

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO. LTD.,
SAMSUNG ELECTRONICS AMERICA, INC.,
SAMSUNG SEMICONDUCTOR, INC., and
SAMSUNG AUSTIN SEMICONDUCTOR, LLC,
Petitioner

v.

CHIEN-MIN SUNG,
Patent Owner

IPR2024-00533
U.S. Patent No. 8,974,270

DECLARATION OF PROF. MING-YI TSAI

Under 37 C.F.R. § 42.120

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Patent Trial and Appeal Board
U.S. Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
Submitted Electronically via PTACTS

1. My name is Ming-Yi Tsai. I am over the age of 18 years old and I am competent to testify to the matters stated in this Declaration.

2. I provide this Declaration in support of Patent Owner Chien-Min Sung (“Dr. Sung”) in the above-captioned proceeding.

3. I am being compensated for the services I render in this proceeding at an hourly rate of \$150. My compensation is in no way dependent on the outcome of this proceeding.

I. BACKGROUND

4. I have extensive experience in the Chemical-Mechanical Processing (“CMP”) of semiconductor devices, with a focus on the design and characterization of CMP pad dressers (also known as CMP pad conditioners and CMP conditioning discs).

5. A copy of my curriculum vitae is attached as Exhibit A.

6. I received my Ph.D. in Mechanical Engineering from National Taiwan University in Taiwan.

7. I am a Distinguished Professor in the Department of Mechanical Engineering, National Chin-Yi University of Technology, Taichung City, Taiwan. My research areas include difficult cut materials, chemical mechanical polishing and abrasive machining.

8. I have published articles through the IEEE and about 100 technical papers in journals and conferences (including international and Taiwanese).

9. Among these publications, I am the lead author of a publication titled Effect of CMP Conditioner Diamond Shape on Pad Topography and Oxide Wafer Performances, Int. J. Adv. Manuf. Technol. 55(1):253–262 (2011) (published online Dec. 4, 2010) (“CCDS article”).

10. I understand that my CCDS article has been cited by Petitioners Samsung Electronics Co. Ltd., Samsung Electronics America, Inc., Samsung Semiconductor, Inc., and Samsung Austin Semiconductor, LLC (“Samsung”) as Exhibit 1013 supporting in their Petition in this case in relation to U.S. Patent 8,974,270 (the “’270 patent), which was issued to Chien-Min Sung, a co-author of mine on other articles. I have received a copy of Samsung’s Petition and am familiar with its contents.

11. My publications also include other articles relating to CMP pad dressers, two of which are cited in the References Section of the CCDS article. Those two articles are Novel Diamond Conditioner Dressing Characteristics of CMP Polishing Pad, Int. J. Mach. Tool Mfg. 49:722–729 (2009), on which Dr. Sung was one of my co-authors, and Dressing Characteristics of Oriented Single Diamond on CMP Polyurethane Pad, Mach. Sci. Technol. 13:92–105 (2009).

II. RELEVANT LEGAL PRINCIPLES

12. I am not an attorney. The following legal principles have been provided to me by counsel.

A. Patent Claims

13. I understand that independent claims are read separately, whereas dependent claims are based on the limitations of another independent and/or dependent claims. To determine the scope of a dependent claim, it must be read together with the claim or claims upon which it depends. In other words, each independent claim stands on its own, whereas each dependent claim includes the elements from that dependent claim plus any claim from which it depends, either directly or indirectly.

B. Anticipation

14. A patent claim to a device is anticipated if the same device, system, or method, including all the claim limitations, is shown in a single prior art reference. The identical invention must be shown in as complete detail as is contained in the patent claim. Every element of the claimed invention must be literally present in the reference, arranged as in the claim.

15. For a prior art reference to anticipate a claim, the reference, as viewed by a person of ordinary skill in the art at the time of the invention, must disclose each and every element of the claim with sufficient clarity to prove its existence in the prior art, and with sufficient clarity to enable one of ordinary skill in the art to

make the invention without undue experimentation. Determination of whether the requisite amount of experimentation is undue may include consideration of (1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the predictability or unpredictability of the art, and (8) the breadth of the claims.

C. Obviousness

16. To obtain a patent, a claimed invention must have, as of the priority date, been non-obvious in light of the prior art in the field.

