

Smith v. Van Gorkom and the Kobayashi Maru: The Place of the Trans Union Case in the Development of Delaware Corporate Law

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SMALL CAN BE INVENTIVE:
THE PATENTABILITY OF NANOSCALE
REPRODUCTIONS OF MACROSCALE MACHINES

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ABSTRACT

Nanotechnology is a thriving new field of research. If even a fraction of the excitement surrounding the field proves to be true, there will be profound benefits in many aspects of our lives. Crucial to its development, however, will be the treatment of nanotechnology with respect to patents. This field has the unique potential to replicate existing machines and devices at a billionth of their size. In light of rulings that “mere scaling” of prior inventions does not create a patentable invention, problems with patentability might arise. This Note tackles this issue, considering the patentability requirements of novelty and non-obviousness, the normative foundations of patent law, and the legal considerations unique to nanotechnology. There is something fundamentally different about machines at this scale that justifies a categorical finding of novelty and non-obviousness over macroscale predecessors.

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INTRODUCTION

In 1959, theoretical physicist Richard P. Feynman delivered a presentation outlining a new field of research—one he believed would unlock a realm of new possibilities.¹ By manipulating and controlling matter on the atomic scale, we could achieve results never possible before, with an enormous range of technical applications.² Feynman recognized that the idea of miniaturization was nothing new, but he envisioned something much more profound than electric motors the size of your fingernail or the Lord's Prayer written on a grain of rice.³ He realized that we had hardly scratched the surface of the degree of miniaturization achievable: that there is “[p]lenty of [r]oom at the [b]ottom.”⁴ One day we might manipulate the very atoms that make up the objects around us, arranging them in any way we want.⁵ He predicted the wealth of new “properties that substances can have.”⁶ Feynman had introduced the world to the concept of nanotechnology.⁷

Indeed, Feynman was right. His now famous lecture marked the beginning of what would become a massive global research initiative.⁸ Today, more than sixty countries have launched national programs dedicated to nanotechnology research.⁹ And with the introduction of any new field technology, a host of new legal

¹ Richard P. Feynman, *There's Plenty of Room at the Bottom*, Annual Meeting of the American Physical Society (Dec. 29, 1959), 23 CALTECH ENGINEERING & SCI. 22 (Feb. 1960).

² *Id.*

³ *Id.*

⁴ *Id.* at 24.

⁵ *See id.* at 25.

⁶ *Id.* at 34.

⁷ While Feynman introduced the concept, use of the term “nano-technology” did not come until later. Professor Norio Taniguchi was the first to coin the phrase. *See* Norio Taniguchi, *On the Basic Concept of 'Nano-Technology,'* in PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON PRODUCTION ENGINEERING pt. II, at 18 (Tokyo 1974). The term was later introduced into the mainstream when used by Eric Drexler in 1986. K. ERIC DREXLER, *ENGINES OF CREATION: THE COMING ERA OF NANOTECHNOLOGY* 5 (1986).

⁸ *See* Haiyan Dong et al., *The Nanotechnology Race Between China and the United States*, 11 NANO TODAY 7, 8–9 (2016).

⁹ *Id.* at 8.

implications is bound to follow.¹⁰ With all the promise of nanotechnology, one important issue moving forward will be how advancements in the field are granted intellectual property protection.¹¹

Unique to nanotechnology is the issue whether existing patents for “macroscale” devices—those we are accustomed to seeing, holding in our hands, etc.—can be said to anticipate similar devices created at the nanoscale.¹² This is especially important when the original patent makes no reference at all to size.¹³ Is it enough that the only improvement over an existing invention is the ability to replicate it at the nanoscale?

Initially, one might expect it would be a major loophole if an inventor could simply scale down a previous invention to dodge an inventor’s patent protection.¹⁴ Surely a patent covers the same invention regardless of size.¹⁵ In fact, this is the stance that courts have taken when confronted with the issue broadly.¹⁶ But nanotechnology deals with miniaturization to the extreme, where researchers are manipulating individual atoms.¹⁷ The question is whether there is something fundamentally different about the nanoscale that should give patents a presumption of validity over their much larger predecessors.¹⁸

This Note attempts to answer this in the affirmative: the world behaves much differently “at the bottom,”¹⁹ and there are unique challenges that make even reproductions of macroscale inventions fundamentally different.²⁰ Part I explores recent

¹⁰ See, e.g., Nanotechnology and intellectual property issues, NANOWERK NEWS (Dec. 26, 2006), <http://www.nanowerk.com/news/newsid=1187.php> [<https://perma.cc/M4RA-YGYM>].

¹¹ *Id.*

¹² Vivek Koppikar et al., *Current Trends in Nanotech Patents: A View from Inside the Patent Office*, 1 NANOTECH. L. & BUS. 24, 28 (2004).

¹³ *Id.* at 28.

¹⁴ *Id.* at 28–29.

¹⁵ *Id.*

¹⁶ See *infra* text accompanying notes 138–59.

¹⁷ EDWARD L. WOLF, NANOPHYSICS AND NANOTECHNOLOGY: AN INTRODUCTION TO MODERN CONCEPTS IN NANOSCIENCE 1 (2d ed. 2006).

¹⁸ See *infra* Parts III, IV.

¹⁹ Feynman, *supra* note 1, at 24.

²⁰ Nanotechnology deals with working machines at the smallest possible scale. WOLF, *supra* note 17, at 1. The smallest object that can be perceived by the typical human eye is roughly 88,646 nanometers. *Visual Acuity of the*

developments in nanotechnology and the range of industries where the technology can be beneficial.²¹ Part II provides a brief summary of the relevant patent law and identifies the most pertinent considerations to this analysis: novelty and obviousness.²² Equipped with these elements, Part III takes on the issue of patenting nanotechnology and shows that nanoscale devices do not in fact interfere with patents of macroscale devices, even as the patent system exists today.²³ Finally, Part IV identifies policy reasons why this outcome is preferred in accordance with the normative object of patent law.²⁴

I. ADVANCEMENTS IN NANOTECHNOLOGY

In a sense, forms of nanotechnology have already existed in nature for perhaps billions of years.²⁵ Living cells, the building blocks of biology, have many components in the nanometer range and utilize the unique properties at this scale.²⁶ Understanding these components can inform our own engineering efforts in nanotechnology.²⁷ Take for example the eye of an insect, which, for many species, consists of an array of thousands of tiny lenses and photoreceptor cells.²⁸ Scientists have learned that this serves a number of important functions, including: reduced light reflection to aid vision; improved camouflage through reduced glare visible to predators; and even self-cleaning properties, like repelling pollen and other small particles that collect on the

Human Eye, NDT RESOURCE CTR., <https://www.nde-ed.org/EducationResources/CommunityCollege/PenetrantTest/Introduction/visualacuity.htm> [<https://perma.cc/QNR3-499M>]; *Convert Inches to Nanometers*, CALCULATE ME, <https://www.calculateme.com/Length/Inches/ToNanometers.htm> [<https://perma.cc/2XTU-2GQJ>].

²¹ See *infra* Part I.

²² See *infra* Part II.

²³ See *infra* Part III.

²⁴ See *infra* Part IV.

²⁵ The first eukaryotic cells developed roughly 2.7 billion years ago. GEOFFREY M. COOPER, *THE CELL: A MOLECULAR APPROACH* 10 (2d. ed. 2000).

²⁶ WOLF, *supra* note 17, at 2.

²⁷ *Id.*

²⁸ Henrik Peisker & Stanislav N. Gorb, *Always on the Bright Side of Life: Anti-Adhesive Properties of Insect Ommatidia Grating*, 213 J. EXPERIMENTAL BIOLOGY 3457, 3457 (2010).

eye.²⁹ Researchers are pursuing applications that will allow us to take advantage of properties at this scale, much in the way nature does.³⁰ Perhaps we can create our own “self-cleaning” surfaces by mimicking the patterns found on the surface of the wing of a butterfly.³¹

Unlike many other new frontiers in scientific discovery, there will not likely be a nanotechnology-specific market.³² There will not be a group of consumers standing in line to get their hands on the latest line of nanotech products.³³ The greatest promise is in the ability to improve products and industries that already exist.³⁴ Rather than creating a new discrete market for goods, it has the potential to expand and improve nearly all existing industries.³⁵ This is not to say, however, that nanotechnology will not be lucrative.³⁶ It is estimated that nanotechnology will soon top \$1 trillion, making it, at least initially, the fastest growing industry in history.³⁷ And applications with enormous potential continue to emerge.³⁸

A. Consumer Product Applications

In astonishing amounts, nanotechnology has already found its way into products we use every day.³⁹ As of March 2015, it was estimated that nanotechnology is used in over 1,800 consumer

²⁹ *Id.* at 3462.

³⁰ *See, e.g.*, Yoseph Bar-Cohen, *Nature as a Model for Mimicking and Inspiration of New Technologies*, 13 INT’L J. AERONAUTICAL & SPACE SCI. 1, 6, 9 (2012) (discussing possibilities for micro-robots in various applications).

³¹ *See* Wing Sze Tung & Walid A. Daoud, *Self-Cleaning Fibers Via Nanotechnology: A Virtual Reality*, 22 J. MATERIALS CHEMISTRY 7858, 7859 (2011).

³² Raj Bawa et al., *The Nanotechnology Patent ‘Gold Rush,’* 10 J. INTELL. PROP. RTS. 426, 427 (2005).

³³ *See id.*

³⁴ *See id.* at 426.

³⁵ *Id.* at 427.

³⁶ *Id.*

³⁷ *Id.*

³⁸ *See infra* Section I.A–E.

