

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

KINIK COMPANY,

Petitioner

v.

CHIEN-MIN SUNG,

Patent Owner

U.S. Patent No. 9,724,802

Issue Date: August 8, 2017

Title: CMP PAD DRESSERS
HAVING LEVELED TIPS AND ASSOCIATED METHODS

Inter Partes Review No. IPR2021-00638

DECLARATION OF DR. STANLEY SHANFIELD

TABLE OF CONTENTS

| | | |
|--------------|--|----|
| I. | INTRODUCTION | 4 |
| II. | BACKGROUND AND EDUCATION | 4 |
| III. | SUMMARY OF MY OPINIONS | 5 |
| IV. | UNDERSTANDING OF THE GOVERNING LAW | 6 |
| | A. Types of Claims - Independent and Dependent | 6 |
| | B. Claim Interpretation | 6 |
| | C. Invalidity by Anticipation or Obviousness | 7 |
| | D. Motivation to Combine | 8 |
| | E. Secondary or Objective Evidence of Obviousness or Nonobviousness | 9 |
| | F. Relevant Time Period For The Obviousness Analysis | 10 |
| | G. Level of Ordinary Skill In The Art In The Relevant Timeframe | 10 |
| V. | DOCUMENTS RELIED UPON | 11 |
| VI. | STATE OF THE ART AT THE TIME OF THE INVENTION | 13 |
| | A. U.S. Patent Publication No. 2012/0302146A1 (the “146 Publication”) [Ex. 1010] | 15 |
| | B. U.S. Patent Application Publication No. US 2007/0155298A1 (the “298 Publication”) [Ex. 1011] | 18 |
| | C. TW Patent Application Publication No. TW 201341113 (the “Taiwan 113 Publication”) [Ex. 1013] | 21 |
| | D. File History of U.S. Patent No. US 9,138,862 B2 (the “862 FH Art”) [Ex. 1014] | 24 |
| | E. “The Fabrication of Ideal Diamond Disk (IDD) by Casting Diamond Film on Silicon wafer,” James C. Sung et al., International Conference on Planarization/CMP Technology, Oct. 25–27, 2007 (“CMP Reference”) [Ex. 1015] | 27 |
| VII. | PROSECUTION HISTORY OF THE ’802 PATENT | 30 |
| VIII. | THE ’802 PATENT | 32 |
| IX. | CLAIM-BY-CLAIM INVALIDITY ANALYSIS | 33 |
| | A. Ground 1: Claims 1–5, 13, and 20 are anticipated by the 146 Publication. | 33 |
| | 1. Claim 1 | 33 |
| | 2. Claim 2 | 40 |
| | 3. Claim 3 | 41 |
| | 4. Claim 4 | 42 |
| | 5. Claim 5 | 42 |
| | 6. Claim 13 | 43 |
| | 7. Claim 20 | 44 |

| | | |
|-----------|--|-----------|
| B. | Ground 2: Claims 1–7 and 13–21 are unpatentable because they are obvious over the 146 Publication in view of the 298 Publication..... | 45 |
| | 1. Claim 1 | 45 |
| | 2. Claims 2–5, 13, and 20 | 47 |
| | 3. Claim 6 | 48 |
| | 4. Claim 7 | 49 |
| | 5. Claim 14 | 50 |
| | 6. Claim 15 | 51 |
| | 7. Claim 16 | 52 |
| | 8. Claim 17 | 53 |
| | 9. Claim 18 | 53 |
| | 10. Claim 19 | 54 |
| | 11. Claim 21 | 55 |
| C. | Ground 3: Claims 1–7, and 13-21 are unpatentable because they are obvious over the Taiwan 113 Publication in view of the 298 Publication..... | 56 |
| | 1. Claim 1 | 56 |
| | 2. Claim 2 | 63 |
| | 3. Claim 3 | 64 |
| | 4. Claim 4 | 65 |
| | 5. Claim 5 | 65 |
| | 6. Claim 6 | 66 |
| | 7. Claim 7 | 67 |
| | 8. Claim 13 | 67 |
| | 9. Claim 14 | 68 |
| | 10. Claim 15 | 69 |
| | 11. Claim 16 | 69 |
| | 12. Claim 17 | 70 |
| | 13. Claim 18 | 71 |
| | 14. Claim 19 | 71 |
| | 15. Claim 20 | 72 |
| | 16. Claim 21 | 73 |
| D. | Ground 4: Claims 8–12 are unpatentable because they are obvious over the Taiwan 113 Publication in view of the 298 Publication and the CMP Reference..... | 74 |
| | 1. Claim 8 | 74 |
| | 2. Claim 9 | 75 |
| | 3. Claim 10 | 76 |
| | 4. Claim 11 | 76 |
| | 5. Claim 12 | 77 |
| E. | Ground 5: Claims 1-3, 6-11, and 13-20 are unpatentable under because they are anticipated by the 862 FH Art | 78 |
| | 1. Claim 1 | 78 |
| | 2. Claim 2 | 84 |
| | 3. Claim 3 | 84 |

| | | |
|-----------|---|----|
| 4. | Claim 6 | 85 |
| 5. | Claim 7 | 86 |
| 6. | Claim 8 | 86 |
| 7. | Claim 9 | 87 |
| 8. | Claim 10 | 88 |
| 9. | Claim 11 | 89 |
| 10. | Claim 13 | 90 |
| 11. | Claim 14 | 92 |
| 12. | Claim 15 | 92 |
| 13. | Claim 16 | 93 |
| 14. | Claim 17 | 94 |
| 15. | Claim 18 | 94 |
| 16. | Claim 19 | 95 |
| 17. | Claim 20 | 96 |
| F. | Ground 6: Claims 4-5 are unpatentable because they are obvious over the 862 FH Art by itself or in view of the 146 Publication | 97 |
| 1. | Claim 4 | 97 |
| 2. | Claim 5 | 98 |
| G. | Ground 7: Claim 12 is unpatentable as obvious over the 862 FH Art in view of the CMP Reference | 98 |
| 1. | Claim 12 | 98 |
| X. | OVERALL CONCLUSIONS | 99 |

I. INTRODUCTION

1. I am over the age of twenty one (21) and am competent to make this Declaration.

2. I have been retained by Kinik Company (“Kinik” or “Petitioner”) to provide my opinions concerning claims 1–21 of U.S. Patent No. 9,724,802 (“the ’802 Patent”). I am being compensated for my time by the hour in preparing this declaration, but my compensation is not tied to the outcome of this matter.

II. BACKGROUND AND EDUCATION

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

4. After obtaining my Ph.D. in 1981, I joined Spire Corporation in Bedford, Massachusetts as a Staff Scientist. I joined Raytheon Corporation in Lexington/Andover, Massachusetts in 1985 as a Section Manager in Semiconductors and Integrated Circuits and later became Manager of Semiconductor Operations. In 1999, I joined AXSUN Technologies in Bedford/Billerica, Massachusetts as Vice President of Operations and later Director of Manufacturing and Wafer Fab Technology. I joined Clarendon Photonics in Newton, Massachusetts in 2001 as Director of Packaging and Integration.

5. I came to Draper Laboratory in Cambridge Massachusetts in 2003 after spending fourteen years at Raytheon. I am currently Division Leader of Advanced Hardware Development (with around 80 staff members), a Distinguished Member of Technical Staff, and Technical Director. I have led the Advanced Hardware Development division in re-invigorating a multi-chip integrated circuit module facility. I have invented and led implementation of an ultra-miniature electronics fabrication technology. I have also developed fabrication technology for semiconductor-based low phase noise oscillator design. During my time at Draper, I have received many awards, including the Draper 2010 Distinguished Performance Award and the 2010 Best Patent Award.

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

7. A copy of my curriculum vitae is submitted herewith as Exhibit 1004.

III. SUMMARY OF MY OPINIONS

8. In my opinion, claims 1–21 of the '802 Patent are invalid as anticipated and/or rendered obvious in view of the prior art.

9. In forming my opinion, I have reviewed and relied on the '802 Patent itself (Ex. 1001), the file history of the '802 Patent (Ex. 1002), the prior art exhibits to the Petition for the IPR of the '802 Patent (Exs. 1010-1017), the declaration by Dr. Sylvia Hall-Ellis and supporting documents (Exs. 1018-1022), my own

experience and expertise in this field, and my belief as to the knowledge of the person of ordinary skill in the relevant art in the 2014 timeframe.

10. I understand that the Patent Owner may submit evidence in rebuttal to my declaration. I intend to review any such evidence and update my opinions if allowed and appropriate.

IV. UNDERSTANDING OF THE GOVERNING LAW

11. I am not an attorney. However, I have been provided with a summary of the applicable law.

12. Specifically, I am informed that an invalidity analysis involves two primary steps. First, the claim language must be construed to determine its proper scope and meaning. Second, the claim language, as construed, must be compared to the prior art using the guidelines below.

A. Types of Claims - Independent and Dependent

13. I understand that there are two types of U.S. patent claims: 1) independent claims and 2) dependent claims. I understand that independent claims only include the aspects stated in the independent claim. I further understand that dependent claims include the aspects stated in that dependent claim, plus any aspects stated in any other claim(s) from which that dependent claim depends.

B. Claim Interpretation

14. Based on my review of the '802 Patent, the claim term “a designated profile” refers to “a predetermined contour above a support substrate to which a plurality of superabrasive particles are intended to align,” as provided in the '802 Patent. (Ex. 1001 at 6:21–25.) Based on my experience, this definition is consistent with the term’s plain and ordinary meaning that a person of ordinary skill in the art (“POSITA”) would have given to each claim term as of the priority date of the '802 Patent (October 3, 2014).

C. Invalidity by Anticipation or Obviousness

15. I understand that a claim is invalid if it is anticipated or rendered obvious by prior art. I understand that anticipation of a claim requires that every element of a claim is disclosed expressly or inherently in a single prior art reference, arranged as in the claim. With regard to inherency, I understand that anticipation by inherency requires that a POSITA would have recognized that the missing descriptive matter is necessarily present in the subject matter described in the reference.

16. I further understand that obviousness of a claim requires that the claim be obvious from the perspective of a POSITA at the time the invention was made. In analyzing obviousness, I understand that it is important to understand the scope of the claims, the level of skill in the relevant art, the scope and content of the prior

art, the differences between the prior art and the claims, and any secondary considerations.

17. I am informed that obviousness may be shown by demonstrating that the invention would be obvious to a POSITA at the time of the invention. An invention may be shown to be obvious based on the teachings of a single prior art reference. An invention may also be shown to be obvious based on the teachings of multiple prior art references, for example, by showing that it would have been obvious to a POSITA to combine the multiple prior art references.

D. Motivation to Combine

18. I understand that there are multiple factors that may be considered in determining whether a POSITA would be motivated to combine multiple prior art references. Factors that may support a conclusion of obviousness may include:

- combining prior art elements according to known methods to yield predictable results;
- simple substitution of one known element for another to obtain predictable results;
- use of known technique to improve similar devices (methods or products) in the same way;
- applying a known technique to a known device (method or product) ready for improvement to yield predictable results;

- “obvious to try” – choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success;
- known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to a POSITA;
- some teaching, suggestion, or motivation in the prior art that would have led a POSITA to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention;
- design need;
- market pressure; and
- when there are a finite number of predictable solutions to a problem.

19. I am informed that I cannot rely on hindsight. In other words, I cannot rely on the teachings of the patent or its claims to show that the claims are obvious. I am informed that a POSITA is a person of ordinary creativity, not an automaton, and that familiar items may have obvious uses beyond their primary purposes. In many cases, a POSITA will be able to fit the teachings of multiple patents or prior art together like pieces of a puzzle.

E. Secondary or Objective Evidence of Obviousness or Nonobviousness

20. I understand that secondary (or objective) considerations are relevant to the determination of whether a claim is obvious. Such secondary (or objective) considerations may include evidence of commercial success caused by an invention, evidence of a long-felt need that was solved by an invention, evidence that others copied an invention, or evidence that an invention achieved a surprising result. I understand that such evidence must have a nexus, or causal relationship to the elements of a claim, in order to be relevant to the obviousness or non-obviousness of the claim. I am presently unaware of any such secondary considerations in relation to claims 1-21 of the '802 Patent.

F. Relevant Time Period For The Obviousness Analysis

21. I also understand that the application that led to the '802 Patent was filed on October 3, 2014. Therefore, for the purposes of this declaration, I have analyzed invalidity as of October 3, 2014, and more generally as of the 2014 time frame.

G. Level of Ordinary Skill In The Art In The Relevant Timeframe

22. I am informed that a POSITA is a hypothetical person who is presumed to have known the relevant art at the time of the invention, which is October 3, 2014 in this proceeding. Factors that may be considered in determining the level of ordinary skill in the art may include: (A) type of problems encountered in the art; (B) prior art solutions to those problems; (C) rapidity with which

innovations are made; (D) sophistication of the technology; and (E) educational level of active workers in the field. In a given case, every factor may not be present, and one or more factors may predominate.

23. I believe that a relevant POSITA of the '802 Patent at its priority date (i.e., October 3, 2014) would have had a Bachelor's degree in an engineering related field, such as electrical engineering, mechanical engineering, material science, or physics, and a minimum of two to three years of experience in the field of integrated circuit processing and fabrication techniques. This description is an approximate, and a higher level of education or specific skill might make up for less experience, and vice-versa.

24. I believe I have a sufficient level of knowledge, experience, and education to provide an expert opinion in the field of the '802 Patent at its priority date, including what a POSITA would have understood from the prior art in this field at that time.

V. DOCUMENTS RELIED UPON

25. In forming my opinions, I have relied upon the following documents:

| EXHIBITS | DESCRIPTION |
|-----------------|---|
| 1001 | U.S. Patent No. 9,724,802 to Chien-Min Sung (the "'802 Patent") |
| 1002 | File History of the '802 Patent |
| 1003 | Declaration of Dr. Stanley Shanfield |

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| 1004 | Curriculum Vitae of Dr. Stanley Shanfield |
| 1005 | Complaint, <i>Sung v. Kinik Co.</i> , No. 1:20-cv-00247-RGA (D. Del. Feb. 20, 2020), ECF No. 1 |
| 1006 | Summons, <i>Sung v. Kinik Co.</i> , No. 1:20-cv-00247-RGA (D. Del. Feb. 20, 2020), ECF No. 6 |
| 1007 | Oral Order, <i>Sung v. Kinik Co.</i> , No. 1:20-cv-00247-RGA (D. Del. Sept. 28, 2020), ECF No. 24 |
| 1008 | Plaintiff's Letter in Response to the Court's Oral Order, <i>Sung v. Kinik Co.</i> , No. 1:20-cv-00247-RGA (D. Del. Oct. 9, 2020), ECF No. 25 |
| 1009 | Order Denying Stay, <i>Sung v. Kinik Co.</i> , No. 1:20-cv-00247-RGA (D. Del. Dec. 10, 2020), ECF No. 26 |
| 1010 | U.S. Patent Publication No. 2012/0302146 (the "146 Publication") |
| 1011 | U.S. Patent Publication No. 2007/0155298 (the "298 Publication") |
| 1012 | U.S. Patent Publication No. 2013/0078895 (the "895 Publication") |
| 1013 | Taiwan Patent Publication No. TW201341113 ("Taiwan 113 Publication") |
| 1014 | File history of U.S. Patent No. 9,138,862 (the "862 FH Art") |
| 1015 | "The Fabrication of Ideal Diamond Disk (IDD) by Casting Diamond Film on Silicon wafer," James C. Sung et al., International Conference on Planarization/CMP Technology, Oct. 25–27, 2007 ("CMP Reference") |
| 1016 | Taiwan Patent No. TW I417169B |
| 1017 | Taiwan Patent Publication No. 201100198 |
| 1018 | Declaration of Dr. Sylvia D. Hall-Ellis |
| 1019 | Curriculum Vitae of Dr. Sylvia D. Hall-Ellis |
| 1020 | MARC record for the Proceedings of the International Conference on Planarization (ICPT) / CMP Technology obtained from the OCLC bibliographic database |
| 1021 | MARC record for the Proceedings of the International Conference on Planarization (ICPT) / CMP Technology obtained from the OCLC bibliographic database |

| | |
|------|---|
| 1022 | Program and invitation for the 2007 International Conference on Planarization (ICPT) / CMP Technology obtained from the program website |
|------|---|

VI. STATE OF THE ART AT THE TIME OF THE INVENTION

26. Semiconductor technologies rapidly advanced in the late 1990s and early 2000s through the time that the application for the '802 Patent was filed, including technologies directed to chemical-mechanical planarization (“CMP”).

27. It is my understanding that a wide variety of CMP dressers were already well-known before the time the '802 Patent was filed (i.e., October 3, 2014), as evidenced by a succession of patent applications directed to such technologies that pre-date October 3, 2014.

