpreting the prior art's patent under a § 112 analysis, and thus limiting the scope of its claims to cover only that which is fairly contemplated by the disclosed invention in its specification, is consistent with the public notice function that patents "not only secure to [the patentee] all to which he is entitled, but [also] apprise the public of what is still open to them."[156] A determination of the scope of the claims embodied in the patent's specification can be assessed through the enabling disclosure and written description requirements of the first paragraph of § 112.[157] While the enabling disclosure and written description requirements are separate and distinct requirements under § 112, together they establish the limitations of what the patent may later claim.[158]

The enablement requirement ensures that the public is put in "possession" of the patented invention by disclosing to a PHOSITA both "how to make" the invention as well as "how to use" it.[159] Thus, the enablement requirement limits the scope of a patent's claims to that which "bear[s] a reasonable correlation to the scope of enablement provided by the specification to persons of ordinary skill in the art."[160] The enablement analysis is inherently fact-specific to each case. However, the "reasonable correlation to the scope of

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[155] In contrast, the use of the traditional reverse doctrine of equivalents is limited to a defense to infringement and is applied *only* with respect to that patent which claims literal infringement of its claims and thus is not applied to other relevant prior art. *See supra* notes 110-127, 131 and accompanying text.

[156] McClain v. Ortmayer, 141 U.S. 419, 424 (1891) (noting that the patent specification may be referred to when limiting the scope of the patent's claim).

[157] The first paragraph of § 112 reads:

> 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 as to *enable* any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

35 U.S.C. § 112, ¶ 1 (2000) (emphasis added).

[158] MUELLER, *supra* note 98, at 87-88 (stating that the two requirements ensure against the patentee from later claiming subject matter as within the scope of the patent's claim that the patentee neither "possessed" nor "enabled" at the time the patent was filed).

[159] *See* 35 U.S.C. § 112, ¶ 1; *see also* MUELLER, *supra* note 98, at 67-68.

[160] *In re* Fisher, 427 F.2d 833, 839 (C.C.P.A. 1970).

enablement" is generally related to whether the patented invention is within a "predictable" or "unpredictable" technology.[161]

In cases involving *predictable* factors, such as mechanical or electrical elements, "a single embodiment provides broad enablement in the sense that, once imagined, other embodiments can be made without difficulty and their performance characteristics predicted by resort to known scientific laws."[162] Conversely, in cases involving *unpredictable* factors, like chemical reactions and physiological activity, "the scope of enablement obviously varies inversely with the degree of unpredictability of the factors involved."[163] The correlation described, interpreting claim scope proportional to the predictability of the elements of the claims, embodies the principles underlying the doctrine of equivalents. In cases involving increasing predictability, the claims of the patent are interpreted broadly to allow the patentee to dominate future variations in his patented invention that a PHOSITA would have regarded as "interchangeable" with the specified claimed invention because it can be said that the subsequent inventions were *enabled* by the initial patent.[164] As such, this correlation also embodies the reverse doctrine of equivalents in cases involving *unpredictable* technology by limiting the scope of the claims when the subsequent invention has "so far changed the principle of the [prior art]" that it cannot be said that the prior patent *enabled* the subsequent invention.[165] Therefore, the relevant inquiry regarding the scope of the prior patent's claims in terms of the enablement requirement of § 112 is whether the enablement disclosure permits a PHOSITA to make and use the *subsequent invention* without undue experimentation.[166]

In contrast to the enabling disclosure, which ensures public "possession" of

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[161] MUELLER, *supra* note 98, at 71-72.

[162] *In re* Fisher, 427 F.2d at 839.

[163] *Id*. at 839.

[164] *See supra* notes 133-137 and accompanying text.

[165] *See In re* Fisher, 427 F.2d at 839. The CCPA explained the rationale for interpreting claim scope:

> It is apparent that such an inventor should be allowed to dominate the future patentable inventions of others where those inventions were based in some way on his teachings. Such improvements, while unobvious from his teachings, are still within his contribution, since the improvement was made possible by his work. It is equally apparent, however, that he must not be permitted to achieve this dominance by claims which are insufficiently supported and hence not in compliance with the first paragraph of 35 U.S.C. § 112.

Id.

