IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
SHERMAN DIVISION

CHIEN-MIN SUNG, Plaintiff, v. SAMSUNG ELECTRONICS CO. LTD., SAMSUNG ELECTRONICS AMERICA, INC., SAMSUNG SEMICONDUCTOR, INC., and SAMSUNG AUSTIN SEMICONDUCTOR LLC, Defendants.	Case No. 4:23-cv-752 **JURY TRIAL DEMANDED**

DECLARATION OF STANLEY SHANFIELD, PH.D.
IN SUPPORT OF DEFENDANTS' PROPOSED CLAIM CONSTRUCTIONS

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I, Dr. Stanley Shanfield, declare:

I. Introduction

1. My name is Stanley Shanfield. I am a Technical Director at Draper Laboratory in Cambridge, MA.

2. I understand that Plaintiff Dr. Chien-Min Sung ("Plaintiff" or "Dr. Sung") filed a patent infringement suit against Samsung Electronics Co., Ltd., Samsung Electronics America, Inc., Samsung Semiconductor, Inc., and Samsung Austin Semiconductor, LLC (collectively, "Defendants"). I have been retained to serve as an expert for Defendants in the field of semiconductor integrated circuit processing and fabrication.

3. Counsel for Defendants has informed me that Plaintiff is currently alleging that Defendants infringe certain claims of U.S. Patent Nos. 9,138,862 (the "'862 Patent") and 9,724,802 (the "'802 Patent") (collectively, the "Asserted Patents").

4. In this Declaration, I provide my analysis and conclusions regarding the level of ordinary skill in the art for the '862 and '802 Patents, and the construction of certain claim terms in the '862 and '802 Patents. In reaching my conclusions, I reviewed and analyzed the '862 and '802 Patents, their prosecution histories, patents and patent applications (and their prosecution histories) in the respective patent families provided in Sections VII.A.2 and VII.B.2, and other relevant materials, including the materials identified in Section IV, from the perspective of a person of ordinary skill in the art, based on my experience in the field of semiconductor integrated circuit processing and fabrication.

5. I am being compensated at my customary hourly rate of $460, and the conclusions that I reach and express in my Declaration have no bearing on my compensation.

6. I do not have any financial interest in the outcome of this case, nor do I have any financial interest in Defendants.

7. I do not personally know Dr. Sung and have never had any personal contact with him.

8. My curriculum vitae ("CV") is attached as Appendix A to this Declaration.

II. Qualifications

9. I received a B.S. Degree in Physics *cum laude* from the University of California, Irvine in 1977. I received a Ph.D. in Physics from the Massachusetts Institute of Technology in 1981.

10. After obtaining my Ph.D. in 1981, I worked as a Staff Scientist at Spire Corporation in Bedford, Massachusetts.

11. From 1985-1999, I worked at Raytheon Corporation. As staff and later as section manager, I developed, among many other projects, reactive ion etching (RIE) processes for patterning dielectrics (silicon dioxide, silicon nitride, silicon oxynitride, etc.), conductive layers (aluminum-copper, copper-silicon, W-silicide, TaN, doped polysilicon, etc.), and organic layers (photoresist, polyimide, etc.). In 1996, I became the Manager of Semiconductor Operations at Raytheon. As Manager, I built and led a 300-employee, $60 million revenue-generating semiconductor development, commercial system design, and electronic module manufacturing operation. I worked directly with engineers in the selection, installation, and optimization of several chemical-mechanical polishing ("CMP") systems, including analysis of operational maintenance and performance monitoring. The manufacturing facility eventually used multiple production CMP systems, and I directly participated in establishing the required metrology (optical thickness monitoring) for maintaining polishing uniformity standards.

12. In 1999, I was a co-founder and Vice President of Operations at AXSUN Technologies in Bedford/Billerica, Massachusetts and, in 2000, became Director of Manufacturing and Wafer Fab Technology.

13. In 2003, I joined the Draper Laboratory in Cambridge, Massachusetts. Currently, I am the Division Leader of Advanced Hardware Development, with around 80 staff members. I am also a Distinguished Member of Technical Staff and Technical Director. I led the Advanced Hardware Development division in relaunching a multi-chip integrated circuit module facility. The laboratory has acquired several semiconductor-grade CMP systems for the purpose of fabricating multi-chip modules and for planarization operations in MEMS devices, and I have been involved in their operation and optimization. I invented and led the implementation of an ultra-miniature electronics fabrication technology. I also developed fabrication technology for semiconductor-based low phase noise oscillator design. I have received many awards at Draper, including the 2010 Distinguished Performance Award and the 2010 Best Patent Award.

14. I have nearly four decades of extensive experience working on and with semiconductors.

15. I have authored over 25 publications in peer-reviewed academic journals, transactions, and books.

16. I am a named inventor on six issued U.S. patents.

17. I am a member of multiple societies, including the IEEE and the American Physical Society (APS).

18. I am familiar with the technology of the ’862 and ’802 Patents.

19. I am familiar with the knowledge and capabilities of a person of ordinary skill in the art at the time of the priority dates of the ’862 and ’802 Patents, which I understand Plaintiff contends are at least as early as May 23, 2011 but no later than March 13, 2013, and at least as early as May 16, 2005 but no later than October 3, 2014, respectively.

20. Additional details about my employment history, fields of expertise, patents, and publications are included in the attached CV (Appendix A).

III. Legal Standards

21. I do not have formal legal training, and I am not an attorney. Defendants' counsel has provided me with the following legal principles relating to claim construction in patent law, which I have applied in my analysis.

A. Person of Ordinary Skill in the Art

22. I have been informed and understand that a patent should be analyzed within the framework of a person of ordinary skill in the art ("POSITA"), which is a hypothetical individual, at the relevant time (the priority date of the patent). I have also been informed and understand that factors considered in determining the level of a POSITA include (1) sophistication of the technology, (2) challenges and types of problems faced within the field, (3) solutions to these problems known at the priority date of the patent, (4) levels of education of professionals actively working in the field, including that of the named inventor, (5) types of testing described in the patent and the requisite skills needed to perform those tests, and (6) the general state of the technology overall.

B. Claim Construction

23. I understand that a claim defines the scope, or metes and bounds, of the claimed invention. I understand that claim construction is a matter of law to be decided by the Court.

24. I understand that a claim is construed in terms of how a POSITA would have understood the claim in light of relevant evidence. I understand that the claim construction inquiry considers the claim language itself. I also understand that the claim language must be read in light of intrinsic evidence of the patent, which includes the patent's abstract, figures, specification, and

prosecution history, and any relevant extrinsic evidence, such as dictionaries, publications, and scientific treatises.

C. Indefiniteness

25. I understand that if a claim term fails to inform the scope of the claimed invention to a POSITA with reasonable certainty, the claim term is indefinite and the claim in which the indefinite term appears is invalid. I understand that any such determination should be made by viewing the claim term in light of the specification, the prosecution history, and the knowledge of a POSITA. I also understand that extrinsic evidence can be useful to understand the underlying technology and meaning of a term in the relevant art during the relevant time period.

26. I understand that a term of degree is not inherently indefinite, but for the word of degree to be not indefinite, the patent must provide some standard for measuring that degree with enough certainty to one skilled in the art when read in the context of the invention.

27. I understand that although a claim term's susceptibility to more than one meaning does not necessarily render it indefinite, a claim term is indefinite if the claim language might mean several different things and no informed and confident choice is available among the contending definitions.

28. I understand that for a claim term to be not indefinite, the patent and prosecution history must disclose a single known approach ascertaining the boundaries of an invention or establish that, where multiple known approaches to measurement exist, a POSITA would know which approach to select. I understand that a claim may be indefinite when different known methods exist for calculating a claimed parameter, but nothing in the record suggests using one method in particular, and application of the different methods result in materially different outcomes for the claim's scope such that a product or method may infringe the claim under one method but not infringe when employing another method.

IV. Materials Considered

29. In arriving at the conclusions set forth in this Declaration, I have relied upon the following materials:

- The '802 Patent, the '862 Patent, U.S. Patent No. 8,974,270, U.S. Provisional Application No. 61/489,074, U.S. Patent Application No. 13/797,704, U.S. Patent No. 8,622,787, U.S. Patent No. 8,393,934, U.S. Patent No. 8,398,466, U.S. Provisional Application No. 60/976,198, U.S. Patent No. 7,762,872, U.S. Patent Application No. 11/357,713, U.S. Provisional Application No. 60/681,798, U.S. Patent Application No. 11/223,786, U.S. Patent No. 8,678,878, U.S. Provisional Application No. 61/246,816, U.S. Patent Application No. 13/034,213, and U.S. Provisional Application No. 61/333,162, and their prosecution histories;
- Plaintiff's Opening Claim Construction Brief in *Sung v. Texas Instruments Incorporated*, No 4:23-CV-00753 (E.D. Tex.) (the "TI Case"), D.I. 57 (public version) ("Dr. Sung's TI Opening Claim Construction Br.") and Exhibits 6 and 7 (D.I. 49-3 and 49-4);
- Plaintiff's P.R. 4-2 Disclosures dated April 24, 2024;
- Sung_Samsung004391; [1] Sung_Samsung004396; Sung_Samsung004402; Sung_Samsung004412; Sung_Samsung004430; Sung_Samsung004438; Sung_Samsung004444; SAMSUNG_CMS_005182; SAMSUNG_CMS_005574.

30. In addition, I have reviewed and considered all other documents mentioned in my Declaration. My conclusions are based on my personal knowledge of these documents as viewed

[1] When I refer to the first bates number of a document or file, I am referring to the entire document or file unless I express note otherwise.

through the lens of a POSITA, which I am familiar with based on my technical education, training, and experience in the field.

V. Level of Ordinary Skill in the Art

31. As I noted in Section III.A, I have been informed that a patent should be analyzed within the framework of a POSITA at the relevant time, i.e., the priority date of the patent.

32. Defendants' counsel informed me that Defendants contend that the'862 Patent has a priority date of March 13, 2013, and that the '802 Patent has a priority date of October 3, 2014.

33. Defendants' counsel also informed me that Dr. Sung contends that the'862 Patent has a priority date of at least as early as May 23, 2011 but no later than March 13, 2013 and that the '802 Patent has a priority date of at least as early as May 16, 2005 but no later than October 3, 2014. I understand that Defendants disagree with Dr. Sung's broad range of priority dates.