28. For example, U.S. Patent Publication No. 2013/0078895 (the “895 Publication”), published on March 28, 2013, is directed to an “an abrasive tool for use as a chemical mechanical planarization (CMP) pad conditioner, also referred to as a CMP pad dresser.” (Ex. 1012 at ¶ 56.) One of the disclosed embodiments of an abrasive tool in the 895 Publication includes “a CMP pad conditioner having a substrate including a first major surface, a second major surface opposite the first major surface, and a side surface extending between the first major surface and the second major, wherein a first layer of abrasive grains is attached to the first major surface and a second layer of abrasive grains is attached to the second major surface.” (*Id.* at 1 (Abstract).) In the 895 Publication, a “first set of protrusions

extend in an axial direction from a lower surface of the substrate” (*id.* at ¶ 89), where a “substrate can include materials such as metals” or be “made of a metal alloy, such as steel” (*id.* at ¶ 59) and “superabrasive materials such as cubic boron nitride or diamond can be used as the abrasive grains.” (*Id.* at ¶ 65.) In an embodiment, “the first layer of abrasive grains can have a flatness of . . . not greater than about 0.005 cm.” (*Id.* at ¶75.)

29. In another example, Taiwan Patent No. TWI417169 B, issued on and publicly available at least since December 1, 2013, “relates to a diamond cutting tool, particularly to a cutting tool with a plurality of cutting tops.” (Ex. 1016 at 5 (Technical Field).) TWI417169 B further discloses:

Provided is a cutting tool with a plurality of cutting tops, comprising: a base, having a working face facing a work piece; and a plurality of grits, arranged on the working face of the base, wherein the grits are respectively processed and formed to have a processing top, the wedge angle of the tops is 30 to 150 degrees, the attack angle between the grits and the work piece is 30 to 150 degrees respectively, the mutual difference between heights of the tops protruding from the working face is within 20%, and the tops are connected to the upper ends of the crystal faces on the outer sides of the grits respectively to improve the wear resistance of the cutting tool, thereby improving the cutting efficiency and lengthening the service life.

30. Taiwan Patent Publication No. TW 21100198 (published on January 1, 2011) also “relates to a conditioner, particularly to a composite conditioner of a

CMP pad a method for manufacturing the same.” (Ex. 1017 at 6.) It explains that “[c]hemical mechanical planarization (CMP) is currently the most attractive technology in the process of planarization of semiconductor wafers. In the CMP process, the function of a polishing pad is to stably and uniformly transport a polishing solution to between a wafer and the polishing pad.” (*Id.*) TW 21100198 provides that its main object is “to provide a composite conditioner in a way that the same polishing end of a large substrate bonds most of the small substrates having grits, the cutting ends of a plurality of grits are kept at the same height easily and various grits of different sizes, shapes and materials are bonded more easily.” (*Id.* at 8.)

31. In my opinion, as supported by disclosures above, as well as descriptions provided in each of the prior art references summarized below, technologies involving CMP dressers have been common and well-known for quite some time, at least since the early-to-mid 2000s.

A. U.S. Patent Publication No. 2012/0302146A1 (the “146 Publication”) [Ex. 1010]

32. It is my understanding that the 146 Publication was filed as U.S. Patent Application No. 13/479,148 on May 23, 2012, and was later published as U.S. Patent Application Publication No. 2012/0302146 on November 29, 2012. (Ex. 1010 at 1.) It is my understanding that the 146 Publication claims priority to May 23, 2011, based on U.S. Provisional Application No. 61/489,074. (*Id.*) It is

my understanding that the publication date of the 146 Publication is earlier than the priority date of the Challenged Claims (October 3, 2014) and that the 146 Publication qualifies as prior art.

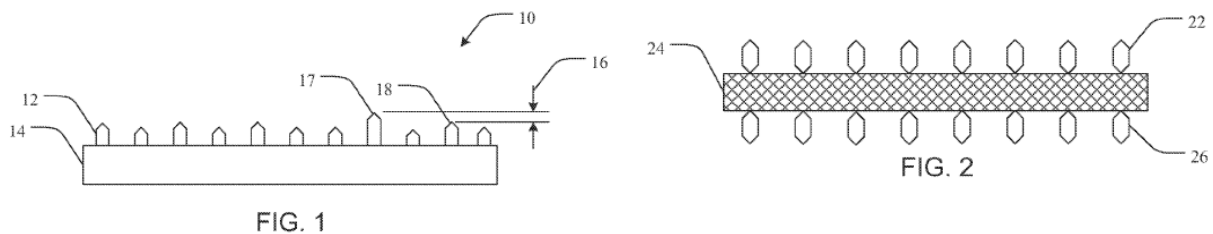
33. The 146 Publication, for example, discloses “CMP pad dressers having leveled tips and associated methods.” (Ex. 1010 at 1 (Abstract).) The 146 discloses many embodiments of CMP pad dressers that disclose the claimed features of the ’802 Patent. (*Id.* at 1.) In the 146 Publication, the terms “conditioner” and “dresser” is “used interchangeably, and refer to a tool used to condition or dress a pad, such as a CMP pad.” (*Id.* at ¶ 21.) “As used herein, ‘superabrasive’ may be used to refer to any crystalline, or polycrystalline material, or mixture of such materials which has a Mohr’s hardness of about 8 or greater.” (*Id.* at ¶ 22.)

34. The 146 Publication provides that the pad conditioners disclosed therein “can be advantageously utilized, for example, in dressing CMP pads that are used in polishing, finishing or otherwise affecting semiconductor materials. Specifically, the present disclosure concerns CMP pad dressers having superabrasive particles with substantially leveled tips.” (Ex. 1010 at ¶ 39.) “The present CMP pad dressers include a layer of superabrasive particles having Substantially leveled tips across the working surface of the finished CMP pad

dresser. A variety of techniques can be utilized to maintain tip leveling, and any such technique is considered to be within the present scope.” (*Id.* at ¶ 41.)

35. In one of the embodiments disclosed in the 146 Publication, “a CMP pad dresser can include a matrix layer and a monolayer of a plurality of superabrasive particles embedded in the matrix, where each superabrasive particle in the monolayer protrudes from the matrix layer. (Ex. 1010 at 1 (Abstract).) In an embodiment disclosed in the 146 Publication, the “difference in the protrusion distance between the highest protruding tip and the next highest protruding tip of the monolayer of superabrasive particles is less than or equal to about 20 microns, and 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.” (*Id.*)

36. Different embodiments of a CMP pad dresser are illustrated in Figures 1 through 5 of the 146 Publication:



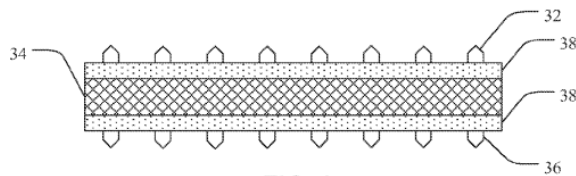


FIG. 3

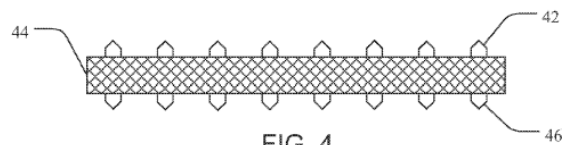


FIG. 4

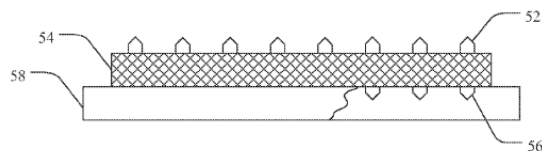


FIG. 5

(Ex. 1010 at 2–3 (Figs. 1–5).)

37. Even the claim language of 146 Publication closely resembles the claims of the '802 Patent. For example, claim 1 of the 146 Publication is as follows:

1. A CMP pad dresser, comprising:
 - a matrix layer;
 - a monolayer of a plurality of superabrasive particles embedded in the matrix layer,
 - wherein each superabrasive particle in the monolayer protrudes from the matrix layer, and
 - wherein 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 and 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.

(Ex. 1010 at 12 (cl. 1).)

B. U.S. Patent Application Publication No. US 2007/0155298A1 (the “298 Publication”) [Ex. 1011]

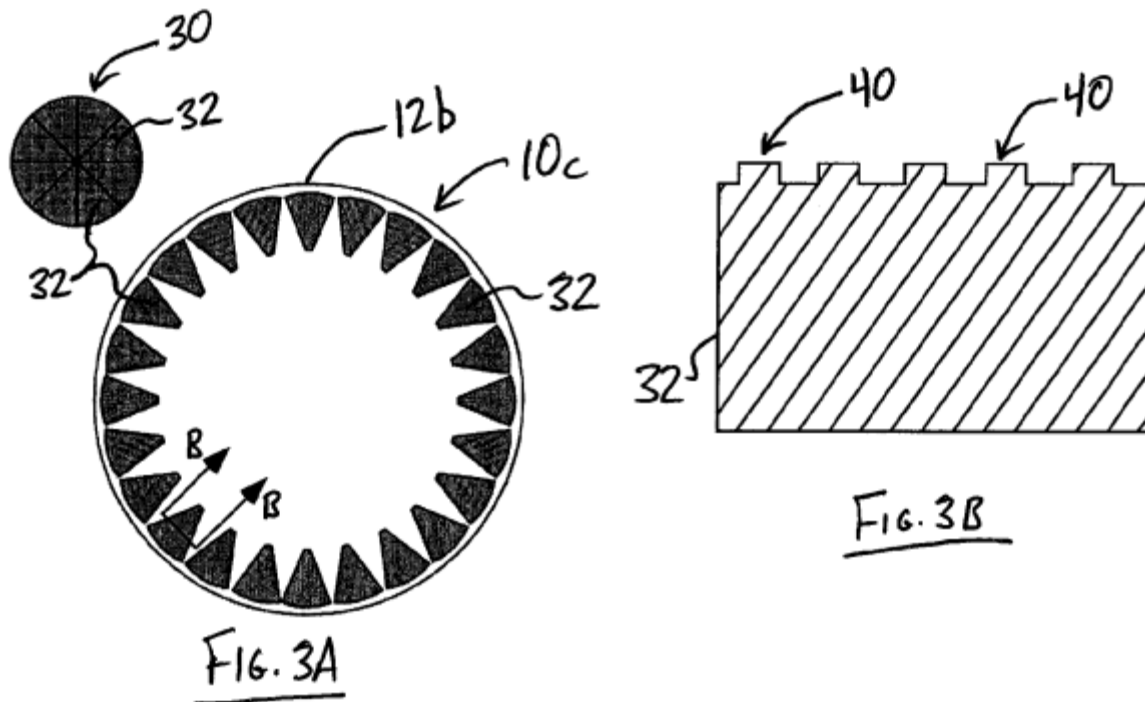
38. It is my understanding that the 298 Publication was filed as U.S. Patent Application No. 11/560,817 on November 16, 2006, and was later published as U.S. Patent Application Publication No. 2007/0155298 on July 5, 2007 (the “298 Publication”). (Ex. 1011 at 1.) It is my understanding that the 298 Publication claims priority to August 24, 2004, based on U.S. Patent Application No. 10/925,894. (*Id.*) It is my understanding that the publication date of the 298 Publication is earlier than the priority date of the Challenged Claims (October 3, 2014) and that the 298 Publication qualifies as prior art.

39. The 298 Publication is directed to reducing “the CMP pad asperities” in “order to polish fragile wafers more and more gently.” (Ex. 1011 ¶7.) It is directed to “conditioners used in dressing CMP pads” and to cutting elements, which refer to “a variety of structures capable of removing (e.g., cutting) material from a workpiece.” (Ex. 1011 ¶¶ 5, 43.)

40. The 298 Publication discloses a “cutting device comprising a base having a solidified organic material layer disposed thereon,” where a “plurality of individual polycrystalline cutting elements are secured in the solidified organic material layer.” (Ex. 1011 at 1 (Abstract).) The 298 Publication discloses that each “of the plurality of individual polycrystalline cutting elements has a substantially matching geometric configuration.” (*Id.*)

41. In the 298 Publication, a “cutting element” refers to “a variety of structures capable of removing (e.g., cutting) material from a working piece,” where a “cutting element can be a mass having several cutting points, ridges or mesas formed thereon or therein.” (Ex. 1011 ¶ 43.) As used in the 298 Publication, a cutting “tip” refers “to a portion of a cutting element that protrudes the greatest distance from a bonding material, e.g., that is the first portion of the cutting element that contacts a workpiece when the article [] is in use.” (*Id.* at ¶ 37.)

42. The 298 Publication discloses several figures illustrating embodiments of a cutting device. For example, Figure 3B shows “an enlarged view of a portion of one cutting element of FIG. 3A, taken along section B-B of FIG. 3A”:



(Ex. 1011 at 4; *see also id.* at 2–7 (showing Figures 1A, 1B, 2A, 2B, 4–12).)

C. TW Patent Application Publication No. TW 201341113 (the “Taiwan 113 Publication”) [Ex. 1013]

43. It is my understanding that the Taiwan 113 Publication was filed as Taiwan Patent Application No. 101112625 on April 10, 2012, and was later published as TW Patent Application Publication No. 201341113 on October 16, 2013. (Ex. 1013 at 1.) It is my understanding that the publication date of the Taiwan 113 Publication is earlier than the priority date of the Challenged Claims (October 3, 2014) and that the Taiwan 113 Publication qualifies as prior art.

44. The Taiwan 113 Publication “relates to a composite conditioner, a method for manufacturing the same and a chemical-mechanical planarization

(CMP) process using the same, particularly to a composite conditioner suitable for planarization of semiconductor wafers, a method for manufacturing the same and a CMP process using the same.” (Ex. 1013 at 6 (under “Technical Field”).)

45. The Taiwan 113 Publication also references other “earlier published patent applications TW 201038362 A1 and TW 201100198 [that] respectively disclose a composite conditioner and a method for manufacturing the same, wherein the sharp corners of the polishing tips of the polishing units of different sizes, shapes and materials pierce into a polishing pad, a pressure is applied on the other side of the polishing units subsequently and resin is filled to fix the polishing units and keep the height difference of the apices of the polishing tips of the polishing units within 20 microns.” (Ex. 1013 at 7.) The Taiwan 113 Publication discusses that “[i]n order to meet the requirements of the processes with a smaller line width, the conditioner needs to be improved continuously to maintain the flatness in the height of the sharp corners of the polishing tips even when sharper polishing tips are used (i.e., the differences in the height of the sharp corners of the polishing tips), to form finer and more uniform scores on the polishing pad and meanwhile, to increase the removal rate of the polishing pad.” (*Id.*)

46. An embodiment of a “composite conditioner” disclosed in the Taiwan 113 Publication includes “a base plate; a plurality of polishing units placed on the base plate and polishing unit including a bonding layer and a plurality of polishing

tips that are bonded in plane by the bonding layer; and an adhesive layer of which thickness is adjustable and used to secure the polishing units on the base plate, wherein a height difference between the first and second highest tips, between the first and tenth highest tips, and between the first and 100th highest tips based on a predetermined plane is respectively less than 10 μm , 20 μm , and 40 μm , and the protrusion height of the first highest tip above the bonding layer is greater than 50 μm .” (Ex. 1013 at 1.) A “comparison diagram of the height difference of tips and the number of working particles among three conditioners including a composite conditioner” manufactured according to an embodiment disclosed in the Taiwan 113 Patent is shown in Figure 3:

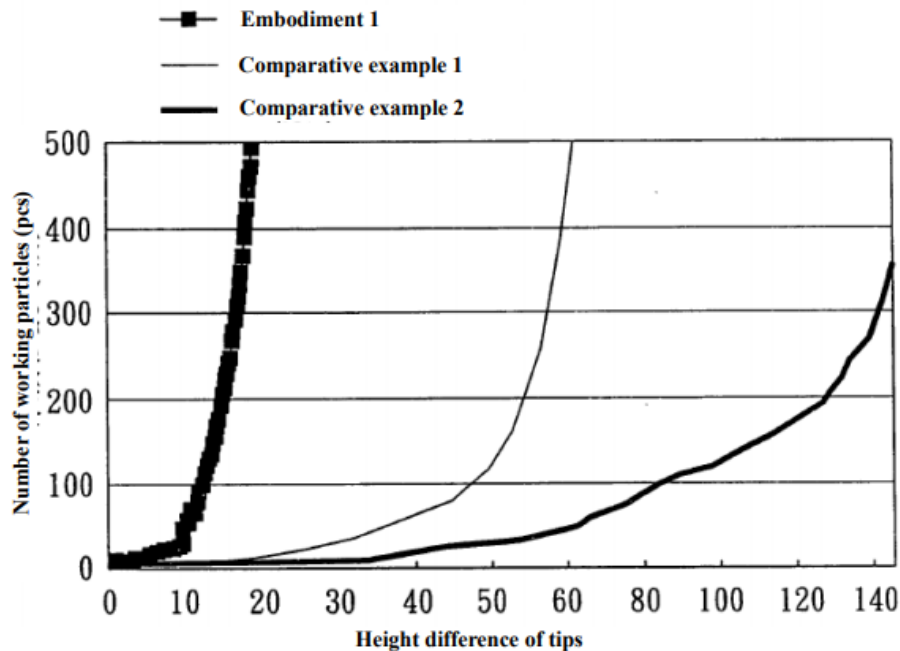


Fig. 3

(Ex. 1013 at 33 (Figure 3).)