[166] *See In re* Wands, 858 F.2d 731, 737 (Fed. Cir. 1988) (recognizing that the qualifying phrase "without undue experimentation" is judicially created); *see also* Amgen, Inc. v. Chugai Pharm. Co., 927 F.2d 1200, 1212 (Fed. Cir. 1991) (holding that "[t]hat some experimentation is necessary does not constitute a lack of enablement; the amount of experimentation, however, must not be unduly extensive").

the actual invention claimed in the patent, the written description requirement ensures that the *inventor* has actual "possession" of the claimed invention at the time the patent application was filed.[167] By requiring the inventor to "convey with reasonable clarity to those skilled in the art that, as of the filing date sought, he or she was in possession of the invention,"[168] the written description requirement limits the scope of a patent's claims to those that "can be determined to be encompassed within [the] original [invention]."[169] Therefore, by preventing inventors from later claiming what was not envisioned at the time the original patent was described, the written description requirement incorporates the doctrines that neither an idea nor the function of an invention is patentable.[170] Only that which has been described in the written description[171] at the time the patent was filed can subsequently be included within the scope of the patent's claims.[172]

A patent can enable without describing, and describe without enabling. Through the enactment of 35 U.S.C. § 112, the scope of a patent's literal claims are limited with respect to its specification and the requirements therein. Therefore, the proper interpretation of a patent's scope is the broadest, ordinary, literal meaning of the claim terms, from the perspective of a PHOSITA, that are coexistent with *both* that which is depicted within the written description as to have been "possessed" by the inventor at the time the patent was filed, *and* that which the public is said to "possess" through the disclosure of how to make and use the claimed invention. Thus, the scope of a patent is necessarily limited to that which is put into "possession" of the public by means of its enabling disclosure.

D. Reevaluating Nonobviousness as Applied to Size-Based Patentability

For a claimed invention to be patentable, 35 U.S.C. § 103 requires that the invention be *nonobvious* from the perspective of a PHOSITA within the subject matter of the claimed invention.[173] This raises the question as to what *is*

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[167] MUELLER, *supra* note 98, at 82-88.

[168] Vas-Cath Inc. v. Mahurkar, 935 F.2d 1555, 1563-64 (Fed. Cir. 1991).

[169] Rengo Co. v. Molins Mach. Co., 657 F.2d 535, 551 (3d Cir. 1981) (holding that "[a]dequate description of the invention guards against the inventor's overreaching by insisting that he recount his invention in such detail that his future claims can be determined to be encompassed within his original creation").

[170] *See supra* notes 7575-87 and accompanying text.

[171] The scope of that which is described in the written description is not limited to its literal interpretation, but should be interpreted to include also "undisclosed, but obviously art-recognized equivalent[s]" of those elements expressly disclosed. *See In re* Smythe, 480 F.2d 1376, 1384 (C.C.P.A. 1973).

[172] *See* MUELLER, *supra* note 98, at 83.

[173] The relevant portion of § 103 states:

A patent may not be obtained though the invention is not identically disclosed or

obvious to a PHOSITA. How does one determine that which is obvious? The Supreme Court, in *Graham v. John Deere Co.*,[174] attempted to quantify the notion of obviousness by basing the determination primarily on three factual inquiries: the scope and content of the prior art; the differences between the claimed invention and the prior art; and the level of ordinary skill in the art.[175] The "scope and content of the prior art" refers to the legally available[176] technology and information to which the claimed invention will be compared. For the purpose of a nonobviousness determination, § 103 presumes that a PHOSITA has "full knowledge" of the "teachings" disclosed in the prior art.[177] Since this presumption of knowledge is based on the "teachings" *disclosed*, the "scope and content of the prior art" to which a PHOSITA is presumed to have knowledge of, must therefore be limited only to that which the prior art has placed into the public's "possession."[178] Likewise, it can only be that which the prior art actually places into the "possession" of the public that forms the basis from which to assess the "differences between the claimed invention and the prior art." Thus, the criterion for the determination of obviousness can be expressed as whether "the differences between the [claimed invention] and the prior art are such that the [claimed invention] as a whole would have been obvious" to a PHOSITA with the combined knowledge of all the content

> described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been *obvious* at the time the invention was made *to a person having ordinary skill in the art to which said subject matter pertains.*

35 U.S.C. § 103(a) (2000) (emphasis added).

[174] 383 U.S. 1 (1966).

[175] *See id.* at 17. The Supreme Court expressed the nonobviousness determination as:

> While the ultimate question of patent validity is one of law . . . the § 103 condition . . . lends itself to several basic factual inquiries. Under § 103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background, the obviousness or nonobviousness of the subject matter is determined.

Id.