34. My conclusions in this Declaration apply equally under either side's proposed priority dates.

35. In view of the factors for determining the level of a POSITA discussed in Section III.A, a POSITA as of the competing priority dates of the '862 and '802 Patents would have had a Bachelor's degree in material science, mechanical engineering, electrical engineering, or physics, and a minimum of two to three years of experience in the field of integrated circuit processing and fabrication techniques. I note that a higher level of education or specific skills in the industry may make up for less experience, and vice versa. A POSITA with the aforementioned background in the field of integrated circuit processing and fabrication techniques would have been knowledgeable and understood a broad range of manufacturing processes that relate to silicon wafers, including CMP processes, which has been around since the late 1980s/early 1990s. Indeed, the '862 and '802 Patents state that silicon wafer manufacturing techniques were well-known and that they form the background of the purported invention. '862 Patent, 1:14-25; '802 Patent, 1:42-

54. Moreover, the ’862 and ’802 Patents describe measurement techniques such as optical scanning that have been generally used in measuring surface characteristics of wafers, CMP pads, and CMP pad conditioners. ’862 Patent, 10:22-11:4; ’802 Patent, 16:20-17:4. Thus, a POSITA with the aforementioned background would have been knowledgeable about and appreciate the technology covered by the Asserted Patents.

36. I understand that Dr. Sung contends in the TI Case that a POSITA would have had “at least a Bachelor of Science or more advanced degree in a relevant science or engineering field, such as physics, electrical engineering, mechanical engineering, or materials science. In addition, at least two years of experience in the semiconductor manufacturing process area would be appropriate, and, two or more years of experience in chemical mechanical polishing would be appropriate.” Dr. Sung’s TI Opening Claim Construction Br. at 12.

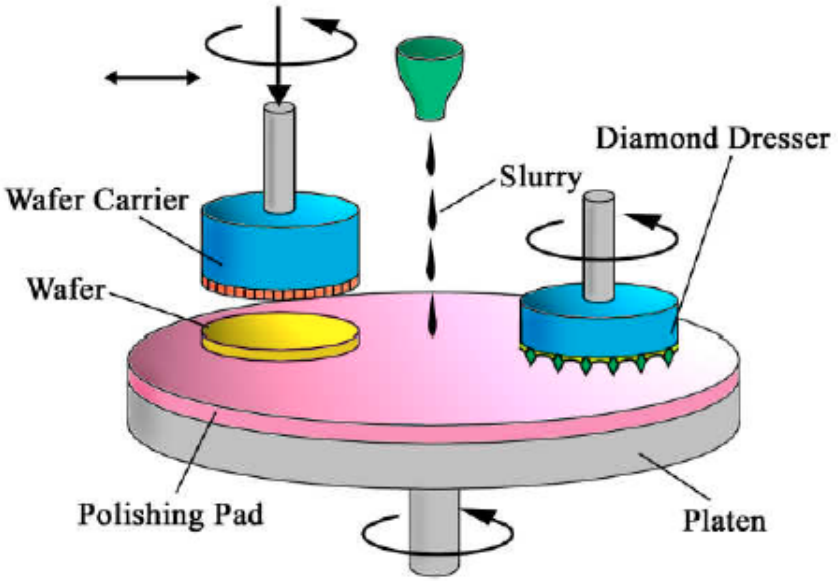
37. It is not clear to me what Dr. Sung means when he asserts “at least two years of experience in the semiconductor manufacturing process area ***would be appropriate***, and, two or more years of experience in chemical mechanical polishing ***would be appropriate***.”

38. To the extent Dr. Sung asserts that a POSITA would have had “two or more years of experience in chemical mechanical polishing” specifically, I disagree. That requirement unnecessarily narrows the level of one skilled in the art. In any case, my conclusions do not change whether I apply my or Dr. Sung’s definition of a POSITA. I met and/or exceeded the requirements for a POSITA under both my and Dr. Sung’s definitions as of the proposed priority dates of the ’862 and ’802 Patents, for at least the reasons provided above in Section II, including my CV.

VI. Technology Background

39. Chemical mechanical planarization or polishing (“CMP”) is a common, widely-used process that has been around since at least the late 1980s/early 1990s. A typical setup for this process is shown in the figure below. The semiconductor wafer (labeled “wafer” in the figure) is

pressed against a rotating polishing pad, also known as a CMP pad. Additionally, a chemical slurry is introduced onto the polishing pad.

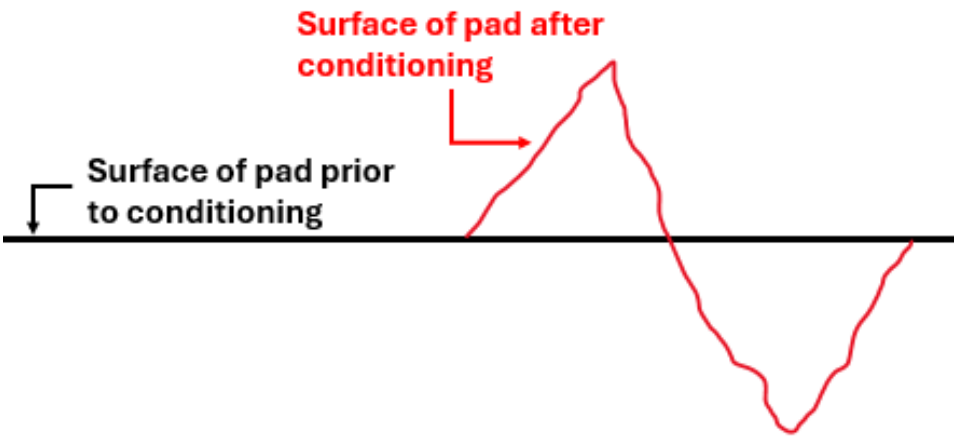


Hiroshi Ishizuka, et al., *PCD Dressers for Chemical Mechanical Planarization with Uniform Polishing*, Proc. of Int'l Conf. on Leading Edge Mfg. in 21st Century: LEM21, 2007, Volume 2007.4, Fig. 2 (SAMSUNG_CMS_005182).

40. The rotating polishing pad is typically made from a soft polymer. The most common polymer used for the polishing pad is polyurethane. The polishing pad can hold the slurry and polish the wafer because it contains small, micron-sized asperities on its surface. The more it is used to polish a wafer, the more wear and tear (and other factors) on the pad dulls the asperities, decreasing the CMP pad's performance. Therefore, the pad is commonly reconditioned by regenerating the asperities for optimal and consistent wafer-polishing performance.

41. As schematically illustrated below, CMP pad dressers, which are also commonly called "CMP pad conditioners," condition CMP pads. CMP pad conditioners typically contain

particles that protrude from the surface that can cut the surface of the CMP pad as the pad dresser rotates against the pad to generate new asperities. When the tip of a particle cuts a location on the CMP pad surface, the particle can push the pad material to the side, generating raised rims that protrude above the original surface as illustrated below. The raised rims form asperities, as shown below.



VII. The Asserted Patents

A. The '862 Patent

1. Overview of the '862 Patent

42. I have reviewed the'862 Patent.

43. The '862 Patent generally describes methods of conditioning CMP pads with CMP pad dressers. '862 Patent, Abstract. According to the '862 Patent, these CMP pad dressers should have superabrasive particles with substantially leveled tips. The '862 Patent describes rotating the CMP pad dressers against the CMP pad to achieve asperities having a certain maximum cutting depth. '862 Patent, 9:33-44 ("Thus, the relative leveling of the monolayer of superabrasive particles can greatly affect the morphology and distribution of asperities cut into the CMP pad by the dresser. For example, in one aspect, the monolayer is leveled such that rotating the dresser

against the CMP [sic] cuts asperities having a maximum cutting depth of about 80 microns … 60 microns … [or] 40 microns.”).

44. The ’862 Patent states that the CMP pad dressers can condition CMP pads by pressing a dresser onto a CMP pad. ’862 Patent, Abstract, 12:12-31. The ’862 Patent further states that “the load placed on the CMP pad by the dresser can affect the morphology of the spacers, such as, in some cases, the asperity depth. The load can be adjusted for a given dresser to adjust penetration depth.” ’862 Patent, 9:63-66. As an example, the ’862 Patent explains that “the load can be from about 0.1 Kg to about 60 Kg. In other aspects, the load can be from about 2 Kg to about 20 Kg. In further aspects, the load may be from about 6 Kg to about 12 Kg.” ’862 Patent, 9:66-10:3. According to the ’862 Patent:

> the load may be Kg/m2. For example, in one aspect an 11.5 Kg load can allow a material removal rate from the wafer of about 200 microns per hour for Cu layers. In a related example, an 11.5 Kg load can allow a material removal rate from the wafer of about 100 microns per hour for oxides. In many cases, a lower load can be used in order to minimize the superabrasive particle damage (e.g., less than or equal to about 2 Kg).

’862 Patent, 10:3-10.

2. Summary of the Prosecution History of the ’862 Patent

45. I have reviewed the prosecution history of the ’862 Patent, which I summarize below.

46. The application for the ’862 Patent was filed on March 13, 2013. The application claimed to be a continuation-in-part of U.S. Patent Application No. 13/479,148 (now U.S. Patent No. 8,974,270), which claimed priority to U.S. Provisional Application No. 61/489,074, filed May 23, 2011. ’862 Patent, Cover.

47. The application for the ’862 Patent included original claims 1-20. Application filed March 13, 2013, ’862 Patent Prosecution History.

48. In an Office Action dated November 6, 2014, claims 1-20 were rejected as obvious over U.S. Patent Application Publication Nos. 2010/0248595 ("Dinh-Ngoc") and 2008/0292869 ("Sung'869"). The Examiner stated that the prior art teaches that "the difference in protrusion distance between the highest 10 protruding tips of the mono layer of superabrasive particles are within about 20 microns or less; and rotating the dresser against the CMP pad such that asperities are cut into the CMP pad having a maximum cutting depth of about 60 microns." Office Action dated November 6, 2014 at 3-4, '862 Patent Prosecution History.

49. The Applicant did not amend any claims. Instead, in response to those rejections, the Applicant stated:

> Examiner argues that Sung['869] discloses that superabrasive particles protruding to a predetermined height produce a cutting depth of less than 20 microns, and infers that this recitation of cutting depth reads on the claim limitation that the highest 10 protruding tips are within about 20 microns or less. It is noted, however, that the depth to which a particle cuts into a deformable substance like a CMP pad is not necessarily a teaching of the protrusion distance of that particle. For example, the downward pressure of the particle as the pad dresser is pressed into the pad can cause compression of the pad material in the direction of the downward pressure. This compression effect in the direction away from the dresser may cause the cutting depth to be less than the protrusion of the dresser particles. Additionally, as the dresser moves across the pad surface, the downward force can cause compression between the leading side of the dresser and the trailing side of the dresser leading to an uneven movement of the pad surface beneath the dresser. The cutting of the pad is at least in part due to these compressive forces overcoming the atomic forces of the pad material.