47. “From Fig. 3, it may be known that during polishing, the conditioner in Embodiment 1 of the present invention has 60 to 70 working particles within a height difference of about 10 microns; in comparison, comparative example 1 and comparative example 2 need a larger height difference of tips in order to provide more working particles, and when the height difference of grits exceeds 40 microns, the conditioner in comparative example 1 can provide only above 100 working particles. Thus, it can be seen that within the same height difference, the conditioner provided by the present invention has much more working grits than the conventional conditioners do.” (Ex. 1013 at 20.)

D. File History of U.S. Patent No. US 9,138,862 B2 (the “862 FH Art”) [Ex. 1014]

48. It is my understanding that U.S. Patent Application No. 13/802,112 (“the 112 Application”) was filed on March 13, 2013, and issued as U.S. Patent No. 9,138,862 on September 22, 2015. I have been informed that, because the 112 Application claimed priority to an already published patent application, the file history of U.S. Patent No. 9,138,862 became a printed publication as of the date of its filing on March 13, 2013 (the “862 FH Art”). The 112 Application has a CIP claim of priority to U.S. Patent Application No. 13/479,148, filed on May 23, 2012, and published on November 29, 2012. It is my understanding that the 862 FH Art includes at least those portions of the ’862 Patent’s file history that were filed on March 13, 2013, and were immediately publicly available as of the filing

date, including the patent specification and claims. Thus I understand that at least the '862 patent's specification, claims and drawings qualify as prior art as they were submitted in the patent's original file history.

49. The 862 FH Art explains that the “semiconductor industry currently spends in excess of one billion U.S. dollars each year manufacturing silicon wafers that must exhibit very flat and smooth surfaces.” (Ex. 1014 at 7:9–10.) “Known techniques to manufacture smooth and even-surfaced silicon wafers are plentiful,” where the “most common of these involves the process known as Chemical Mechanical Polishing (CMP) which includes the use of a polishing pad in combination with an abrasive slurry.” (*Id.* at 7:10–13.) “Of central importance in all CMP processes is the attainment of high performance levels in aspects such as uniformity of polished wafer, smoothness of the IC circuitry, removal rate for productivity, longevity of consumables for CMP economics, etc.” (*Id.* at 7:13–16.)

50. The 862 FH Art is directed to “efficient methods of conditioning a CMP pad,” where one “such method can include pressing a CMP pad dresser against a CMP pad, where the dresser includes a monolayer of a plurality of superabrasive particles protruding from a matrix layer.” (Ex. 1014 at 1:19–22.)

51. In an embodiment disclosed in the 862 FH Art, 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 and the difference in protrusion distance between the highest 10 protruding tips of the monolayer of superabrasive particles are within about 20 microns or less.” (Ex. 1014 at 1:22–26.) The disclosed method “can further include 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. In another aspect, at least 100 tips of the plurality of superabrasive particles cut asperities into the CMP pad as the dresser is rotated. In another aspect, at least 50 tips of the plurality of superabrasive particles cut asperities into the CMP pad as the dresser is rotated. In a further aspect, at least 25 tips of the plurality of superabrasive particles cut asperities into the CMP pad as the dresser is rotated.” (*Id.* at 1:26–2:3.)

52. Different embodiments of a CMP dresser are disclosed in the 862 FH

Art:

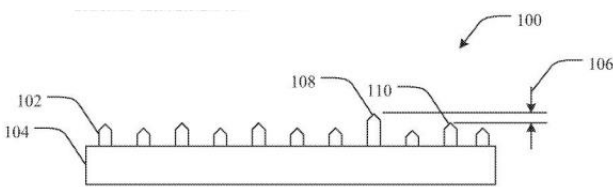


FIG. 1

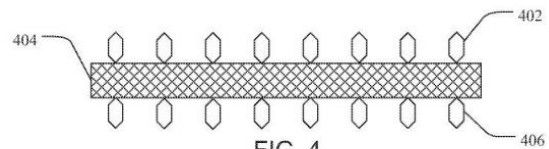


FIG. 4

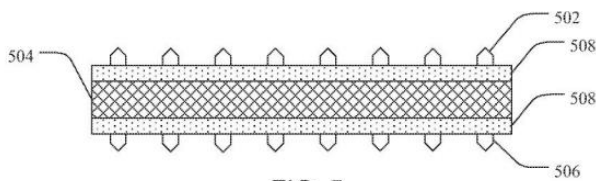


FIG. 5

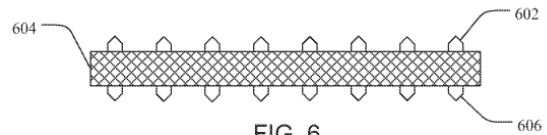


FIG. 6

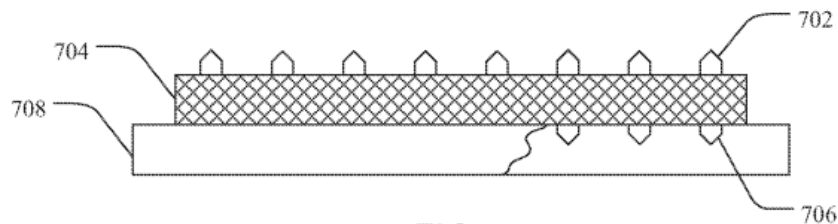


FIG. 7

(Ex. 1014 at 43 – 45 (Figures 1 and 4–7).)

53. Claim language of the 862 FH Art is also instructive:

1. A method of conditioning a CMP pad, comprising:

pressing a CMP pad dresser against a CMP pad, the dresser including a monolayer of a plurality of superabrasive particles protruding from a matrix layer, wherein 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 and the difference in protrusion distance between the highest 10 protruding tips of the monolayer 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.

(Ex. 1014 at 39 (claim 1).)

54. The 862 FH Art also discloses “interactions between the CMP pad and a workpiece being polished,” where “the workpiece is a semiconductor device.” (Ex. 1014 at 2:16-17, 20.)

E. “The Fabrication of Ideal Diamond Disk (IDD) by Casting Diamond Film on Silicon wafer,” James C. Sung et al., International Conference on Planarization/CMP Technology, Oct. 25–27, 2007 (“CMP Reference”) [Ex. 1015]

55. It is my understanding that the CMP Reference was authored by James C. Sung with subject matter coauthors, and that it was publicly available no later than September 28, 2007. (Ex. 1015 at 1; Ex. 1018 ¶ 38.) It is my understanding that the publication date is much earlier than the priority date of the Challenged Claims (October 3, 2014) and that the CMP Reference qualifies as prior art.

56. The CMP Reference explains that “[w]ith the relentless densification of interconnected circuitry dictated by Moore’s Law, the CMP manufacture of such delicate wafers requires the significant reduction of polishing pressure, not only globally, but also locally on every tip of individual pad asperities.” (Ex. 1015 at 1.) To help meet this goal, “a new design of diamond disk was fabricated by casting diamond film on a silicon wafer that contains patterned etching pits. This silicon mold was subsequently removed by dissolution in a hydroxide solution. The diamond film followed the profile of the etching pits on silicon to form pyramids of identical in size and shape. The variation of their tip heights was in microns of single digit that was about one order of magnitude smaller than conventional diamond disks for CMP production.” (*Id.*)

57. In describing what it calls “CMP of Future Semiconductors,” the CMP Reference provides that the “future CMP must be capable to polish precursors of such circuits to within a few nanometers (nm) of the design across a

wafer surface of possibly 450 mm in diameter. Thus, the local deviation of polished depth may be at most one tenth of one PPM (part per million) of the global scale of the wafer.” (Ex. 1015 at 1.) “During the CMP operation, a diamond disk must be used to dress the polyurethane pad that is permeated with abrasive impregnated slurry. The diamond disk contains discrete diamond grits that remove the polishing debris and at the same time groove the pad surface to form asperities.” (*Id.* at 2.)

58. In describing diamond pad conditioners, the CMP Reference provides: “Diamond disks for dressing CMP pads are typically made by attaching discrete diamond grits onto a stainless steel substrate. The bonding matrix is typically a metal that can be formed by either electroplating or brazing. The distribution of diamond grits may be chaotic, clustered, or regular.” (Ex. 1015 at 2.)

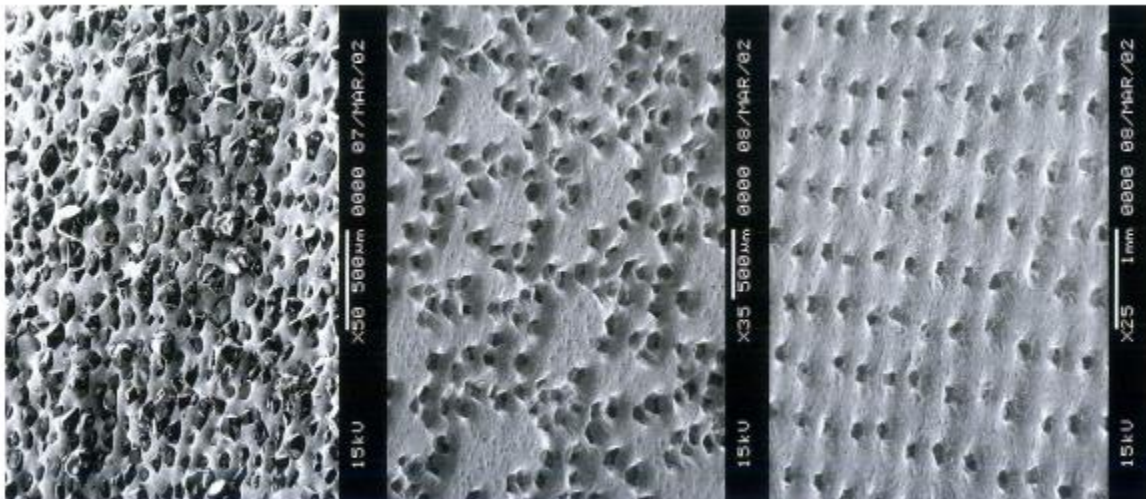


Fig. 2: CMP pad conditioners with diamond grits distributed at random, in clusters, or forming a grid.

(*Id.*)

59. The CMP Reference discloses that “[b]ecause diamond grits always vary in size and shape, the height of diamond tips on a typical pad conditioner may differ by more than 50 microns.” (Ex. 1015 at 2.)

VII. PROSECUTION HISTORY OF THE ’802 PATENT

60. Based on my review of the prosecution history (Ex. 1002), U.S. Patent Application No. 14/506,476 (“the ’476 Application”) was filed on October 3, 2014 and issued as the ’802 Patent on August 8, 2017. (Ex. 1001 at 1 (Cover); Ex. 1002 at 1–7.) The 476 Application was filed with 24 original claims, listing Chien-Min Sung as the inventor. (Ex. 1002 at 1, 50–53.)

61. It is my understanding that the ’476 Application includes a large and complex family of other applications including multiple continuations-in-part or CIP patent applications.

62. It is my understanding that the USPTO issued two office actions before issuing a notice of allowance. (Ex. 1002) It is my understanding that in a first office action, the examiner rejected claims some claims using U.S. Patent Publication No. 2010/0248595 (“*Dinh-Ngoc*”), which had a filing date of December 31, 2009 (*id.* at 126–129), and other claims based on *Dinh-Ngoc* in view of U.S. Patent Publication No. 2008/0292861.

63. It is my understanding that the Patent owner argued against unpatentability over *Dinh-Ngoc* and the ’861 patent publication based solely on a

claim of priority to a prior filed patent family member — Patent App. No. 11/560,817 (“the ’817 Application”) and other parent patent applications that pre-date the cited prior art. From my review it is my understanding that the patent owner did not make any substantive argument that his claims were distinguishable over the cited prior art. (Ex. 1002 at 192–195.)

64. In the second office action, the Examiner appeared to accept (without analysis) that the previously cited prior art did not qualify as prior art because of the patent owner’s priority claim to the ’817 patent application (Ex. 1002 at 207.) The examiner at this time appeared to rely on a 2004 U.S. Patent Pub. No. 2004/0048557 (“*Nabeya*”). At that time, it is my understanding that the examiner allowed the subject matter of then-numbered claims 11–15, and claim 11 would go on to be renumbered to claim 1 of the ’802 Patent. (*Id.* at 207.)

65. It is my understanding that in response to the examiner’s indication of allowable subject matter, the then-numbered claims 1–10 and 23–24 were canceled, claims 11–15 and 17–22 were left unamended, claim 16 was transformed into a dependent claim of claim 11, and claims 25–33 were newly added, all having dependency from independent claim 11. (Ex. 1002 at 236–239.) It is my understanding that the examiner issued an allowance, that the patent owner paid the issue fee, and that the patent was issued, and that at no time did the Patent

Owner ever tell the patent examiner that he intended to disclaim the priority claims of the '802 Patent.

VIII. THE '802 PATENT

66. Based on my review of the '802 Patent, it covers “CMP pad dressers, methods associated with pad conditioning (e.g., smoothing, polishing, dressing), and the CMP polishing of a work piece.” (Ex. 1001 at 9:24–27.) The '802 Patent provides that “Traditional CMP pad dresser manufacturing methods, even many of those describing techniques for leveling superabrasive particle tips” were known before the '802 Patent, but that such traditional methods and techniques contained “significant variation in tip height across the surface of the dresser that is not accounted for by an intended tip alignment profile,” which could be “problematic with brazing techniques.” (*Id.* at 9:36–49.) Looking at independent claim 1, my understanding of the claim’s essence relates to (1) a tip variation along a designated profile of from about 5 microns to about 100 microns, (2) a difference in protrusion distance between the highest and the second highest protruding tips that is less than or equal to about 50 microns, and (3) a difference in protrusion distance between the highest 1% of the protruding tips that is within about 80 microns or less. (*Id.* at cl. 1.) I have been informed by counsel that the priority date of the '802 Patent to be used in my invalidity analysis is October 3, 2014,

which is the filing date of the '802 Patent. My description, understanding, and analysis of the '802 Patent and its claims can be further found in Section IX below.

IX. CLAIM-BY-CLAIM INVALIDITY ANALYSIS

A. Ground 1: Claims 1–5, 13, and 20 are anticipated by the 146 Publication.

67. It is my opinion that the 146 Publication anticipates claims 1–5, 13, and 20.

1. Claim 1

68. In my opinion, the 146 Publication discloses and anticipates every limitation of claim 1 under the broadest reasonable interpretation standard.

69. Language of claim 1 is provided below, broken into its sub-parts or elements so as to make it easier to discuss. The first sub-part is the preamble of claim 1.

| | |
|-------------------|---------------------|
| Claim 1[preamble] | “A CMP pad dresser” |
|-------------------|---------------------|

70. The preamble is actually disclosed in the title of the 146 Publication—“CMP Pad Dresser Having Leveled Tips and Associated Methods.”

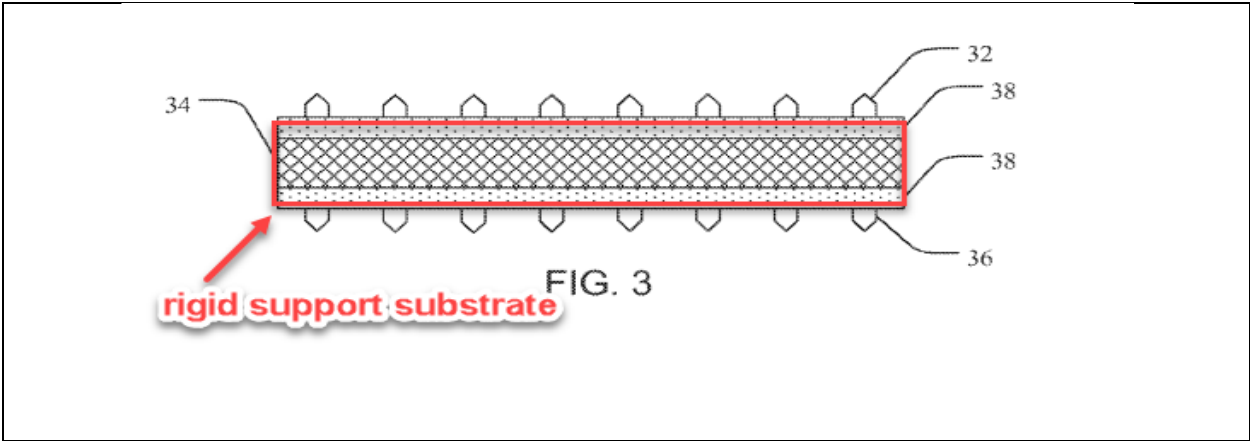
71. The 146 Publication describes “CMP pad dressers having leveled tips and associated methods.” (Ex. 1010 at Abstract) Thus, it is my opinion that the 146 Publication teaches the preamble.