[176] While the categorization of the specific technology and information that is "legally available" for use as a prior art is beyond the scope of this paper, it should be noted that it is generally governed by 35 U.S.C. § 102 and the concept of analogous art. *See* MUELLER, *supra* note 98, at 139-146.

[177] *In re* Wood, 599 F.2d 1032, 1036 (C.C.P.A. 1979) (noting the rationale behind presuming knowledge of the teachings disclosed in the prior art as an "attempt to more closely approximate the reality of the circumstances surrounding the making of an invention").

[178] *See In re* Hoeksema, 399 F.2d 269, 274 (C.C.P.A. 1968) (holding that "the true test of any prior art relied on to show or suggest that a [claimed invention] is [obvious], is whether the prior art is such as to place the disclosed [invention] in the possession of the public").

disclosed within the scope of legally available prior art.[179]

The nonobviousness requirement is ultimately one of judgment,[180] based on an objective evaluation from the perspective of a hypothetical person (a PHOSITA), as to whether the claimed invention represents enough of a qualitative advance over the teachings of the prior art as to warrant the protection of a patent.[181] The measure of what constitutes "enough of a qualitative advance" over the prior art implicates the same principles as those raised when interpreting the proper scope of an existing patent's claims. The inquiry ultimately comes down to whether the claimed invention owes its existence to its inventor's ingenuity,[182] or whether the claimed invention is merely an "equivalent" variation of the prior art whose existence "was to be expected"[183] based on the teachings disclosed in the prior art in combination with the ordinary scientific knowledge of those in the art.

To determine whether the subsequent miniaturization of an existing patented product to the nano-scale, standing alone, can satisfy the nonobviousness patentability requirement, we need to reexamine the rationale behind the precedent holding that a change in size alone is not sufficient to establish patentability over the prior art.[184] In the context of these prior cases, it is not surprising that the courts would find that a change in size alone fails to satisfy the nonobviousness requirement of 35 U.S.C. § 103. The important issue is how the court (or the USPTO in the case of initially reviewing a patent application) came to the conclusion of obviousness.

It is insufficient to rely on common sense as the basis for a finding of

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[179] *See* 35 U.S.C. §103(a) (2000).

[180] *See In re* Lee, 277 F.3d 1338, 1345 (Fed. Cir. 2002) (stating that "[t]he determination of patentability on the ground of unobviousness is ultimately one of judgment"); *see also* Graham v. John Deere Co., 383 U.S. 1, 18 (1966) (noting that "[w]hat is obvious is not a question upon which there is likely to be uniformity of thought in every given factual context" and compared the judgment to that of determining negligence).

[181] *See generally* MUELLER, *supra* note 98, at 131-47 (providing an overview of the nonobviousness requirement).

[182] The idea that it is the presence of "ingenuity which constitute[s] [an] essential element[] of every invention" that distinguishes nonobviousness from a mere obvious extension of the teachings disclosed in the prior art has been recognized by the Supreme Court since 1851. *See* Hotchkiss v. Greenwood, 52 U.S. 248, 267 (1851).

[183] *See* BLACK'S LAW DICTIONARY 1108 (8th ed. 2004) (defining "obviousness" as being easily apparent to a PHOSITA that "the invention was to be expected" when considering the scope and content of the prior art). *See also In re* Dow Chem. Co., 837 F.2d 469, 473 (Fed. Cir. 1988) (holding that a claimed invention is obvious when "the prior art would have suggested to one of ordinary skill in the art that [the invention] should be carried out and *would have a reasonable likelihood of success*, [when] viewed in light of the prior art") (emphasis added).

[184] *See supra* notes 32-38 and accompanying text for the development of this precedent.

obviousness.[185] Instead, the decision must be based on an application of the law to the facts.[186] Before concluding from the precedent that a mere change in size is prima facie obvious, one must first consider the fact that these cases were based on *predictable* technology. Thus, when determining obviousness, the content of the prior art that a PHOSITA is presumed to have knowledge of will "bear a reasonable correlation to the scope of enablement" with that prior art's disclosure.[187] Since *both* the prior art and the claimed invention in these cases were within the same *predictable* subject matter, the single embodiment disclosed in the prior art provides for broad enablement of other embodiments of that invention relating to size. This is because once the knowledge of how to make and use that embodiment was disclosed, a PHOSITA could combine that knowledge with his own knowledge of the scientific laws that govern that subject matter and be in "possession" of the claimed invention.[188]