17. To prove that prior art or a combination of prior art renders a patent obvious, it is necessary, by a preponderance of the evidence to: (1) identify the particular references that, singly or in combination, make the patent obvious; (2) prove that those references qualify as prior art to the patent; (3) specifically identify which elements of the patent claim appear in each of the asserted references; (4) explain how the prior art references could have been combined in order to create the inventions claimed in the asserted claim; and (5) identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in a way the claimed new invention does. It must be shown that a person of ordinary skill would have had reason to attempt to make the device, or carry out the claimed method, and would have had reasonable

expectation of success in doing so. Reasonable expectation of success is assessed as of the date of the invention described in the patent.

18. Obviousness can also be based on an “obvious-to-try” theory. In addition to the aforementioned requirements, a proper obvious-to-try conclusion also requires: (1) that at the relevant time, there had been a recognized problem or need in the art, which may include a design need or market pressure to solve the problem; and (2) that there had been a finite number of identified, potential solutions to that recognized need or problem known to persons of ordinary skill in the art. An obviousness inquiry based on an obvious-to-try rationale must always be undertaken in the context of the subject matter in question, including the characteristics of the technology, its state of advance, the nature of the known choices, the specificity or generality of the prior art, and the predictability of results in the area of interest.

19. The claimed invention must be considered as a whole in analyzing obviousness or non-obviousness. In determining the differences between the prior art and the claims, the question under the obviousness inquiry is not whether the differences themselves would have been obvious, but whether the claimed invention as a whole would have been obvious.

20. As part of the process of determining the scope and content of the prior art, it is appropriate to consider whether there is evidence of a “teaching,

suggestion, or motivation” to combine the teachings in the prior art, the nature of the problem or the knowledge of a person having ordinary skill in the art.

21. In assessing obviousness, I have been instructed to consider the distortion caused by hindsight bias, to guard against slipping into the use of hindsight, and to be cautious of arguments that rely upon after-the-fact reasoning and avoid the temptation to read into the prior art the teaching of the invention in issue.

22. The following factors should be considered in analyzing obviousness: (1) the scope and content of the prior art; (2) the differences between the prior art and the claims; (3) the level of ordinary skill in the pertinent art, and (4) the objective evidence of non-obviousness (if present).

23. Certain objective indicia can be important evidence regarding whether a patent is obvious or non-obvious. Such indicia include:

- a. Commercial success;
- b. Long-felt, but unsolved needs in the art for the invention, particularly in the face of prior art later asserted to lead to a solution;
- c. Failure of others;
- d. Skepticism by experts
- e. Praise by others;
- f. Unexpected results;

- g. Recognition of a problem;
- h. Copying of the invention by others in the field.

24. An objective indicium cannot be relevant to the obviousness discussion for a patent unless that objective indicium is connected, or has a “nexus,” with the invention claimed in the patent at issue.

III. THE LEVEL OF ORDINARY SKILL IN THE ART

25. I have also been informed that there is a concept in patent law known as a person having ordinary skill in the art (“POSITA”). I have been informed that this concept refers to a person who is trained in the relevant technical field of a patent without possessing extraordinary or otherwise exceptional skill. Further, I have been informed that factors such as the education level of those working in the field, the sophistication of the technology, the types of problems encountered in the art, prior art solutions to those problems, and the speed at which innovations are made may help establish the level of skill in the art.

26. I understand that Samsung’s expert Dr. Stanley Shanfield has provided the following proposed definition of a POSITA for the ’270 patent:

[A] POSITA as of the earliest claimed filing date of the ’270 Patent (i.e., May 23, 2011) would have had a bachelor’s degree in an engineering related field, such as material science, mechanical engineering, electrical engineering, or physics, and a minimum of two to three years of experience in the field of integrated circuit processing and fabrication techniques. I note that a higher level of education or specific skills in the industry may make up for less experience, and vice versa.

(Ex. 1002 at ¶ 63.)

27. I have been made aware that Dr. Shanfield has failed to provide any explanation or analysis as to how or why he reached this conclusion.

28. It is my opinion that Dr. Shanfield's definition of a POSITA is deficient because it is overly broad, merely requiring experience "in the field of integrated circuit processing and fabrication techniques," and it lacks any specific reference to CMP technology, which is a specialized branch of semiconductor manufacturing. The '270 Patent states, "the present disclosure provides CMP pad dressers and associated methods thereof." (Ex. 1001 at 1:28-29.) Therefore, a POSITA would have necessarily had specific experience with the design and development of CMP pad dressers, including the background and progression of CMP design as outlined below, and would have been able to apply that knowledge to the context of the '270 patent.