Applicant's Response dated April 6, 2015 at 4-5, '862 Patent Prosecution History. The Applicant further stated that the "combination of the downward compression with the compression radiating from the leading side of the cutting particle demonstrates that a recitation of cutting depth is not necessarily a measurement or teaching of the protrusion height of a particle." Applicant's Response dated April 6, 2015 at 5, '862 Patent Prosecution History.

50. The Examiner then issued a Notice of Allowance. The '862 Patent was issued on September 22, 2015. '862 Patent, Cover.

B. The ’802 Patent

1. Overview of the ’802 Patent

51. I have reviewed the ’802 Patent.

52. The ’802 Patent generally describes CMP pad dressers with superabrasive particles. ’802 Patent, Abstract. The ’802 Patent is directed to CMP pad dressers that have substantially leveled tips. ’802 Patent, 9:30-33 (“Specifically, in some aspects the present disclosure concerns CMP pad dressers having superabrasive particles with substantially leveled tips.”). The ’802 Patent describes “rotating the dresser against a CMP pad” to “cut[] asperities into the CMP pad having a cutting depth of less than or equal to about 50 microns.” ’802 Patent, 2:55-62.

53. The ’802 Patent states that the CMP pad dressers can condition CMP pads by pressing a dresser onto a CMP pad. ’802 Patent, Abstract, 20:45-57. The ’802 Patent further states that “the load placed on the CMP pad by the dresser can affect the morphology of the spacers, such as, in some cases, the asperity depth. The load can be adjusted for a given dresser to adjust penetration depth.” ’802 Patent, 15:60-63. As an example, the ’802 Patent explains that “the load can be from about 0.1 Kg to about 60 Kg. In other aspects, the load can be from about 2 Kg to about 20 Kg. In further aspects, the load may be from about 6 Kg to about 12 Kg.” ’802 Patent, 15:63-67. According to the ’802 Patent:

> the load may be Kg/m2. For example, in one aspect an 11.5 Kg load can allow a material removal rate from the wafer of about 200 microns per hour for Cu layers. In a related example, an 11.5 Kg load can allow a material removal rate from the wafer of about 100 microns per hour for oxides. In many cases, a lower load can be used in order to minimize the superabrasive particle damage (e.g., less than or equal to about 2 Kg).

’802 Patent, 15:67-16:7.

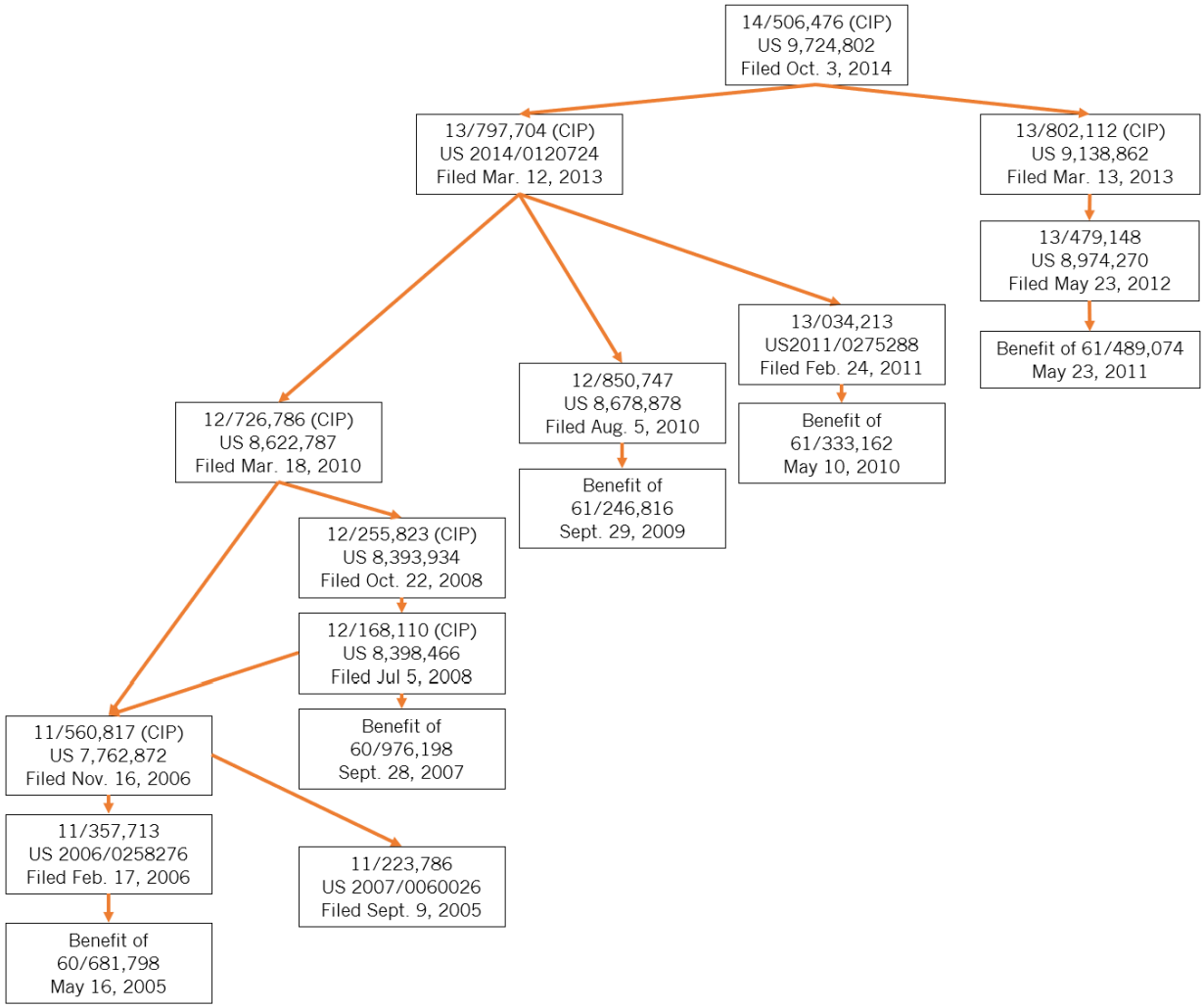
54. The ’802 Patent describes the alleged invention as “concern[ing] CMP pad dressers having superabrasive particles with substantially leveled tips,” where in some aspects, the

superabrasive particles "are aligned across a designated profile, and as such, are 'leveled' with respect to that profile." '802 Patent, 9:30-36. "While it is intended that the tips of the superabrasive particles align along the designated profile, some level of deviation may occur." '802 Patent, 11:35-37.

2. Summary of the Prosecution History of the '802 Patent

55. I have reviewed the prosecution history of the '802 Patent, which I summarize below.

56. The application for the '802 Patent was filed on October 3, 2014. The application claimed priority to multiple applications, as shown graphically below. '802 Patent, Cover.



57. The application for the ’802 Patent included original claims 1-24. Application filed October 3, 2014 at 42-45, ’802 Patent Prosecution History.

58. In an Office Action dated October 30, 2015, claims 11-15 were rejected in part under 35 U.S.C. § 112 as being indefinite. The Examiner stated that the claims are indefinite because it is “unclear [] how the highest 1% is determined,” referring to the claimed limitation “the protrusion difference between the highest 1% of the protruding tips are within 80 microns or less.” Office Action dated October 30, 2015 at 2, ’802 Patent Prosecution History. The Examiner also stated that the scope of the claim is “unascertainable” because “it does not make sense that the protrusion difference of 80 microns is more than ‘the difference in protrusion distance between the highest protruding tip and the second highest protruding tip of the monolayer of superabrasive particles is less than or equal to about 50 microns.’” Office Action dated October 30, 2015 at 2-3, ’802 Patent Prosecution History.

59. In a May 2, 2016 Response to the Office Action, the Applicant argued in response to the 35 U.S.C. § 112 rejections that the specification provides methods of determining the heights of the tips of superabrasive particles, such as “an optical scanning process” where “the scanner can scan downward in space toward the dresser until the highest tip is located. The highest tip can then be set to the reference point.” Applicant’s Response dated May 2, 2016 at 6-7, ’802 Patent Prosecution History.

60. The Applicant also argued that “a typical CMP pad dresser can have greater than 10,000 superabrasive particles,” so “the highest 1% [of particles] would include the highest 100 superabrasive particles.” Applicant’s Response dated May 2, 2016 at 7, ’802 Patent Prosecution History. According to the Applicant, the height distributions between the first and second highest superabrasive particles would be narrower than the height distributions among the highest 1% of

superabrasive particles. Applicant's Response dated May 2, 2016 at 7, '802 Patent Prosecution History.

61. The Applicant also argued that a previous patent application in the '802 Patent family (U.S. Patent Application No. 11/560,817, resulting in U.S. Patent No. 7,762,872) disclosed the limitation of tips varying "from the designated profile by from about 5 microns to about 100 microns," thus antedating the Examiner's reference. Applicant's Response dated May 2, 2016 at 8-9, '802 Patent Prosecution History (quoting '872 Patent, 9:31-32). The Applicant amended claim 11 (and claims 12-15 dependent thereon) to include the limitation "wherein a tip of each of the plurality of superabrasive particles aligns along a designated profile with a tip variation of from about 5 microns to about 100 microns," which the Applicant stated was "fully supported in the '817 application." Applicant's Response dated May 2, 2016 at 10-11, '802 Patent Prosecution History.

62. In an Office Action dated July 15, 2016, the Examiner rejected claims 1-10 and 16-24 as being obvious over U.S. Patent Application Publication No. 2004/0048557 ("Nabeya"). The Examiner maintained the statement that "the claimed limitations of 'cutting depth' is treated as the same as the tip variation because the tip height of abrasive particles is the cutting depth as the pad dresser is pressed into the polishing pad." Office Action dated July 15, 2016 at 3, '802 Patent Prosecution History.

63. In a November 15, 2016 Response, the Applicant cancelled claims 1-10 and 23-24, amended claims 16-22 to depend on the allowed claim 11, and added new claims 25-33 depending from the allowed claim 11. Applicant's Response dated November 15, 2016 at 1-7.

64. The Examiner then issued a Notice of Allowance. The '802 Patent issued on August 8, 2017. '802 Patent, Cover.

VIII. Claim Terms

65. I understand that Plaintiff asserts claims 1-13, 15, and 17-20 of the ’862 Patent and claims 1-21 of the ’802 Patent. Accordingly, my analysis in this Declaration is limited to those claims.

66. I have reviewed the following claim terms of the ’862 and ’802 Patents in view of the intrinsic and extrinsic evidence, and I conclude that the following claim terms—as used in the asserted claims—are indefinite.