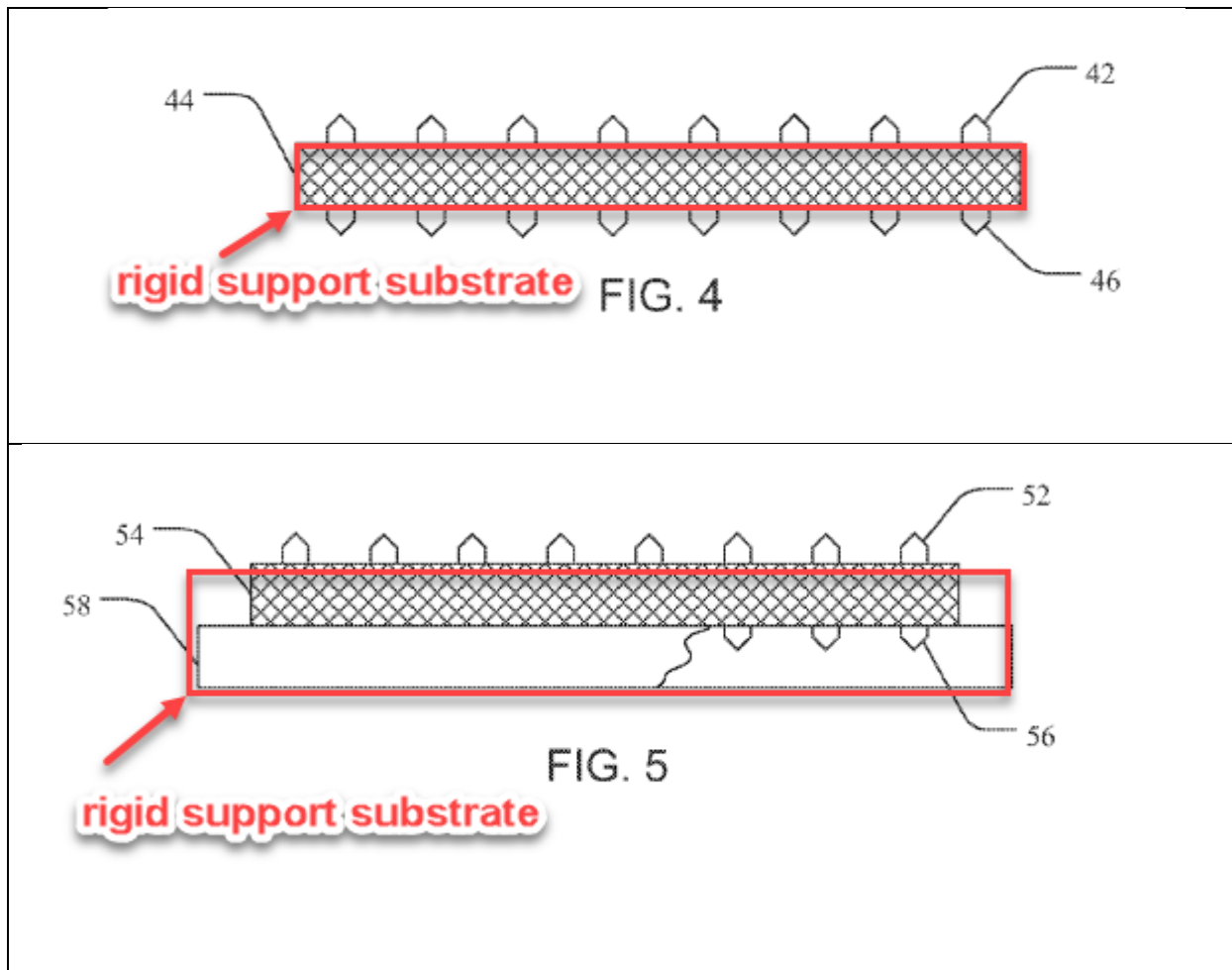
72. The next element is Claim 1[a] element, which is provided below.

| | |
|------------|-----------------------------|
| Claim 1[a] | “a rigid support substrate” |
|------------|-----------------------------|

73. Based on my opinion, the 146 Publication discloses the feature of Claim element 1[a].

74. The 146 Publication teaches a “*rigid support* [that] is coupled to the matrix layer.” Ex. 1010 ¶ 3. The “rigid support can be a non-polymeric material such as a metal layer.” *Id.* ¶ 70. Further, to the extent a matrix layer is coupled to a rigid support, in my opinion, a POSITA would further understand that this bilayer itself would itself become a rigid support substrate that supports a monolayer of superabrasive particles. Thus, it is my opinion that the 146 Publication teaches claim element 1[b]. Exemplary embodiments from the 146 Publication illustrating rigids support are illustrated below:





Exemplary embodiments from the 146 Publication. (Ex. 1010 at 2–3 (Fig. 3–5))

75. The next element is Claim 1[b], which is provided below.

| | |
|------------|--|
| Claim 1[b] | “a monolayer of a plurality of superabrasive particles coupled to the support substrate” |
|------------|--|

76. Based on my opinion, the 146 Publication discloses the feature of Claim element 1[b].

77. The 146 Publication teaches “at least one of the first and second monolayers of superabrasive particles [that] can be coupled to the metal support layer.” (Ex. 1010 ¶ 65.) As mentioned and shown above, a metal support layer can

itself be a rigid support substrate, as can the above FIG. 4 illustration (Ex. 1010 at 2 (Fig. 4)), but, in my opinion, the composite rigid support structures shown in FIGS. 3 & 5 (Ex. 1010 at 2–3 (Fig. 3, 5)) also provide a rigid support for the illustrated monolayers. Thus, it is my opinion that the 146 Publication teaches claim element 1[b].

78. The next element is Claim 1[c], which is provided below.

| | |
|------------|---|
| Claim 1[c] | “wherein each superabrasive particle in the monolayer extends away from the support substrate to a protrusion distance” |
|------------|---|

79. In my opinion, the 146 Publication discloses Claim element 1[c].

80. The 146 Publication teaches a CMP pad dresser that includes “a matrix layer and a monolayer of a plurality of superabrasive particles embedded in the matrix layer, where each superabrasive particle in the monolayer protrudes from the matrix layer.” (Ex. 1010 ¶ 3; *see also id.* at Abstract (disclosing that “each superabrasive particle in the monolayer protrudes from the matrix layer.”).)

81. The 146 Publication explains that a “protrusion” refers to “the height of a particle relative to some reference point.” (*Id.* ¶ 45.) In my opinion, the “reference point” here can be a matrix layer, which as described above can also be the top surface of a rigid substrate or a metal layer. *Id.*

82. The 146 Publication further discloses an embodiment in which the “difference in the protrusion distance between the highest protruding tip and the

next highest protruding tip of the monolayer of superabrasive particles can be less than or equal to about 20 microns.” (*Id.* ¶ 3)

83. The next element is Claim 1[d], which is provided below.

| | |
|------------|---|
| Claim 1[d] | “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” |
|------------|---|

84. In my opinion, the 146 Publication discloses Claim element 1[d].

85. The 146 Publication teaches “include a layer of superabrasive particles having substantially leveled tips across the working surface of the finished CMP pad dresser.” (Ex. 1010 ¶ 41.)

86. The 146 Publication shows many embodiments with different tip variations, directed to “minimizing the relative height movement of the superabrasive particles relative to one another.” (*Id.* ¶ 40.) For example, the 146 Publication discloses the following exemplary embodiment:

In a further aspect, a CMP pad dresser is provided. Such a dresser can include a plurality of superabrasive particles arranged as a working surface, wherein *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*, 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 difference in protrusion distance between the highest protruding tip and the 100th highest protruding tip is less than or equal to about 40 microns, and the highest protruding tip has a protrusion distance of greater than or equal to about 50 microns.

(Ex. 1010 ¶ 9.)

87. Further, the 146 Publication discloses having a tip of each of the plurality of superabrasive particle aligned along a designated planar profile. For example, the 146 Publication describes that “a planar leveling surface can be used to apply pressure to the monolayer and thus maintain the level nature of the superabrasive particle tips. as the superabrasive particles are pressed into the metal support layer.” (*Id.* at ¶ 68.) A POSITA would understand that these superabrasive particles being pressed into the metal support layer in a manner to maintain their level nature would be along a planar designated profile and the ’802 Patent specifically included a planar surface as being one of the designated profiles. (Ex. 1001 at 6:25-28 (“Examples of such profiles may include, without limitation, flat or planar profiles, curved profiles, wavy profiles, convex profiles, concave profiles, multi-tiered profiles, and the like, including combinations thereof.”).)

88. Based on my review, the 146 Publication discloses a designated level or planar profile with a tip variation that ranges from less than or equal to about 10 microns (which discloses “about 5 microns”) to within 80 microns (which discloses “about 100 microns”). Because the 146 Publication teaches a designated profile with a tip variation within the claimed range, I believe a POSITA would understand this claimed element to have been disclosed by the prior art reference. I am informed that the patent laws are consistent with my technical understanding.

See Titanium Metals Corp. v. Banner, 778 F.2d 775, 782 (Fed. Cir. 1985) (“when, as by a recitation of ranges or otherwise, a claim covers several compositions, the claim is ‘anticipated’ if *one* of them is in the prior art.”) (emphasis in original); *ClearValue Inc. v. Pearl River Polymers Inc.*, 668 F.3d 1340, 1345 (Fed. Cir. 2012) (holding a claim anticipated because “there is no allegation of criticality or any evidence demonstrating any difference across the range.”))

89. The next element is Claim 1[e] element, which is provided below.

| | |
|------------|--|
| Claim 1[e] | “wherein 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” |
|------------|--|

90. In my opinion, the 146 Publication discloses Claim element 1[e].

91. The 146 Publication teaches an embodiment where the “difference in the protrusion distance between the highest protruding tip and the next highest protruding tip of the monolayer of superabrasive particles can be less than or equal to about 50 microns.” (Ex. 1010 at cl. 1)

92. The 146 Publication also discloses other embodiments where the difference in the protrusion distance between the two highest protruding tips are less than or equal to about 20 microns, 15 microns, or 10 microns. (*See id.* ¶¶ 3, 4, 42.) In my opinion, such differences all satisfy or qualify as the claimed difference of “less than or equal to about 50 microns.”

93. The next element is Claim 1[f] element, which is provided below.

| | |
|------------|--|
| Claim 1[f] | “[wherein] 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.” |
|------------|--|

94. In my opinion, the 146 Publication discloses Claim element 1[f].

95. The 146 Publication provides an embodiment where “the difference in protrusion distance between the highest 1% of the protruding tips of the first monolayer of superabrasive particles are within about 80 microns or less.” (Ex. 1010 ¶ 3) “In other words, for the 1% of the plurality of superabrasive particles that have the highest protruding tips, the variance in protrusion distance for that 1% is less than or equal to about 80 microns.” (*Id.* at ¶ 42)

96. Based on my review, it is my opinion that the 146 Publication discloses each and every limitation recited in claim 1 and, therefore, anticipates independent claim 1.

2. Claim 2

97. It is my opinion that the 146 Publication anticipates claim 2.

98. Based on my review, claim 2 is dependent on claim 1 and additionally recites the language provided below.

| | |
|---------|--|
| Claim 2 | "wherein 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.” |
|--|--|

99. Based on my review, claim 2 requires the difference in protrusion distance between the highest protruding tip and the second highest protruding tip to be less than or equal to about 10 microns. (Ex. 1001 cl. 2.) In my opinion, the 146 Publication anticipates all elements of claim 1, as discussed in Section IX.A.1, and further discloses an embodiment, where “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.” (Ex. 1010 ¶ 4.)

3. Claim 3

100. It is my opinion that the 146 Publication anticipates claim 3.

101. Based on my review, claim 3 is dependent on claim 1 and additionally recites the language provided below.

| | |
|---------|---|
| Claim 3 | “the difference in protrusion distance between the highest protruding tip and the second highest protruding tip is less than about 10 microns.” |
|---------|---|

102. Based on my review, claim 3 requires that the difference in protrusion between the highest protruding tip and the second highest protruding tip to be less than about 10 microns. (Ex. 1001 cl. 3.) In my opinion, the 146 Publication anticipates all elements of claim 1, as discussed in Section IX.A.1, and further discloses an embodiment, where “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.” (Ex. 1010 ¶ 4.)

4. Claim 4

103. It is my opinion that the 146 Publication anticipates claim 4.

104. Based on my review, claim 4 is dependent on claim 1 and additionally recites the language provided below.

| | |
|---------|---|
| Claim 4 | “wherein the difference in protrusion distance between the highest protruding tip and the 10 th highest protruding tip is less than or equal to about 20 microns.” |
|---------|---|

105. Based on my review, claim 4 requires that 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. (Ex. 1001 cl. 4.) In my opinion, the 146 Publication anticipates all elements of claim 1, as discussed in Section IX.A.1, and further discloses an embodiment, where “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.” (Ex. 1010 ¶ 43.)

5. Claim 5

106. It is my opinion that the 146 Publication anticipates claim 5.

107. Based on my review, claim 5 is dependent on claim 1 and additionally recites the language provided below.

| | |
|---------|--|
| Claim 5 | “wherein the difference in protrusion distance between the highest protruding tip and the 100 th highest protruding tip is less than or equal to about 40 microns.” |
|---------|--|

108. Based on my review, claim 5 requires that 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.” (Ex. 1001 cl. 5.) In my opinion, the 146 Publication anticipates all elements of claim 1, as discussed in Section IX.A.1, and further discloses an embodiment, where “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.” (Ex. 1010 ¶ 4.)

6. Claim 13

109. It is my opinion that the 146 Publication anticipates claim 13.

110. Based on my review, claim 13 is dependent on claim 1 and additionally recites the language provided below.

| | |
|----------|--|
| Claim 13 | “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 10 microns to about 50 microns.” |
|----------|--|

111. Based on my review, claim 13 requires that 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. (Ex. 1001 cl.

13.) In my opinion, the 146 Publication anticipates all elements of claim 1, as discussed in Section IX.A.1, and further discloses the following embodiment:

In a further aspect, a CMP pad dresser is provided. Such a dresser can include a plurality of superabrasive particles arranged as a working surface, wherein 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, 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 difference in protrusion distance between the highest protruding tip and the 100th highest protruding tip is less than or equal to about 40 microns, and the highest protruding tip has a protrusion distance of greater than or equal to about 50 microns.

(Ex. 1010 ¶ 9)

87. Based on my review, the 146 Publication discloses another embodiment in which the “difference in the protrusion distance between the highest protruding tip and the next highest protruding tip of the monolayer of superabrasive particles can be less than or equal to about 50 microns.” (*Id.* at cl. 1). It is my opinion that the 146 Publication discloses a designated profile with a tip variation that ranges from less than or equal to about 10 microns to less than or equal to about 50 microns, as recited in claim 13.

7. Claim 20

112. It is my opinion that the 146 Publication anticipates claim 20.

113. Based on my review, claim 20 is dependent on claim 1 and additionally recites the language provided below.

| | |
|----------|---|
| Claim 20 | “wherein the plurality of superabrasive particles is arranged across the support substrate in a predetermined pattern.” |
|----------|---|

114. Based on my review, claim 20 requires that the plurality of superabrasive particles be arranged across the support substrate in a predetermined pattern. (Ex. 1001 cl. 20.) In my opinion the 146 Publication anticipates all elements of claim 1, as discussed in Section IX.A.1, and further discloses an embodiment, where “the superabrasive particles can be arranged into a predetermined pattern.” (Ex. 1010 ¶ 58)

B. Ground 2: Claims 1–7 and 13–21 are unpatentable because they are obvious over the 146 Publication in view of the 298 Publication

115. It is my opinion that the 146 Publication and the 298 Publication render obvious claims 1–7 and 13–21 of the ’802 Patent.

1. Claim 1

116. As discussed above, it is my opinion that the 146 Publication discloses and anticipates each and every limitation of claim 1. (Section IX.A.1.)

117. With regard to claim element 1[d], “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,” in my opinion, the 146 Publication discloses a designated profile with a tip variation that ranges from less than or equal to about 10 microns (which is “about 5 microns”) to within 80

microns (which is “about 100 microns”). (Section IX.A.1.) Because the 146 Publication teaches a designated profile with a tip variation within the claimed range, in my opinion, the 146 Publication expressly teaches claim element 1[d]. Further, in my opinion, a POSITA would understand that a teaching of 80 microns in this context is “about 100 microns” and that a teaching of 5 microns is “less than or equal to about 10 microns or less.” For these reasons, it is my opinion that the 146 Publication expressly or inherently teaches claim element 1[d].