The same analysis does not apply in the case of a nano-scaled version with respect to its macro-scale prior art. Although the prior art may be within a *predictable* technology, the claimed invention at the nano-scale lies within the realm of *unpredictable* technology.[189] Given that the prior art's scope of enablement, which is directly proportional to the amount of knowledge a PHOSITA is presumed to have from that reference, decreases as the *unpredictability* of the claimed invention increases, it cannot be assumed that a PHOSITA can combine his own knowledge with that disclosed by the prior art, and be said to be "in possession" of the claimed nano-scaled invention.[190]

When determining nonobviousness, § 103 mandates that the claimed invention be considered "as a whole."[191] The claimed invention, considered as a whole, includes the claimed invention itself and a way to produce it.[192]

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[185] *See In re* Lee, 277 F.3d 1338, 1344-45 (Fed. Cir. 2002) (holding that "[c]ommon knowledge and common sense, even if assumed to derive from the agency's expertise" are insufficient to find obviousness without a reasoned explanation).

[186] *Id.*

[187] *See supra* note 160 and accompanying text.

[188] *See supra* note 162 and accompanying text for an analysis of how predictability within a subject matter relates to a prior art's scope of enablement. The scope of enablement in turn determines that which a PHOSITA is presumed to have knowledge of. *See supra* note 178 and accompanying text.

[189] *See supra* notes 71-74 and accompanying text.

[190] *See supra* notes 163 and 178 and accompanying text for an analysis of the correlation between the prior art's scope of enablement and the amount of knowledge a PHOSITA is presumed to have.

[191] 35 U.S.C. § 103(a) (2000) (stating whether "the subject matter *as a whole* would have obvious") (emphasis added).

[192] *In re* Hoeksema, 399 F.2d 269, 273 (C.C.P.A. 1968) (noting that when considering the claimed invention as a whole, a court must include the method of making the claimed invention because "unless there is some known or obvious way to make the [claimed

Therefore, "[i]n determining the quantum of prior art disclosure which is necessary to declare [a claimed invention] [obvious] within section [103], the stated test is whether a reference contains an 'enabling disclosure' . . . such that a skilled artisan could take its teachings in combination with his own knowledge of the particular art and be in possession of the invention."[193] Thus, if the combined scope and content of all the legally available prior art does *not enable* a PHOSITA to produce the nano-scaled version of an *existing* device, it may not be legally concluded that the nano-scaled claimed invention is obvious, even if there is no difference other than size.[194]

The miniaturization of existing, macro-scale, patented products to the nano-scale, standing alone, *will* satisfy the nonobviousness patentability requirement of 35 U.S.C. § 103 when the prior art references fail to provide an enabling method for the nano-scaled version. Thus, the USPTO agent at the September 11 NCP initiative meeting erred in relying on the precedent established by *In re Rose*[195] when suggesting that limitations relating to size alone are insufficient to establish nonobviousness in light of the macro-scale prior art.

IV. RECOMMENDATION: PROPER EXAMINATION OF NANOTECHNOLOGY PATENTS BY THE USPTO

The USPTO has published over 10,255 patent applications containing the term "nano" in the patent since March 15, 2001.[196] Furthermore, the USPTO has seen the number of patents issued directly relating to the field of nanotechnology grow exponentially over the past ten years.[197] This raises the question whether the USPTO can handle this exponential increase in

invention], the invention is nothing more than a mental concept expressed . . . on paper"). *See also supra* notes 75-88 and accompanying text for a discussion on the prohibition of patenting ideas.

[193] *In re* Hoeksema, 399 F.2d at 273 (reversing an obviousness rejection of a patent application for a chemical compound; holding that a claimed compound could be nonobvious, even though its exact chemical structure is disclosed in the written description of a prior art, when no process existed at the time that would have enabled its production); *cf.* Amgen, Inc. v. Hoechst Marion Roussel, Inc., 314 F.3d 1313, 1354 (Fed. Cir. 2003) (holding that "a claimed invention cannot be anticipated by a prior art reference if the allegedly anticipatory disclosers cited as prior art are not enabled").

[194] *In re* Hoeksema, 399 F.2d at 274 (holding that "the absence of a known or obvious process for making the claimed compounds overcomes a presumption that the compounds are obvious, based on close relationships between their structures and those of prior art compounds").

[195] 220 F.2d 459 (C.C.P.A. 1955); *see supra* notes 32-38 and accompanying text.