³⁹ Robert Paull et al., *Investing in Nanotechnology*, 21 NATURE BIOTECHNOLOGY 1144, 1144 (2003), https://www.researchgate.net/publication/9071803_Investing_in_nanotechnology [<http://perma.cc/Q57X-MVA3>].

products already on the market.⁴⁰ Titanium dioxide, found in sunscreen, is being reduced to nano-sized particles, which can provide the same sun protection without that unsightly white appearance.⁴¹ Sunglass lenses have been coated with nanoscale coatings that do not affect optical performance but provide increased resistance to scratching.⁴² Wilson, the popular tennis brand, has even developed a premium line of longer-lasting tennis balls by applying an internal clay nanoparticle coating.⁴³ While these consumer products are exciting, recent discoveries in other industries show potential for even more profound applications in the future.⁴⁴

B. Computing Applications

One very promising field for nanotechnology is computer science. Richard Feynman himself suggested this from the very beginning, in his 1959 speech.⁴⁵ Despite living in a time where computers filled entire rooms, Feynman asked why we cannot “make them very small, make them of little wires, little elements.”⁴⁶ Indeed, we have. Over the years, in a phenomenon described as Moore’s Law,⁴⁷ key elements of computer chips have become increasingly smaller, allowing the number of transistors in a computer chip to double roughly every two years.⁴⁸ This has led to

⁴⁰ See Marina E. Vance et. al., *Nanotechnology in the Real World: Redeveloping the Nanomaterial Consumer Products Inventory*, 6 BEILSTEIN J. NANOTECH. 1769, 1771 (2015), <http://www.beilstein-journals.org/bjnano/articles/6/181> [<http://perma.cc/YT3C-8D6R>].

⁴¹ A. P. Popov et. al, *TiO₂ Nanoparticles as an Effective UV-B Radiation Skin-Protective Compound in Sunscreens*, 38 J. PHYSICS D: APPLIED PHYSICS 2564, 2569 (2005).

⁴² DOUGLAS MULHALL, OUR MOLECULAR FUTURE 114 (2002).

⁴³ Wilson Double Core tennis balls contained Nanolok coating to prevent air from escaping. *Nanolok Technology*, INMAT, <http://www.inmat.com/tech-elastomer.shtml> [<https://perma.cc/7MXZ-5FBW>] (last visited Nov. 13, 2017).

⁴⁴ See *infra* Section I.B–E.

⁴⁵ Feynman, *supra* note 1, at 25.

⁴⁶ *Id.*

⁴⁷ The term is attributed to Gordon Moore, the co-founder of Intel, Inc. WOLF, *supra* note 17, at 7, Fig. 1.2.

⁴⁸ Moore postulated that the number of components in an integrated circuit would double roughly every two years. See Gordon E. Moore, *Cramming More Components onto Integrated Circuits*, 38 ELECTRONICS 114, 115 (1965), reprinted in IEEE SSCS NEWSLETTER 33, 34 (Sept. 2006).

increasingly smaller and faster processors as well, opening the door for modern devices such as the smartphone.⁴⁹

For Moore's prediction to continue to hold true, computers must eventually take advantage of computing at the nanoscale.⁵⁰ And the future looks promising.⁵¹ Rather than using transistor circuits, in which information is stored by "flipping" between one of two states (binary 1s or 0s), we could use a single atom or single photon to store the information.⁵² In this field, known as quantum computing, the biggest challenge lies in manipulating these individual atoms into a "flipped" state, in which they become extremely unstable.⁵³ In a significant recent advancement in the field, researchers in Australia created a quantum bit that remains stable for ten times longer than any before.⁵⁴ This could mark a major step towards the elusive quantum computer.⁵⁵

C. Medical Applications

Nanotechnology presents perhaps its most groundbreaking applications in the medical field.⁵⁶ Recent research suggests that the use of nanoparticles may lead to a major shift in the way we

⁴⁹ Samsung recently announced it will be the first in the industry to mass produce a new chip that uses a new 10-nanometer transistor technology. Press Release, *Samsung Starts Industry's First Mass Production of System-on-Chip with 10-Nanometer FinFET Technology*, SAMSUNG NEWSROOM (Oct. 17, 2016), <https://news.samsung.com/global/samsung-starts-industrys-first-mass-production-of-system-on-chip-with-10-nanometer-finfet-technology> [http://perma.cc/GKD4-MBKJ].

⁵⁰ See *supra* text accompanying notes 45–49.

⁵¹ See *infra* text accompanying notes 52–54.

⁵² Feynman even imagined *this* in his initial 1959 speech! Feynman, *supra* note 1, at 26 (“[N]othing ... says the computer elements cannot be made enormously smaller than they are now.”).

⁵³ *Quantum computers: 10-fold boost in stability achieved*, PHYSORG, <https://www.phys.org/news/2016-10-quantum-fold-boost-stability.html> [http://perma.cc/2DR5-WC5Q] [hereinafter *Quantum computers*] (“The greatest hurdle in using quantum objects for computing is to preserve their delicate superpositions long enough to allow us to perform useful calculations.”).

⁵⁴ Arne Laucht et al., *A Dressed Spin Qubit in Silicon*, 12 NATURE NANOTECH. 61, 66 (2017).

⁵⁵ Development of quantum computers has been referred to as the “space race of the 21st century.” *Quantum computers*, *supra* note 53.

⁵⁶ See Nicolas Bertrand et al., *Cancer Nanotechnology: The Impact of Passive and Active Targeting in the Era of Modern Cancer Biology*, 66 ADVANCED DRUG DELIVERY REV. 2, 3 (2014).

treat diseases.⁵⁷ In the near future, we may use nanoparticles to deliver drugs in a way that specifically targets individual cells, such as cancer cells, by selectively maintaining therapeutic levels where desired while reducing toxicity in other areas of the body.⁵⁸ To facilitate this approach, researchers have recently experimented with the creation of nanoparticles with unique shapes and sizes.⁵⁹ Scientists are beginning to learn how different nanoparticle shapes affect navigation through biological systems, which can help in targeting difficult-to-reach cancer cells.⁶⁰

Other research shows that iron nanoparticles, when attached to tumor cells, prompt immune cells already present in the body to attack the tumor cells.⁶¹ This effect, when used in conjunction with surgery, could greatly increase the effectiveness of surgical tumor removal, targeting any residual cells missed during the procedure.⁶² Other promising research suggests that nanotechnology may even be able to spur new growth of nerve cells, such as in damaged spinal cords or brain cells.⁶³ Eventually, doctors may even utilize small chip-based “nanolabs,” placed into the bloodstream, capable of monitoring and tracking individual cells.⁶⁴

D. Energy Applications

Recent advancements may indicate profound applications in energy production and storage as well.⁶⁵ Modern silicon solar

⁵⁷ *Id.* at 19.

⁵⁸ *Id.* at 3.

⁵⁹ Randall Toy et al., *Shaping Cancer Nanomedicine: The Effect of Particle Shape on the In Vivo Journey of Nanoparticles*, 9 *NANOMED.* 121, 127 (2014).

⁶⁰ *Id.* at 121.

⁶¹ Saeid Zanganeh et al., *Iron Oxide Nanoparticles Inhibit Tumour Growth by Inducing Pro-Inflammatory Macrophage Polarization in Tumour Tissues*, 11 *NATURE NANOTECH.* 986, 986 (2016).

⁶² *Id.*

⁶³ Lijie Zhang et al., *Nanotechnology and Nanomaterials: Promises for Improved Tissue Regeneration*, 4 *NANO TODAY* 66, 75–76 (2009).

⁶⁴ Holger Bartos et al., *Microfluidics Meets Nano: Lab-on-a-Chip Devices and Their Potential for Nanobiotechnology*, in *NANOBIO TECHNOLOGY: CONCEPTS, APPLICATIONS AND PERSPECTIVES* 13, 26–27 (Christof M. Niemeyer & Chad A. Mirkin eds. 2005).

⁶⁵ See *infra* text accompanying notes 66–71.

cells can achieve a maximum theoretical efficiency of 33.16 percent,⁶⁶ which presents a significant barrier in the efficacy of solar energy.⁶⁷

Nanotechnology research in solar energy production shows promise to significantly increase solar cell efficiency.⁶⁸ In 2008, a study at Stanford University showed a potential solar radiation absorption rate of approximately 93 percent utilizing silicon “nanowires” and “nanocoones,” nearly twice that of traditional thin-film solar cells.⁶⁹ More recently, silicon nanowire arrays have been produced up to 96 percent absorption.⁷⁰ With such improved efficiencies, nanotechnology could potentially make solar power a prominent source of energy.⁷¹

Promising applications for energy storage are emerging as well.⁷² A proliferation of consumer devices, medical devices, and even electric vehicles now rely on rechargeable lithium-ion batteries as a power source.⁷³ Silicon has shown to be an attractive anode material for these devices but suffers problems with pulverization and capacity fading, leading to reduced battery life under repeated charging.⁷⁴ New research suggests that using nanowire-based silicon electrodes may eliminate pulverization with little fading during cyclic loading, providing increased battery performance.⁷⁵

E. Agricultural Applications

Nanotechnology may also provide helpful advantages in the agriculture industry.⁷⁶ Much like the targeted cancer drug

⁶⁶ Sven Rühle, *Tabulated Values of the Shockley-Queisser Limit for Single Junction Solar Cells*, 130 SOLAR ENERGY 139, 140 (2016).

⁶⁷ *See id.*

⁶⁸ Jia Zhu et al., *Optical Absorption Enhancement in Amorphous Silicon Nanowire and Nanocone Arrays*, 9 NANO LETTERS 279, 281–82 (2009).

⁶⁹ *Id.* at 281.

⁷⁰ Michael D. Kelzenberg et al., *Enhanced Absorption and Carrier Collection in Si Wire Arrays for Photovoltaic Applications*, 9 NATURE MATERIALS 239, 240 (2010).

⁷¹ *Id.* at 239.

⁷² Candace K. Chan et al., *High-Performance Lithium Battery Anodes Using Silicon Nanowires*, 3 NATURE NANOTECH. 31, 31 (2008).