29. Accordingly, I believe a POSITA for purposes of the '270 patent would have had at least a bachelor's degree in mechanical engineering or other relevant field of engineering and at least two years of experience in developing CMP technology, including some specific experience with the design and development of CMP pad dressers.

30. I have a keen understanding of this level of skill in the art as it existed at the time the '270 patent was filed. I was directly involved the development of

chemical-mechanical planarization (CMP) technology and CMP pad conditioners specifically as reflected in my curriculum vitae and am capable of rendering an informed opinion on the level of ordinary skill in the art at the relevant time frame. Moreover, I am capable of rendering an opinion from the perspective of one of ordinary skill in the art at the relevant timeframe, as I have done below.

IV. PRECISION IN ALIGNING SUPERABRASIVE PARTICLES IN CMP PAD DRESSERS

31. Based on my experience, atomic-level precision in aligning the tip heights on a CMP pad dresser was not practically achievable circa 2011 in brazed diamond disks (BDD).

32. Based on my experience in CMP pad design and measurement, and my understanding of the development of CMP pad dressers at that time, circa 2005–2007, it was not practically achievable to consistently and predictably manufacture a BDD CMP pad dresser having superabrasive particle tip height variation less than 50 microns.

33. That level of variation causes a substantial variation in the cut depth of the pad dresser during actual usage and causes excessive wear and mechanical stress that aids in the removal of protruding superabrasive particles.

34. It was thought that this problem could be solved by controlling the variation in tip height distribution during pad dresser manufacturing. It was predicted that this reduction in height tip variation would result in the mechanical

stresses being substantially evenly distributed over the bulk of the superabrasive particles during actual usage, rather than being disproportionately concentrated on the protruding particles. As a result, it was predicted that this reduction in variation in tip height would help retain the superabrasive particles when actually using the CMP pads.

35. By 2009, a number of different publications continued to recognize that the tips of superabrasive particles on CMP pad dressers would not be at the same height or have the same shape or orientation. Nevertheless, it was still assumed that mechanical stresses would be substantially equally distributed among the bulk of the superabrasive particles during the use of the CMP pad dressers.

36. Despite the lack of empirical underpinnings, this assumption continued to underlie CMP pad dresser design and usage. Even a cutting-edge CMP conditioner simulation in 2010 still took this “bulk view” of the superabrasive particles, with its model applying a uniform distribution of particles that considered variations in their density and the radius of their distribution on the CMP pad. (This was justified by citing to another study titled Pad Conditioning Density Distribution in CMP Process with Diamond Dresser, IEEE Trans. Semicond. Manuf. 20(4):464–474, by Tyan that the distribution patterns of the superabrasive particles did not significantly influence the final dressing results.)

37. Because these variables were not considered to be significant contributors to variance in the performance of CMP pad dressers, as of 2009, those of skill in the art still considered the dressing behavior of superabrasive particles, and of CMP pad dressers, in operation to be “unpredictable.” That unpredictability in actual usage remained the prevailing understanding, and remained a problem to be solved, notwithstanding the motivation to reduce tip height variation as much as possible.

38. In April 2009, I published an article titled Dressing Characteristics of Oriented Single Diamond on CMP Polyurethane Pad in a publication called Machining Science and Technology. (This is attached to the Patent Owner Response as Ex. 2006.) As far as I know, this was the first time that anyone had characterized how even one superabrasive particle would perform in practice when used to condition a CMP pad dresser. Recognizing the unpredictable performance of CMP pad dressers, I sought to study how a single superabrasive particle on such a dresser actually functioned in order to gain greater insight into the operation of such particles in bulk. Among other conclusions, I realized that orienting the diamond such that the point (rather than a line or a face) was used for cutting removed less of the CMP pad and produced a pad that polished at a higher and more consistent rate during the CMP process.

39. In 2012, I was the lead author (with Dr. Sung as one of my co-authors) of an article titled Organic Diamond Disk Versus Brazed Diamond Disk for Dressing a Chemical-Mechanical Polishing Pad. Diamond & Related Materials 23 (2012) 144–149. This article describes my work using a stylus-type 2D surface to measure the variation in tip-height for two different types of pad dressers, one of which was a novel type of pad dresser that we created and studied (“ODD”). We tried to level the tips of our ODD as much as possible, but we were only able to achieve leveling of the superabrasive tips to within 15um variation via reverse casting methods.