[196] *See* UNITED STATES PATENT AND TRADEMARK OFFICE, PUBLISHED APPLICATIONS, http://www.uspto.gov/patft/index.html (last visited Nov. 5, 2005) (searching the term "nano" in published applications).

[197] Koppikar, *supra* note 26, at 2.

nanotechnology patent applications under its current structure.[198]

Historically, patent examiners at the USPTO "required expertise in only one field of science to effectively research and grant competent patents."[199] Nanotechnology, on the other hand, presents a unique challenge to the USPTO because it involves emerging technology encompassing multiple disciplines.[200] Consequently, very few individuals have the broad, comprehensive knowledge of nanotechnology necessary to adequately examine patent applications in this field.[201] Combine this shortage of qualified examiners with the ever growing number of nanotechnology patent applications, and the result is that we are likely to experience a backlog and delay in the patent prosecution process. Delays in obtaining issued patents will likely adversely impact the pace of the American nanotechnology industry's growth.[202]

Presently, the classification of an incoming patent application initially determines which technical group examines the application.[203] This classification further determines the scientific area in which the examiner searches for potential prior art.[204] While the classification of certain nanotechnology patent applications is straightforward and fits easily into one of the current examining groups, a significant amount of nanotechnology is interdisciplinary and resists such classification.[205] Despite this cross-

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[198] Terry K. Tullis, *Current Intellectual Property Issues in Nanotechnology*, 2004 UCLA J.L. & TECH. NOTES 12 (2004), http://www.lawtechjournal.com/notes/2004/12_040809_tullis.php.

[199] Sonia E. Miller, *A Matter of Scale: Nanotechnology's Novelty Poses Challenges to Patent Process* (Aug. 3, 2004), http://news.nanoapex.com/modules.php?name=News&file=article&sid=4841.

[200] *See* POOLE & OWENS, *supra* note 6, at 5. *See also supra* text accompanying note 24.

[201] Albert P. Halluin & Lorelei P. Westin, *Nanotechnology: The Importance of Intellectual Property Rights in an Emerging Technology* (2003), *available at* http://www.howrey.com/nanotech_history/presentations/Nanotechnology_Manuscript_2003.pdf; *see also* Mullally, *supra* note 36, at t7 (noting the difficulty locating examiners with sufficient knowledge and experience in nanotechnology to examine patents); *see also* POOLE & OWENS, *supra* note 6, at 5 (noting that the interdisciplinary nature of nanotechnology makes it difficult for someone to understand and draw on developments in the different areas of the field).

[202] Patents are essential to emerging technology businesses because most venture capitalists require a substantial patent portfolio to insure their risky investment in a pioneering technology start-up. Halluin, *supra* note 201, at 8.

[203] *See* Lance D. Reich, *Protecting Tiny Gizmos: The Patent and Trademark Office is Preparing for Nanotechnology Applications*, NAT'L L.J., Jan. 26, 2004, at S1.

[204] *Id.*

[205] Timothy M. Hsieh *et al.*, *The Patent Office Grapples with Nanotechnology* (July 22, 2003), http://www.smalltimes.com/document_display.cfm?document_id=6374; *see also* Miller, *supra* note 199 (noting nanotechnology's cross-disciplinary diversity which makes easy classification difficult).

disciplinary nature of nanotechnology, the USPTO has no immediate plans to create a nanotechnology examining group.[206] Because there is no specialized nanotechnology examining group, there is a risk that similar interdisciplinary nanotechnology applications could be sent to examiners in different examining groups.[207] For example, a nanotechnology patent application with a bottom-up approach to a new semiconductor could impact not only semiconductors, but material science as well. Because nanotechnology patent applications like this are interdisciplinary, some of these applications will go to a chemical examiner, and others to an electrical examiner; neither of whom might do a search for prior art in the other's respective field.[208] Therefore, under the current USPTO structure, there is a greater risk that examiners inexperienced in nanotechnology will examine patents having either overlooked relevant prior art, or misunderstood the prior art they did locate in a field unfamiliar to them.[209] This process "is a recipe for inferior patents that could plague the nanotechnology industry."[210]

It took the USPTO eight years[211] to establish a specialized biotechnology examining group after coming to the realization that none of its existing technology groups could competently examine biotechnology applications.[212] The USPTO's decision not to form a specialized nanotechnology examining group appears to disregard the lessons learned from biotechnology's early days.[213]

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[206] Koppikar, *supra* note 26, at 4; *see also* Hsieh, *supra* note 205 (adding that the USPTO "doesn't seem interested in extensive consultations with the nanotechnology industry" either).