⁷³ *Id.*

⁷⁴ *Id.*

⁷⁵ *Id.*

⁷⁶ Prem Lal Kashyap et al., *Chitosan Nanoparticle Based Delivery Systems for Sustainable Agriculture*, 77 INT’L J. BIOLOGICAL MACROMOLECULES 36, 37 (2015).

delivery discussed above, nanoparticles could provide targeted delivery of fertilizers or pest control products.⁷⁷ This would reduce the amount of sprayed chemicals, not only improving cost efficiency, but providing environmental benefits as well.⁷⁸ Silica nanoparticles may be used to transport DNA and chemicals through plant cellular walls, which may lead to advances in plant breeding and genetic engineering.⁷⁹ Even the way we store and package food could see great benefits from nanotechnology.⁸⁰

F. Legal Implications

With such abundant research continually ongoing, the future applications of nanotechnology are promising to say the least.⁸¹ Nanotechnology may very well represent a new frontier of possibility across many industries.⁸² As the science community plugs along in its research and makes continued breakthroughs, the legal community will have to keep up.⁸³

As nanotechnologies are introduced into agriculture and food production, it may create challenges for the Food and Drug Administration.⁸⁴ Nanoparticles may also have an unforeseen impact on the environment, which the Environmental Protection

⁷⁷ *Id.* at 48.

⁷⁸ One foreseeable benefit would be bringing back the honey bee. Researchers have found alarming declines in bee populations worldwide. *See, e.g.,* Jay D. Evans & Ryan S. Schwarz, *Bees Brought to Their Knees: Microbes Affecting Honey Bee Health*, 19 *TRENDS MICROBIOLOGY* 614, 614 (2011). Fertilizers and pesticides likely contribute to this problem. *See* Cleiton G. Rodrigues et al., *Leaf Fertilizers Affect Survival and Behavior of the Neotropical Stingless Bee Friesella Schrottkyi*, 109 *J. ECON. ENTOMOLOGY* 1001, 1005–07 (2016). By targeting plants more precisely, perhaps nanotechnology will reduce the impact on nontarget organisms such as bees.

⁷⁹ Francois Torney et al., *Mesoporous Silica Nanoparticles Deliver DNA and Chemicals into Plants*, 2 *NATURE NANOTECH.* 295, 295 (2007).

⁸⁰ Anu Keshwani et al., *Advancements of Nanotechnology in Food Packaging*, 4 *WORLD J. PHARMACY & PHARMACEUTICAL SCIS.* 1054, 1056 (2015).

⁸¹ *See, e.g.,* Linda MacDonald Glenn & Jeanann S. Boyce, *Nanotechnology: Considering the Complex Ethical, Legal, and Societal Issues with the Parameters of Human Performance*, 2 *NANOETHICS* 265, 268 (2008).

⁸² *Id.*

⁸³ For an overview of issues surrounding nanotechnology, *see id.* at 265.

⁸⁴ *See* PATRICK M. BOUCHER, *NANOTECHNOLOGY: LEGAL ASPECTS* 100–01 (2008).

Agency will likely look to regulate.⁸⁵ Though not quite nano-sized, the microbeads found in cosmetic products provide a recent example of unforeseen environmental impacts of particles on rivers, lakes, and oceans that prompted regulation.⁸⁶

Concerns may arise in the regulation of nanotechnologies as imports and exports as well.⁸⁷ And, as more products are placed in the market, cases of products liability with nanotechnology will almost certainly be brought.⁸⁸ Perhaps nanoscience will even open up new avenues for criminal activity as well—something not too far-fetched given the anthrax attacks of 2001.⁸⁹

More central to the focus of this Note, however, courts will have to determine how intellectual property law will treat developments and inventions in nanotechnology.⁹⁰ Specifically, courts must determine how the well-established patent system will apply to this unique field of technology.⁹¹ The examples considered so far set the stage for this analysis.⁹²

II. REQUIREMENTS FOR PATENTABILITY

To understand the issues surrounding potential interference with larger-scale patents, a brief overview of the requirements for patentability is helpful.⁹³ This Part reviews these requirements, with a particular focus on their application to nanotechnology.⁹⁴

⁸⁵ *Id.* at 110–11.

⁸⁶ Congress enacted The Microbead-Free Waters Act of 2015 to prohibit sale or distribution of rinse-off cosmetics containing plastic microbeads. See Microbead-Free Waters Act of 2015, Pub. L. No. 114-114, 129 Stat. 3129–30 (to be codified at 21 U.S.C. §§ 301, 331).

⁸⁷ BOUCHER, *supra* note 84, at 129.

⁸⁸ For an extreme example of potential liability, see MICHAEL CRICHTON, PREY 83 (2002) (depicting the inadvertent creation of a rapidly reproducing “nanoswarm” exhibiting predatory behavior).

⁸⁹ BOUCHER, *supra* note 84, at 217.

⁹⁰ *Nanotechnology and intellectual property issues*, NANOWERK, <https://www.nanowerk.com/news/newsid=1187.php> [<https://perma.cc/2AA5-PESP>].

⁹¹ Behfar Bastani & Dennis Fernandez, *Intellectual Property Rights in Nanotechnology*, IPLOFT, <http://www.iploft.com/Nanotechnology.pdf> [<https://perma.cc/P9TV-P5UF>].

⁹² See *supra* Part I.

⁹³ See *infra* Section II.A–E.

⁹⁴ *Id.*

A. General Requirements

The patent law system essentially operates as a *quid pro quo* between an inventor and the general public.⁹⁵ In exchange for a form of limited monopoly over the use, sale, and production of an invention, the inventor fully discloses the invention, and how it is made, to the public.⁹⁶ This enriches society with the knowledge of the invention and, once the patent expires, the ability to make and use the invention freely.⁹⁷ In the meantime, the patent might inspire other inventors to “invent around” the patent, potentially leading to new discoveries that would not otherwise have been made.⁹⁸ The patent law system incentivizes inventors to bring ideas into the public realm, rather than tuck them away in secrecy.⁹⁹

To protect the public’s interest in this *quid pro quo*, the inventor must meet certain requirements dictated by the patent system.¹⁰⁰ There are a number of disclosure requirements to ensure the patent properly provides the public with the benefit of their bargain.¹⁰¹ In filing a patent, an inventor must include a “written description of the invention, and the manner and process of making and using it.”¹⁰² The patent must describe the invention clearly enough that someone skilled in the art would be able to make and use the invention with minimal experimentation.¹⁰³ It must also clearly define the limits of what is being claimed so that others are aware of the boundaries of the legal right.¹⁰⁴

⁹⁵ *Ariad Pharm., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1345 (Fed. Cir. 2010) (“[O]ne describes an invention, and, if the law’s other requirements are met, one obtains a patent.”).

⁹⁶ *Bastani & Fernandez*, *supra* note 91.

⁹⁷ *See id.*

⁹⁸ *Slimfold Mfg. Co. v. Kinkead Indus.*, 932 F.2d 1453, 1457 (Fed. Cir. 1991) (“Designing around patents is, in fact, one of the ways in which the patent system works to the advantage of the public in promoting progress in the useful arts”).

⁹⁹ *See Bastani & Fernandez*, *supra* note 91.

¹⁰⁰ *Ariad Pharm.*, 598 F.3d at 1345.

¹⁰¹ 35 U.S.C. § 112 (2012).

¹⁰² *Id.*

¹⁰³ *In re ‘318 Patent Infringement Litig.*, 583 F.3d 1317, 1323 (Fed. Cir. 2009).

¹⁰⁴ ROBERT PATRICK MERGES & JOHN FITZGERALD DUFFY, *PATENT LAW AND POLICY: CASES AND MATERIALS* 263 (LexisNexis, 6th ed. 2013).

Additionally, only certain types of inventions are eligible for protection.¹⁰⁵ The patent must fall into one of four eligible patent categories: process, machine, manufacture, or composition of matter.¹⁰⁶ Abstract ideas, such as mathematical equations or naturally occurring phenomena, are not patentable.¹⁰⁷ This subject matter requirement is traditionally treated as a distinct issue in patent law, separate from the other major requirements of utility, novelty, and non-obviousness.¹⁰⁸

B. Utility

An invention must satisfy a utility requirement for patentability.¹⁰⁹ This is based on statutory language requiring that an invention be “new and *useful*”¹¹⁰ and that the application disclose the “manner and process of making and *using* the invention.”¹¹¹ Since the utility requirement arises from two single words in the statute, the bulk of the inquiry has developed through case law.¹¹²

This utility requirement is generally not a difficult standard to meet as a browse through the patent database might reveal.¹¹³ The vast majority of patents are granted with minimal inquiry into utility.¹¹⁴ Many of the nanotechnology applications identified in Part I would almost certainly pass this low bar: a

¹⁰⁵ See 35 U.S.C. § 101 (2012).

¹⁰⁶ *Id.* A nanotechnology patent could conceivably be filed under any of these four categories. An inventor could patent a process for creating a nanotechnology component (such as nanotubes or buckyballs) or a process for achieving a specific result such as those listed in Part I. See *supra* Part I. A nanoscale machine or device could be invented, such as the chip-based “nanolab” with medical applications. See *supra* text accompanying note 64. Patents in manufacture might arise when a basic building block, such as nanotubes, are reformed to produce a desirable product. A composition of matter patent might involve the manipulation of individual atoms to create materials in a way that was previously unachievable.

¹⁰⁷ *Mayo Collaborative Servs. v. Prometheus Labs., Inc.*, 566 U.S. 66, 66 (2012).

¹⁰⁸ MERGES & DUFFY, *supra* note 104, at 69.

¹⁰⁹ See § 101.

¹¹⁰ *Id.* (emphasis added).

¹¹¹ *Id.* § 112 (emphasis added).

