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

v.

Chien-Min Sung

June 20, 2025

IPR2024-00533; U.S. Patent No. 8,974,270
IPR2024-00534; U.S. Patent No. 9,138,862
IPR2024-00535; U.S. Patent No. 9,724,802

SAMSUNG

IPR2024-00534
Samsung Electronics Co. Ltd. et al v. Chien-Min Sung
Samsung's Exhibit 1070
Ex. 1070, Page 1

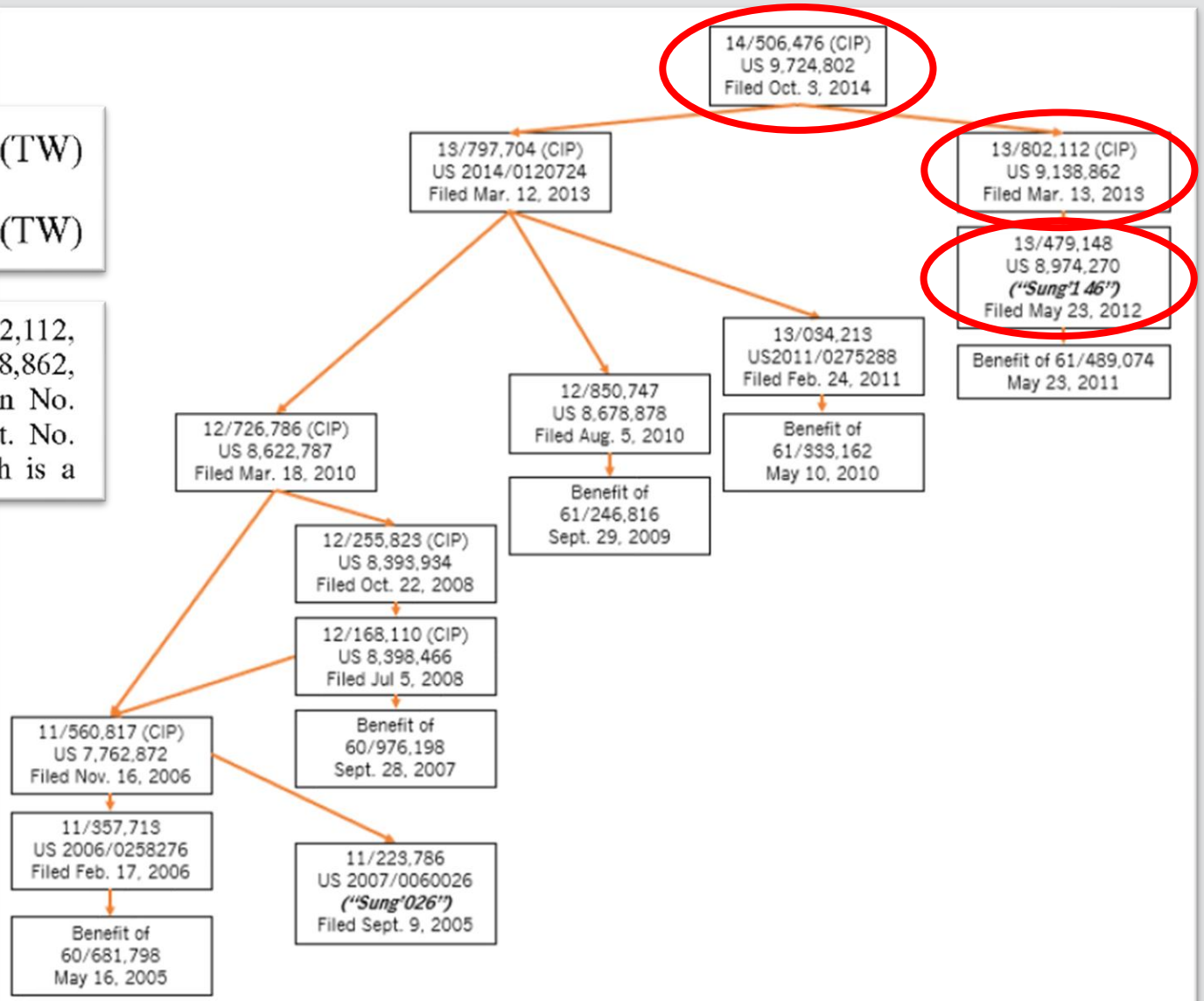
DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The ‘802, ‘862, and ‘270 Patents

Applicant: **Chien-Min Sung**, Tansui (TW)

Inventor: **Chien-Min Sung**, Tansui (TW)