40. Based on the difficulty in reducing variation in tip height variation, the cutting performance of CMP pad dressers remained unpredictable in actual use circa 2011 even to those at the cutting edge of the field, like me.

41. In particular, even one of extraordinary skill in the art circa 2011 would not have been able to readily predict or otherwise determine, without substantial experimentation involving the intended usage conditions, the expected cutting depth and effect, or performance, produced by a CMP pad dresser in actual use based on a particular amount of variation between the tip heights of its superabrasive particles as it was manufactured. Nor would one of even extraordinary skill in the art circa 2011 have been able to readily predict or otherwise determine a maximum cutting depth from the use of such a CMP pad

dresser with any particular level of variation in superabrasive particle tip height. This was demonstrated, among other places, by my 2009 article (Ex. 2006), which considered the effect of only a single working superabrasive particle.

42. Rather, making such determinations about the actual cutting depth that would result from any pattern of variation in the tip height of the superabrasive particles would require substantial characterization of the usage conditions of the CMP pad dresser, including the characteristics of the CMP pad itself.

43. It would have required substantial and extensive experimentation, which would have involved involve detailed surface measurements of CMP pad dressers post-manufacture and post-use, along with examination of various types of CMP pads on which they were used, for one of even extraordinary skill in the art to begin to understand a general relationship between a particular variation in particle tip height and a particular cutting depth produced on a particular CMP pad.

44. Similarly, as a result of the unpredictability of CMP pad dressers in actual use, one of skill in the art would not have been able to determine, without substantial and extensive experimentation, the number or location of the superabrasive tips that would actually cut asperities into the CMP pad dresser during use. As with the cutting depth, this determination would also have required characterization of the actual usage conditions, including operating parameters and consideration of the characteristics of the CMP being conditioned.

45. This difficulty in determining which superabrasive particles actually performed cutting only increases as the variation in tip height became more tightly controlled. That is because extreme outlying superabrasive particles would be most likely to actually cut asperities, and so such particles are more likely to perform the cutting, and so reducing the variance in outlying parties correspondingly reduces the ability to predict which particles will cut.

46. As we now understand, it is the outlying superabrasive particles that provide the greatest contribution to the behavior of the CMP pad dresser in operation. Characterization of these outliers is what thus provides the most insight into the expected and actual behavior of a CMP pad dresser in operation.

47. Moreover, as I explained in my Dressing Characteristics of Oriented Single Diamond on CMP Polyurethane Pad article in 2009, the extent to which cutting occurs also depends on the orientation of the superabrasive particles, with point orientation being most likely to cut, and a face-orientation unlikely to cut and instead producing wear dominated by plowing action. So height variation among particles and particle location cannot alone identify those that are cutting the pad.

V. THE DISCLOSURE OF SUNG '479 FROM THE PERSPECTIVE OF A PERSON OF ORDINARY SKILL IN THE ART CIRCA 2011

48. I am aware that Petitioners cite extensively to US 2008/0096479 A1 (“Sung ’479”) as the primary reference in the above-captioned proceedings.

49. As its first page indicates, Sung '479 is a patent application titled “Low-melting point superabrasive tools and associated methods.” It was filed by Dr. Chien-Min Sung on October 18, 2006, and published on April 24, 2008. (Ex. 1005.)

50. Sung '479 purported to address “issues with properly holding very small superabrasive particles” in a CMP pad dresser as well as “metal braze alloys [that] have the tendency to warp and buckle during a heating process, causing additional issues in obtaining a CMP pad dresser having superabrasive particle tips leveled to within a narrow tolerance range.” (Ex. 1005 at [0007]; *see also* [0006].)

51. To reduce “the variance between the tip heights of a plurality of superabrasive particles in a tool,” Sung '479 discussed “utilizing a braze having a low-melting point to bond the superabrasive particles.” (Ex. 1005 at [0050]; *see id.* at [0051] (providing “a method for making a low-melting point superabrasive tool having a plurality of superabrasive particles”).) Sung '479 explained that “[s]uch low-melting point braze materials do not generate significant warpage due to the lower temperatures utilized to construct the tool.” (*Id.* at [0050].)