118. To the extent such disclosures of the 146 Publication do not teach claim element 1[d], however, it is my opinion that the subject matter is expressly disclosed in the 298 Publication.

119. In my opinion, the 298 Publication teaches that “the plurality of individual polycrystalline cutting elements 16a, 16b can include at least one cutting tip (18a and 18b, respectively), with the cutting tips of the cutting elements being aligned in a common plane (20a, 20b, respectively).” (Ex. 1011 ¶ 50.) Here, “[i]t may also be beneficial for the cutting elements to protrude from the solidified organic material layer to a predetermined height or series of heights that is/are along a designated profile.” (*Id.* ¶ 61.) Based on my review, one of the embodiments discloses that “the plurality of cutting elements are arranged such that their tips vary from the designated profile by from about 5 microns to about

100 microns.” *Id.* ¶ 66. In my opinion, the 298 Publication thus expressly teaches claim element 1[d].

120. Based on my review, a POSITA would have been motivated to combine the 146 Publication and the 298 Publication for several reasons. In my opinion, the 146 Publication and the 298 Publication, as well as the ’802 Patent, are all directed CMP pad dressers for CMP polishing of semiconductor wafers. (*See, e.g.*, Ex. 1010 ¶¶ 2–3; Ex. 1011 ¶¶ 3–4.) Further, the 146 Publication and the cited portions of the 298 Publication address the same issue of conditioning CMP polishers. (*See, e.g.*, Ex. 1010 ¶¶ 2–10; Ex. 1011 ¶¶ 3–7.) And the 146 Publication and the cited portions of the 298 Publication are both directed to providing CMP pad dressers having a designated profile with a tip variation to achieve their goals. In my opinion, a POSITA would have known that the 146 Publication could be used with the 298 Publication, and more specifically that 146 Publication’s teachings of the tips along a designated profile with a tip variation could be used with the 298 Publication’s teachings regarding the same, and vice versa.

121. It is my opinion that the 146 Publication and the 298 Publication thus render obvious claim element 1[d], as well as the entire claim 1.

2. Claims 2–5, 13, and 20

122. Based on my review, claims 2–5, 13, and 20 all depend from claim 1, which is disclosed in and rendered obvious by the 146 Publication in view of the

298 Publication. (Section IX.B.1.) Further, in my opinion, a POSITA would have been motivated to combine the teachings of the 146 Publication and of the 298 Publication in the context of these claims as well. (Section IX.B.1). As discussed above, the additional limitations of dependent claims 2–5, 13, and 20 are each disclosed in and anticipated by the 146 Publication. (Sections IX.A.2–7.)

123. It is my opinion that the 146 Publication and the 298 Publication render obvious the additional limitations of dependent claims 2–5, 13, and 20.

3. Claim 6

124. Based on my review, claim 6 is dependent on claim 1 and additionally recites the language provided below.

| | |
|---------|---|
| Claim 6 | “wherein the plurality of superabrasive particles includes a plurality of working superabrasive particles, such that 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.” |
|---------|---|

125. In my opinion, the 146 Publication and the 298 Publication render obvious claim 1 (Section IX.B.1), and the 298 Publication further discloses that the term “cutting element” is used to describe “a variety of structures capable of removing (e.g., cutting) material from a workpiece.” (Ex. 1011 ¶ 43.) In my opinion, the 298 Publication discloses:

As such, in one aspect, a majority of the plurality of individual cutting elements may protrude to a predetermined height above the solidified

organic material layer. . . . [I]n 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 . . . a cutting depth of from about 1 micron to about 20 microns when used to abrade a workpiece. In yet another specific aspect . . . a cutting depth of from about 10 micron to about 20 microns when used to abrade a workpiece. In yet another aspect . . . depth of up to or more than 50 or 100 microns.

(Ex. 1011 ¶ 59).

126. In my opinion, the cutting depths disclosed in the 298 Publication (e.g., of less than about 20 microns, of from about 1 micron to about 20 microns, and of from about 10 microns to about 20 microns) satisfy and meet “a cutting depth of less than or equal to about 50 microns,” as recited in claim 6. The 298 Publication thus discloses the additional limitation of claim 6, in my opinion. Accordingly, it is my opinion that the 146 Publication and the 298 Publication render obvious dependent claim 6.

4. Claim 7

127. Based on my review, claim 7 is dependent on claim 6 and additionally recites the language provided below.

| | |
|---------|---|
| Claim 7 | “wherein the cutting depth is from about 10 microns to about 50 microns.” |
|---------|---|

128. In my opinion, the 146 Publication and the 298 Publication render obvious claim 6, as discussed in Section IX.B.3, and the 298 Publication further

discloses that the term “cutting element” is used to describe “a variety of structures capable of removing (e.g., cutting) material from a workpiece.” (Ex. 1011 ¶ 43.)

129. In my opinion, the cutting depths disclosed in the 298 Publication (e.g., of from about 10 microns to about 20 microns, and of up to or more than 50 or 100 microns) satisfy and meet a cutting depth that “is from about 10 microns to about 50 microns,” as recited in claim 7. The 298 Publication thus discloses the additional limitation of claim 7, in my opinion.

130. Accordingly, it is my opinion that the 146 Publication and the 298 Publication render obvious dependent claim 7.

5. Claim 14

131. Based on my review, claim 14 is dependent on claim 1 and additionally recites the language provided below.

| | |
|----------|--|
| Claim 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.” |
|----------|--|

132. In my opinion, the 146 Publication and the 298 Publication render obvious claim 1, as discussed in Section IX.B.1, and the 298 Publication further teaches that “the plurality of individual polycrystalline cutting elements . . . being aligned in a common plane.” (Ex. 1011 ¶ 50.) Here, “[i]t may also be beneficial for the cutting elements to protrude from the solidified organic material layer to a

predetermined height or series of heights that is/are along a designated profile.”
(Id. ¶ 61.) In my opinion, one of the embodiments discloses “the plurality of cutting elements are arranged such that their tips vary from the designated profile by from about 20 microns to about 40 microns.” *(Id.* ¶ 67.) The 298 Publication thus discloses the additional limitation of claim 14, in my opinion.

133. Accordingly, it is my opinion that the 146 Publication and the 298 Publication render obvious dependent claim 14.

6. Claim 15

134. Based on my review, claim 15 is dependent on claim 1 and additionally recites the language provided below.

| | |
|----------|---|
| Claim 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.” |
|----------|---|

135. In my opinion, the 146 Publication and the 298 Publication render obvious claim 1, as discussed in Section IX.B.1, and the 298 Publication further teaches that “the plurality of individual polycrystalline cutting elements 16a, 16b can include at least one cutting tip (18a and 18b, respectively), with the cutting tips of the cutting elements being aligned in a common plane (20a, 20b, respectively).”
(Ex. 1011 ¶ 50.) Here, “[i]t may also be beneficial for the cutting elements to protrude from the solidified organic material layer to a predetermined height or

series of heights that is/are along a designated profile.” (*Id.* ¶ 61.) In my opinion, one of the embodiments discloses that the plurality of cutting elements are “arranged such that their tips vary from the designated profile by less than about 20.” (*Id.* ¶ 67.) The 298 Publication thus discloses the additional limitation of claim 15, in my opinion.

136. Accordingly, it is my opinion that the 146 Publication and the 298 Publication render obvious dependent claim 15.

7. Claim 16

137. Based on my review, claim 16 is dependent on claim 1 and additionally recites the language provided below

| | |
|----------|---|
| Claim 16 | “wherein the protrusions of the plurality of superabrasive particles produce cutting depths of less than about 20 microns when used to abrade a CMP pad.” |
|----------|---|

138. Based on my review, the 146 Publication and the 298 Publication render obvious claim 1, as discussed in Section IX.B.1, and the 298 Publication further teaches that the term “cutting element” is used to describe “a variety of structures capable of removing (e.g., cutting) material from a workpiece.” (Ex. 1011 ¶ 43.) The 298 Publication further discloses an embodiment, where “the predetermined height may produce a cutting depth of less than about 20 microns

when used to abrade a workpiece.” (Ex. 1011 ¶ 59). Thus, in my opinion, the 298 Publication discloses the additional limitation of claim 16.

139. Accordingly, it is my opinion that the 146 Publication and the 298 Publication render obvious dependent claim 16.

8. Claim 17

140. Based on my review, claim 17 is dependent on claim 1 and additionally recites the language provided below.

| | |
|----------|--|
| Claim 17 | "wherein 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." |
|----------|--|

141. In my opinion the 146 Publication and the 298 Publication render obvious claim 1, as discussed in Section IX.B.1, and the 298 Publication further teaches cutting tips that are aligned in a common plane and along a designated profile. The 298 Publication further discloses an embodiment, where “the predetermined height may produce a cutting depth of from about 1 micron to about 20 microns when used to abrade a workpiece.” (Ex. 1011 ¶ 59.) In my opinion, the 298 Publication thus discloses the additional limitation of claim 17.

142. Accordingly, it is my opinion that the 146 Publication and the 298 Publication render obvious dependent claim 17.

9. Claim 18

143. Based on my review, claim 18 is dependent on claim 1 and additionally recites the language provided below.

| | |
|----------|--|
| Claim 18 | “wherein 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.” |
|----------|--|

144. In my opinion, the 146 Publication and the 298 Publication render obvious claim 1, as discussed in Section IX.B.1, and the 298 Publication further teaches cutting tips aligned in a common plane and along a designated profile. The 298 Publication further discloses an embodiment, where “the predetermined height may produce a cutting depth of from about 10 micron to about 20 microns when used to abrade a workpiece.” (Ex. 1011 ¶ 59). In my opinion, the 298 Publication thus discloses the additional limitation of claim 18.

145. Accordingly, it is my opinion that the 146 Publication and the 298 Publication render obvious dependent claim 18.

10. Claim 19

146. Based on my review, claim 19 is dependent on claim 1 and additionally recites the language provided below.

| | |
|----------|---|
| Claim 19 | “wherein the designated profile includes a configuration selected from the group consisting of a plane, a slope, a curved shape, a dome shape, and combinations thereof.” |
|----------|---|

147. In my opinion, the 146 Publication and the 298 Publication render obvious claim 1, as discussed in Section IX.B.1, and the 298 Publication further teaches cutting tips that are aligned in a common plane and along a designated profile, as discussed in Section IX.B.5. Further, the 298 Publication discloses that “the designated profile may be a plane,” may have a slope, or “may have a curved shape,” where an “example of a curved shape is a dome shape tool.” (Ex. 1011 ¶¶ 61, 62, 64.) In my opinion the 298 Publication thus discloses the additional limitation of claim 19.

148. Accordingly, it is my opinion that the 146 Publication and the 298 Publication render obvious dependent claim 19.

11. Claim 21

149. Based on my review, claim 21 is dependent on claim 20 and additionally recites the language provided below.

| | |
|----------|--|
| Claim 21 | “wherein the predetermined pattern includes an even distribution of the plurality of superabrasive particles spaced at a distance of from about 100 microns to about 800 microns.” |
|----------|--|

150. In my opinion, the 146 Publication and the 298 Publication render obvious claim 20, as discussed in Section IX.B.2, and the 146 Publication discloses an embodiment, where “the superabrasive particles can be arranged into a predetermined pattern.” (Ex. 1010 ¶ 58.) In my opinion, one of the embodiments

of the 298 Publication discloses the “cutting elements can be evenly spaced from one another at a distance ‘d’ of from about 100 microns to about 800 microns.” (Ex. 1011 ¶ 55.) In my opinion, the 146 Publication thus discloses the additional limitation of claim 21.

151. Accordingly, it is my opinion that the 146 Publication and the 298 Publication render obvious dependent claim 21.

C. Ground 3: Claims 1–7, and 13-21 are unpatentable because they are obvious over the Taiwan 113 Publication in view of the 298 Publication

152. In my opinion, the Taiwan 113 Publication and the 298 Publication render obvious claims 1–7 and 13–21 of the ’802 Patent.

1. Claim 1

153. Based on my review, the Taiwan 113 Publication in view of the 298 Publication disclose and render obvious every limitation of claim 1.

154. Language of claim 1 is provided below, broken into its sub-parts or elements so as to make it easier to discuss. The first sub-part is the preamble of claim 1.

| | |
|-------------------|---------------------|
| Claim 1[preamble] | “A CMP pad dresser” |
|-------------------|---------------------|

155. Based on my review, the preamble is disclosed in the Taiwan 113 Publication, which “relates to a composite conditioner, a method for manufacturing the same and a chemical-mechanical planarization (CMP) process using the same.”

(Ex. 1013 at 6.) Because the '802 Patent provides that “the terms ‘conditioner’ and ‘dresser’ can be used interchangeably” (Ex. 1001 at 4:10–12), in my opinion, the Taiwan 113 Publication’s disclosure of “a composite conditioner” teaches the preamble.

156. The next element is Claim 1[a] element, which is provided below.

| | |
|------------|-----------------------------|
| Claim 1[a] | “a rigid support substrate” |
|------------|-----------------------------|

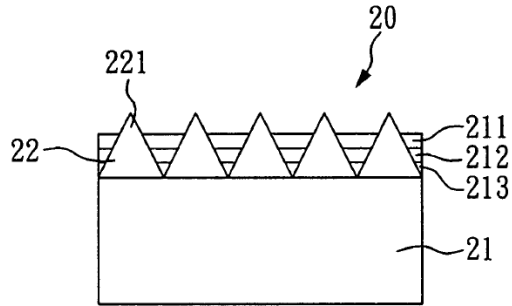
157. Based on my review, claim element 1[a] is disclosed in the Taiwan 113 Publication, which teaches that an “ordinary diamond conditioner is manufactured by the additive method, that is, diamond grits are horizontally arranged on a flat substrate (of stainless steel 316 for example).” (Ex. 1013 at 13.) Because “stainless steel” is a rigid material, it is my opinion that the Taiwan 113 Publication teaches claim element 1[a].

158. The next element is Claim 1[b], which is provided below.

| | |
|------------|--|
| Claim 1[b] | “a monolayer of a plurality of superabrasive particles coupled to the support substrate” |
|------------|--|

159. Based on my review, claim element 1[b] is disclosed in the Taiwan 113 Publication, which teaches forming diamond grits on a surface of the conditioner, where a single layer of polishing grits 22 is coupled to the substrate 21. (Ex. 1013 at 18–19.)

圖 1G



Id. at 30 (Fig. 1G). Because “diamond grits” are superabrasive particles, it is my opinion that the Taiwan 113 Publication teaches claim element 1[b].

160. The next element is Claim 1[c], which is provided below.

| | |
|------------|---|
| Claim 1[c] | “wherein each superabrasive particle in the monolayer extends away from the support substrate to a protrusion distance” |
|------------|---|

161. Based on my review, claim element 1[c] is disclosed in the Taiwan 113 Publication, which teaches a “height of the polishing tips [that] refers to the height that the polishing tips protrude from the surface of the bonding layer” and “a bonding layer 213 arranged between the surface of the unit substrate 21 and the polishing tips 221.” (Ex. 1013 at 9, 18.) Thus, in my opinion, The Taiwan 113 Publication teaches claim element 1[c].

162. The next element is Claim 1[d], which is provided below.

| | |
|------------|---|
| Claim 1[d] | “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” |
|------------|---|

163. Based on my review, claim element 1[d] is disclosed in the Taiwan 113 Publication, which teaches an embodiment of a conditioner that “has 60 to 70 working particles within a height difference of about 10 microns,” as well as an embodiment where “the height difference of grits exceeds 40 microns.” (Ex. 1013 at 20.) This can also be seen in Figure 3 below, where the x axis expresses the height differences of the tips in microns.

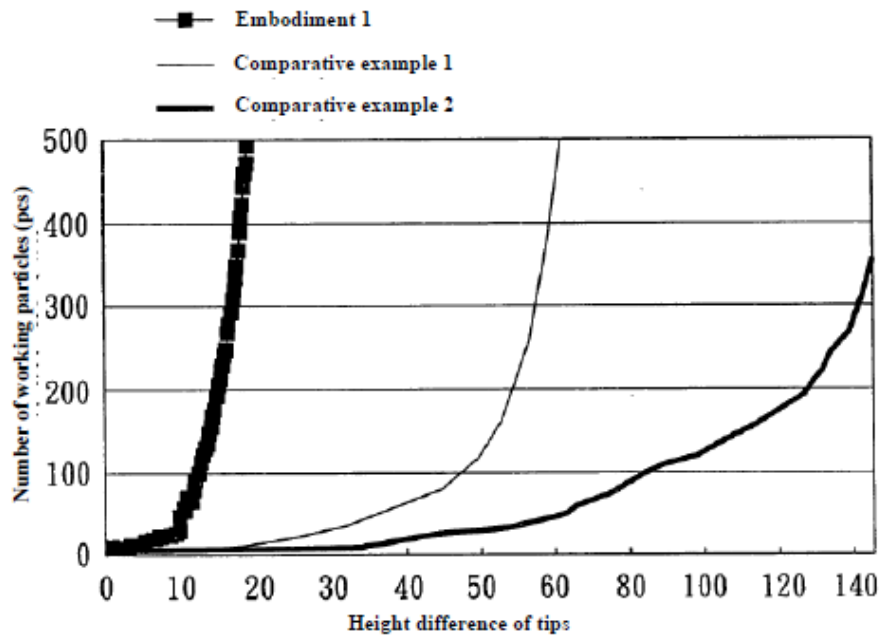


Fig. 3

Ex. 1013 at 33 (Fig. 3).