¹¹² MERGES & DUFFY, *supra* note 104, at 209.

¹¹³ See, e.g., U.S. Patent No. 6,368,227 (filed Nov. 17, 2000) (describing a “method of swing[ing] on a swing ... in which a user ... induces side to side motion by pulling alternately on one chain and then the other.”).

¹¹⁴ MERGES & DUFFY, *supra* note 104, at 209.

nanotechnology device that delivers drugs to selectively target cancer cells is at least as useful as a “beerbrella”¹¹⁵ that keeps your favorite brewed beverage protected from the sun.¹¹⁶

One issue, however, known as practical or specific utility, may present problems for certain nanotechnology patents in the way it prevented a number of biotechnology patents.¹¹⁷ This requires that the invention be refined and developed to the point that the inventor can identify a specific benefit.¹¹⁸ Inventors must take care not to file for a patent too early in development, or they may fail this requirement.

C. Novelty

More important to the issue here, however, are the requirements of novelty and non-obviousness. In order for a patent to be granted, the invention must not already be publicly available.¹¹⁹ That is to say, that the invention must be new or novel.¹²⁰ This is one of the most basic requirements of a patent system: to receive the benefit of a patent, the inventor must disclose to the public an invention not already within the public sphere.¹²¹

Novelty is determined through a search of what is referred to as “prior art,” including previously granted patents as well as other sufficient public uses or publications.¹²² The idea of novelty is interpreted to mean something distinct from inventiveness¹²³—a

¹¹⁵ See generally U.S. Patent No. 6,637,447 (filed Oct. 19, 2001).

¹¹⁶ This of course depends on how the application is drafted. Utility is analyzed based on the claims and description and whether they identify and enable a use. See § 112.

¹¹⁷ Many early biotechnology patents were invalidated for failing to establish a specific utility. See, e.g., *In re Fisher*, 421 F.3d 1365, 1379 (Fed. Cir. 2005) (invalidating patent for purified nucleic acid sequences); *Brenner v. Manson*, 383 U.S. 519, 540 (1966) (Harlan, J., concurring) (invalidating patent for creating steroid).

¹¹⁸ See *Brenner*, 383 U.S. at 534–35 (“Until the process claim has been reduced to production of a product shown to be useful, the metes and bounds of that monopoly are not capable of precise delineation.”).

¹¹⁹ 35 U.S.C. § 102(a)(1) (2012).

¹²⁰ *Id.*

¹²¹ See MERGES & DUFFY, *supra* note 104, at 337.

¹²² See § 102(a)(1).

¹²³ See *Allied Wheel Prods., Inc. v. Rude*, 206 F.2d 752, 760 (6th Cir. 1953); 69 C.J.S. *Patents* § 34 (2017).

patent will not fail to meet the novelty requirement just because it was discovered purely by accident.¹²⁴

D. Non-Obviousness

In a sense, the doctrine of non-obviousness picks up where novelty leaves off.¹²⁵ While an invention might be novel in that it is not explicitly described in prior art, the non-obvious requirement asks whether the idea is sufficiently inventive.¹²⁶ An inventor would receive an unfair benefit in a patent that is just an obvious application of a known technology.¹²⁷ This requirement can be thought of as the “nontriviality” requirement of patent law, and it is the most stringent of the basic patent law requirements.¹²⁸

As with novelty, the starting point for this inquiry is an examination of the prior art.¹²⁹ The court analyzes obviousness with regard to a “person having ordinary skill in the art” related to the subject matter.¹³⁰ The test is to determine whether such a person would have found the technology to be obvious based on a combination of prior art references.¹³¹

This concept originally arose in *Hotchkiss v. Greenwood* in 1851.¹³² The patent at issue was for a new and useful improvement over existing doorknobs by instead using clay and porcelain.¹³³ The Supreme Court affirmed the decision of the lower court in invalidating the patent because nothing inventive was brought to the table.¹³⁴ There was nothing new about the knob; it was simply made from a different material than had previously been used.¹³⁵ After *Hotchkiss*, the 1952 Patent Act codified this requirement stating that “[a] patent may not be obtained ... [if the

¹²⁴ 69 C.J.S., *supra* note 123, at § 34.

¹²⁵ *See* MERGES & DUFFY, *supra* note 104, at 606.

¹²⁶ *See id.*

¹²⁷ *See id.*

¹²⁸ *See id.*

¹²⁹ *See id.*

¹³⁰ 35 U.S.C. § 103 (2012). This is often abbreviated as “PHOSITA.”

¹³¹ *Id.*

¹³² *See* 52 U.S. 248, 252 (1851).

¹³³ *Id.* at 249–50.

¹³⁴ *See id.* at 272.

¹³⁵ *Id.* at 271.

differences over prior art] would have been obvious at the time the invention was made to a person having ordinary skill in the art.”¹³⁶ The Supreme Court later expanded upon this definition of non-obviousness in *Graham v. John Deere Co.*, providing further framework for the analysis.¹³⁷

The issue addressed in this Note lies firmly within the bounds of novelty and non-obviousness: when an inventor creates something described in prior art—just at a scale not contemplated by the original invention—is it in fact new? And, if so, is it sufficiently inventive?

E. Issues of Scale

Though novelty and non-obviousness are separate and distinct requirements, courts have addressed the two together with regard to issues of scale.¹³⁸ Specifically, courts have examined whether mere changes in size meet the requirements for novelty or non-obviousness.¹³⁹ Because nanotechnology essentially just describes scientific advancements made at an extreme scale, it is worth reviewing the courts’ decisions on this matter separately. And the case law is not very supportive at first glance. The United States Patent and Trademark Office (USPTO)¹⁴⁰ points to three cases in particular that highlight this notion.¹⁴¹

The first case, *In re Rose*, dealt with a patent application for a “Package of, Apparatus for Packaging and Method of Handling and Storing Lumber.”¹⁴² The claims at issue describe how individually banded bundles of lumber are stacked in a specific way to form a “lumber package.”¹⁴³ In response to a challenge of

¹³⁶ 35 U.S.C. § 103 (1952).

¹³⁷ See 383 U.S. 1, 17 (1966).

¹³⁸ See *infra* text accompanying notes 140–59.

¹³⁹ *Id.*

¹⁴⁰ U.S. PATENT AND TRADEMARK OFFICE, MPEP § 2144.04(IV)(A) (9th ed. 2015), <http://www.uspto.gov/web/offices/pac/mpep/mpep.htm> [<https://perma.cc/LCE3-482H>].

¹⁴¹ *Id.*

¹⁴² 220 F.2d 459, 459 (C.C.P.A. 1955).

¹⁴³ The Board of Appeals of the Patent Court found “[t]he number of strips in a bundle, the number of bundles in a layer, the number of layers of bundles and the relative dimensions of the strips, the bundles and the package

his patent, the applicant argued that his lumber package was significantly larger and had to be lifted by truck whereas the prior lumber packages could be lifted by hand.¹⁴⁴ The United States Court of Customs and Patent Appeals found that this size limitation was not “patentably significant since it at most relates to the size of the article under consideration which is not ordinarily a matter of invention.”¹⁴⁵ Effectively, the only difference was that the patent described heavier, larger bundles of lumber.¹⁴⁶

Similarly, in *Gardner v. TEC Systems*, the United States Court of Appeals for the Federal Circuit addressed the issue of whether size limitations were a non-obvious improvement for the purposes of patentability.¹⁴⁷ Thomas Gardner was awarded a patent for a device used in drying ink on high-gloss paper for printing periodicals.¹⁴⁸ Gardner brought an unsuccessful infringement claim against TEC Systems, which he then appealed.¹⁴⁹ The court affirmed the dismissal, holding that his patent was invalid for obviousness.¹⁵⁰ In comparison to prior art, the only distinction in Gardner’s claims were dimension restrictions, calling for certain spacing between the device and the paper relative to other dimensions of the machine.¹⁵¹ The court held that mere recitation of dimensions does not distinguish it in any meaningful way over the prior art.¹⁵²

Finally, in *In re Rinehart*,¹⁵³ the United States Court of Customs and Patent Appeals addressed the issue of scaling in regards to obviousness.¹⁵⁴ The patent application in question described a method for producing polymeric ethylene terephthalate (PET) resin by heating acid in the presence of glycol under high

are all deemed matters of choice involving differences in degree and/or size and are not patentable distinctions.” *Id.* at 463.

¹⁴⁴ *Id.*

¹⁴⁵ *Id.* (citing *In re Yount*, 171 F.2d 317, 318 (C.C.P.A. 1948)).

¹⁴⁶ *See id.*

¹⁴⁷ *Gardner v. TEC Sys., Inc.*, 725 F.2d 1338, 1344 (Fed. Cir. 1984), *cert. denied*, 469 U.S. 830 (1984).

¹⁴⁸ *Id.* at 1340.

¹⁴⁹ *Id.* at 1339.

¹⁵⁰ *Id.* at 1350.

¹⁵¹ *See id.* at 1345–46.

¹⁵² *Id.* at 1346.

¹⁵³ 531 F.2d 1048, 1051 (C.C.P.A. 1976).

¹⁵⁴ *See id.*

pressures at a specific glycol-to-acid ratio.¹⁵⁵ The only substantive difference between the applicant's claims and the prior art was the recitation that the process was for "commercial scale production" using "commercial scale quantities."¹⁵⁶ The court found that one skilled in the art could easily determine the proper ratio and successfully solve the problem of scaling up the prior art process to a commercial scale.¹⁵⁷ The language used by the court, that "mere scaling up of a prior art process capable of being scaled up ... would not establish patentability in a claim to an old process so scaled,"¹⁵⁸ is particularly troubling for nanotechnology devices. The question remains whether these devices are a "mere scaling" down of larger, very similar devices or whether they are in fact new and inventive.¹⁵⁹

III. PATENTS FOR NANOTECHNOLOGY DEVICES

As a threshold matter, there is no question that nanotechnology devices, categorically, are patentable.¹⁶⁰ There is nothing inherent about devices at this scale that precludes them from meeting the patentability requirements described above.¹⁶¹ In fact, thousands of nanotechnology patents have already been granted,¹⁶² and patent filings continue to increase at an almost alarming rate.¹⁶³ And other nanotechnology patents can and

¹⁵⁵ *Id.* at 1049.