52. In short, Sung '479 disclosed CMP pad dressers with certain features formed in certain ways that were thought to reduce tip height variance and minimize mechanical stress on the superabrasive particles based on the assumption

that the bulk of the superabrasive particles performed cutting and thus substantially equally shared substantially all of the mechanical stresses during actual use.

53. Sung '479 did not identify the level of height deviation between superabrasive particles that was likely to occur because of limitations of the manufacturing process at that time. Sung '479 also did not teach how any of its various disclosed CMP pad dresser designs would operate in practice. Sung '479 failed to explain how reducing particle tip height variation (or any particular range of particle tip heights) in its invention correlated to performance in dressing CMP pads. Sung '479 assumed that reducing particle tip variation would result in superior performance in operation, consistent with the prevailing thinking about how CMP pad dressers functioned.

54. Sung '479 did not provide any description of particular superabrasive particles that would actually cut asperities in the CMP pad during conditioning and thus experience greater mechanical forces. Sung '479 also did not teach any way that such particles could be identified.

VI. CONTEXT OF THE '270 PATENT

55. The '270 patent reflected the understanding that only a small percentage of superabrasive particles in a typical CMP pad dresser provide the greatest contribution to the behavior of the CMP pad dresser in operation. Characterization of these particles is what thus provides the most insight into the

expected and actual behavior of a CMP pad dresser in operation. For example, though a CMP pad dresser may have thousands of superabrasive particles, only a small subset of those particles may actually cut the CMP pad.

56. The '270 patent indicates this understanding at least by its example that only the few tallest superabrasive particles of a CMP pad dresser that determine overall effectiveness of the CMP pad dresser's performance during CMP pad conditioning. The example in the '270 patent identifies that as few as the thirty highest protruding superabrasive particles of a CMP pad dresser may drive performance or effectiveness of the CMP pad dresser. (*See* Ex. 1001 at 13:65-14:6.)

57. The '270 patent focuses on bounding and characterizing the protrusion among, and variance in, the outlying superabrasive particles that actually performed the work. (*See, e.g.*, Ex. 1001 at Abstract.) In contrast, prior so-called "solutions" attempted to eliminate the outliers to share the workload.

58. So, while Sung '479 based on the technological understanding at the time, presented a concept that "the superabrasive particle tips may be leveled to spread the mechanical forces impinging on the tool across *substantially all of the particles*" ([0067]) (emphasis added), the '270 patent focuses only on the working particles. This reflects (and results from) the revised understanding that the

performance of a CMP dresser is determined primarily by the outliers in protrusion, and not by the evenness of the bulk material.

59. The assumptions underlying Sung '479—that relatively low height deviations among the diamond tips in manufacturing would result in shared work across the overwhelming majority of the diamond grit because the bulk of the diamond grits were involved in pad dressing—would not have been applied by a POSITA in contravention of what the subsequent development of the art as reflected in the '270 patent expressly taught to the contrary.

VII. SUNG '479 IS NOT ENABLING TO TEACH “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”

60. Thus, it is my understanding that Sung '479 does not disclose claim element [1B] unless its contents describe a single embodiment with sufficient specificity to have enabled a POSITA to create a CMP pad dresser satisfying the structural requirements of claim element [1B], i.e., a CMP pad dresser having a first layer of superabrasive particles such that the difference in protrusion distance between the highest protruding tip and the second highest protruding tip of the superabrasive particles is less than or equal to about 50 microns.

61. It is my opinion that a POSITA could not have combined Sung '479's disclosure with his own knowledge to make the claimed invention of the '270 patent without undue experimentation.

62. Sung '479 describes operation in different and non-overlapping brazing conditions than those of the '270 patent. Sung '479 is expressly limited to brazes having melting point temperatures of under 700 degrees (*e.g.*, Ex. 1005 at Abstract, [0009], [0013], [0051], [0061], [0063], claim 1), while the '270 patent uses brazes having melting point temperatures of 700-1200 degrees (*e.g.*, Ex. 1001 at 11:64-12:2). A POSITA would not have been able to apply the low-temperature teachings of Sung'479 to the higher-temperature brazes of the '270 patent without undue experimentation.

63. The disclosure of Sung '479 also lacks crucial details for implementing the described "leveling process" to align particle tips along its so-called "designated profile." For example, it provides no description for the composition or properties of the "leveling surface" used to level the particle tips such that it allows for the plurality of superabrasive particles to have RA values of "less than about 40 μm ," "less than about 30 μm ," "less than about 20 μm ," or "less than about 10 μm ." (Ex. 1005 at [0067].) Sung '479 discloses these different RA values are possible but does not indicate *how* to achieve these differing results using the ambiguous "leveling surface" or *why* the results would differ using this

“leveling surface.” A POSITA would not have known how to achieve these various results without extensive trial-and-error experimentation.