A. “About”

67. The term “about” is used to qualify the limits of numerical ranges for certain measurements in the claims of the ’862 and ’802 Patents. Specifically, the term “about” is recited in claims 1, 6-8, and 15 of the ’862 Patent and claims 1-7, 10-18, and 21 of the ’802 Patent as set forth in the table below.[2]

Claims	Term
’862 Patent	
1	“the difference in protrusion distance between the highest protruding tip and the second highest protruding tip of the monolayer of superabrasive particles is less than or equal to **about** 10 microns” “the difference in protrusion distance between the highest 10 protruding tips of the monolayer of superabrasive particles are within **about** 20 microns or less”
1	“rotating the dresser against the CMP pad such that asperities are cut into the CMP pad having a maximum cutting depth of **about** 60 microns”
6-8	“up to **about** [90% / 50% / 33%] of the dresser radius”
15	“a line width of less than or equal to **about** 30 nm”
’802 Patent	
1	“a tip of each of the plurality of superabrasive particles aligns along a designated profile with a tip variation of from **about** 5 microns to **about** 100 microns”

[2] All claims depending on a claim reciting the term “about” require that term by virtue of their dependency.

13-15	"the highest protruding tip of each of the plurality of superabrasive particles align along the designated profile with a tip variation of [from **about** 10 microns to **about** 50 microns / from **about** 20 microns to **about** 40 microns / less than **about** 20 microns]"
1-3	"the difference in protrusion distance between the highest protruding tip and the second highest protruding tip [of the monolayer of superabrasive particles is less than or equal to **about** 50 microns / is less than or equal to **about** 10 microns / is less than **about** 10 microns]"
1	"the difference in protrusion distance between the highest 1% of the protruding tips of the monolayer of superabrasive particles are within **about** 80 microns or less"
4-5	"the difference in protrusion distance between the highest protruding tip and [the 10th highest protruding tip is less than or equal to **about** 20 microns / the 100th highest protruding tip is less than or equal to **about** 40 microns]"
6	"rotating the dresser against a CMP pad cuts asperities into the CMP pad having a cutting depth of less than or equal to **about** 50 microns"
7	"the cutting depth is from **about** 10 microns to **about** 50 microns"
16-18	"cutting depths of [less than **about** 20 microns / from **about** 1 micron to **about** 20 microns / from **about** 10 microns to **about** 20 microns]"
10-12	"[from **about** 1000 to **about** 6000 / from **about** 2000 to **about** 5000 / at least **about** 1000] working superabrasive particles"
12	"working superabrasive particles that protrude from the rigid support substrate to distances within **about** 30 microns of one another"
21	"superabrasive particles spaced at a distance of from **about** 100 microns to **about** 800 microns"

68. Based on my review of the intrinsic and extrinsic evidence, I conclude that the term "about" is indefinite because it fails to inform the scope of the claimed invention to a POSITA with reasonable certainty.

69. I recognize that the term "about" is permitted in claims in certain contexts when it informs the scope of the claimed invention with reasonable certainty. For example, if there are established manufacturing tolerances that are universally recognized by POSITAs in a particular field, a POSITA may find it appropriate to account for those manufacturing tolerances with

qualifiers like the word "about." The usage of the term "about" in the context of the '862 and '802 Patent claims, however, does not provide sufficient clarity for two reasons.

70. First, there are no established manufacturing tolerances recognized by POSITAs that apply to the claim terms that are qualified using the term "about." For example, I am not aware of any established manufacturing tolerances in relation to the height of CMP pad dresser tips, tip variation, cutting depth, and the spacing between superabrasive particles. As a specific example, claim 1 of the '862 Patent requires that the "difference in protrusion distance between the highest protruding tip and the second highest protruding tip of the monolayer of superabrasive particles is less than or equal to **about** 10 microns." There is no established acceptable manufacturing tolerance that would allow a POSITA to determine whether a difference of 10.1 microns, 10.5 microns, 11 microns, or 15 microns, is "about 10 microns" as recited in the claim. Plaintiff has likewise not identified any evidence that shows any established manufacturing tolerances that a POSITA could use to determine how far from 10 microns a difference in protrusion distance could be while still being "about 10 microns" as required by the claim. There are no such established manufacturing tolerances for any of the other quantities that the claims qualify using the claim term "about," and no such established manufacturing tolerances are provided or described in the Asserted Patents.

71. As another example, claim 1 of the '862 Patent requires "rotating the dresser against the CMP pad such that asperities are cut into the CMP pad having a maximum cutting depth of **about** 60 microns." There is no established way—and the '862 Patent provides none—to determine whether a particular maximum cutting depth of, for example, 59 microns, 59.9 microns, 60.1 microns, or 61 microns is "about 60 microns" as required by the claim. So there are multiple

places in the asserted claims where a POSITA would have to guess whether a particular numerical quantity is "about" the claimed quantity.

72. To take an example from the '802 patent, claim 1 requires that "a tip of each of the plurality of superabrasive particles aligns along a designated profile with a tip variation of from **about** 5 microns to **about** 100 microns." There is no guidance within the patent or generally established and known knowledge at the relevant time that would allow a POSITA to determine whether, for example, 90 microns, 95 microns, 99 microns, 99.9 microns, 100.1 microns, 101 microns, 105 microns, or 110 microns is "about 100 microns" as required by the claim.

73. Second, the '862 and '802 Patents define the term "about" in the specifications in a way that makes the metes-and-bounds of the claimed quantities even less precise. In particular, the '862 and '802 Patents state that "[a]s used herein, the term 'about' is used to provide flexibility to a numerical range endpoint by providing that a given value may be ***'a little above'*** or ***'a little below'*** the endpoint." '862 Patent, 6:29-31; '802 Patent, 8:29-36. The definition—"a little above" or "a little below"—exacerbates the imprecision inherent in the already imprecise term "about." To use one of my previous examples regarding claim 1 of the '862 Patent, is a "difference in protrusion distance" that is 10.1 microns "a little above" the claimed 10 micron protrusion distance? What about 10.5 microns? What about 11 microns? What about 15 microns? The '862 Patent provides no guidance that would allow a POSITA to make that determination with reasonable certainty.

74. Taking my example for claim 1 of the '802 patent: is 101 microns "a little above" the claimed 100 microns? What about 105 microns? What about 110 microns? The '802 Patent provides no guidance that would allow a POSITA to make that determination with reasonable certainty.

75. Thus, the Asserted Patents do not provide any guidance on what it means to be "a little above" or "a little below" a particular value and are silent on how to determine with reasonable certainty the boundaries of the claimed ranges modified with the term "about." Indeed, the Asserted Patents state that the use of the term "about" is intended to "provide ***flexibility*** to a numerical range endpoint." '862 Patent, 6:29-31; '802 Patent, 8:29-36. But the Asserted Patents do not provide any guidance as to how much flexibility is permitted when determining whether a particular "difference in protrusion distance," for example, satisfies the claimed limit or not. The same problems occur in each of the claim terms that qualify numerical limits using the term "about."

76. The surrounding claim language only amplifies the imprecision that results from the claims' use of the term "about." For example, the term "about" is used in connection with values that limit the difference in protrusion distance between certain "highest protruding tips," "cutting depth," and "tip variation." But as I explain in Sections VIII.B-D below, a POSITA would not have understood with reasonable certainty how to measure those quantities. Thus, a POSITA would not have been able to reasonably ascertain the "flexible" endpoints of numerical ranges or limits associated with such unclear parameters.

77. Neither the prosecution histories of the '862 and '802 Patents nor the specifications and prosecution histories of their patent families clarify the meaning of "a little above" and "a little below." Thus, even viewing the specifications and the prosecution histories together, a POSITA would have been unable to ascertain with reasonable certainty where to draw the line on the "flexible" numerical ranges or limits to understand the scope of the claimed ranges or limits.

78. I further understand that in Plaintiff's P.R. 4-2 Disclosures, Plaintiff identified extrinsic evidence that purportedly supports his position that no construction is necessary. Pl's

P.R. 4-2 Disclosures dated Apr. 24, 2024, at 9-10 (citing documents). I have reviewed each of those documents and they do not change my conclusions. Those documents do not shed any light on the boundaries of a range or limit when qualified using the terms "about," "a little above," or "a little below."

79. Accordingly, I conclude that the term "about" is indefinite because its scope cannot be determined with reasonable certainty.

B. The "Difference In Protrusion Distance" Terms

80. The next set of terms are what I refer to as the "difference in protrusion distance" terms in both the '802 and '862 Patents. As shown in the table below,[3] each of these terms purports to quantify[4] "the difference in protrusion distance" either (a) "between the highest protruding tip and the second highest protruding tip," (b) "between the highest 10 protruding tips," (c) "between the highest 1% of the protruding tips," (d) "between the highest protruding tip and the 10th highest protruding tip," or (e) "between the highest protruding tip and the 100th highest protruding tip."

Claims	Term
'862 Patent	
1	"the difference in protrusion distance between the highest protruding tip and the second highest protruding tip … is less than or equal to about 10 microns"
1	"the difference in protrusion distance between the highest 10 protruding tips … are within about 20 microns or less"
'802 Patent	
1	"the difference in protrusion distance between the highest protruding tip and the second highest protruding tip … is less than or equal to about 50 microns"

[3] All claims depending on a claim reciting a "difference in protrusion distance" term require that term by virtue of their dependency.

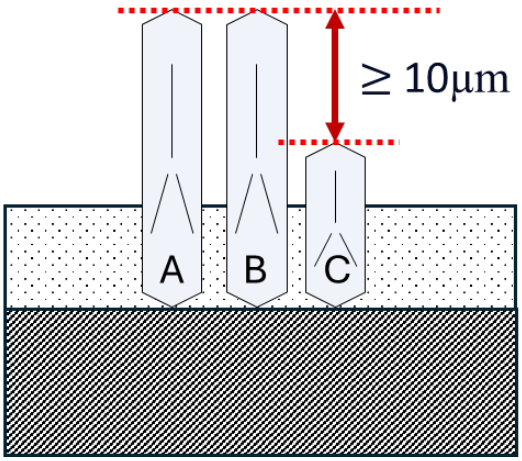
[4] For the reasons explained above with respect to the term "about," I conclude that the purported quantification in each of these terms (e.g., "less than or equal to about 10 microns")—which all include the term "about"—are indefinite. For the "difference in protrusion distance" terms addressed in this section, I will focus on the first portion of these terms (e.g., "the difference in protrusion distance between the highest protruding tip and the second highest protruding tip").