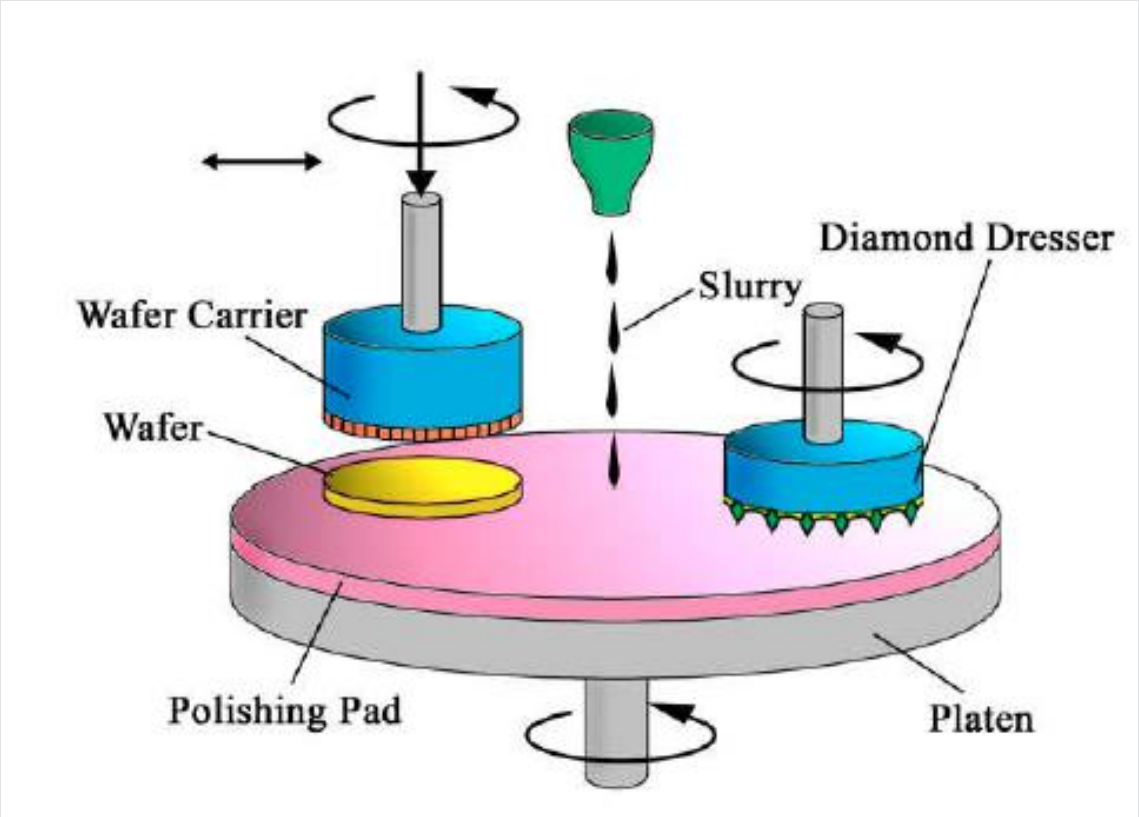
Continuation-in-part of application No. 13/802,112, filed on Mar. 13, 2013, now Pat. No. 9,138,862, which is a continuation-in-part of application No. 13/479,148, filed on May 23, 2012, now Pat. No. 8,974,270, application No. 14/506,476, which is a

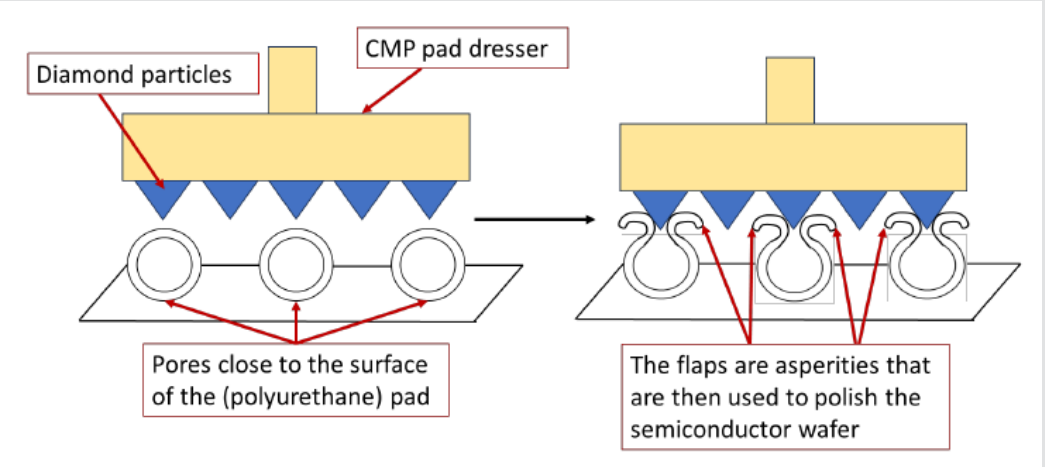


IPR2024-00535, Pet. at 13

Chemical Mechanical Polishing (CMP) Overview

- CMP pad dresser "revives" the pad surface by "cutting" the surface of the CMP pad to generate new asperities
  - CMP pad dresser rotates as it is pressed against the CMP pad