¹⁵⁶ *Id.*

¹⁵⁷ *See id.* at 1054.

¹⁵⁸ *Id.* at 1053.

¹⁵⁹ *Id.*

¹⁶⁰ *See Nanotechnology Cross-Reference Art Collection*, U.S. PATENT AND TRADEMARK OFFICE (2012), https://www.uspto.gov/patents/resources/classification/class_977_nanotechnology_cross-ref_art_collection.jsp [<https://perma.cc/ZWJ5-CZVZ>].

¹⁶¹ *See supra* Part II.

¹⁶² *See* U.S. PATENT AND TRADEMARK OFFICE, PATENT FULL-TEXT AND IMAGE DATABASE, <http://patft.uspto.gov> [<https://perma.cc/TEF3-TDPK>] (searching for term "nano" under "Quick Search" in patent claims returns over 87,000 results).

¹⁶³ Commentators have expressed concern with the rate of patent filings in nanotechnology. *See, e.g.,* Raj Bawa, *Nanotechnology Patent Proliferation and the Crisis at the U.S. Patent Office*, 17 ALB. L.J. SCI. & TECH. 699, 717 (2007). [hereinafter Bawa, *Patent Proliferation*].

should prevent patents filed at that scale, subject to the patentability considerations already defined.¹⁶⁴

The more difficult question arises when prior art for a much larger device challenges a nanotechnology patent.¹⁶⁵ While this is a unique and potentially rare situation, it could have a profound effect on patents at the nanoscale level.¹⁶⁶ Take for example the invention of a “nanodrill.”¹⁶⁷ Perhaps one day researchers will develop a device, similar to the drill you would find in your DIY tool kit, with a rotating shaft capable of grinding away small holes just a few nanometers wide.¹⁶⁸ This would not be much of a stretch based on the progress of current developments.¹⁶⁹

It is easy to imagine potential uses for such a device too. In drug delivery applications, this could be used to target the interior of cells or penetrate certain barriers such as the blood-brain barrier.¹⁷⁰ In fact, a similar concept can already be found in nature. Scientists discovered that certain bacteria use a nano-sized “drill” to cut away holes in the exterior of our cellular walls to attack our cells.¹⁷¹ A man-made version of this could have exciting implications for medical treatment.¹⁷²

This illustration, though admittedly simplistic, shows how a claim might be brought from patent holders of larger-scale drills.¹⁷³ There likely is not any single owner of a patent on a drill as a whole and, if someone ever did, it would be long expired

¹⁶⁴ *Supra* text accompanying notes 100–08.

¹⁶⁵ See R. Scott Roe, *Nanotechnology: When Making Something Smaller is Nonobvious*, 12 B.U.J. SCI. & TECH. L. 127, 131–32 (2006).

¹⁶⁶ See *id.* at 129–30.

¹⁶⁷ For a similar product, see, e.g., HONEYBEE ROBOTICS: NANO DRILL, <https://www.honeybeerobotics.com/portfolio/nano-drill/> [<https://perma.cc/KYS3-XZR8>].

¹⁶⁸ See, e.g., *id.*

¹⁶⁹ Researchers have already created nanoscale motors powered by light. See Nagatoshi Koumura et al., *Light-Driven Monodirectional Molecular Rotor*, 401 NATURE 152, 152 (1999); Ming Liu et al., *Light-Driven Nanoscale Plasmonic Motors*, 5 NATURE NANOTECH. 570, 570 (2010).

¹⁷⁰ See *supra* text accompanying notes 56–64.

¹⁷¹ See Henri-Francois Renard et al., *Endophilin-A2 Functions in Membrane Scission in Clathrin-Independent Endocytosis*, 517 NATURE 493, 496 (2014).

¹⁷² See Michael E. Gertner, *Nanotechnology and its Impact on Clinical Medicine*, 1 NANOTECH. L. & BUS. 147, 147 (2004).

¹⁷³ See Vivek Koppikar et al., *Current Trends in Nanotech Patents: A View from Inside the Patent Office*, 1 NANOTECH. L. & BUS. 24, 28 (2004).

by now.¹⁷⁴ Any patents relating to drills today are likely based on small features and improvements.¹⁷⁵ For the purposes of this Note, assume a patent exists for a powered drill that covers all of the basic ways in which it functions.¹⁷⁶ Based on the courts' rulings on issues of scale,¹⁷⁷ the outcome of an infringement suit will likely depend on the extent to which the device is merely a scaled-down version of the existing patent.¹⁷⁸

A. Patents for Nanoscale Devices Are Inherently Novel

As noted previously, a claim must be novel in relation to applicable prior art.¹⁷⁹ The prior art we are concerned with might describe generally the same functions as a new “nanodevice,” just with no mention of scale.¹⁸⁰ The only real difference may be that the new device is composed of individual atoms or the method of construction might be through self-assembly of molecules.¹⁸¹ Although the original patent may describe the same device in broad terms, it should not preclude the new application on the nanoscale.¹⁸²

To fully appreciate the novelty of the nanodevice, it is important to consider just how small we are talking.¹⁸³ What does our world look like “at the bottom?”¹⁸⁴ Nanotechnology consists of the study and manipulation of materials ranging from 1 to 100

¹⁷⁴ Patents last for twenty years. 35 U.S.C. § 154(a)(2) (2012).

¹⁷⁵ See, e.g., U.S. Patent No. 9,573,264 (filed December 17, 2010) (claiming handheld power tool with a “gear unit” and “switch device for switching the gear unit”).

¹⁷⁶ Cf. Koppikar et al., *supra* note 173, at 28 (discussing how the growing number of patents has severely limited the advancements in a field and how those in commercial development must always be aware of the patents in their field).

¹⁷⁷ See cases cited *supra* notes 132–59.

¹⁷⁸ Roe, *supra* note 165, at 133.

¹⁷⁹ See *supra* note 95 and accompanying text.

¹⁸⁰ See Robert A. Freitas, *What is Nanomedicine*, 1 NANOMED. 2, 2 (2004) (discussing the characteristics and capabilities of nanotechnology other than size).

¹⁸¹ See, e.g., *id.* at 7 (referencing the materials of construction being made up of atoms).

¹⁸² See Roe, *supra* note 165, at 133–34.

¹⁸³ See Gregory Mandel, *Nanotechnology Governance*, 59 ALA. L. REV. 1323, 1328 (2008) (discussing the possibilities technology can bring when operating at the nanoscale).

¹⁸⁴ Feynman, *supra* note 1, at 22.

nanometers.¹⁸⁵ The prefix “nano” means one billionth, and thus, one nanometer is just one-billionth of a meter.¹⁸⁶

Even with that description, it is difficult to conceptualize this scale.¹⁸⁷ Some more illustrative comparisons might help. A sheet of newspaper is about 100,000 nanometers thick.¹⁸⁸ The human hair is typically about 80,000 nanometers in diameter.¹⁸⁹ Yet carbon nanotubes, small cylindrical tubes of carbon used in numerous nanotechnology applications, are a mere 1 nanometer in diameter.¹⁹⁰ Until recently, microscopes capable of resolving images at this scale did not exist.¹⁹¹ Devices at this scale approach the fundamental limitations of size.¹⁹²

Even physics behave differently at this scale.¹⁹³ Of course, there is only one set of laws of physics that apply universally, but the classical physical laws we are accustomed to are minimized at this scale.¹⁹⁴ Engineering constraints based on viscosity, friction, gravitational load, and wind resistance do not apply to the degree that it would make any meaningful difference.¹⁹⁵ In their place, are intermolecular forces such as Van der Waals attraction, capillary action, and ionic repulsion that are negligible at a larger scale.¹⁹⁶ In fact, these unique properties are what makes nanotechnology so promising.¹⁹⁷ Scientists and engineers can take advantage of new forces and behaviors in ways that

¹⁸⁵ *What is Nanotechnology?*, U.S. NAT'L NANOTECHNOLOGY INITIATIVE, <http://www.nano.gov/nanotech-101/what/definition> [<https://perma.cc/GTX2-APXC>].

¹⁸⁶ *Id.*

¹⁸⁷ *Size of the Nanoscale*, U.S. NATIONAL NANOTECHNOLOGY INITIATIVE, <https://www.nano.gov/nanotech-101/what/nano-size> [<https://perma.cc/JU9E-US28>].

¹⁸⁸ *What is Nanotechnology?*, *supra* note 185.

¹⁸⁹ *Size of the Nanoscale*, *supra* note 187.

¹⁹⁰ *Id.*

¹⁹¹ Inventors Gerd Binnig and Heinrich Rohrer were awarded the Nobel Prize in Physics in 1986 for the invention of the scanning tunneling microscope, capable of resolving images on the scale of 0.1 nanometers. C. BAI, *SCANNING TUNNELING MICROSCOPY AND ITS APPLICATIONS* 1 (2d. ed. 1992).

¹⁹² Anything we create must be composed of atoms and a mere 10 atoms side-by-side would measure about 1 nanometer. WOLF, *supra* note 17, at 1.

¹⁹³ WOLF, *supra* note 17, at 2.

¹⁹⁴ *Id.*

¹⁹⁵ *Id.* at 26.

¹⁹⁶ Hendrik Hölscher et al., *Nanoscale Imaging and Force Analysis with Atomic Force Microscopy*, in 6 *NANOTECH.* 43, 55–56 (Harald Fuchs ed., 2009).