1	"the difference in protrusion distance between the highest 1% of the protruding tips … are within about 80 microns or less"
2	"the difference in protrusion distance between the highest protruding tip and the second highest protruding tip is less than or equal to about 10 microns"
3	"the difference in protrusion distance between the highest protruding tip and the second highest protruding tip is less than about 10 microns"
4	"the difference in protrusion distance between the highest protruding tip and the 10th highest protruding tip is less than or equal to about 20 microns"
5	"the difference in protrusion distance between the highest protruding tip and the 100th highest protruding tip is less than or equal to about 40 microns"

81. Based on my review of the intrinsic and extrinsic evidence, I conclude that the "difference in protrusion distance" terms are indefinite because they fail to inform the scope of the claimed invention to a POSITA with reasonable certainty. A POSITA would not have understood the scope of the claimed invention with reasonable certainty because it would have been unclear what the "highest protruding tip" means as compared with "the second highest protruding tip," "the highest 10 protruding tips," "the highest 1% of the protruding tips," "10th highest protruding tip," and "the 100th highest protruding tip" when determining the "difference in protrusion distance." As explained below, a POSITA would have understood that a particular CMP pad conditioner might satisfy the "difference in protrusion distance" limitation under one interpretation of the "difference in protrusion distance" terms, but not under a different interpretation, thereby leading to an uncertainty in claim scope that materially affects the outcome when determining whether a particular structure satisfies the claim. Accordingly, the "difference in protrusion distance" terms are indefinite.

82. The uncertainty in claim scope is readily apparent when considering a CMP pad conditioner with diamond particles as illustrated below. In this example, the CMP pad conditioner includes three diamond particles, two of which have the same protrusion distance of 50 microns and the last of which has a protrusion distance of 35 microns.

Diamond Particle	Protrusion Distance
A	50 microns
B	50 microns
C	35 microns



83. When determining whether the CMP pad conditioner satisfies the limitation "the difference in protrusion distance between the highest protruding tip and the second highest protruding tip … is less than or equal to about 10 microns," a POSITA could map the particle with the "highest protruding tip" to Diamond Particle A because Diamond Particle A has the highest protruding tip distance. But a POSITA is left to guess whether the "second highest protruding tip" is the one that has the same protrusion distance as "the highest protruding tip" (i.e., Diamond Particle B), or the one that has the or next highest protrusion distance (i.e., Diamond Particle C). And depending on what the "second highest protruding tip" is, the CMP pad conditioner depicted above may or may not fall within the scope of the claim. For example, if the "second highest protruding tip" is interpreted to be Diamond Particle B that has the same protrusion distance as Diamond Particle A, then the CMP pad conditioner in this example satisfies the limitation because the difference in protrusion distance is 0 microns and is therefore less than 10 microns as claimed (even ignoring the indefinite term "about" that I discussed above).[5] But if the "second highest protruding tip" means the protruding tip with a next highest protrusion distance (in the above example, Diamond Particle C), then the CMP pad conditioner in this example does ***not*** satisfy the

[5] I refer to this interpretation as the "absolute highest method."

limitation because the protrusion distance is 15 microns and is therefore more than 10 microns as claimed (even ignoring the indefinite term "about" that I discussed above).[6] Because this "difference in protrusion distance" limitation is amenable to two inconsistent interpretations that materially affect the outcome—one that satisfies the claim limitation and the other that does not—it is indefinite.

84. Similar ambiguity exists for the other "difference in protrusion distance" terms as well, because a POSITA would not have understood with reasonable certainty whether "the highest 10 protruding tips," "the highest 1% of the protruding tips," "the 10th highest protruding tip," or "the 100th highest protruding tip" include those that are of equal height or only those that have the next highest protrusion distance that is different from the highest.

85. I have reviewed the intrinsic evidence and have not seen any guidance on the proper claim scope for each "difference in protrusion distance" term. For example, the specifications of the '802 and '862 Patents do not define the "difference in protrusion distance" terms. Instead, the '862 Patent, for example, refers to Figure 1 and states: "The difference in protrusion distance 106 between the highest protruding tip 108 and the next highest protruding tip 110 of the monolayer of superabrasive particles is described as the protrusion difference." '862 Patent, 8:37-40; '802 Patent, 14:31-34, 18:31-35. But Figure 1 does not explain how to analyze the scenario where two or more protruding tips are the highest protruding tips with the same protrusion distance.

[6] I refer to this interpretation as the "next relative highest method."

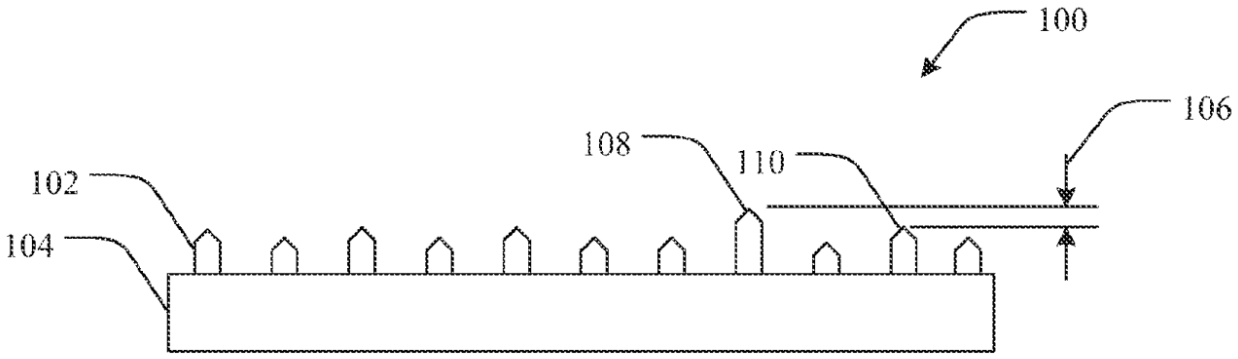


FIG. 1

’862 Patent, Fig. 1; ’802 Patent, Fig. 1. Therefore, a POSITA would not have understood from the specification and Figure 1 what the “highest protruding tip” and the “second highest protruding tip” would have been when two or more protruding tips have both equal and highest protrusion distances.

86. To the extent Plaintiff contends that the “difference in protrusion distance” terms are not indefinite because the specifications describe direct and indirect measurement techniques to measure protrusion distances, that does not change my conclusions. The patent specifications acknowledge that “[v]arious methods can be utilized to measure superabrasive particle tip height to determine the difference in protrusion distance between tips.” ’862 Patent, at 10:22-24; ’862 Patent at 10:28-11:4 (addressing direct and indirect measurement techniques); ’802 Patent, at 16:20-17:4 (same). But those portions of the specifications do not explain to a POSITA which interpretation of the “difference in protrusion distance” terms to apply when making those measurements.

87. I further understand that in Plaintiff’s P.R. 4-2 Disclosures, Plaintiff identified extrinsic evidence that purportedly supports his position that no construction is necessary. Pl’s P.R. 4-2 Disclosures dated Apr. 24, 2024, at 11-13, 24-28 (citing documents). I have reviewed each of those documents and they do not change my conclusions. Those documents do not shed

light on the meaning of the "difference in protrusion distance" terms, or how to calculate the difference in protrusion distance in the context of the '862 and '802 Patents when there are multiple highest tips of equal height.

88. Accordingly, I conclude that the "difference in protrusion distance" terms are indefinite because their scope cannot be determined with reasonable certainty.

C. The "Cutting Depth" Terms

89. The next set of terms are what I refer to as the "cutting depth" terms in both the '862 and '802 Patents, as shown in the table below.[7]

Claims	Term
'862 Patent	
1	"rotating the dresser against the CMP pad such that asperities are cut into the CMP pad having a maximum cutting depth of about 60 microns"
'802 Patent	
6	"rotating the dresser against a CMP pad cuts asperities into the CMP pad having a cutting depth of less than or equal to about 50 microns"
7	"the cutting depth is from about 10 microns to about 50 microns"
16	"the protrusions of the plurality of superabrasive particles produce cutting depths of less than about 20 microns when used to abrade a CMP pad"
17	"the protrusions of the plurality of superabrasive particles produce cutting depths of from about 1 micron to about 20 microns when used to abrade a CMP pad"
18	"the protrusions of the plurality of superabrasive particles produce cutting depths of from about 10 microns to about 20 microns when used to abrade a CMP pad"

90. Based on my review of the intrinsic and extrinsic evidence, I conclude that the "cutting depth" terms are indefinite because they fail to inform the scope of the claimed invention to a POSITA with reasonable certainty.

[7] All claims depending on a claim reciting a "cutting depth" term require that term by virtue of their dependency.

91. The "cutting depth" terms are generally directed to rotating the dresser against the CMP pad to cut asperities into the CMP pad having "a cutting depth" that falls within a certain numerical range. Accordingly, to determine whether a structure or process satisfies the "cutting depth" terms, a POSITA must measure the "cutting depth" of the CMP pad.

92. However, a POSITA would not have been able to determine with reasonable certainty when a process satisfies the "cutting depth" terms because a POSITA would not have understood with reasonable certainty how the "cutting depth" should be measured.

93. The specifications of the '862 and '802 Patents do not provide any guidance on how the "cutting depth" should be measured. For example, the Detailed Description of the '862 Patent uses the term "cutting depth" only four times, and none of those instances explains what the cutting depth is or how the cutting depth should be measured:

> Thus, the relative leveling of the monolayer of superabrasive particles can greatly affect the morphology and distribution of asperities cut into the CMP pad by the dresser. For example, in one aspect, the monolayer is leveled such that rotating the dresser against the CMP cuts asperities having a maximum ***cutting depth*** of about 80 microns. In another aspect, the monolayer is leveled such that rotating the dresser against the CMP cuts asperities having a maximum ***cutting depth*** of about 60 microns. In yet another aspect, the monolayer is leveled such that rotating the dresser against the CMP cuts asperities having a maximum ***cutting depth*** of about 40 microns.

'862 Patent, 9:33-44 (emphasis added).

> The method can further include 206 rotating the dresser against the CMP pad such that asperities are cut into the CMP pad having a maximum ***cutting depth*** of about 60 microns.

'862 Patent, 12:23-26 (emphasis added).

94. Similarly, the Detailed Description of the '802 Patent uses the term "cutting depth" only 12 times, and none of those instances explains what the cutting depth is or how the cutting depth should be measured:

> As such, in one specific aspect the predetermined height or protrusion distance may produce a ***cutting depth*** of less than about 20 microns when used to dress a CMP pad. In another specific aspect, the predetermined height or protrusion distance may produce a ***cutting depth*** of from about 1 micron to about 20 microns when used to dress a CMP pad. In yet another specific aspect, the predetermined height or protrusion distance may produce a ***cutting depth*** of from about 10 micron to about 20 microns when used to dress a CMP pad.

'802 Patent, 12:35-44 (emphasis added).