164. It is my opinion that, because the Taiwan 113 Publication teaches a designated profile with a tip variation within the claimed range (see, e.g. above the number of working particles or tips at 10 microns and around this range), the Taiwan 113 Publication expressly teaches claim element 1[d].

165. To the extent that claim element 1[d] is considered in this proceeding to not be expressly shown in the Taiwan 113 Publication, it is my opinion that it is expressly disclosed in the 298 Publication, as discussed in Section IX.B.1.

166. Based on my review, a POSITA would have been motivated to combine the Taiwan 113 Publication and the 298 Publication for several reasons. In my opinion, the Taiwan 113 Publication and the 298 Publication, as well as the '802 Patent, are all directed to the same field, for example, to CMP used in the manufacturing process of semiconductor devices. (*See, e.g.*, Ex. 1013 at 6; Ex. 1011 ¶¶ 3–4.) Further, it is my opinion that the Taiwan 113 Publication and the cited portions of the 298 Publication address the same issue of forming and/or using CMP pad dressers for conditioning CMP pads for polishing semiconductor wafers. (*See, e.g.*, Ex. 1013 at 6; Ex. 1011 ¶¶ 3–7.) In my opinion, the Taiwan 113 Publication and the cited portions of the 298 Publication are both directed to providing a designated profile of pad dressers with a tip variation to achieve their goals. Thus, it is my opinion that a POSITA would have known that the Taiwan 113 Publication could be used with the 298 Publication, and more specifically that the Taiwan 113 Publication's teachings of the tips along a designated profile with a tip variation could be used with the 298 Publication's teachings regarding the same, and vice versa.

167. Thus, in my opinion, the Taiwan 113 Publication and the 298 Publication render obvious claim element 1[d], as well as the entire claim 1.

168. The next element is Claim 1[e] element, which is provided below.

| | |
|------------|--|
| Claim 1[e] | “wherein 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” |
|------------|--|

169. In my opinion, claim element 1[e] is disclosed in the Taiwan 113 Publication, which teaches a height difference between the first and second highest tips of less than or equal to about 50 μm . (*See* Ex. 1013 at 33 (Fig. 3).) The Taiwan 113 Publication thus, in my opinion, teaches claim element 1[e].

170. The next element is Claim 1[f] element, which is provided below.

| | |
|------------|--|
| Claim 1[f] | “[wherein] 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.” |
|------------|--|

171. Based on my review, claim element 1[f] is disclosed in the Taiwan 113 Publication, which teaches an embodiment of a conditioner that “has 60 to 70 working particles within a height difference of about 10 microns,” as well as an embodiment where there are 500 particles within 20 microns of height difference, as shown in Figure 3. (Ex. 1013 at 21.) Figure 3 below shows microns of tip differences along the x-axis:

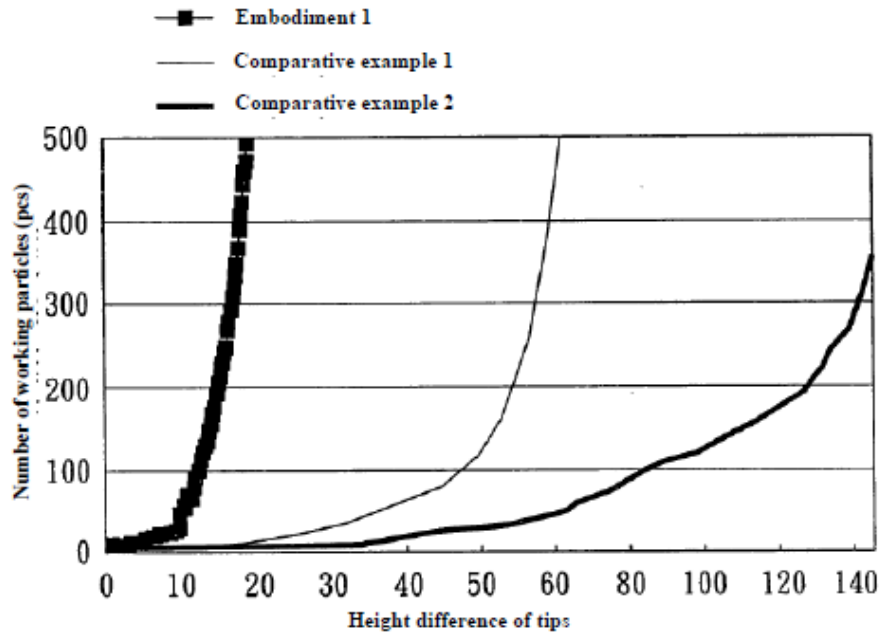


Fig. 3

Ex. 1013 at 33 (Fig. 3).

172. It is my belief that a POSITA would understand that a difference in protrusion distance of about 10 microns among 60 to 70 working particles and an embodiment with 500 working particles with a protrusion difference of about 20 microns as reflected in the graph of Figure 3 would also mean that the difference in protrusion distance between the highest 1% of the protruding tips is within about 80 microns or less, as recited in claim element 1[f]. It is my opinion that, because the Taiwan 113 Publication teaches a designated profile with a tip variation within the claimed range, the Taiwan 113 Publication expressly teaches claim element 1[f].

173. To the extent claim element 1[f] is considered in this proceeding to not be expressly shown in the Taiwan 113 Publication, it is my opinion that it is expressly disclosed in the 298 Publication, which teaches a “designated profile” that is a plane, where “the plurality of cutting elements are arranged such that their tips vary from the designated profile by from about 10 microns to about 50 microns.” (Ex. 1011 ¶¶ 61, 66.) Based on my review, the 298 Publication thus teaches claim element 1[f]. In my opinion, a POSITA would have been motivated to combine the Taiwan 113 Publication and the 298 Publication for several reasons, as discussed in Section IX.B.1. Based on my review, The Taiwan 113 Publication and the 298 Publication thus render obvious claim element 1[f], as well as the entire claim 1.

174. Accordingly, it is my opinion that the Taiwan 113 Publication and the 298 Publication disclose each and every limitation recited in claim 1 and, therefore, render obvious independent claim 1.

2. Claim 2

175. Based on my review, claim 2 is dependent on claim 1 and additionally recites the language provided below.

| | |
|---------|---|
| Claim 2 | "wherein 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." |
|---------|---|

176. Based on my review, the Taiwan 113 Publication and the 298 Publication render obvious claim 1, as discussed in Section IX.C.1, and the Taiwan 113 Publication further teaches that “a height difference between the first and second highest tips . . . based on a predetermined plane is respectively less than 10 μm .” (Ex. 1013 at Abstract, cl. 1.) In my opinion, the Taiwan 113 Publication thus discloses the additional limitation of claim 2.

177. Accordingly, my opinion is that the Taiwan 113 Publication and the 298 Publication render obvious dependent claim 2.

3. Claim 3

178. Based on my review, claim 3 is dependent on claim 1 and additionally recites the language provided below.

| | |
|---------|---|
| Claim 3 | “the difference in protrusion distance between the highest protruding tip and the second highest protruding tip is less than about 10 microns.” |
|---------|---|

179. Based on my review, the Taiwan 113 Publication and the 298 Publication render obvious claim 1, as discussed in Section IX.C.1, and the Taiwan 113 Publication further teaches that “a height difference between the first and second highest tips . . . based on a predetermined plane is respectively less than 10 μm .” (Ex. 1013 at Abstract, cl. 1.) In my opinion, the Taiwan 113 Publication thus discloses the additional limitation of claim 3.

180. Accordingly, it is my opinion that the Taiwan 113 Publication and the 298 Publication render obvious dependent claim 3.

4. Claim 4

181. Based on my review, claim 4 is dependent on claim 1 and additionally recites the language provided below.

| | |
|---------|---|
| Claim 4 | “wherein the difference in protrusion distance between the highest protruding tip and the 10 th highest protruding tip is less than or equal to about 20 microns.” |
|---------|---|

182. Based on my review, the Taiwan 113 Publication and the 298 Publication render obvious claim 1, as discussed in Section IX.C.1, and the Taiwan 113 Publication further teaches that “a height difference between the first and second highest tips, between the first and tenth highest tips, and between the first and 100th highest tips based on a predetermined plane is respectively less than 10 μm , 20 μm , and 40 μm .” (Ex. 1013 at Abstract, 10.) In my opinion, the Taiwan 113 Publication thus discloses the additional limitation of claim 4.

183. Accordingly, it is my opinion that the Taiwan 113 Publication and the 298 Publication render obvious dependent claim 4.

5. Claim 5

184. Based on my review, claim 5 is dependent on claim 1 and additionally recites the language provided below.

| | |
|---------|--|
| Claim 5 | “wherein the difference in protrusion distance between the highest protruding tip and the 100 th highest protruding tip is less than or equal to about 40 microns.” |
|---------|--|

185. Based on my review, the Taiwan 113 Publication and the 298 Publication render obvious claim 1, as discussed in Section IX.C.1, and the Taiwan 113 Publication further teaches that “a height difference between the first and second highest tips, between the first and tenth highest tips, and between the first and 100th highest tips based on a predetermined plane is respectively less than 10 μm, 20 μm, and 40 μm.” (Ex. 1013 at Abstract, 10.) In my opinion, the Taiwan 113 Publication thus discloses the additional limitation of claim 5.

186. Accordingly, it is my opinion that the Taiwan 113 Publication and the 298 Publication render obvious dependent claim 5.

6. Claim 6

187. Based on my review, claim 6 is dependent on claim 1 and additionally recites the language provided below.

| | |
|---------|---|
| Claim 6 | “wherein the plurality of superabrasive particles includes a plurality of working superabrasive particles, such that 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.” |
|---------|---|

188. Based on my review, the Taiwan 113 Publication and the 298 Publication render obvious claim 1, as discussed in Section IX.C.1, and the 298 Publication further discloses the additional limitation of claim 6, as discussed in Section IX.B.3.

189. Accordingly, it is my opinion that the Taiwan 113 Publication and the 298 Publication render obvious dependent claim 6.

7. Claim 7

190. Based on my review, claim 7 is dependent on claim 6 and additionally recites the language provided below.

| | |
|---------|---|
| Claim 7 | “wherein the cutting depth is from about 10 microns to about 50 microns.” |
|---------|---|

191. Based on my review, the Taiwan 113 Publication and the 298 Publication render obvious claim 6, as discussed in Section IX.C.6, and the 298 Publication further discloses the additional limitation of claim 7, as discussed in Section IX.B.4.

192. Accordingly, it is my opinion that the Taiwan 113 Publication and the 298 Publication render obvious dependent claim 7.

8. Claim 13

193. Based on my review, claim 13 is dependent on claim 1 and additionally recites the language provided below.

| | |
|----------|--|
| Claim 13 | “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 10 microns to about 50 microns.” |
|----------|--|

194. Based on my review, the Taiwan 113 Publication and the 298 Publication render obvious claim 1, as discussed in Section IX.C.1, and the 298 Publication further discloses “the plurality of cutting elements are arranged such that their tips vary from the designated profile by from about 10 microns to about 50 microns.” (Ex. 1011 ¶ 66.) In my opinion, a POSITA would appreciate that when all the tips vary from the designated profile by from about 10 microns to about 50 microns, the highest protruding tip would align along the designated profile with a tip variation of from about 10 microns to about 50 microns.

195. Accordingly, it is my opinion that the Taiwan 113 Publication and the 298 Publication render obvious dependent claim 13.

9. Claim 14

196. Based on my review, claim 14 is dependent on claim 1 and additionally recites the language provided below.

| | |
|----------|--|
| Claim 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.” |
|----------|--|

197. Based on my review, the Taiwan 113 Publication and the 298 Publication render obvious claim 1, as discussed in Section IX.C.1, and the 298 Publication further discloses the additional limitation of claim 14, as discussed in Section IX.B.5.

198. Accordingly, it is my opinion that the Taiwan 113 Publication and the 298 Publication render obvious dependent claim 14.

10. Claim 15

199. Based on my review, claim 15 is dependent on claim 1 and additionally recites the language provided below.

| | |
|----------|---|
| Claim 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.” |
|----------|---|

200. Based on my review, the Taiwan 113 Publication and the 298 Publication render obvious claim 1, as discussed in Section IX.C.1, and the 298 Publication further discloses the additional limitation of claim 15, as discussed in Section IX.B.6.

201. Accordingly, it is my opinion that the Taiwan 113 Publication and the 298 Publication render obvious dependent claim 15.

11. Claim 16

202. Based on my review, claim 16 is dependent on claim 1 and additionally recites the language provided below.

| | |
|----------|---|
| Claim 16 | “wherein the protrusions of the plurality of superabrasive particles produce cutting depths of less than about 20 microns when used to abrade a CMP pad.” |
|----------|---|

203. Based on my review, the Taiwan 113 Publication and the 298 Publication render obvious claim 1, as discussed in Section IX.C.1, and the 298 Publication further discloses the additional limitation of claim 16, as discussed in Section IX.B.7.

204. Accordingly, it is my opinion that the Taiwan 113 Publication and the 298 Publication render obvious dependent claim 16.

12. Claim 17

205. Based on my review, claim 17 is dependent on claim 1 and additionally recites the language provided below.

| | |
|----------|--|
| Claim 17 | "wherein 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.” |
|----------|--|

206. Based on my review, the Taiwan 113 Publication and the 298 Publication render obvious claim 1, as discussed in Section IX.C.1, and the 298

Publication further discloses the additional limitation of claim 17, as discussed in Section IX.B.8.

207. Accordingly, it is my opinion that the Taiwan 113 Publication and the 298 Publication render obvious dependent claim 17.

13. Claim 18

208. Based on my review, claim 18 is dependent on claim 1 and additionally recites the language provided below.

| | |
|----------|--|
| Claim 18 | “wherein 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.” |
|----------|--|

209. Based on my review, the Taiwan 113 Publication and the 298 Publication render obvious claim 1, as discussed in Section IX.C.1, and the 298 Publication further discloses the additional limitation of claim 18, as discussed in Section IX.B.9.

210. Accordingly, it is my opinion that the Taiwan 113 Publication and the 298 Publication render obvious dependent claim 18.

14. Claim 19

211. Based on my review, claim 19 is dependent on claim 1 and additionally recites the language provided below.

| | |
|----------|--|
| Claim 19 | “wherein the designated profile includes a configuration selected from |
|----------|--|

| | |
|--|---|
| | the group consisting of a plane, a slope” |
|--|---|

212. Based on my review, the Taiwan 113 Publication and the 298 Publication render obvious claim 1, as discussed in Section IX.C.1, and the 298 Publication further discloses the additional limitation of claim 19, as discussed in Section IX.B.10.

213. Accordingly, it is my opinion that the Taiwan 113 Publication and the 298 Publication render obvious dependent claim 19.

15. Claim 20

214. Based on my review, claim 20 is dependent on claim 1 and additionally recites the language provided below.

| | |
|----------|---|
| Claim 20 | “wherein the plurality of superabrasive particles is arranged across the support substrate in a predetermined pattern.” |
|----------|---|

215. Based on my review, the Taiwan 113 Publication and the 298 Publication render obvious claim 1, as discussed in Section IX.C.1, and the 298 Publication further teaches that “in one embodiment of the invention, the cutting elements are formed in pyramidal shapes” and that “the PCD layer was EDM [electrical discharge machining] shaped to form pyramids distributed in a predetermined pattern.” (Ex. 1011 ¶¶ 70, 107.) The 298 Publication further discloses that “a stainless steel plate was placed on the top of the flowing epoxy and pressed toward the PCD until only a thin layer of epoxy remained between the

backing of the PCD and the steel substrate.” (*Id.* ¶ 108.) In my opinion, this means that the 298 Publication’s superabrasive particles, formed in pyramids, are arranged across the steel support substrate in a predetermined pattern. (*See also id.* at cl. 31.)

216. Accordingly, it is my opinion that the Taiwan 113 Publication and the 298 Publication render obvious dependent claim 20.

16. Claim 21

217. Based on my review, claim 21 is dependent on claim 20 and additionally recites the language provided below.

| | |
|----------|--|
| Claim 21 | “wherein the predetermined pattern includes an even distribution of the plurality of superabrasive particles spaced at a distance of from about 100 microns to about 800 microns.” |
|----------|--|

218. Based on my review, the Taiwan 113 Publication and the 298 Publication render obvious claims 1 and 20, as discussed in Sections IX.C.1 and X.C.15, and the 298 Publication further discloses that the “cutting elements can be evenly spaced from one another at a distance ‘d’ of from about 100 microns to about 800 microns.” (Ex. 1011 ¶ 55.)