[207] Mullally, *supra* note 36, at t7.

[208] Doug Brown, *U.S. Patent Examiners May Not Know Enough About Nanotech* (Feb. 4, 2002), http://www.smalltimes.com/document_display.cfm?document_id=3035; *see also* Koppikar, *supra* note 26, at 4 (noting that under the USPTO's current structure, there is no way of ensuring uniform handling of similar, interdisciplinary, nanotechnology patent applications).

[209] Specialized examiners may not be familiar with the advances in other areas necessary for the complete examination of a multidisciplinary nanotechnology patent application. Mullally, *supra* note 36, at t7.

[210] Brown, *supra* note 208 (quoting Mark Modzelewski, founder and president of the NanoBusiness Alliance, the nanotechnology industry's trade association).

[211] The Supreme Court expanded the statutory subject matter of patents to include biotechnology in 1980. *See* Diamond v. Chakrabarty, 447 U.S. 303 (1980). The USPTO did not create a biotechnology examining group until 1988. U.S. CONGRESS, OFFICE OF TECHNOLOGY ASSESSMENT, NEW DEVELOPMENTS IN BIOTECH.: PATENTING LIFE--SPECIAL REPORT 60 (Apr.1989), *available at* http://www.wws.princeton.edu/cgi-bin/byteserv.prl/~ota/disk1/1989/8924/8924.PDF.

[212] *See* Hsieh, *supra* note 205.

[213] *See id.*

While specific changes to the USPTO's organizational structure is beyond the scope of this Note, it is clear that the USPTO needs to develop either a specialized nanotechnology group or sub-groups within each existing group that can effectively communicate with each other when examining nanotechnology-related patents. Nanotechnology is inherently interdisciplinary, and the ordinary level of skill in the art is different than that of any other single USPTO examining group in existence today. Since a PHOSITA is the measure in which to determine nonobviousness, the USPTO needs to determine what would be obvious to one in the field of nanotechnology in light of the entire prior art. As this field grows, the potentially-related art will become overwhelming. Examiners will have to look at prior art in multiple fields including prior inventions, processes to reduce the size to the nano-scale, the tools and skill of the art, etc. To form the basis of a nonobviousness rejection for a patent application of a nano-scaled version of existing macro-scale prior art, the examiner must have a firm understanding of what would be obvious to a PHOSITA in the field of nanotechnology. Relying on a per se rule that miniaturization down to the nano-scale, standing alone, is obvious, is inconsistent with the principles of our patent system.

V. CONCLUSION

The USPTO, in a presentation at the September 11, 2003, NCP meeting, suggested that miniaturization down to the nano-scale, standing alone, is not patentable. In its argument, the USPTO relied on a series of precedent highlighted by *In re Rose*. The focus of this Note was to reexamine that precedent and determine whether that doctrine is applicable in the case of subsequently developed nano-scale versions in light of the underlying principles of our patent system. The enabling disclosure and written description requirements of § 112 combine to establish the limitations of that which the prior art encompasses. The precedents relied upon by the USPTO were all based on predictable technologies, and as such, the single embodiment disclosed by the prior art provided for broad enablement of subsequent claimed inventions relating to size limitations alone. From this, it was easy to recognize that the subsequent claimed inventions were in fact obvious. A PHOSITA, who along with her own knowledge of the scientific laws that governed *both* the prior art and the claimed invention, was constructively put in possession of the claimed invention by the disclosures of the prior art.

This same analysis, however, is inapplicable in the case of a nano-scaled version of a macro-scale prior art. The scientific laws that govern the two inventions, the macro-scale and the nano-scale, are fundamentally different. It cannot be assumed that a PHOSITA can combine her own knowledge with that disclosed by the prior art, and be said to be in possession of the claimed nano-scale version. Thus, if the combined scope and content of all the available prior art does not *enable* a PHOSITA to produce the nano-scaled version of an

existing device, it may not be legally concluded that the nano-scaled claimed invention is obvious, even if there is no difference other than size. Therefore, the miniaturization of existing, macro-scale, patented products to the nano-scale, standing alone, *will* satisfy the nonobviousness patentability requirement of 35 U.S.C. § 103 when the prior art references fail to provide an enabling method that puts the public in possession of the nano-scaled version. Relying on a per se rule that miniaturization down to the nano-scale, standing alone, is obvious, is inconsistent with the principles of our patent system.