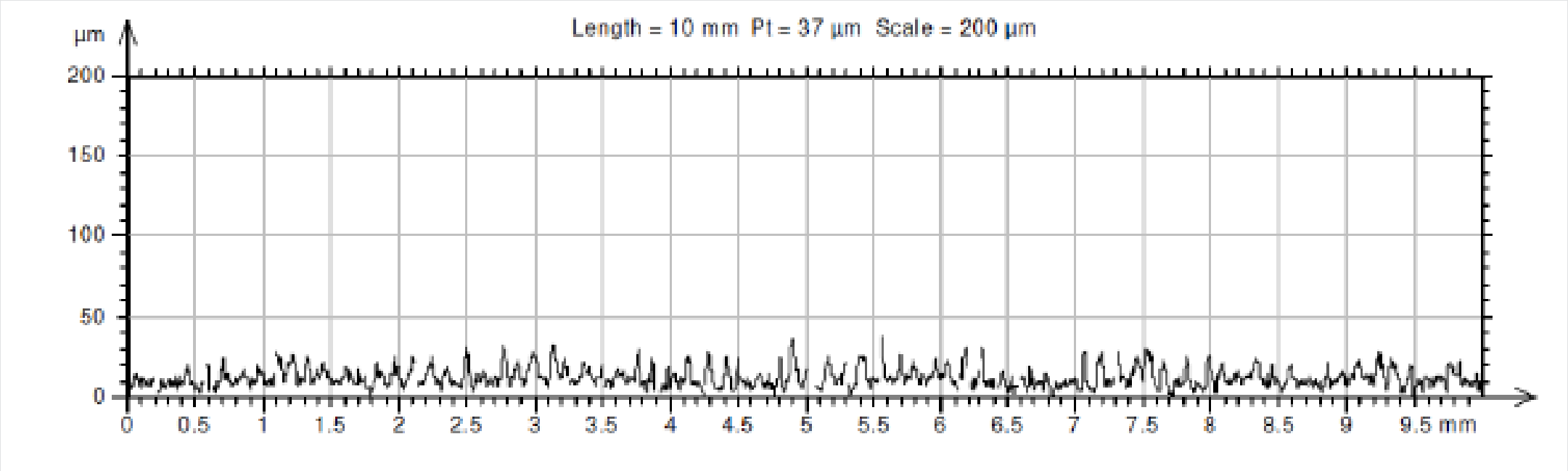
IPR2024-00533, Pet. at 6-8; Ex. 1009, Fig. 2; Ex. 1002, ¶¶37-40
IPR2024-00534, Pet. at 7-8; Ex. 1011, Fig. 2; Ex. 1002, ¶¶37-40
IPR2024-00535, Pet. at 6-8; Ex. 1013, Fig. 2; Ex. 1002, ¶¶38-41

CMP Pad Dressers Having Leveled Diamond Tips Were Known

- CMP pad dressers having diamond tips leveled within 50 µm were known

"Design, Characteristics and Performance of Diamond Pad Conditioners," Mater. Res. Soc. Symp. Proc., Vol 1249, 2010

"[I]llustrates the improvements in flatness and diamond height distribution"