¹⁹⁷ See WOLF, *supra* note 17, at 2.

have previously been unavailable.¹⁹⁸ This becomes important in the consideration of novelty.

In the pre-nanotechnology era, the laws of physics were not a factor in determining novelty.¹⁹⁹ Patent examiners could at the very least assume that basic concepts such as friction and gravity were uniform between two inventions.²⁰⁰ When comparing a nanotechnology patent with a patent for a much larger-scale invention, these assumptions are no longer valid.²⁰¹ And this should make a difference when considering novelty.²⁰² The two inventions are inherently different because they are premised on a different set of physical properties.²⁰³

Our nanodrill might look and act similar to the ones we are accustomed to, or even achieve the same result, but it will utilize different forces to do so.²⁰⁴ Rather than electromagnetism, the motor may use light photons to create torque.²⁰⁵ The “bearings” might spin completely frictionless,²⁰⁶ something of which engineers at Black & Decker only dream.²⁰⁷ In essence, even if the claims are written with identical language with the only apparent difference being a recitation of dimensions, they cannot simply describe the same device.²⁰⁸ So when a patent for a device at this scale comes across an examiner’s desk, there should be, at the very least, a strong presumption that the claims are novel in comparison to all non-nanotechnology devices in the prior art.²⁰⁹

¹⁹⁸ See, e.g., WOLF, *supra* note 17, at 24.

¹⁹⁹ See *supra* text accompanying notes 195–96.

²⁰⁰ *Id.* Initially, very few patent examiners were even familiar with nanotechnology. Bawa, *Patent Proliferation*, *supra* note 163, at 725.

²⁰¹ See, e.g., WOLF, *supra* note 17, at 24.

²⁰² MERGES & DUFFY, *supra* note 104, at 337.

²⁰³ See *infra* text accompanying notes 204–09.

²⁰⁴ See *infra* text accompanying notes 215–17.

²⁰⁵ Nanoscale technologies can take advantage of some of these fundamental differences as with the motor that is propelled by light photons. See *supra* note 169.

²⁰⁶ WOLF, *supra* note 17, at 25.

²⁰⁷ Black & Decker does not sell nanodrills as of August 2017. See *Drills*, BLACK & DECKER, <http://www.blackanddecker.com/en-us/products/power-tools/portable-power-tools/drills/params/1/24/newest/-/-/-/-/-/> [https://perma.cc/JY3Y-FZTW].

²⁰⁸ See *supra* text accompanying notes 204–07.

²⁰⁹ See *supra* Section III.B.

B. Patents for Nanoscale Devices Are Non-Obvious

Perhaps more concerning may be the treatment of nanotechnology patents with regard to obviousness.²¹⁰ This requirement, called “inventive step” in some patent law systems,²¹¹ requires that the device be sufficiently inventive over combinations of prior art.²¹² There are very good reason why nanotechnology devices are, broadly speaking, inventive.

First, there is nothing obvious about the process researchers undertake in pioneering this new field of science.²¹³ It would be naïve to claim otherwise. Billions of dollars have poured into nanotechnology research, and scientists are still tackling major preliminary hurdles.²¹⁴ We do not quite yet have quantum computers because researchers can only keep atoms in their altered state for 2.4 milliseconds, which is still a whopping ten times longer than previous attempts.²¹⁵ Scientists imagine ways to target drug delivery to cancer cells, but we are at the early stages of learning how different-shaped nanoparticles navigate through the body.²¹⁶ It would seem that if there were anything obvious about the science, we would at the very least have nanoscale versions of all existing technology figured out.²¹⁷

It was only until fairly recently that researchers were able to create a nanoscale version of a car, complete with four wheels, independently rotating alkyne axels, and a photon-propelled motor.²¹⁸ This nanocar could have important applications in

²¹⁰ See, e.g., MERGES & DUFFY, *supra* note 104, at 606.

²¹¹ “An invention shall be considered as involving an inventive step if, having regard to the state of the art, it is not obvious to a person skilled in the art.” Convention on the Grant of Eur. Patents art. 56, Oct. 5, 1973, 13 I.L.M. 270, 286.

²¹² MERGES & DUFFY, *supra* note 104, at 606.

²¹³ *Id.*

²¹⁴ See *infra* text accompanying notes 224–27.

²¹⁵ *Nanotechnology Update: Corporations Up Their Spending as Revenues for Nano-Enabled Products Increase*, LUX RES. (Feb. 17, 2014), <https://members.luxresearchinc.com/research/report/13748> [<https://perma.cc/X7PG-8CHG>]; see *Quantum computers*, *supra* note 53.

²¹⁶ See *Quantum computers*, *supra* note 53.

²¹⁷ Bertrand et al., *supra* note 56, at 19.

²¹⁸ See *infra* text accompanying notes 218–29.

²¹⁹ BOUCHER, *supra* note 84, at 7–8.

transporting materials around, allowing precise placement of nanostructures.²¹⁹

Scientists had to overcome significant challenges in creating this car however. In the original nanocar, the wheels bonded with the surface below, locking the car in place.²²⁰ It was not until researchers increased the temperature to 200 degrees Celsius before the wheels were freed and the car could traverse the surface.²²¹ As one author points out, it was far from a matter of taking the blueprints of a Ferrari and producing it at this scale.²²² The same would be true for a nanodrill, or for that matter, any nanoscale reproductions.²²³ Significant challenges would prevent anyone from simply pulling the specifications for a Black & Decker power tool and reducing the dimensions by a factor of one billion.²²⁴

The strongest arguments for invalidating nanotechnology patents based on obviousness might draw from various courts' rulings regarding size—that mere scaling down of prior art is not an inventive step.²²⁵ These cases are easily distinguishable when applied to nanotechnology, however.²²⁶ One of the main rulings related to issues of scale is *In re Rose*, discussed at length in Part II.²²⁷ The Court emphasized that the lumber package invention “at most relates to the size of the article under consideration which is not *ordinarily* a matter of invention.”²²⁸ While it may

²¹⁹ *Id.*

²²⁰ BOUCHER, *supra* note 84, at 7 (stating that Shirai created the world's first nanocar); Yasuhiro Shirai et al., *Directional Control in Thermally Driven Single-Molecule Nanocars*, 5 NANO LETTERS 2330, 2331 (2005) (explaining that the wheels bonded to the surface).

²²¹ Shirai et al., *supra* note 220, at 2333.

²²² BOUCHER, *supra* note 84, at 16.

²²³ *Id.* at 17.

²²⁴ Such a design would require an electrical system. *See, e.g., 20V MAX Lithium Drill/Driver*, BLACK & DECKER, <http://www.blackanddecker.com/en-us/products/power-tools/portable-power-tools/drills/20v-max-lithium-drilldriver/bdccc120c> [<https://perma.cc/GL32-YBLA>]. However, nanoscale electrical systems have not been invented yet. *See* BOUCHER, *supra* note 84, at 17.

²²⁵ *See* Gardner v. TEC Sys., Inc., 725 F.2d 1338, 1346 (Fed. Cir. 1984), *cert. denied*, 469 U.S. 830 (1984); *In re Rinehart*, 531 F.2d 1048, 1054 (C.C.P.A. 1976); *In re Rose*, 220 F.2d 459, 463 (C.C.P.A. 1955).

²²⁶ *See, e.g., infra* text accompanying notes 227–29.

²²⁷ *See supra* text accompanying notes 142–46.

²²⁸ *Rose*, 220 F.2d at 463 (emphasis added).

not *ordinarily* be a matter of invention, in the case of nanotechnology, that is the very heart of the invention.²²⁹

In the example of the nanodrill, the only difference may be the use of single atoms as the material of construction.²³⁰ One could argue this is effectively a mere recitation of dimensions.²³¹ But at some point this line of reasoning breaks down.²³² Perhaps it is obvious to scale down an invention by factors of two, ten, one hundred, or even thousands.²³³ But when the object is scaled down by a factor of one billion times, to the point where the same fundamental forces do not even apply, and where a highly specialized microscope is required to even visualize the new scale, it is no longer *merely* scaled down.

Finally, it is unclear who a “person having ordinary skill in the art” would be.²³⁴ The brilliant engineers developing the most impressive automobiles on the road today would not be the same engineers able to finally create the nanocar.²³⁵ Nanotechnology is a highly technical and scientific field, and any advancements come from a very specialized subdivision of scientists and engineers.²³⁶ At the time of this Note, there are at least seventy specialized degree programs in nanotechnology²³⁷ in the US, and many schools offer doctorate programs in the field.²³⁸ Although a “person having ordinary skill in the art” is afforded some creativity

²²⁹ See *What is Nanotechnology?*, *supra* note 185.

²³⁰ See, e.g., *20V MAX Lithium Drill/Driver*, *infra* note 224; *What is Nanotechnology?*, *supra* note 185.

²³¹ *Gardner v. TEC Syst., Inc.*, 725 F.2d 1338, 1346 (Fed. Cir. 1984).

²³² See *infra* text accompanying notes 233–34.

²³³ J.C. Payne of Valley View, Texas, did the opposite with a ball of string. See *Largest Ball of String*, GUINNESS WORLD RECORDS, <http://www.guinnessworldrecords.com/world-records/largest-ball-of-string-yarn-thread> [<https://perma.cc/D2A8-ZJGW>]; *Koch Industries Cotton Butcher Twine*, BLAINE'S FARM & FLEET, <https://www.farmandfleet.com/products/376410-koch-industries-cotton-butcher-twine.html?feedsource=3&gclid=EAIaIQobChMI3Keu5tbz1QIV1mGCh%E2%80%A6> [<https://perma.cc/SC6M-G3TS>].

²³⁴ 35 U.S.C. § 103 (1952).

²³⁵ See BOUCHER, *supra* note 84, at 16.