219. Accordingly, it is my opinion that the Taiwan 113 Publication and the 298 Publication render obvious dependent claim 21.

D. Ground 4: Claims 8–12 are unpatentable because they are obvious over the Taiwan 113 Publication in view of the 298 Publication and the CMP Reference

220. In my opinion, the Taiwan 113 Publication, the 298 Publication, and the CMP Reference render obvious claims 8-12 of the '802 Patent.

1. Claim 8

221. Based on my review, claim 8 is dependent on claim 6 and additionally recites the language provided below.

| | |
|---------|---|
| Claim 8 | “wherein the plurality of working superabrasive particles includes at least 100 working superabrasive particles.” |
|---------|---|

222. Based on my review, the Taiwan 113 Publication and the 298 Publication render obvious claim 6, as discussed in Section IX.C.6, and the CMP Reference discloses the additional limitation of claim 8. In fact, in my opinion, it has been well-known to produce CMP pad dressers having the claimed ranges of particles since at least 2007. For instance, Figure 2 of the CMP Reference (Ex. 1015 at 2 (Fig. 2).) provides an SEM photograph showing many thousands of particles on a pad dresser. The below table provides a measured disclosure of particle numbers based upon the SEM particle density and known pad dresser sizes:

| Nominal | | Total Number of Working Superabrasive Particles | | |
|-------------------------------|-----------------------------|---|--------------|------------------|
| Dressing Tool Diameter (inch) | Dressing Tool Diameter (mm) | Left Hand Image | Center Image | Right Hand Image |
| 1 | 25 | 39270 | 7854 | 2945 |
| 2 | 50 | 157080 | 31416 | 11781 |
| 3 | 75 | 353429 | 70686 | 26507 |
| 4 | 100 | 628319 | 125664 | 47124 |
| 5 | 125 | 981748 | 196350 | 73631 |
| 6 | 150 | 1413717 | 282743 | 106029 |
| 7 | 175 | 1924226 | 384845 | 144317 |
| 8 | 200 | 2513274 | 502655 | 188496 |

From: "The Fabrication of Ideal Diamond Disk (IDD) by Casting Diamond Film on a Si Wafer"
International Conference on Planarization/CMP Technology - October 25 - 27, 2007 Dresden
VDE VERLAG GMBH · Berlin-Offenbach (Kinik)

223. Based upon the disclosed profiles of tip heights and working superabrasive particles, in my opinion, the above-disclosed densities result in “at least 100 working superabrasive particles” thereby disclosing the claimed limitation. *Id.* Further, given that these references are all in the same technical field, a POSITA would have been motivated to combine the references in the manner discussed above.

224. Accordingly, it is my opinion that the Taiwan 113 Publication, the 298 Publication, and the CMP Reference render obvious dependent claim 8.

2. Claim 9

225. Based on my review, claim 9 is dependent on claim 6 and additionally recites the language provided below.

| | |
|---------|--|
| Claim 9 | "wherein the plurality of working superabrasive particles includes at least 1000 working superabrasive particles." |
|---------|--|

226. Based on my review, the Taiwan 113 Publication and the 298 Publication render obvious claim 6, as discussed in Section IX.C.6, and the CMP Reference discloses at least 1000 particles in accordance with disclosed tip profiles

and superabrasive particle densities, which is the additional limitation of claim 9. (See Ex. 1015 at 2 (Fig. 2).) Further, as discussed above, an POSITA would have been motivated to combine these references.

227. Accordingly, it is my opinion that the Taiwan 113 Publication, the 298 Publication, and the CMP Reference render obvious dependent claim 9.

3. Claim 10

228. Based on my review, claim 10 is dependent on claim 6 and additionally recites the language provided below.

| | |
|----------|--|
| Claim 10 | “wherein the plurality of working superabrasive particles includes from about 1000 to about 6000 working superabrasive particles.” |
|----------|--|

229. Based on my review, the Taiwan 113 Publication and the 298 Publication render obvious claim 6, as discussed in Section IX.C.6, and the CMP Reference discloses at least 1000 to 6000 working superabrasive particles in accordance with disclosed tip profiles and superabrasive particle densities, which is the additional limitation of claim 10. (See Ex. 1015 at 2 (Fig. 2).) Further, as discussed above, an POSITA would have been motivated to combine these references.

230. Accordingly, it is my opinion that the Taiwan 113 Publication, the 298 Publication, and the CMP Reference render obvious dependent claim 10.

4. Claim 11

231. Based on my review, claim 11 is dependent on claim 6 and additionally recites the language provided below.

| | |
|----------|--|
| Claim 11 | "wherein the plurality of working superabrasive particles includes from about 2000 to about 5000 working superabrasive particles." |
|----------|--|

232. Based on my review, the Taiwan 113 Publication and the 298 Publication render obvious claim 6, as discussed in Section IX.C.6, and the CMP Reference also discloses the claimed range (i.e., 2000 to 6000 working superabrasive particles) of claim 11. (*See* Ex. 1015 at 2 (Fig. 2).) Further, as discussed above, an POSITA would have been motivated to combine these references.

233. Accordingly, it is my opinion that the Taiwan 113 Publication, the 298 Publication, and the CMP Reference render obvious dependent claim 11.

5. Claim 12

234. Based on my review, claim 12 is dependent on claim 6 and additionally recites the language provided below.

| | |
|----------|--|
| Claim 12 | "wherein the plurality of working superabrasive particles include at least about 1000 working superabrasive particles that protrude from the rigid support substrate to distances within about 30 microns of one another." |
|----------|--|

235. Based on my review, the Taiwan 113 Publication and the 298 Publication render obvious claim 6, as discussed in Section IX.C.6, and the CMP Reference discloses the additional limitation of claim 12. (Figure 2 of the CMP Reference showing at least 1,000 particles that protrude from the rigid support substrate to distances within about 30 microns of one another, as seen in the left-most figure and dimensions shown on the SEM). (Ex. 1015 at 2 (Fig. 2).) Further, as discussed above, an POSITA would have been motivated to combine these references.

236. Accordingly, it is my opinion that the Taiwan 113 Publication, the 298 Publication, and the CMP Reference render obvious dependent claim 12.

E. Ground 5: Claims 1-3, 6-11, and 13-20 are unpatentable under because they are anticipated by the 862 FH Art

237. It is my opinion that the 862 FH Art anticipates claims 1-4, 6-11, and 13-20 of the '802 Patent.

1. Claim 1

238. In my opinion, the 862 FH Art discloses and anticipates every limitation of claim 1.

239. Language of claim 1 is provided below, broken into its sub-parts or elements so as to make it easier to discuss. The first sub-part is the preamble of claim 1.

| | |
|-------------------|---------------------|
| Claim 1[preamble] | “A CMP pad dresser” |
|-------------------|---------------------|

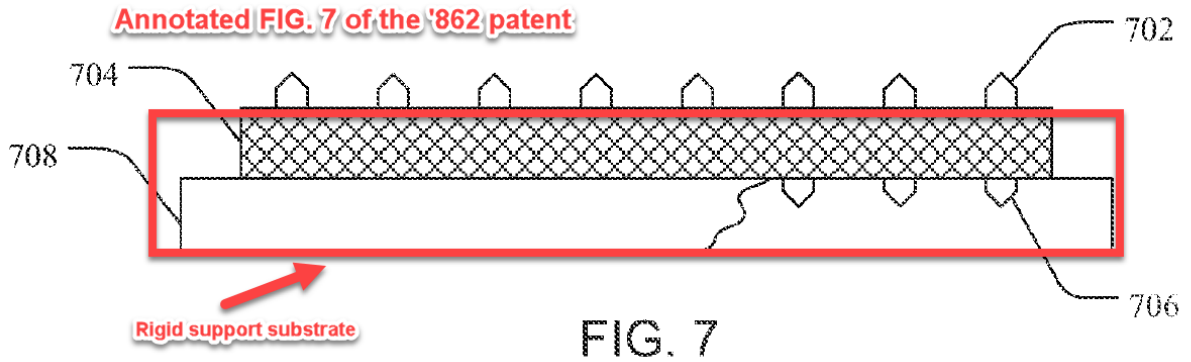
240. In my opinion, the preamble is disclosed in the 862 FH Art.

241. The 862 FH Art is directed to “CMP pad dressers having leveled tips and associated methods.” (Ex. 1014 at 42 (Abstract).). Thus, it is my opinion that the 862 FH Art thus teaches the preamble.

213. The next element is Claim 1[a] element, which is provided below.

| | |
|------------|-----------------------------|
| Claim 1[a] | “a rigid support substrate” |
|------------|-----------------------------|

242. Based on my review, claim element 1[a] is disclosed in the 862 FH Art. The '862 FH Art teaches a “rigid support substrate” as the metal support layer 404 (*see* Ex. 1014 at 44 (Fig. 4)) and/or the metal support layer 704 mounted to the rigid support 708 which collectively would create a rigid support bilayer comprising the metal support layer 704 and the rigid support 708 as illustrated below in the annotated FIG. 7 (Ex. 1014 at 45 (Fig. 7)) from the 862 FH Art. The 862 FH Art describes that the “rigid support can be made from any material compatible with the abrading or dressing process [such as] polymeric materials, metal materials, ceramic materials, glasses, composites, and the like.” (Ex. 1014 at 31:15–18.) Thus, in my opinion, the 862 FH Art teaches claim element 1[a].



243. The next element is Claim 1[b], which is provided below.

| | |
|------------|--|
| Claim 1[b] | “a monolayer of a plurality of superabrasive particles coupled to the support substrate” |
|------------|--|

244. Based on my review, claim element 1[b] is disclosed in the 862 FH Art, which is shown in the above FIG. 7. Further, the 862 FH Art discloses multiple methods of coupling the superabrasive particles to a support substrate. For example, it is described that the superabrasive particles can be bonded to the metal support layer by brazing or electrodeposition or sintering or metal bonding through heat or pressure. (Ex. 1014 at 29:15–31:5.) Thus, it is my opinion that the 862 FH Art teaches claim element 1[b].

245. The next element is Claim 1[c], which is provided below.

| | |
|------------|---|
| Claim 1[c] | “wherein each superabrasive particle in the monolayer extends away from the support substrate to a protrusion distance” |
|------------|---|

246. Based on my review, claim element 1[c] is disclosed in the 862 FH Art. The 862 FH Art describes protrusion distances of the superabrasive particles

above the support substrate as illustrated below in the Petitioner-annotated FIG. 1 from the 862 FH Art (Ex. 1014 at 43 (Fig. 1)) where it shows protrusion distances for superabrasive particles 108 and 110 and describes the “difference” 106 between those protrusion distances.

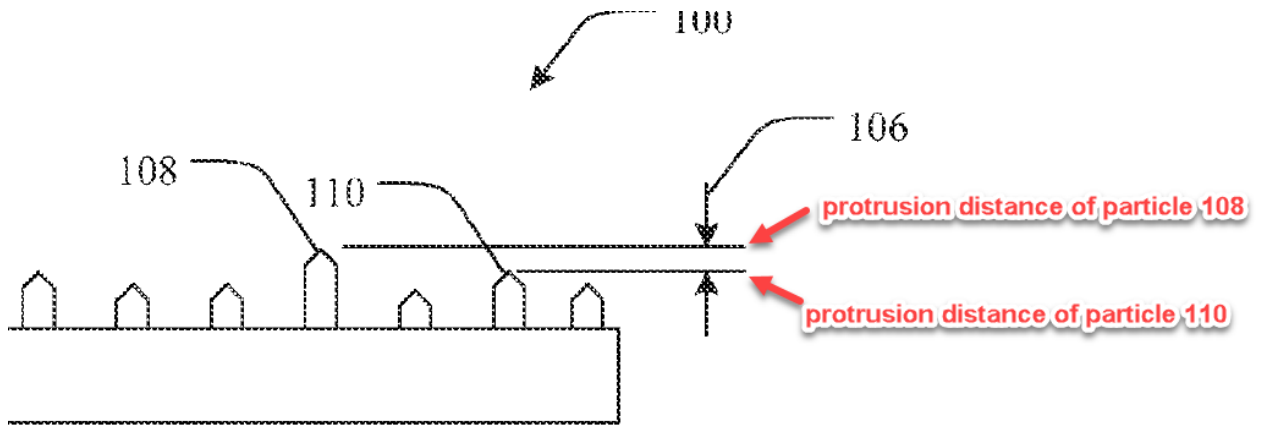


FIG. 1

247. In my opinion, a POSITA would understand that these protrusion distances are the distances that each monolayer particle extends above the support substrate as illustrated in the above annotated FIG. 1 of the 862 FH Art. For these reasons, it is my opinion that the 862 FH Art also inherently teaches claim element 1[c].

248. The next element is Claim 1[d], which is provided below.

| | |
|------------|---|
| Claim 1[d] | “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” |
|------------|---|

249. Based on my review, claim element 1[d] is disclosed in the 862 FH Art, which teaches tip variations along a designated profile with a defined tip variation. Specifically, the '862 FH Art discloses that “the highest 1% of protruding tips can be located around the periphery of the monolayer” and that “substantially all of the asperities are cut in the CMP pad by superabrasive particles located at a peripheral location of the dresser.” (Ex. 1014 at 20:9–11.) In my opinion, another embodiment of the '862 FH Art discloses that “the peripheral location extends from an outer edge of the dresser inwardly toward a center point of the dresser for up to about 90% of the dresser radius.” (*Id.* 20:11–13.) There are other “uniform predetermined pattern[s]” described in the 862 FH Art specification. (*Id.* at 19–20.) Further, in my opinion, the various tip variations described in the 862 FH Art describe the “the tip variation from about 5 microns to about 100 microns.” Alternative tip variation ranges described in the 862 FH Art include “60 microns or less” and “40 microns or less.” (*See, e.g.*, Ex. 1014 at 20:4–6.) Again, it is my opinion that these ranges satisfy the limitation of between 5 and 100 microns. The 862 FH Art thus, in my opinion, teaches claim element 1[d].

250. The next element is Claim 1[e] element, which is provided below.

| | |
|------------|---|
| Claim 1[e] | “wherein 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” |
|--|--|

251. Based on my review, claim element 1[e] is disclosed in the 862 FH Art, which teaches that “the difference in protrusion distance 106 between the highest protruding tip 108 and the next highest protruding tip 110 of the monolayer is described as the protrusion difference. In one aspect the protrusion difference can be less than or equal to about 50 microns. In another aspect, the protrusion difference can be less than or equal to about 20 microns. In a further aspect, the protrusion difference can be less than or equal to about 10 microns.” (Ex. 1014 at 19:9-15.) In my opinion, these variations described in the ’862 FH Art anticipate this limitation. Thus, it is my opinion that the 862 FH Art teaches claim element 1[e].

252. The next element is Claim 1[f] element, which is provided below.

| | |
|------------|--|
| Claim 1[f] | “[wherein] 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.” |
|------------|--|

253. Based on my review, claim element 1[f] is disclosed in the 862 FH Art, which teaches the tip variations as being such that “for the 1% of the plurality of superabrasive particles that have the highest protruding tips, the variance in protrusion distance for that 1% is less than or equal to about 80 microns.” (Ex. 1014 at 19:26-28.) In my opinion, this, along with other variations described in the

862 FH Art, clearly meet this limitation. Thus, it is my opinion that the 862 FH Art teaches claim element 1[f].

254. Accordingly, it is my opinion that the 862 FH Art discloses each and every limitation recited in claim 1 and, therefore, anticipates independent claim 1.

2. Claim 2

255. Based on my review, claim 2 is dependent on claim 1 and additionally recites the language provided below.

| | |
|---------|---|
| Claim 2 | "wherein 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." |
|---------|---|

256. Based on my review, the 862 FH Art anticipates all elements of claim 1, as discussed in Section IX.E.1, and further discloses an embodiment, where “the difference in protrusion distance between the highest protruding tip and the second highest protruding tip of the monolayer . . . is less than or equal to about 10 microns.” (Ex. 1014 at 39:8-9.)

257. Thus, it is my opinion that the 862 FH Art anticipates dependent claim 2.

3. Claim 3

258. Based on my review, claim 3 is dependent on claim 1 and additionally recites the language provided below.

| | |
|---------|---|
| Claim 3 | “the difference in protrusion distance between the highest protruding tip and the second highest protruding tip is less than about 10 microns.” |
|---------|---|

259. In my opinion, any description of “less than or equal to about 10 microns” also discloses “less than about 10 microns.”

260. For all the same reasons that the 862 FH Art discloses the limitations of claim 2, it is my opinion that it also discloses the limitations of claim 3.