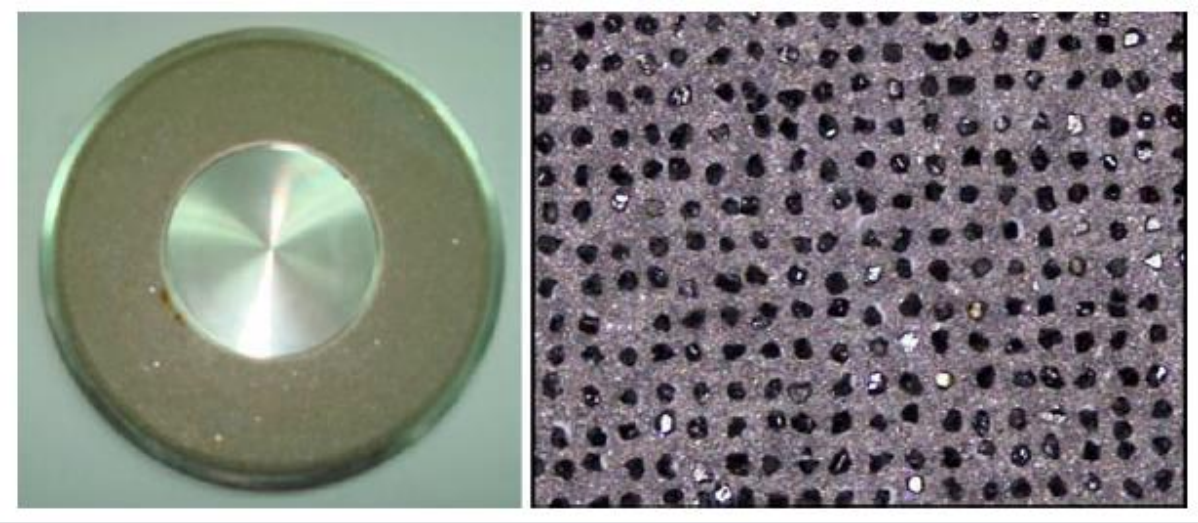


IPR2024-00535, Pet. at 9; Ex. 1015, Fig. 4; Ex. 1002, ¶¶52-53
IPR2024-00534, Pet. at 12; Ex. 1015, Fig. 4; Ex. 1002, ¶¶48-49

CMP Pad Dressers

- CMP pad dressers have diamond particles attached to substrate using brazes or organic materials

Brazed Diamond Disk (BDD)



"The Effect of CMP conditioner diamond shape on pad topography and oxide wafer performances," International Journal of Advanced Manufacturing Technology, 55:253-262, 2011

Organic Diamond Disk (ODD)

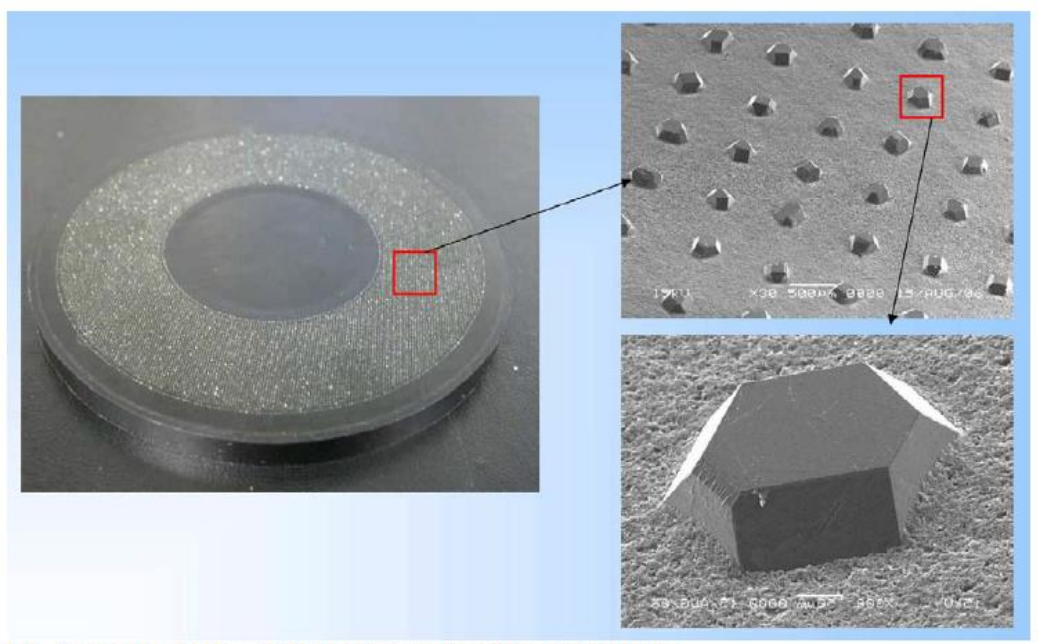


Fig. 3: The bonding conditions of diamond in the epoxy matrix.

"The Organic Diamond Disk (ODD) for dressing of Polishing Pads of Chemical Mechanical Planarization," International Conference on Planarization / CMP Technology, 25-27 October 2007

IPR2024-00535, Pet. at 8-10; Ex. 1006, Figure 3; Ex. 1008, Figure 3
IPR2024-00534, Pet. at 9-11; Ex. 1005, Figure 3; Ex. 1014, Figure 3
IPR2024-00533, Pet. at 8; Ex. 1013, Figure 3