> Though any predetermined height that would be useful in an abrading or cutting tool would be considered to be within the presently claimed scope, in one specific aspect the predetermined height may produce a ***cutting depth*** of less than about 20 microns when used to abrade a workpiece. In another specific aspect, the predetermined height may produce a ***cutting depth*** of from about 1 micron to about 20 microns when used to abrade a workpiece. In yet another specific aspect, the predetermined height may produce a ***cutting depth*** of from about 10 micron to about 20 microns when used to abrade a workpiece.

'802 Patent, 12:55-65 (emphasis added).

> In use the dresser can be engaged against a CMP pad and cut asperities into the CMP pad having a ***cutting depth*** of less than or equal to about 50 microns. In another aspect, the ***cutting depth*** is from about 10 microns to about 50 microns.

'802 Patent, 13:63-67 (emphasis added).

> For example, in one aspect, the monolayer is leveled such that rotating the dresser against the CMP cuts asperities having a maximum ***cutting depth*** of about 80 microns. In another aspect, the monolayer is leveled such that rotating the dresser against the CMP cuts asperities having a maximum ***cutting depth*** of about 60 microns. In yet another aspect, the monolayer is leveled such that rotating the dresser against the CMP cuts asperities having a maximum ***cutting depth*** of about 40 microns.

'802 Patent, 15:32-41 (emphasis added).

> Such a method can include applying a CMP pad dresser to a CMP pad, and moving at least one of the CMP pad or the CMP pad dresser with respect to one another to cut asperities into the CMP pad having a ***cutting depth*** of from about 10 microns to about 50 microns.

'802 Patent, 18:16-20 (emphasis added).

95. The prosecution histories of the '862 and '802 Patents also fail to provide any guidance on how the "cutting depth" should be measured. For example, during the prosecution of

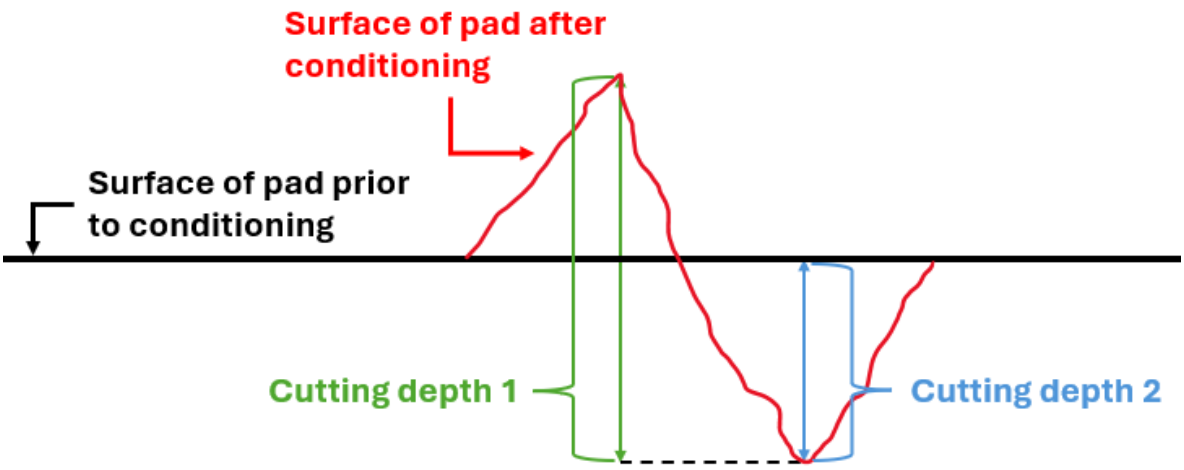
the ’802 Patent, the Examiner rejected the then-pending claims, stating that “the claimed limitations of ‘cutting depth’ is treated as the same as the tip variation because ***the tip height of abrasive particles is the cutting depth*** as the pad dresser is pressed into the polishing pad.” Office Action dated Oct. 30, 2015 at 3-4, ’802 Patent Prosecution History (emphasis added). The Applicant, however, disagreed with the Examiner’s interpretation of “cutting depth,” without providing any explanations on what the “cutting depth” is or how it should be measured. Applicant’s Response dated May 2, 2016 at 9, ’802 Patent Prosecution History.

96. I have also reviewed the parents of the ’862 and ’802 Patents and their prosecution histories, but none of them provide guidance on how the “cutting depth” should be measured. Accordingly, the intrinsic evidence fails to provide any guidance on how the “cutting depth” should be measured.

97. That lack of guidance or clarity regarding the term “cutting depth” renders the “cutting depth” terms indefinite because a POSITA would have understood that the “cutting depth” terms are amenable to multiple different interpretations, and depending on which interpretation is used, a process may or may not fall within the claim scope, resulting in a materially different outcome depending on which interpretation is used.

98. For example, claim 1 of the ’862 Patent recites “rotating the dresser against the CMP pad such that ***asperities are cut into the CMP pad having a maximum cutting depth of about 60 microns***.” ’862 Patent, cl. 1 (emphasis added). As shown below in green, a POSITA could reasonably understand that the “cutting depth” is the distance from the highest point of an asperity (the raised rims that result from cutting) to the lowest point of a groove created by the diamond tip. But as shown below in blue, a POSITA could also reasonably understand that the “cutting depth” is the distance from a surface prior to cutting and the lowest point of the groove

created by the diamond tip. Each interpretation results in a different value of "cutting depth" (i.e., "Cutting depth 1" and "Cutting depth 2") as illustrated below:



99. Now, suppose that "Cutting depth 1" in the above illustration is 70 microns, and that "Cutting depth 2" in the above illustration is 30 microns. If the POSITA takes the first interpretation of "cutting depth," (i.e., the cutting depth shown in green, which is the distance from the highest point of the asperity to the lowest point of the groove created by the diamond tip), then the POSITA would determine that the illustrated structure does not satisfy the limitation because the cutting depth (Cutting depth 1) is 70 microns, which is greater than the maximum cutting depth of 60 microns (even ignoring the indefinite term "about" that I discussed above). But if the POSITA takes the second interpretation of "cutting depth," (i.e., the cutting depth shown in blue, which is the distance from the surface prior to cutting and the lowest point of the groove created by the diamond tip), the POSITA would determine that the illustrated structure satisfies the limitation because the cutting depth (Cutting depth 2) is 30 microns and is therefore less than the maximum cutting depth of 60 microns (even ignoring the indefinite term "about" that I discussed above). Thus, depending on which interpretation is used, a POSITA would arrive at a materially different outcome.

100. As illustrated, the "cutting depth" terms are amenable to two inconsistent interpretations that lead to materially different outcomes—one that satisfies the claim limitation and the other that does not—and thus, the "cutting depth" terms are indefinite.

101. I understand that Dr. Sung states that "[t]he term 'cutting depth' [means] the depth at which a CMP pad is penetrated." Dr. Sung's TI Opening Claim Construction Br. at 21. But that does not provide any guidance or resolve the ambiguity around how the "cutting depth" should be measured. Even under Dr. Sung's supposed definition, the "cutting depth" terms are amenable to two inconsistent interpretations that lead to materially different outcomes—one that can satisfy the claim limitation and the other that does not—and thus, the "cutting depth" terms are indefinite.

102. I further understand that in Plaintiff's P.R. 4-2 Disclosures, Plaintiff identified extrinsic evidence that purportedly supports his position that no construction is necessary. Pl's P.R. 4-2 Disclosures dated Apr. 24, 2024, at 14-15, 31-35 (citing documents). I have reviewed each of those documents and they do not change my conclusions.

103. I understand that Dr. Sung argues that "[n]umerous technical publications on CMP pad conditioning have used th[e] term" "cutting depth," citing to Lee, et al., *Approaches to Sustainability in Chemical Mechanical Polishing (CMP): A Review* (the "Lee Publication") and Nguyen, et al., *Analysis and improvement of the pad wear profile in fixed abrasive polishing* (the "Nguyen Publication"). Dr. Sung's TI Opening Claim Construction Br. at 23 (citing Exs.6 and 7 in D.I. 49-3 and 49-4 of the TI Case). But those publications do not change my analysis for two reasons. First, those publications were published in 2021 and 2015, respectively, after the priority dates of the '862 and '802 Patents. As such, those publications do not show how a POSITA would have understood the term "cutting depth" at the time of the priority dates of the '862 and '802 patents. Second, although those publications do use the term "cutting depth," they fail to shed any

light on how a POSITA would have understood the term "cutting depth." The Lee Publication does not explain what it means by "cutting depth," much less how the "cutting depth" should be measured. The Nguyen Publication shows graphs with "number of passes" and "pad diameter" and merely states that the "total number of abrasive grains distributed on the conditioner did not influence the pad wear profile but affected the cutting depth on the pad part which is conditioned." *Sung v. Texas Instruments Incorporated*, No 4:23-CV-00753 (E.D. Tex.), D.I 49-4 at 4. But nowhere does the Nguyen Publication explain what it means by "cutting depth."

104. Accordingly, I conclude that the "cutting depth" terms are indefinite because their scope cannot be determined with reasonable certainty.

D. The "Tip Variation" Terms

105. The "tip variation" terms appear only in the asserted claims of the '802 Patent, as shown in the table below.[8]

Claims	Term
'802 Patent	
1	"wherein a tip of each of the plurality of superabrasive particles aligns along a designated profile with a tip variation of from about 5 microns to about 100 microns"
13	"wherein the highest protruding tip of each of the plurality of superabrasive particles aligns along the designated profile with a tip variation of from about 10 microns to about 50 microns"
14	"wherein the highest protruding tip of each of the plurality of superabrasive particles align along the designated profile with a tip variation of from about 20 microns to about 40 microns"
15	"wherein the highest protruding tip of each of the plurality of superabrasive particles align along the designated profile with a tip variation of less than about 20 microns"

[8] All claims depending on a claim reciting a "tip variation" term require that limitation by virtue of their dependency.

106. Based on my review of the intrinsic and extrinsic evidence, I conclude that the "tip variation" terms are indefinite because the terms fail to inform the scope of the claimed invention to a POSITA with reasonable certainty.

107. The "tip variation" terms are ambiguous because it is unclear ***what*** variation is being quantified. The "tip variation" terms are amenable to two inconsistent interpretations that result in materially different outcomes, where a structure can satisfy the claim term under one interpretation but not satisfy the claim term under another interpretation. Therefore, it would be impossible for a POSITA to determine the scope of the invention with reasonable certainty.