²³⁶ *Nanotechnologist*, NATIONAL CAREERS SERVICE, <https://nationalcareerservice.direct.gov.uk/job-profiles/nanotechnologist> [<https://perma.cc/G4V9-KBT5>].

²³⁷ *College, Grad School, and Post Doc Opportunities*, U.S. NAT'L NANO-TECHNOLOGY INITIATIVE, <https://www.nano.gov/education-training/university-college> [<https://perma.cc/3QBG-VG7F>].

²³⁸ *Id.*

when courts determine obviousness, nanotechnology is too unique of a field to be considered obvious to experts of any macroscale technologies.²³⁹

For these reasons, anything produced in the field of nanotechnology is inherently non-obvious with regard to macroscale devices.²⁴⁰ The examples used in this Part of course may be oversimplified, and the biggest area of concern will not likely come from the consumer power tools market.²⁴¹ But any time the two patents are at such different scales that different forces are used and one invention consists of individual atoms, at the very least, a strong presumption should exist that anything produced at that scale is non-obvious.²⁴²

IV. POLICY REASONS WHY MACROSCALE PATENTS SHOULD NOT ANTICIPATE NANOSCALE REPRODUCTIONS

The previous Part of this Note attempted to show, through a technical application of the law, that nanotechnology patents should not be deemed invalid solely due to larger scale prior art.²⁴³ It is important to keep in mind the normative objectives of patent law when making this consideration.²⁴⁴ Broadly interpreting prior art claims to cover nanoscale counterparts would frustrate rather than serve these normative goals.²⁴⁵

The Constitution grants Congress the power to “promote the progress of science and useful arts, by securing ... to authors and inventors the exclusive right to their respective [w]ritings and [d]iscoveries.”²⁴⁶ Pursuant to this “intellectual property clause,” Congress has expressly authorized the USPTO to grant and issue

²³⁹ 35 U.S.C. § 103 (1952). Compare *College, Grad School, and Post Doc Opportunities*, *supra* note 237, with *Occupational Outlook Handbook: Mechanical Engineers*, BUREAU OF LABOR STATISTICS, <https://www.bls.gov/ooh/architecture-and-engineering/mechanical-engineers.htm> [<https://perma.cc/KJ7Y-2A9K>].

²⁴⁰ See *supra* Section III.C.

²⁴¹ *Search Results: “power tool”*, PROJECT ON EMERGING NANOTECHNOLOGIES, <http://www.nanotechproject.org/cpi/search-products/?title=drill> [<https://perma.cc/LW95-Z4XR>].

²⁴² For another argument for heightened standard of obviousness in nanotechnology, see *Roe*, *supra* note 165.

²⁴³ See *supra* Part III.

²⁴⁴ See *infra* text accompanying note 248.

²⁴⁵ *Id.*

²⁴⁶ U.S. CONST. art. I, § 8, cl. 8.

patents and “establish regulations, not inconsistent with the law.”²⁴⁷ It is this promotion of “science and useful arts” upon which all of the patent system is based.²⁴⁸

Federal patent laws must strike a delicate balance between promoting innovation and recognizing the need for imitation within the competitive economy.²⁴⁹ Patents essentially grant inventors with a monopoly of limited duration to exclude others from making, using, selling, or importing the invention.²⁵⁰ This incentivizes inventors, and investors, to put time, money, and effort towards developing an idea because they know they will have an opportunity to recoup these costs.²⁵¹ The public also benefits from the rich market of technologies that are made available as a result.²⁵² So, although the inventor holds a temporary monopoly, which is generally frowned upon, the result is a publicly available description of the invention that can either be invented around or used as a platform for refinement.²⁵³

Although critics debate whether patent law truly serves this purpose,²⁵⁴ the ultimate goal is to promote the progress of science and innovation.²⁵⁵ Thus any application of patent laws that fails to serve this function would be inappropriate, perhaps even Constitutionally so.²⁵⁶

A. *Overprotection Concerns*

Patent law promotes innovation by providing economic incentives for inventors to devote the resources necessary for innovation.²⁵⁷ It does so by limiting competition on the back end (after

²⁴⁷ 35 U.S.C. § 2(a)–(b) (2012).

²⁴⁸ “The Patent Clause itself reflects a balance between the need to encourage innovation and the avoidance of monopolies which stifle competition without any concomitant advance in the ‘Progress of Science and useful Arts.’” *Bonito Boats, Inc. v. Thunder Craft Boats, Inc.*, 489 U.S. 141, 146 (1989).

²⁴⁹ *Id.*

²⁵⁰ *Id.* at 150.

²⁵¹ *Id.*

²⁵² *Id.* at 151.

²⁵³ *See id.*

²⁵⁴ *See, e.g.*, N. STEPHAN KINSELLA, *AGAINST INTELLECTUAL PROPERTY* 16–23 (2008).

²⁵⁵ U.S. CONST. art. I, § 8, cl. 8.

²⁵⁶ *See id.*

²⁵⁷ *See supra* text accompanying note 95.

the patent is granted) but by promoting competition on the front end (racing to be the first to file).²⁵⁸ Thus, the success of our patent law system depends largely on economic incentives generated by the patent.²⁵⁹

To strike the balance in a way that promotes innovation rather than restricts it, the monopoly created by the patent must be finely tuned.²⁶⁰ To the extent that a patent holder can assert his right to exclude over other inventors, in markets not reasonably related to his invention, the economic rationale for patents begins to break down.²⁶¹ The inventor may gain too much from his patent in ways that exceed the incentive required to justify his investment and that restrict other inventors from realizing their incentives.²⁶²

The issue in this Note considers a limited situation, where prior art is on the scale of one billion times larger.²⁶³ In this case, it is highly unlikely that the two inventors here would see any competition from their respective inventions. In the case of the nanodrill, it is hard to imagine any market in which the two inventors would be in competition. The Black & Decker drill would have applications in consumer products, construction and a number of related industries, whereas the nanodrill will likely have applications in the medical and pharmaceutical industries.²⁶⁴ The two could operate in conjunction seeing little interference within their respective markets.²⁶⁵ The same would be true for many of the promising applications presented in Part I.

To be fair to the macroscale inventor, he likely never considered any nanoscale applications of his invention.²⁶⁶ And nobody

²⁵⁸ *The Patent Race is On: "First to File" Takes Effect March 16, 2013*, LEXISNEXIS CORP. L. ADVISORY, <https://www.lexisnexis.com/communities/corporatecounselnewsletter/b/newsletter/archive/2013/03/02/the-patent-race-is-on-first-to-file-takes-effect-march-16-2013.aspx> [<https://perma.cc/MZF4-32AM>].

²⁵⁹ See *Bonito Boats, Inc. v. Thunder Craft Boats, Inc.*, 489 U.S. 141, 152 (1989).

²⁶⁰ *Id.* at 167 (noting the "careful balance" of the patent statute).

²⁶¹ *In re BRCA1- and BRCA2-Based Hereditary Cancer Test Patent Litig.*, 774 F.3d 755, 763 (Fed. Cir. 2014).

²⁶² See *Bonito Boats*, 489 U.S. at 152.

²⁶³ See *supra* Part III.

²⁶⁴ *Id.*

²⁶⁵ See Mark A. Lemley, *Patenting Nanotechnology*, 58 STAN. L. REV. 601, 614 (2005).

²⁶⁶ *Id.* at 621.

would expect him to; it is outside of his expertise.²⁶⁷ But to grant him rights, and then restrict later entrepreneurial experts in nanotechnology, would give him too much.²⁶⁸ He only needs the incentives required to put forth his investment, which he has already received.²⁶⁹ Anything else would surpass the normative goals of patent law and give him too broad of a monopoly.²⁷⁰

B. Chilling Effect on Innovation

While providing too much protection for previous inventors would disrupt the balance intended by the patent system, so too would the restraint placed on new inventors.²⁷¹ Nanotechnology development is highly research-intensive and requires a significant upfront investment.²⁷² Therefore, patents become even more important in bringing nanotechnology products to market.²⁷³ Researchers and investors will be less likely to put forth the initial investment if there is uncertainty surrounding the protection they can receive.²⁷⁴ This creates a sort of “chilling effect” on nanotechnology, which is the very thing patents are designed to avoid.²⁷⁵ To the extent that patents are hindering, rather than promoting, the progress of science, the protection they provide begins to frustrate the normative objectives of patent law.²⁷⁶

C. Reducing the Nanotechnology Patent Thicket

The unique way in which nanotechnology has developed creates an exceptional need to avoid a further chilling effect.²⁷⁷ From early on, the United States has supported the excitement

²⁶⁷ See *id.*

²⁶⁸ See *id.* at 620.

²⁶⁹ See Raj Bawa, *Nanotechnology Patenting in the US*, 1 NANOTECH. L. & BUS. 31, 32 (2004) [hereinafter Bawa, *Nanotechnology Patenting*].

²⁷⁰ Lemley, *supra* note 265, at 618.

²⁷¹ Amit Makker, *The Nanotechnology Patent Thicket and the Path to Commercialization*, 84 S. CAL. L. REV. 1163, 1181, 1184–85 (2011).

²⁷² See Bawa, *Patent Proliferation*, *supra* note 163, at 719.

²⁷³ *Id.* at 719–23.

²⁷⁴ Bawa, *Nanotechnology Patenting*, *supra* note 269, at 32.

²⁷⁵ See Makker, *supra* note 271, at 1176.