Brazed CMP Pad Dressers (BDD) Made Using Reverse Casting

spacer layer

temporary substrate

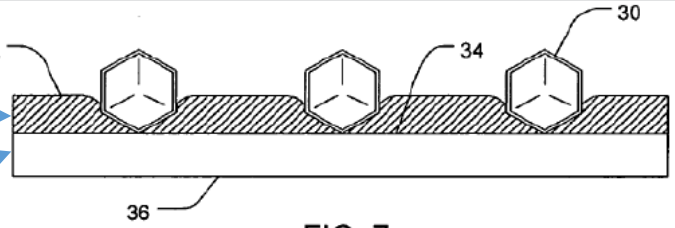


FIG. 7

low-melting point braze layer

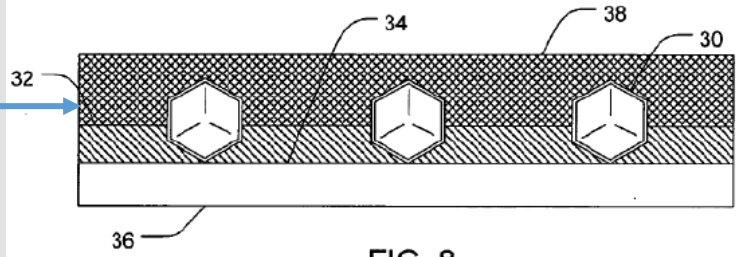


FIG. 8

low-melting point braze layer

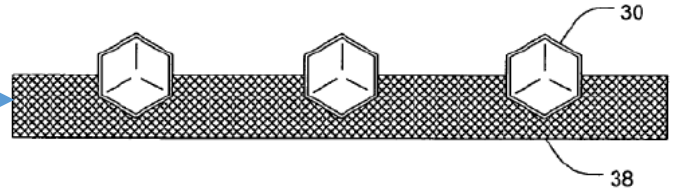


FIG. 9

low-melting point braze layer

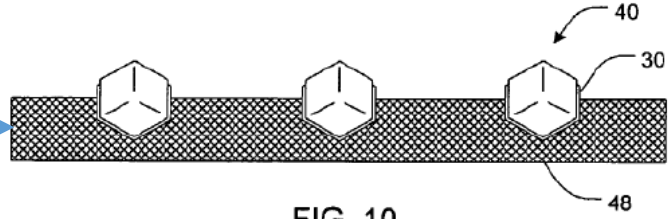


FIG. 10

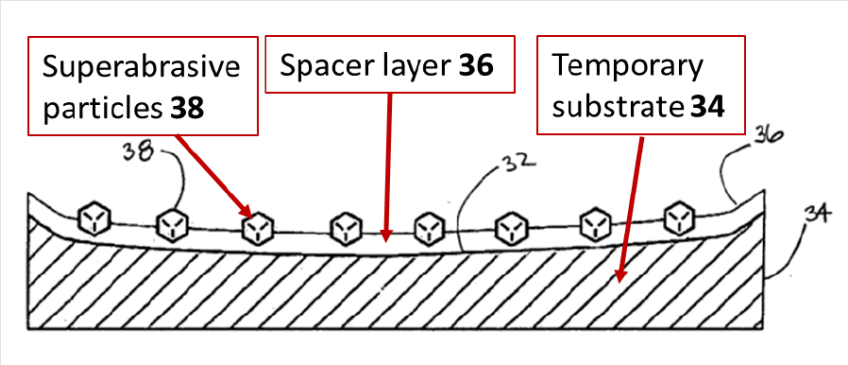
(19) **United States**
(12) **Patent Application Publication**
Sung

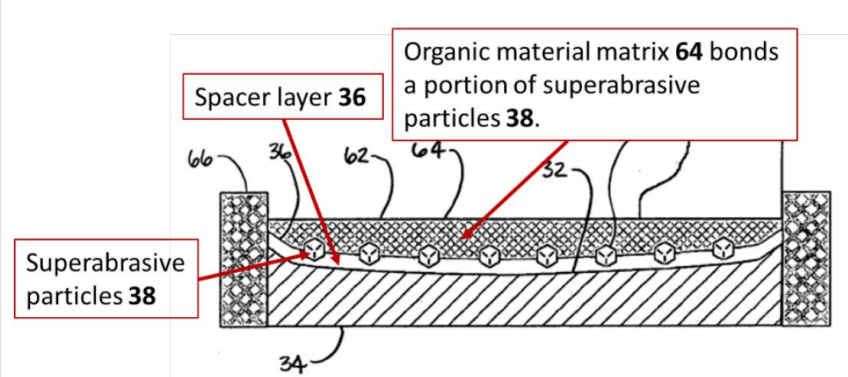
(10) **Pub. No.: US 2008/0096479 A1**
(43) **Pub. Date: Apr. 24, 2008**

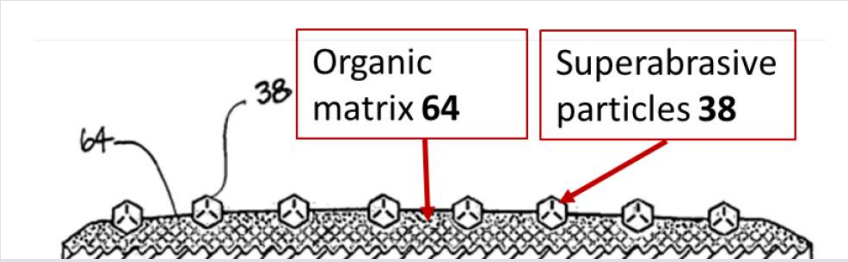
[0082] Various reverse casting methods may be utilized to manufacture the superabrasive tools, and particularly the CMP pad dressers according to aspects of the present invention. As shown in FIG. **7**, a spacer layer **32** may be

IPR2024-00533, Pet. at 25-28; Ex. 1005, [0082]-[0086], Figures. 7-10

Organic CMP Pad Dressers (ODD) Made Using Reverse Casting







(19) **United States**
(12) **Patent Application Publication** (10) **Pub. No.: US 2007/0060026 A1**
Sung (43) **Pub. Date: Mar. 15, 2007**

[0083] Various reverse casting methods may be utilized to manufacture the CMP pad dresser of the present invention.