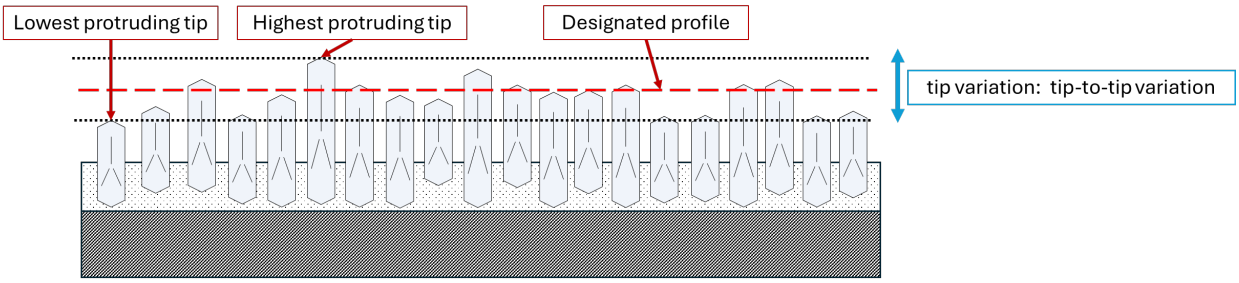
108. For example, claim 1 recites "wherein a tip of each of the plurality of superabrasive particles aligns along a designated profile with a tip variation of from about 5 microns to about 100 microns." This limitation can be interpreted in at least two different ways:

109. First, this limitation can be reasonably interpreted to mean that the ***tip-to-tip variation*** of the plurality of superabrasive particles is from about 5 microns to about 100 microns. In other words, the distance between the highest tip and lowest tip is between "about 5 microns and about 100 microns."

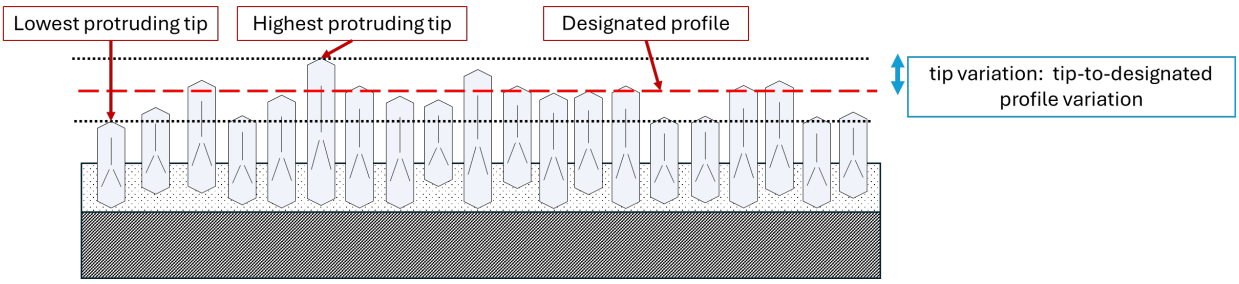
110. Second, this limitation can also be reasonably interpreted to mean that the ***tip-to-designated profile variation*** of the plurality of superabrasive particles is from "about 5 microns to about 100 microns." In other words, the distance between the highest / lowest tip and the designated profile is between "about 5 microns and about 100 microns."

111. The two interpretations are illustrated below:

First Interpretation:



Second Interpretation:



112. I understand that Plaintiff contends that the "tip variation" terms should be interpreted under the second interpretation (i.e., as the ***tip-to-designated profile variation***). Dr. Sung's TI Opening Claim Construction Br. at 17-21. Specifically, Plaintiff contends:

> [C]laim 1 of the '802 patent recites, "wherein a tip of each of the plurality of superabrasive particles aligns along a designated profile with a tip variation of from about 5 microns to about 100 microns" ['802 Patent at 27:61-64] and ***the specification states, "tips vary from the designated profile by from about 5 microns to about 100 microns"*** ['802 Patent at 11:50-52]. This is a ***one-to-one correspondence of the claims aligning with the specification***, unambiguous intrinsic evidence as to at least one meaning of the claim language.

Dr. Sung's TI Opening Claim Construction Br. at 17-18 (emphasis added). Plaintiff further stated:

> Additionally, immediately before the paragraph of the specification describing how "tips vary," the specification describes a "designated profile" and that "the highest protruding tip of each of the plurality of superabrasive particles align along" that designated profile. ['802 Patent, 11:29-35.] It is understood that "some level of deviation may occur" with regard to this alignment. ['802 Patent, 11:35-37.] The specification also makes clear that, "when referring to the designated profile, it should be noted that the term 'tip' is intended to include the highest protruding point of a superabrasive particle." ['802 Patent, 11:42-44.] The very next sentence states, "As such, in one aspect the plurality of superabrasive particles are arranged

> such that ***their tips vary from the designated profile by from about 1 micron to about 150 microns***." ['802 Patent, 11:46-49.]

Dr. Sung's TI Opening Claim Construction Br. at 18-19 (emphasis added).

113. However, as I explained above, the "tip variation" terms can also be interpreted under the first interpretation (i.e., as a ***tip-to-tip variation***). The specification supports this first interpretation as well. For example, the specification explains that "superabrasive tip alignment ***can additionally be described in terms of height distribution***, or in some cases ***protrusion distance from the support substrate***." '802 Patent, 11:12-16, 11:16-20 (describing the benefits of CMP pad dressers with "[a]n even height distribution of superabrasive particles … compared to CMP pad dressers lacking such an even height distribution"). The specification further explains that "each of the plurality of superabrasive particles can be defined by a protrusion distance from an exposed surface of a binding material from which they ***protrude to a predetermined height***" where "the ***predetermined height may vary*** between tool applications" and then describes several embodiments under this view (e.g., "the predetermined height may be greater than about 20 microns," "the ***variation from the predetermined height*** may be from about 1 micron to about 20 microns," "the ***variation from the predetermined height*** may be from about 5 microns to about 20 microns," "the ***variation from the predetermined height*** may be from about 10 microns to about 20 microns."). '802 Patent, 12:18-30; '802 Patent, 21:27-31 (describing "***variations in tip height level***" irrespective of any profile). The specification further describes an embodiment in Figure 1 that explains how to measure the difference in protrusion distance between two particles irrespective of any profile, but not how to measure the difference in protrusion distance compared to a designated profile.

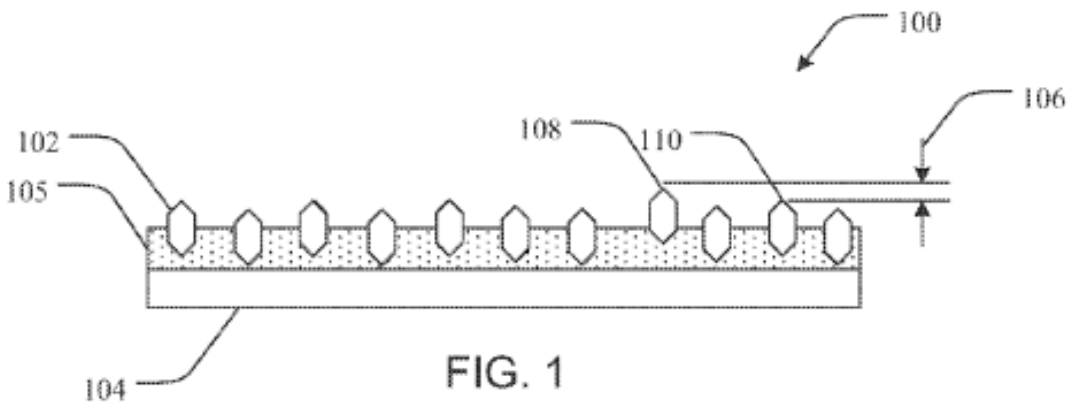


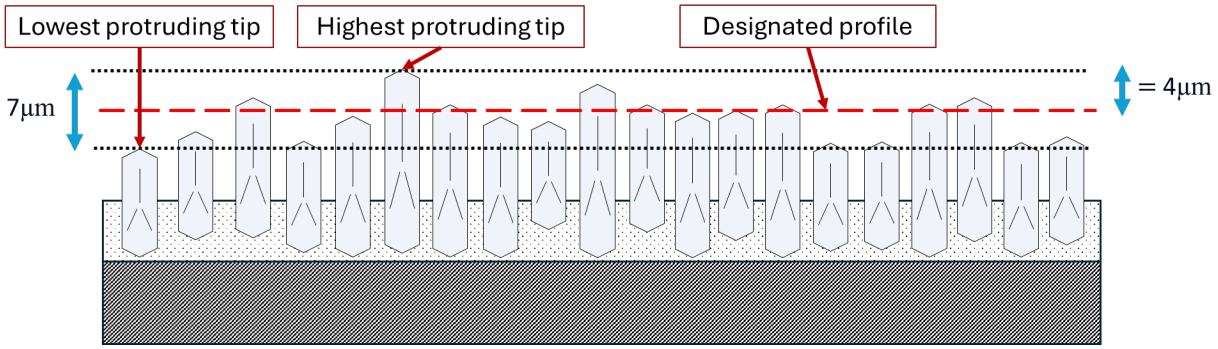
FIG. 1

’802 Patent, Fig. 1, 18:26-42.

114. I have reviewed additional intrinsic evidence (including patents and applications in the same patent family and their prosecution histories) and have not seen any guidance that would have informed a POSITA to apply one interpretation over the other. I am also unaware of any relevant extrinsic evidence that would have informed a POSITA to apply one interpretation over the other. Because the intrinsic evidence demonstrates that the “tip variation” terms are subject to multiple interpretations leading to materially different outcomes without any clear indication of the correct interpretation, and there is no extrinsic evidence weighing in favor of one interpretation over the other, a POSITA would not know with reasonable certainty which interpretation to apply. Accordingly, the “tip variation” terms are indefinite.

115. The indefiniteness of the “tip variation” terms is readily apparent when considering a CMP pad conditioner with diamond particles as illustrated below. In this example, the CMP pad conditioner has tips of superabrasive particles aligned along a planar designated profile. The tip-to-tip variation, i.e., the distance between the highest protruding tip and the lowest protruding tip is 7 microns. However, for the tip-to-designated profile variation, the distance between the highest / lowest protruding tip and the designated profile is 4 and 3 microns, respectively. Accordingly, depending on how the “tip variation” is measured, the same structure has different “tip variation”

values: 7 microns in the tip-to-tip measurement and 4 and 3 microns in the tip-to-designated profile measurement. And because claim 1 recites "wherein a tip of each of the plurality of superabrasive particles aligns along a designated profile with a tip variation of ***from about 5 microns to about 100 microns***," the structure would satisfy the limitation under the first interpretation of the "tip variation," but not under the second interpretation. *See* '802 Patent, cl. 1 (emphasis added). Because the "tip variation" limitation is amenable to two inconsistent interpretations—one that can satisfy the limitation and the other that does not—the "tip variation" limitations are indefinite.