64. Sung ’479 also fails to disclose how to achieve alignment along a so-called “designated profile.” Sung ’479 states that “[i]t may also be beneficial for the superabrasive particles to protrude from the solidified braze layer to a predetermined height or series of heights that is/are along a designated profile.” (Ex. 1005 at [0069].) But no direction is given as to how to align the particles in such a way on a plane, let alone in “multiple slopes” or a “curved shape.” (*Id.* at [0070]-[0071].) At best, Sung ’479 states that “the superabrasive particles may be arranged along a leveling surface that has a shape corresponding to a particular designated profile.” (*Id.* at [0071].) But again, it provides no direction as to what constitutes such a “leveling surface” or *how* such a “leveling surface” could be used to, or would be able to, create a BDD CMP pad dresser with superabrasive particles “arranged such that their tips vary from the designated profile by less than about 1 microns.” (*Id.* at [0072].) A POSITA would not have been able to arrange particles in such a way on a BDD without undue experimentation. As stated above, circa 2005-2007, when Sung ’479 was filed, it was not practically achievable to consistently and predictably manufacture a BDD CMP pad dresser having superabrasive particle tip height variation less than 50 microns.

65. Sung '479 also fails to instruct how to remove the “spacer layer” and “temporary spacer layer” from the low-melting point braze matrix to expose the superabrasive particles without damaging, removing, or otherwise shifting the particles from the braze matrix during construction of its “superabrasive tool.” (See Ex. 1005 at [0085]-[0086].) Sung '479 provides even less guidance for the higher-temperature braze matrices described and claimed in the '270 patent. Sung '479 merely states that the spacer layers can be removed by “peeling, grinding, sandblasting, scraping, rubbing, abrasion, etc.,” and that even after these caustic actions, “[t]he braze material may be etched, sandblasted or abraded to further expose the superabrasive particles.” (*Id.* at [0086].) But Sung '479 does not indicate how such actions allow the particles to achieve or retain any alignment or leveling. A POSITA would have been required to perform undue experimentation to perform these layer-removal steps and retain particle alignment.

66. Sung '479 also fails to instruct how to level particles on a double-sided CMP pad dresser, such as that of claim 1 of the '270 patent. Sung '479 only includes a single sentence stating that “superabrasive particles 14 may be disposed . . . along multiple surfaces as shown in FIG. 6.” (Ex. 1005 at [0054].) Figure 6 is shown below:

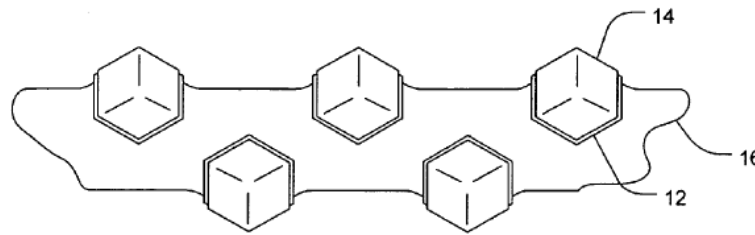


FIG. 6

(Ex. 1005, Fig. 6.) No support or other attachment is shown or described to explain how such a structure would be, or could be, used in practice. Further, again, no description is given as to *how* particles on such a two-sided structure would be leveled or *the extent to which* those particles even could be leveled. There is no discussion how to achieve “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” in a two-sided CMP pad dresser. Sung ’479 even fails to provide height ranges associated with Figure 6. A POSITA would not have been able to create a working structure in this form without undue experimentation, let alone such a structure with level particles.

67. Sung ’479 also lacks any disclosure of working examples or prototypes to validate its leveling processes. As stated above, a POSITA could not have readily replicated the disclosed methods, especially given the limitations of the time period.

68. For at least all of the above reasons, Sung ’479 does not include an enabling disclosure of “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” in a CMP pad dresser, much less in a two-sided CMP pad dresser, as set forth in claim 1 of the ’270 patent.