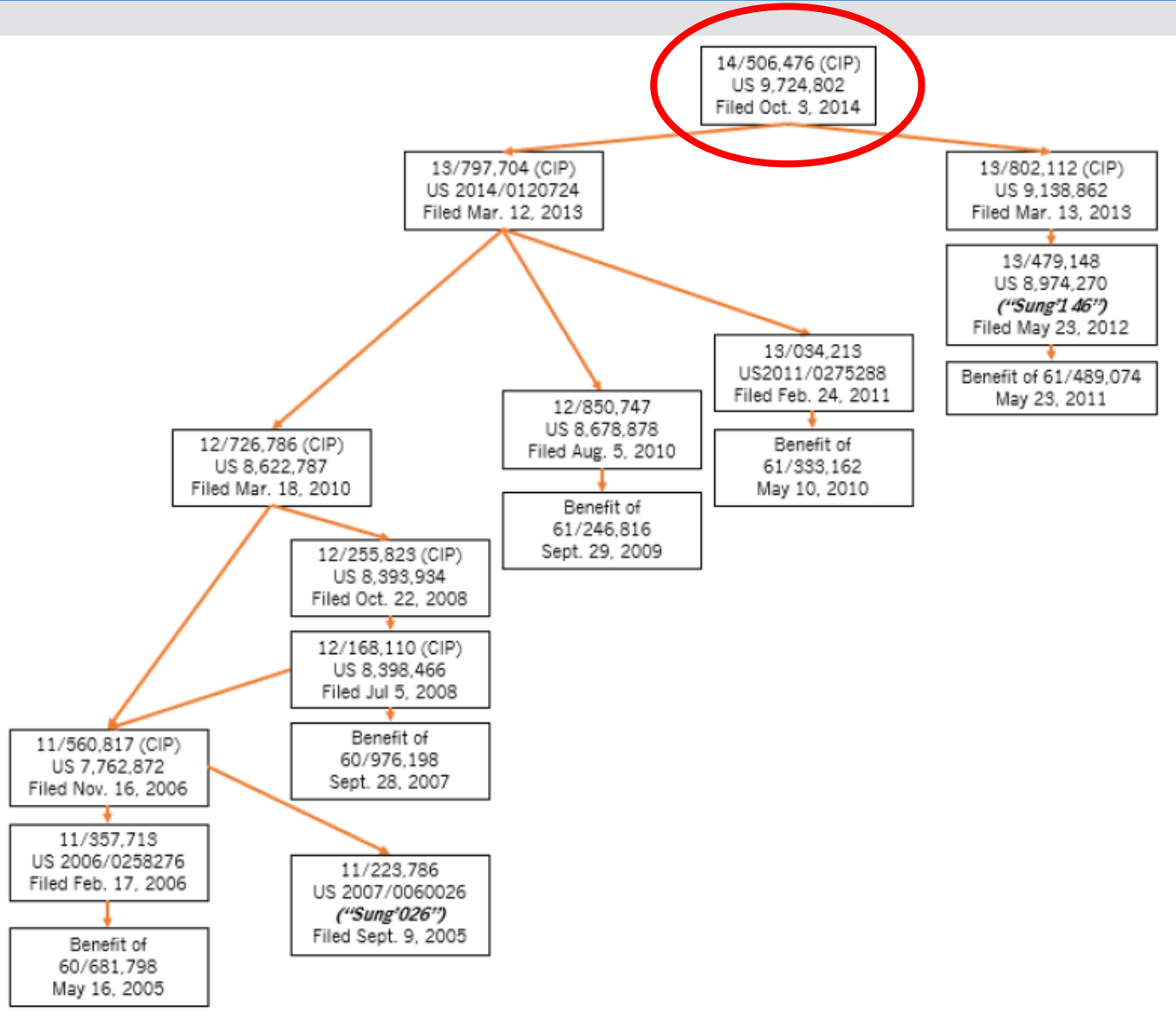
IPR2024-00534, Pet. at 18-21; Ex. 1004, [0083]-[0092] Figures 2-8
IPR2024-00535, Pet. at 27-28, 56-57; Ex. 1005, [0083]-[0092], Figures 2-8