116. I further understand that in Plaintiff's P.R. 4-2 Disclosures, Plaintiff identified extrinsic evidence that purportedly supports his position that no construction is necessary. Pl's P.R. 4-2 Disclosures dated Apr. 24, 2024, at 21-23 (citing documents). I have reviewed each of those documents and they do not change my conclusions. Those documents do not shed light on the meaning of "tip variation" or how to calculate it in the context of the '802 Patent.

117. Accordingly, I conclude that the "tip variation" terms are indefinite because their scope cannot be determined with reasonable certainty.

I declare under the penalty of perjury under the laws of the United States of America that the foregoing declaration is true and correct.

Executed on: May 15, 2024 By: Stanley Shanfield

Dr. Stanley Shanfield

Appendix A

Stanley Shanfield

Curriculum Vitae for Stanley Shanfield

Education:

Massachusetts Institute of Technology, Ph.D., Physics, 1981

University of California, Irvine, B.S. Cum Laude, Physics, 1977

Educational Awards:

Outstanding Research Project, U.C. Regents Award, 1977

Phi Beta Kappa, 1977

Four Year Scholarship, Tuition & Research, ERDA/DOE, 1977-1981

Hands-On Professional Expertise:

Semiconductor Physics & Chemistry
Semiconductor Fabrication: Silicon and III-V Materials
Semiconductor Device & Integrated Circuit Engineering
Semiconductor Equipment: Front & Back End
Semiconductor Packaging Design and Manufacturing
Passive Component Design and Manufacturing
RF Design and Fabrication
Digital Design & Fabrication
Semiconductor Manufacturing in Silicon and III-V Materials
MEMS Design and Fabrication: Electrical, Optical, & Sensing Devices
Fiber Optic Device Design and Fabrication
Integrated Optics & Electro-Optical Devices
Plasma Physics

Specialized Training:

Global Positioning Electronics, Systems and Components
Six Sigma Semiconductor Manufacturing
Microwave Engineering
US Patent Law in Technology
Patent Application and Prosecution
Semiconductor Plasma Processing
Thin Film Physics and Technology
MEMS-based Gyroscopes and Accelerometers
Thermoelectric Materials & Technology
Phased Array Radar Engineering
Antennas and Electromagnetic Propagation
Solid State Optical Devices
Fiber Optic Communication System Operation
HALT and HAST Reliability Testing Methods

Professional Experience:

Draper Laboratory Cambridge, MA ***2003 – present***

Division Leader, Advanced Hardware Development
Distinguished Member of Technical Staff
Technical Director

Led division (about 80 staff) in re-invigorating multi-chip integrated circuit module facility, more than doubling associated revenues in two years. By most accounts, made division a viable business & technological entity again. Invented & led implementation of an ultra-miniature electronics fabrication technology which became a top laboratory priority. Led team in realization & fabrication of a newly designed precision MEMS-based gyroscope and associated ASIC. Found funding and led team in developing a miniature power source with energy density at least two orders of magnitude higher than any source previously built. Developed fabrication technology for semiconductor-based low phase noise oscillator design, allowing for receiver operation with extremely low signal strength. Many awards received, most recently, the Draper 2010 Distinguished Performance Award, and 2010 Best Patent Award. Recent work in ASIC process design and circuit design for ultra-high performance government and space systems.

Clarendon Photonics Newton, MA ***2002 – 2003***

Director, Packaging & Integration

30 person photonic chip startup with $18 million 2nd round funding. Invented and productized new, low cost and reliable semiconductor processing, packaging and pig-tailing technology for optical add-drop multiplexer. Established assembly and packaging process and developed control electronics. Partner with Micron Technologies, using their R&D semiconductor facility.

AXSUN Technologies Bedford/Billerica, MA ***1999 – 2002***

Vice President, Operations, Co-Founder
1999 – 2000

Initially three staff members with $6 million funding. Designed, fabricated and productized AXSUN's micro-electromechanical (MEM) Fabry-Perot optical filter. Patents granted on semiconductor processing and control electronics. Completed facility and semiconductor processing design, then completely equipped. Raised 2nd round funding for $36 million. Established process and fabrication facility in Belfast, Northern Ireland for producing thick oxide silicon-on-insulator material.

Director, Manufacturing & Wafer Fab Technology **2000 – 2001**

After 3rd round funding, led device manufacturing, creating wafer fab and assembly infrastructure; hired 70+ people, led production. Delivered first generation product for revenue to multiple customers. Converted pure technology to dominant company revenue with high yield.

Company purchased by Volcano Technologies, San Diego.

Raytheon Corporation Lexington/Andover, MA ***1985 - 1999***

Manager, Semiconductor Operations **1996 – 1999**

Built and led a 300 employee, $60 million revenue 24/7 semiconductor development and manufacturing operation resulting from the consolidation of a number of smaller organizations. Key player in technological development and recipient of Raytheon's 6 Sigma Leadership training. Decision maker in Texas Instrument group acquisition, providing significant expert opinion on semiconductor and design facilities. Obtained state-of-art yields using best available steppers, deep reactive ion etching, plasma assisted CVD, and ion-implantation equipment, and disciplined design-for steppers, deep reactive ion etching, plasma assisted CVD, and ion-implantation equipment, and disciplined design-for-manufacturing
circuit design and layout methodology.

Research Laboratory Manager **1992 – 1996**

Leader of a 90 employee development and contract research organization in high performance semiconductor devices and circuits, measurement, assembly and wafer fab. Led a team which invented and implemented a major revenue generating technology (.$100 million) based on semiconductor device development (pseudomorphic high electron mobility transistor). Increased outside research funding by 50% in 3 years through superior technical performance relative
to competitors.

Section Manager, Semiconductors & ICs **1985 – 1992**

Led a MM-Wave Circuit and Module Development program over 2 years, leading to production win of a satellite terminal electronics generating $320 million in sales. Developed processes for fabricating high power, high frequency multi-function integrated circuits, and combining high performance digital and analog devices in a single integrated circuit.

Spire Corporation Bedford, MA ***1981 – 1984***

Staff Scientist
Senior Staff Scientist

Developed new methods for low temperature deposition of plasma-assisted CVD epitaxial silicon. Wrote joint papers with MIT professor, and had process adopted by equipment manufacturers. Built, operated and characterized ion-assisted deposition system for making coating for semiconductor and machine tool industries. Process eventually purchased by Kennametal, Inc.

Publications

Restricted Publications & Reports

Process Sequence for Formation of Ultra-High Density Multi-Chip Modules:
A high yield, low cost method for creating a system-in-a-package consisting of numerous semiconductor die, passive components, and sensors. Process formed basis for new (2008) facility.

Design and Method of Fabrication of Ultra-High Density Radioisotope Power Source:
In test, a miniature power source that achieves energy density more than 1000X the best chemical battery. Method uses planar semiconductor processing of bulk thermoelectric materials.

Design and Method of Achieving Extremely Low Crystal Oscillator Phase Noise:
Method developed for very low power refrigeration of quartz or sapphire crystal resonators, resulting in extremely low phase noise oscillators. The low phase noise allows extremely high sensitivity in digital receivers, including GPS receivers, leading to use in extremely low signal conditions.

Design, Evaluation & Production of MEMS-based Fabry-Perot Interferometer:
Design and method for ultra-compact spectral analyzer made using semiconductor and optical thin film processing.

Design & Evaluation of Ultra-Fast Control Electronics for Integrated Optical Multiplexer:
Design and performance evaluation of silicon-based integrated optical multiplexer using chip-based local heating

Design and Fabrication of Q-band MILSTAR Communications Terminal Transmitter:
Record power and efficiency 44 GHz transmitter design using new transistor design, and combined waveguide

Key Publications (selected)

Process Characterization of PSG and BPSG Plasma Deposition, J. Electrochem. Soc., Volume 131, Issue 9, pp. 2202-2203

A double-recessed Al0.24GaAs/In0.16GaAs pseudomorphic HEMT for Ka- and Q-band power Applications, Electron Device Letters, IEEE, Volume 14, Issue 9, pp. 456 - 458

Formation of Thick Metal Structures on GaAs MMICs Using Image Reversal Lithography and Evaporated Metal Deposition, J. Electrochem. Soc., Volume 136, Issue 9, pp. 2687-2690

Contact Hole Etching in Load-Locked Hexagonal Reactive Ion Etch System, J. Electrochem. Soc., Vol. 131, No. 8, 1984

An AlGaAs/InGaAs pseudomorphic high electron mobility transistor with Improved Breakdown Voltage for X and Ku-band power applications, Microwave Theory and Techniques, IEEE Transactions on, Volume 41, Issue 5, May 1993, pp. 752 - 759

Hot-electron-induced Degradation of Metal-Semiconductor Field-Effect Transistors, Integrated Circuit Symposium, 1994. Technical Digest 1994., 16th Annual Volume , Issue , 16-19 Oct. 1994, pp. 259

Ion Beam Deposition of Cubic Boron Nitride, J. Vac. Sci. Technol. A Volume 1, Issue 2, pp. 323-325

Patents

US Patent 6504235 - Passivation layer and process for semiconductor devices
Method of coating semiconductor devices that prevented parametric shift in electrical performance. Solved key processing problem.

US Patent 4440108 - Ion Beam Deposition Apparatus
Design of equipment for deposition of thin films in the presence of ion bombardment. System produced thin films of interest for mechanical, electrical and optical properties and was sold as an equipment product.

US Patent 6525880 - Integrated Tunable Fabry-Perot filter and Method of Making Same
Design and method for fabricating very small, very high performance variable optical filter using semiconductor fabrication technology. In current use in fiber optical networks, chemical sensors, and 3-D medical imaging applications.

US Patent 5175020 - Boron Nitride Films and Process of Making Same
Ion assisted deposition of ultra-hard cubic boron nitride films for semiconductor and machine tool applications. Significant use in both areas.

US Patent 4526673 - Coating Method
Method for deposition of thin films used in semiconductor device fabrication. Method based on direct control of the kinetics of thin film deposition.

US Patent 7727806 - Systems and Methods for High Density Multi-Component Modules
Method for fabrication of electronic modules using multiple thinned integrated circuits, patterned multi-level interconnects, passive electronic components, and sensors

US Patent Application 2009/TBD - Devices, systems, and methods for controlling the temperature of resonant elements
Devices and systems for achieving low phase noise crystal oscillators using unique low power thermoelectric structures

Contact information for Stanley Shanfield

STANLEY SHANFIELD
342 Otis Street
Newton, MA 02465

Phone:
617-969-9574 (home)
617-258-3392 (office)
617-699-7262 (mobile)
Email: shanfield@alum.mit.edu