VIII. CHOU AND SUNG ’479 DO NOT DISCLOSE “A FIRST MONOLAYER OF SUPERABRASIVE PARTICLES . . . , 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”

69. It is my understanding that Dr. Shanfield opines that “Chou teaches that all of the first monolayer of particles 232 are designed to participate in the grinding action, which a POSITA would have recognized to be achievable by reducing the protrusion distance differences between the particles.” I disagree. Chou was filed in 2008 and was therefore affected by the same incorrect assumptions regarding tip leveling as Sung ’479, which were shown to be incorrect by the time of the ’270 patent. *See, e.g.*, ¶¶34-36, 55-59, above. Those assumptions would not have been applied by a POSITA in contravention of what the subsequent development of the art as reflected in the ’270 patent expressly taught to the contrary. *See also* ¶59, above.

70. Chou does not explain how reducing particle tip height variation (or any particular range of particle tip heights) in its apparatus correlates to performance in dressing CMP pads. Chou assumes that reducing particle tip

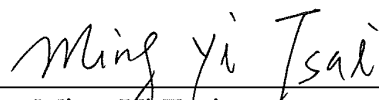
variation post-manufacturing would result in superior performance in operation, consistent with the then-prevailing thinking—now recognized to be incorrect—about how dressers actually functioned. Even with this assumption, Chou does not describe the protrusion distances of its particles.

71. It is also my opinion that it would not have been obvious to a POSITA to level the particle heights of Chou to the values disclosed in Sung '479.

72. Rather, only through hindsight would a POSITA have been able to have selected from the among the potentially infinite combinations of parameters relating to the distinct embodiments described in Sung '479 (including designated profile shape ([0070]-[0071]), the 13 specific permitted variations from the tip profile ([0072]), and wide ranges of particle size ([0057], [0073])) to form the one particular combination that is purported to satisfy claim element [1B]. Neither Petitioners nor their expert disclose how or why that one particular combination would be chosen among the combination of parameters.

I hereby declare that all statements made herein of my own knowledge are true and that all statements are made on information and are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001.

Dated: January 6, 2025



Dr. Ming-Yi Tsai

EXHIBIT A

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AWARDS & CERTIFICATIONS

- 2014-2023 NSTC/MOST Special Outstanding Talent Award
- 2016 CSME Annual meeting Paper Award
- 2016-2017 TAMI Industrial Collaboration Contribution Award
- 2017 ICSS Best Paper Award
- 2017 the 3rd ICI Best Paper Award

PROFILE

I am currently the Dean of the College of Engineering at the National Chin-Yi University of Technology and a distinguished professor. My research interests include machining, semiconductor processing technology, abrasive processing, and chemical mechanical polishing. I have published about 100 papers in journals and conferences (both international and Taiwanese) and obtained about 5 patents. At the same time, I have also assisted more than 50 industry-university projects and served as the host of many integrated projects, including the National Science and Technology Council's next-generation smart manufacturing key technology research and development project and the Difficult to Cut Materials Processing Technology Alliance. These research contents not only cover the improvement indicators of advanced grinding and polishing technology but also consider specific practical applications and industrial economic benefits. Therefore, its research results are oriented towards industrial application potential and value. In the past five years. It has also been awarded to the special outstanding talents funded by the Ministry of Science and Technology for 6 consecutive years, the 2017 ICSS Best Paper Award, the 3rd ICI Best Paper Award in 2017, and the 2016 CSME Annual Meeting Best Paper Award. These results have given me research skills and conference management and preparation skills.

WORK EXPERIENCE

UNIVERSITY CHAIR PROFESSOR

National Chin-Yi University of Technology

August 2007 - Present

- Teaching professional subjects: including planning course content, setting up progress, and testing methods.
- Guiding MA, and PhD students : guiding students to conduct research in related fields and increase relevant professional knowledge
- Administrative work: Assisting with university, college, or department-related work.
- Conduct planning and research: apply for and implement relevant academic research projects, such as industry-university cooperation and government projects.

OTHER EXPERIENCE

- Director of Chemical Mechanical Planarization User Group Taiwan (Jan 2014 - Dec 2016)
- Director of Taiwan Society of Abrasive Technology (TSAT) (Jan 2013 - Dec 2021)
- Vice Director of Taiwan Society of Abrasive Technology (TSAT) (Jan 2021 - Dec 2022)
- Chairman of Taiwan Society of Abrasive Technology (TSAT) (Jan 2024 - Dec 2026)

PUBLISH PAPER LIST

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