IPR2024-00535
U.S. Patent No. 9,724,802

SAMSUNG

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The '802 Patent



Pet. at 13

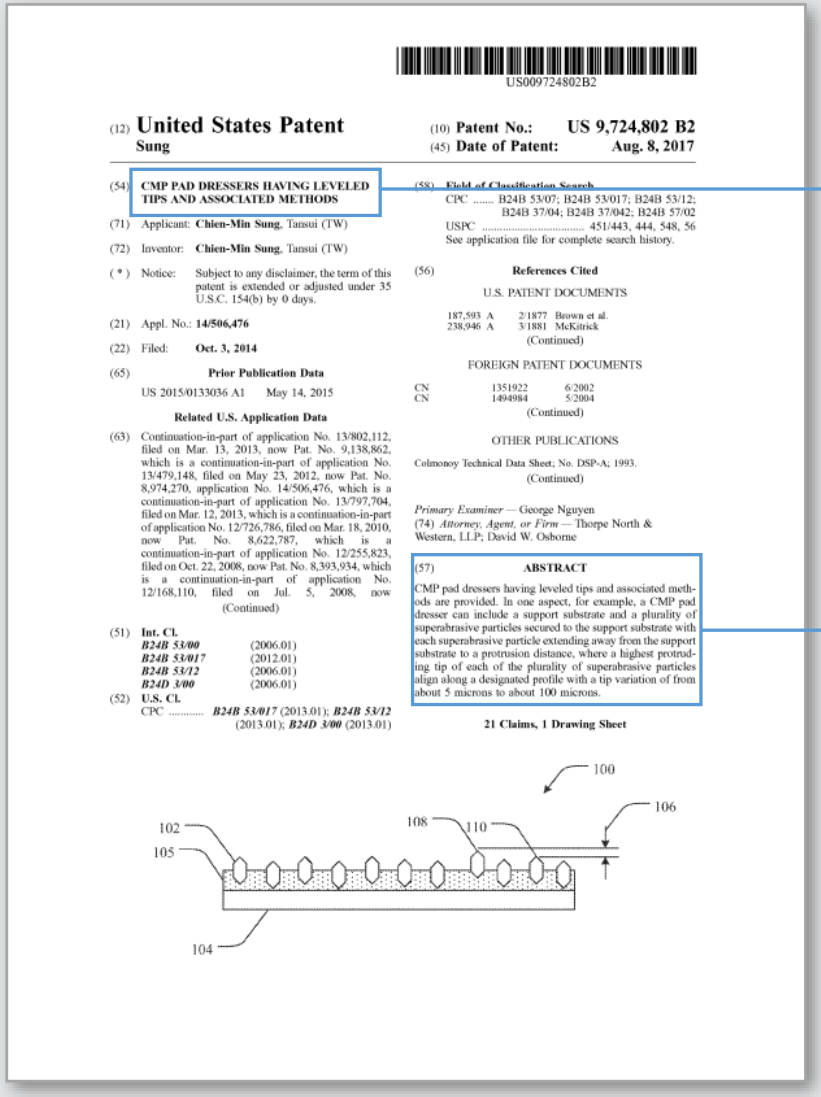
Outline

A Overview of the ’802 Patent

B Overview of the Prior Art

C The Disputed Issues

The ’802 Patent



US009724802B2

(12) **United States Patent**
Sung

(10) **Patent No.: US 9,724,802 B2**
(45) **Date of Patent: Aug. 8, 2017**

(54) **CMP PAD DRESSERS HAVING LEVELED TIPS AND ASSOCIATED METHODS**

(71) Applicant: **Chien-Min Sung**, Tansui (TW)

(72) Inventor: **Chien-Min Sung**, Tansui (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/506,476**

(22) Filed: **Oct. 3, 2014**

(65) **Prior Publication Data**

US 2015/0133036 A1 May 14, 2015

Related U.S. Application Data

(63) Continuation-in-part of application No. 13/802,112, filed on Mar. 13, 2013, now Pat. No. 9,138,862, which is a continuation-in-part of application No. 13/479,148, filed on May 23, 2012, now Pat. No. 8,974,270, application No. 14/506,476, which is a continuation-in-part of application No. 13/797,704, filed on Mar. 12, 2013, which is a continuation-in-part of application No. 12/726,786, filed on Mar. 18, 2010, now Pat. No. 8,622,787, which is a continuation-in-part of application No. 12/255,823, filed on Oct. 22, 2008, now Pat. No. 8,393,934, which is a continuation-in-part of application No. 12/168,110, filed on Jul. 5, 2008, now

(Continued)

(51) **Int. Cl.**

B24B 53/00	(2006.01)
B24B 53/017	(2012.01)
B24B 53/12	(2006.01)
B24D 3/00	(2006.01)

(52) **U.S. Cl.**
CPC ***B24B 53/017*** (2013.01); ***B24B 53/12*** (2013.01); ***B24D 3/00*** (2013.01)

(58) **Field of Classification Search**
CPC B24B 53/07; B24B 53/017; B24B 53/12; B24B 37/04; B24B 37/042; B24B 57/02
USPC 451/443, 444, 548, 56
See application file for complete search history.