²⁷⁶ See, e.g., *id.*

²⁷⁷ See Lemley, *supra* note 265, at 613–14.

surrounding nanotechnology and has become a key player in the new “nano-race.”²⁷⁸ By 1991, the United States National Science Foundation had launched an entire program dedicated to nanoscience research.²⁷⁹ In the year 2000, at the same school where Feynman first gave his influential speech, President Bill Clinton announced that his 2001 budget request would include \$500 million dedicated to a new National Nanotechnology Initiative (NNI).²⁸⁰

This Initiative has continued to grow through today. President Obama’s 2017 budget, submitted in February 2016, provides over \$1.4 billion dedicated towards the NNI.²⁸¹ This will bring the cumulative total funding for the NNI to nearly \$24 billion since Clinton’s announcement.²⁸² As shown by this dedication in funding, there is little doubt that nanotechnology will continue to be an important focus of research for quite some time.²⁸³

Following the wave of lucrative funding that the NNI has provided, researchers are swarming to develop the technology.²⁸⁴ Patents are crucially important in the commercialization of the technologies and serve as useful business tools for securing investments.²⁸⁵ Because nanotechnology is highly research-intensive, getting products into the marketplace will be greatly hindered without patent protection.²⁸⁶ Recognizing this, startups, corporations, and universities have aggressively sought to carve out broad and far-reaching patent protection.²⁸⁷ And the USPTO has

²⁷⁸ By 2015, an estimated combined total of over \$250 billion had been invested in nanotechnology research by US government and private sectors making the US a global leader in the field. *See* Dong et al., *supra* note 8, at 8.

²⁷⁹ Hsinchun Chen et al., *Global Nanotechnology Development from 1991 to 2012: Patents, Scientific Publications, and Effect of NSF Funding*, 15 J. NANOPARTICLE RES. 1, 1 (2013).

²⁸⁰ Corie Lok, *Small Wonders*, 467 NATURE 18, 19 (2010).

²⁸¹ *NNI Budget*, U.S. NAT’L NANOTECHNOLOGY INITIATIVE, <http://www.nano.gov/about-nni/what#content#content> [<https://perma.cc/ZJ8W-YR65>].

²⁸² *Id.*

²⁸³ *See id.*

²⁸⁴ *See Frequently Asked Questions*, U.S. NAT’L NANOTECHNOLOGY INITIATIVE, <https://www.nano.gov/nanotech-101/nanotechnology-facts> [<https://perma.cc/54M3-GXVP>].

²⁸⁵ Bawa, *Patent Proliferation*, *supra* note 163, at 713, 719.

²⁸⁶ *Id.* at 719.

²⁸⁷ Bawa et al., *supra* note 32, at 428.

been generous in granting them.²⁸⁸ This has been referred to as the “gold rush” of nanotechnology patents.²⁸⁹

This “gold rush” has created many concerns among commentators.²⁹⁰ At least as early as 2004, commentators pointed out that nanotechnology advancements will be impeded by the “patent thicket” that has developed.²⁹¹ During this key developmental stage, the USPTO granted hundreds of overly broad and far-reaching patents that clearly overlap.²⁹² As Professor Mark Lemley points out, nanotechnology is unique in that the very building blocks of the industry have been patented up front.²⁹³ During the proliferation of patents being granted through 2004, relatively few actual products were being produced.²⁹⁴ This means that the majority of patents are on the building blocks of the technology, rather than the final product.²⁹⁵ Many of these “building block” patents come from universities trying to gather protection for their researchers.²⁹⁶ This is different than many other fields of invention in history, such as computers, software, and the Internet, where the basic building blocks went unpatented.²⁹⁷

Not only have the building blocks been patented up front, but due to the patent “gold rush,” many of these building blocks have been granted overlapping patents.²⁹⁸ Take the carbon nanotube for example, which is a basic building block with promising properties.²⁹⁹ John Miller points out that the USPTO granted patents for carbon nanotubes very generously early

²⁸⁸ John C. Miller & Drew L. Harris, *The Carbon Nanotube Patent Landscape*, 3 NANOTECH. L. & BUS. 427, 436 (2006).

²⁸⁹ Bawa et al., *supra* note 32, at 428.

²⁹⁰ See, e.g., Charles Choi, *Nano World: Nano patents in conflict*, UPI (April 25, 2005), http://www.upi.com/Science_News/2005/04/25/Nano-World-Nano-patents-in-conflict/19021114431853/ [<https://perma.cc/C2YM-E4SD>].

²⁹¹ See, e.g., Lemley, *supra* note 265, at 618.

²⁹² Sean O’Neill et al., *Broad Claiming In Nanotechnology Patents: Is Litigation Inevitable?*, 4 NANOTECH. L. & BUS. 29, 30 (2007).

²⁹³ Lemley, *supra* note 265, at 613–14.

²⁹⁴ *Id.* at 604.

²⁹⁵ *Id.* at 606.

²⁹⁶ See *id.* at 615.

²⁹⁷ *Id.* at 606.

²⁹⁸ *Id.* at 618 (citing JOHN C. MILLER ET AL., *THE HANDBOOK OF NANOTECHNOLOGY: BUSINESS, POLICY, AND INTELLECTUAL PROPERTY LAW* 69–71 (2005)).

²⁹⁹ See Miller & Harris, *supra* note 288, at 428–32.

on.³⁰⁰ By 2006, there were already 446 patents for carbon nanotubes issued in the US.³⁰¹ Miller suggests this is likely due to a number of challenges the patent office faced in dealing with such a new industry.³⁰²

First, nanotube research has applications in a wide range of disciplines, including chemical and materials engineering, semiconductors, and biotechnology.³⁰³ Prior to 2004, the USPTO did not have a dedicated nanotechnology examination group or a prior art classification for nanotechnology.³⁰⁴ As a result, very similar patent applications were directed to different technology centers where they were reviewed in reference to case law and prior art unique to that technology center.³⁰⁵

Second, Miller notes, applications have used different terminology to describe the same ideas.³⁰⁶ The terms “single shell nanocylinders,” “buckytubes,” “nanowires,” and “nanotubes” have all been used to describe the same thing.³⁰⁷ This resulted in increased difficulty for patent examiners in dealing with nanotechnology at such an early stage.³⁰⁸

While patents are important for promoting commercial development, they can also impede this development.³⁰⁹ With the unique way in which nanotechnology patenting has unfolded, there are already significant obstacles for anyone new to the market.³¹⁰ Imagine if the new nanodrill required nanotubes as part of its construction.³¹¹ There would potentially be hundreds of infringement claims with regard to the drill’s use of nanotubes alone.³¹² While licensing agreements with patent holders is often an option for navigating patents, when the volume of

³⁰⁰ *Id.* at 436.

³⁰¹ *Id.* at 435–36.

³⁰² *Id.* at 436.

³⁰³ *Id.* at 427, 436.

³⁰⁴ See Bawa, *Nanotechnology Patenting*, *supra* note 269, at 47.

³⁰⁵ See Ruben Serrato et al., *The Nanotech Intellectual Property Landscape*, 2 NANOTECH. L. & BUS. 150, 152 (2005).

³⁰⁶ Miller & Harris, *supra* note 288, at 436.

³⁰⁷ *Id.*

³⁰⁸ See *id.*

³⁰⁹ Lemley, *supra* note 265, at 618.

³¹⁰ See, e.g., *id.* at 620.

³¹¹ See Miller & Harris, *supra* note 288, at 437.

³¹² See *id.*

potential infringement claims is so large, licensing with every patent owner can be cost-prohibitive.³¹³ If the hypothetical macro-scale drill patent owner could then bring his own patent infringement claims, it would only further complicate the matter.³¹⁴

Allowing the entire body of patents issued prior to the nanotechnology “gold rush” to further limit development in the field would be devastating.³¹⁵ As patent filings become more focused on commercially viable products, rather than building blocks, there is already enough of a patent thicket that is a cause for significant concern.³¹⁶ With all of the promise that nanotechnology brings, any additional unnecessary restriction should be avoided.³¹⁷

CONCLUSION

Nanotechnology is in a crucial stage of development and presents enormous possibilities for technical innovation.³¹⁸ If even a small fraction of the benefits promised by recent research pan out, nanotechnology will likely revolutionize medicine, computing, agriculture, and potentially many other industries.³¹⁹ It also presents unique challenges both for researchers but also for the law.³²⁰ In any new field of technology, the protection offered by patents is crucial to development, and the law is often faced with new challenges in interpreting the technology.³²¹ But nanotechnology is unique. The entire field is based on manipulating matter at an extremely small scale, and much of the benefits might come simply from reproducing existing devices at this scale.³²²

The law should not restrict development by extending broad protection from patents that are outside of the realm of nanotechnology.³²³ Protection for the macroscale devices should

³¹³ Bawa, *Patent Proliferation*, *supra* note 163, at 731.

³¹⁴ *See id.*

³¹⁵ Lemley, *supra* note 265, at 618–20.

³¹⁶ Bawa, *Nanotechnology Patenting*, *supra* note 269, at 43; *see* Lemley, *supra* note 265, at 620–21.

³¹⁷ Makker, *supra* note 271, at 1164.

³¹⁸ *Id.*

³¹⁹ Bawa et al., *supra* note 32, at 429.

³²⁰ *See* Makker, *supra* note 271, at 1196.

³²¹ *See id.*

³²² Chen et al., *supra* note 279, at 1; Lemley, *supra* note 265, at 621.

³²³ Lemley, *supra* note 265, at 621.

not preclude these nanoscale applications, and based on the patentability requirements of novelty and obviousness, there is no reason to do so.³²⁴ There is something inherently innovative and unique about development at this scale that is presumptively novel from macroscale prior art.³²⁵ Further, it would disrupt the normative objectives of patent law by providing too much protection for the previous patents and overly restricting new ones.³²⁶

Researchers are on the brink of immensely promising and exciting applications in a new field of science.³²⁷ By avoiding the conclusion that this work is a mere matter of scale, we can eliminate at least one of the challenges researchers are faced with in bringing the benefits of this new technology into fruition.³²⁸

³²⁴ *Id.*

³²⁵ *Id.*

³²⁶ Makker, *supra* note 271, at 1176.

³²⁷ *Id.* at 1164.

³²⁸ *See supra* Part IV.