4. Claim 6

261. Based on my review, claim 6 is dependent on claim 1 and additionally recites the language provided below.

| | |
|---------|---|
| Claim 6 | “wherein the plurality of superabrasive particles includes a plurality of working superabrasive particles, such that 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.” |
|---------|---|

262. Based on my review, the 862 FH Art discloses and claims a “plurality of superabrasive particles protruding from a matrix layer” 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.” (*See, e.g.*, Ex. 1014 at 39:6, 11-12.)

263. In my opinion, a POSITA would understand that a maximum cutting depth of about 60 microns also discloses “less than or equal to about 50 microns.” The 862 FH Art also discloses that the plurality of superabrasive particles includes

a plurality of working particles. (*See, e.g.*, Ex. 1014 at 18:17-19 (describing that some of the more than 10,000 superabrasive particles are working superabrasive particles); *id.* at 12:26–13:5 (describing “working” and “non-working” superabrasive particles, where working superabrasive particles are the particles that remove debris and/or cut into a CMP pad during a dressing procedure).)

264. Accordingly, it is my opinion that the '862 FH Art discloses all elements of claim 6 and anticipates claim 6.

5. Claim 7

265. Based on my review, claim 7 is dependent on claim 6 and additionally recites the language provided below.

| | |
|---------|---|
| Claim 7 | “wherein the cutting depth is from about 10 microns to about 50 microns.” |
|---------|---|

266. I have already explained above that the 862 FH Art anticipates claim 6. *See supra* Section IX.E.4. Based on my review, the 862 FH Art discloses “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.” (Ex. 1014 at 39:11-12.) In my opinion, a POSITA would understand that a maximum cutting depth of about 60 microns as disclosed and claimed in the 862 FH Art which discloses a cutting depth “from about 10 microns to about 50 microns.”

267. Accordingly, it is my opinion that 862 FH Art anticipates claim 7.

6. Claim 8

268. Based on my review, claim 8 is dependent on claim 6 and additionally recites the language provided below.

| | |
|---------|---|
| Claim 8 | “wherein the plurality of working superabrasive particles includes at least 100 working superabrasive particles.” |
|---------|---|

269. I have already explained above that the 862 FH Art anticipates claim 6. *See supra* Section IX.E.4. Based on my review, the 862 FH Art describes that “in another aspect, at least 100 tips of the plurality of superabrasive particles cut asperities into the CMP pad as the dresser is rotated.” (Ex. 1014 at 7:28-29.) In my opinion, this cutting of asperities is the definition of a “working superabrasive particle” in the 862 FH Art, so this limitation is clearly disclosed and anticipated by the 862 FH Art.

270. Accordingly, it is my opinion that 862 FH Art anticipates claim 8.

7. Claim 9

271. Based on my review, claim 9 is dependent on claim 6 and additionally recites the language provided below.

| | |
|---------|--|
| Claim 9 | “wherein the plurality of working superabrasive particles includes at least 1000 working superabrasive particles.” |
|---------|--|

272. I have already explained above that the 862 FH Art anticipates claim 6. *See supra* Section IX.E.4. Based on my review, the 862 FH Art discloses that a typical CMP pad dresser can have greater than 10,000 superabrasive particles.

(Ex. 1014 at 18:17.) The 862 FH Art describes that “in some cases there may be only a few working superabrasive particles that are actually able to cut the CMP pad.” (Ex. 1014 at 18:18-19), and as described above, discloses at least 100 working superabrasive particles. (*Id.* at 7:28-29.) In my opinion, a POSITA would therefore understand that some minority fraction of particles on a pad dresser, e.g. 15%, could be operating as “working” superabrasive particles. Based on my review, the 862 FH Art also discloses that a typical CMP pad dresser can have greater than 10,000 superabrasive particles. (Ex. 1014 at 18:17.) Consequently, for a typical CMP pad dresser of more than 10,000 particles, it is my opinion that a POSITA would understand that the 862 FH Art discloses at least 1,000 working superabrasive particles in a CMP pad dresser. Further, even to the extent it is determined that the 862 FH Art does not expressly disclose at least 1,000 working superabrasive particles, this would be an obvious variation that one of ordinary skill in the art would employ according to their design needs in a given pad dresser design, so this limitation is further obvious based upon the disclosure of the 862 FH Art.

273. Accordingly, it is my opinion that the 862 FH Art anticipates and/or obviates claim 9.

8. Claim 10

274. Based on my review, claim 10 is dependent on claim 6 and additionally recites the language provided below.

| | |
|----------|--|
| Claim 10 | “wherein the plurality of working superabrasive particles includes from about 1000 to about 6000 working superabrasive particles.” |
|----------|--|

275. I have already explained above that the 862 FH Art anticipates claim 6. *See supra* Section IX.E.4. Based on my review, the 862 FH Art discloses that a typical CMP pad dresser can have greater than 10,000 superabrasive particles. (Ex. 1014 at 18:17.) The 862 FH Art also discloses that “in some cases there may be only a few working superabrasive particles that are actually able to cut the CMP pad.” (*Id.* at 18:18–19) In my opinion, a POSITA would understand that the above disclosures from the 862 FH Art discloses from about 1000 to about 6000 working superabrasive particles in a CMP pad dresser. Further, even to the extent it is determined that the 862 FH Art does not expressly disclose from about 1000 to about 6000 working superabrasive particles, this would be an obvious variation that one of ordinary skill in the art would employ according to their design needs in a given pad dresser design, so this limitation is further obvious based upon the disclosure of the 862 FH Art.

276. Accordingly, it is my opinion that the 862 FH Art anticipates and/or obviates claim 10.

9. Claim 11

277. Based on my review, claim 11 is dependent on claim 6 and additionally recites the language provided below.

| | |
|----------|--|
| Claim 11 | “wherein the plurality of working superabrasive particles includes from about 2000 to about 5000 working superabrasive particles.” |
|----------|--|

278. I have already explained above that the 862 FH Art anticipates claim 6. *See supra* Section IX.E.4. Based on my review, the 862 FH Art discloses that a typical CMP pad dresser can have greater than 10,000 superabrasive particles. (Ex. 1014 at 18:17.) The 862 FH Art also discloses that “in some cases there may be only a few working superabrasive particles that are actually able to cut the CMP pad.” (*Id.* at 18:18–19.) In my opinion, a POSITA would understand that the above disclosures from the 862 FH Art discloses from about 2000 to about 6000 working superabrasive particles in a CMP pad dresser. Further, even to the extent it is determined that the 862 FH Art does not expressly disclose from about 2000 to about 6000 working superabrasive particles, this would be an obvious variation that one of ordinary skill in the art would employ according to their design needs in a given pad dresser design, so this limitation is further obvious based upon the disclosure of the 862 FH Art.

279. Accordingly, it is my opinion that the 862 FH Art anticipates and/or obviates claim 11.

10. Claim 13

280. Based on my review, claim 13 is dependent on claim 1 and additionally recites the language provided below.

| | |
|----------|--|
| Claim 13 | “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 10 microns to about 50 microns.” |
|----------|--|

281. I have already explained above that the 862 FH Art anticipates claim 1. *See supra* Section IX.E.1. Based on my review, the 862 FH Art discloses tip variations along a designated profile with a defined tip variation. Specifically, the 862 FH Art discloses that “the highest 1% of protruding tips can be located around the periphery of the monolayer” and that “substantially all of the asperities are cut in the CMP pad by superabrasive particles located at a peripheral location of the dresser.” (Ex. 1014 at 20:8-11.) In my opinion, another embodiment of the 862 FH Art discloses that “the peripheral location extends from an outer edge of the dresser inwardly toward a center point of the dresser for up to about 90% of the dresser radius.” (*Id.* at 20:12-13.) There are other “uniform predetermined pattern[s]” described in the 862 FH Art specification. (*Id.* at 20:19-20.) Alternative tip variation ranges described in the ’862 patent include “60 microns or less” and “40 microns or less.” (*Id.* at 20:4-6.) In my opinion, these tip variation ranges clearly encompass and anticipate the claimed “10 microns or less” range.

282. Accordingly, it is my opinion that the 862 FH Art anticipates claim 13.

11. Claim 14

283. Based on my review, claim 14 is dependent on claim 1 and additionally recites the language provided below.

| | |
|----------|--|
| Claim 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.” |
|----------|--|

284. I have already explained above that the 862 FH Art anticipates claim 1. *See supra* Section IX.E.1. Based on my review, the 862 FH Art discloses tip variations along a designated profile with a defined tip variation as described above. Further, as described above, in my opinion, the claimed range of 20 microns to about 40 microns would be understood by a POSITA to include ranges of “60 microns or less” and “40 microns or less” (*see, e.g.*, Ex. 1014 at 20:4-6.)

285. Accordingly, it is my opinion that 862 FH Art anticipates claim 14.

12. Claim 15

286. Based on my review, claim 15 is dependent on claim 1 and additionally recites the language provided below.

| | |
|----------|--|
| Claim 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.” |
|--|--|

287. I have already explained above that the 862 FH Art anticipates claim 1. *See supra* Section IX.E.1. Based on my review, the 862 FH Art discloses tip variations along a designated profile with a defined tip variation as described above. Further, as described above, in my opinion, the claimed range of less than about 20 microns would be understood by a POSITA be taught by prior art disclosing a range of “40 microns or less” (*see, e.g.*, Ex. 1014 at 20:4-6).

288. Accordingly, it is my opinion that the 862 FH Art anticipates claim 15.

13. Claim 16

289. Based on my review, claim 16 is dependent on claim 1 and additionally recites the language provided below

| | |
|----------|---|
| Claim 16 | “wherein the protrusions of the plurality of superabrasive particles produce cutting depths of less than about 20 microns when used to abrade a CMP pad.” |
|----------|---|

290. I have already explained above that the 862 FH Art anticipates claim 1. *See supra* Section IX.E.1. Based on my review, the 862 FH Art describes a goal of leveling the monolayer of superabrasive particles such that a “maximum cutting depth of about 40 microns” is achieved. (*See, e.g.*, Ex. 1014 at 21:3-4.) In my opinion, a POSITA would understand that the 862 FH Art is also disclosing

cutting depths of less than 40 microns such as cutting depths less than 20 microns when used to abrade a CMP pad.

291. Accordingly, it is my opinion that the 862 FH Art anticipates claim 16.

14. Claim 17

292. Based on my review, claim 17 is dependent on claim 1 and additionally recites the language provided below.

| | |
|----------|--|
| Claim 17 | "wherein 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." |
|----------|--|

293. I have already explained above that the 862 FH Art anticipates claim 1. *See supra* Section IX.E.1. Based on my review, the 862 FH Art describes a goal of leveling the monolayer of superabrasive particles such that a “maximum cutting depth of about 40 microns” is achieved. (*See, e.g.*, Ex. 1014 at 21:3-4.) In my opinion, a POSITA would understand that the 862 FH Art is also disclosing cutting depths of less than 40 microns such as cutting depths from about 1 micron to about 20 microns when used to abrade a CMP pad.

294. Accordingly, it is my opinion that the 862 FH Art anticipates claim 17.

15. Claim 18

295. Based on my review, claim 18 is dependent on claim 1 and additionally recites the language provided below.

| | |
|----------|--|
| Claim 18 | “wherein 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.” |
|----------|--|

296. I have already explained above that the 862 FH Art anticipates claim 1. *See supra* Section IX.E.1. Based on my review, the 862 FH Art describes a goal of leveling the monolayer of superabrasive particles such that a “maximum cutting depth of about 40 microns” is achieved. (*See, e.g.*, Ex. 1014 at 21:3-4.) In my opinion, a POSITA would understand that the 862 FH Art is also disclosing cutting depths of less than 40 microns such as cutting depths from about 10 micron to about 20 microns when used to abrade a CMP pad.

297. Accordingly, it is my opinion that the 862 FH Art anticipates claim 18.

16. Claim 19

298. Based on my review, claim 19 is dependent on claim 1 and additionally recites the language provided below.

| | |
|----------|---|
| Claim 19 | “wherein the designated profile includes a configuration selected from the group consisting of a plane, a slope, a curved shape, a dome shape, and combinations thereof.” |
|----------|---|

299. I have already explained above that the 862 FH Art anticipates claim 1. *See supra* Section IX.E.1. Based on my review, the 862 FH Art discloses that “the superabrasive particles may lie along a slope, curvature, or some other arrangement that is not parallel to the metal support layer.” (Ex. 1014 at 22:22–23.) Further, the 862 FH Art discloses “parallel to the metal support layer” would be a plane, which, in my opinion, would also fall within the group recited in dependent claim 19.

300. Accordingly, it is my opinion that the 862 FH Art anticipates claim 19.

17. Claim 20

301. Based on my review, claim 20 is dependent on claim 1 and additionally recites the language provided below.

| | |
|----------|---|
| Claim 20 | “wherein the plurality of superabrasive particles is arranged across the support substrate in a predetermined pattern.” |
|----------|---|

302. I have already explained above that the 862 FH Art anticipates claim 1. *See supra* Section IX.E.1. Based on my review, the 862 FH Art describes that “substantially all of the superabrasive particles are arranged in uniform predetermined pattern at a peripheral location of the dresser.” (Ex. 1014 at 20:19–20; *see also id.* at 26:24–27:17 (describing multiple predetermined patterns of superabrasive particles).)

303. Accordingly, it is my opinion that the 862 FH Art anticipates claim 20.

F. Ground 6: Claims 4-5 are unpatentable because they are obvious over the 862 FH Art by itself or in view of the 146 Publication

304. It is my opinion that the 862 FH Art by itself or in view of the 146 Publication anticipates claims 4-5.

1. Claim 4

305. In my opinion, the 862 FH Art discloses and anticipates every limitation of claim 4 by itself or in view of the 146 Publication.

306. Based on my review, claim 4 depends from independent claim 1 and further recites the language provided below.

| | |
|---------|---|
| Claim 4 | “wherein 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.” |
|---------|---|

307. I have already explained above that the 862 FH Art anticipates claim 1. *See supra* Section IX.E.1. Based on my review, the 862 FH Art is silent as to differences between a highest and a 10th highest protruding tip, but, in my opinion, such a difference is just another measure of the distribution of flatness. The '802 Patent provides no basis or engineering design metric for this measure of flatness being critical in any way. Accordingly, it is my opinion that this measure of flatness would be an obvious variation to one of ordinary skill in the art in

possession of the 862 FH Art, or alternatively one of ordinary skill in the art would be motivated to combine the teachings of the 146 Publication in the same field of endeavor to the teachings of the 862 FH Art as the 146 Publication was combined applied above in combination with the 298 Publication, as discussed in Section IX.B.1.

2. Claim 5

308. In my opinion, the 862 FH Art discloses and anticipates every limitation of claim 5 by itself or in view of the 146 Publication.

309. Based on my review, claim 5 depends from claim 1 and further recites the language provided below.

| | |
|---------|--|
| Claim 5 | “wherein 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.” |
|---------|--|

310. I have already explained above that the 862 FH Art anticipates claim 1. *See supra* Section IX.E.1. For the same reasons expressed in Section IX.F.1 above for claim 4, it is my opinion that dependent claim 5 is similarly obvious over the 862 FH Art, or alternatively in light of the 146 Publication as described above.

G. Ground 7: Claim 12 is unpatentable as obvious over the 862 FH Art in view of the CMP Reference

1. Claim 12

311. In my opinion, the 862 FH Art discloses and anticipates every limitation of claim 12 by itself or in view of the CMP Reference.

312. Based on my review, claim 12 depends from claim 6 and further recites the language provided below.

| | |
|----------|--|
| Claim 12 | “wherein the plurality of working superabrasive particles include at least about 1000 working superabrasive particles that protrude from the rigid support substrate to distances within about 30 microns of one another.” |
|----------|--|

313. I have already explained above that the 862 FH Art anticipates claim 6. *See supra* Section IX.E.4. The 862 FH Art discloses at least about 1000 working superabrasive particles, as discussed in Section IX.E.7. Further, in the same field of endeavor and applied to the same objective—providing substantially leveled superabrasive particles in a pad dresser—Figure 2 of the CMP Reference discloses the additional limitation of claim 12 of at least 1,000 particles that protrude from the rigid support substrate to distances within about 30 microns of one another (as can be seen in the left-most figure and the dimensions shown on the SEM). (Ex. 1015 at 2 (Fig. 2)). Accordingly, this combination renders obvious claim 12.

X. OVERALL CONCLUSIONS

296. For the reasons stated above, it is my opinion that a person of ordinary skill in the art at the relevant time would find claims 1-21 of the '802 Patent to be

anticipated and/or obvious in view of the prior art. I thus believe claims 1-21 of the '802 Patent should be canceled.

I hereby declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct, and that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I understand that willful false statements and the like are punishable by fine or imprisonment, or both (18 U.S.C. § 1001).

Executed on March 10, 2021

A handwritten signature in cursive script, appearing to read "S. Shanfield", is written above a horizontal line.

Stanley Shanfield