(56) **References Cited**

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187,593	A	2/1877	Brown et al.
238,946	A	3/1881	McKitrick

(Continued)

FOREIGN PATENT DOCUMENTS

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CN	1494984	5/2004

(Continued)

OTHER PUBLICATIONS

Colmonoy Technical Data Sheet; No. DSP-A; 1993.

(Continued)

Primary Examiner — George Nguyen
(74) *Attorney, Agent, or Firm* — Thorpe North & Western, LLP; David W. Osborne

(57) **ABSTRACT**

CMP pad dressers having leveled tips and associated methods are provided. In one aspect, for example, a CMP pad dresser can include a support substrate and a plurality of superabrasive particles secured to the support substrate with each superabrasive particle extending away from the support substrate to a protrusion distance, where a highest protruding tip of each of the plurality of superabrasive particles align along a designated profile with a tip variation of from about 5 microns to about 100 microns.

21 Claims, 1 Drawing Sheet

CMP PAD DRESSER HAVING LEVELED TIPS AND ASSOCIATED METHODS

(57) **ABSTRACT**

CMP pad dressers having leveled tips and associated methods are provided. In one aspect, for example, a CMP pad dresser can include a support substrate and a plurality of superabrasive particles secured to the support substrate with each superabrasive particle extending away from the support substrate to a protrusion distance, where a highest protruding tip of each of the plurality of superabrasive particles align along a designated profile with a tip variation of from about 5 microns to about 100 microns.

Ex. 1001

Overview of the ‘802 Patent

- A CMP pad dresser having a layer of superabrasive particles:
  - [1D] each superabrasive particle aligns along a designated profile with variation of about 5-100 microns
  - [1E] two highest tip height difference ≤ 50 microns
  - [1F] highest 1% tip height difference ≤ 80 microns

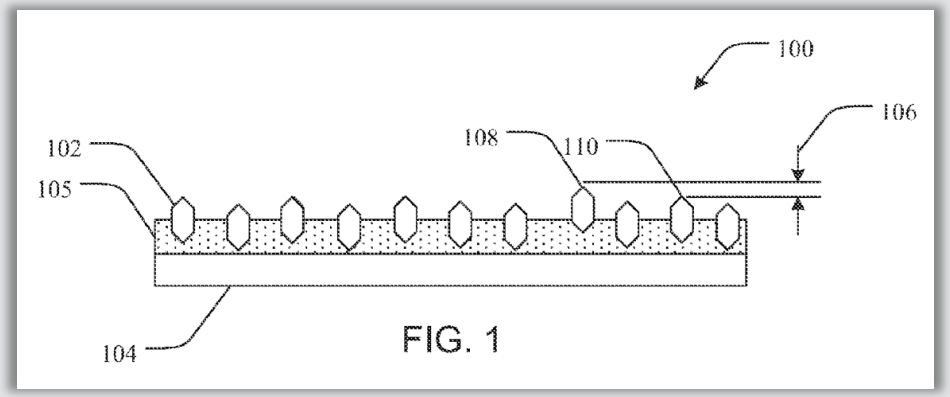


FIG. 1

1. A CMP pad dresser, comprising:
a rigid support substrate; and
a monolayer of a plurality of superabrasive particles coupled to the support substrate, wherein each superabrasive particle in the monolayer extends away from the support substrate to a protrusion distance, 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, 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.

Pet. at 11-12; Ex. 1001, Fig. 1, claim 1

Overview of the ‘802 Patent

- Reverse casting is one exemplary technique to fabricate the claimed CMP pad dresser

Additionally, so-called “reverse casting” methods can be used to accurately orient and attach the dressing segments to the support substrate. Such methods can include initially securing the plurality of dressing segments to a substrate using a “mask” material. The portions of the dressing segments protruding from the mask material can then be attached to the rigid support using the methods discussed herein, after which (or during which), the masking material can be removed.

Pet. at 11-12; Ex. 1001, 25:14-22

Outline

A Overview of the ‘802 Patent

B Overview of the Prior Art

C The Disputed Issues

Prior Art References Relied Upon

Ground	Challenged Claims	References
IA/IB (102/103)	1-5, 13, 15, 19-21	Tsai
II	1-3, 6-14, 16-18	Tsai with Sung'026
III	1-7, 13-21	Sung'146 with Sung'026

Pet. at 6

Overview of Tsai

- Describes an Organic Diamond Disk ("ODD")
- ODD made by the same reverse casting method to make the claimed CMP pad dressers
- Teaches tip-to-tip variation of about 19.8 microns

The ODD is manufactured by reverse casting polymers.

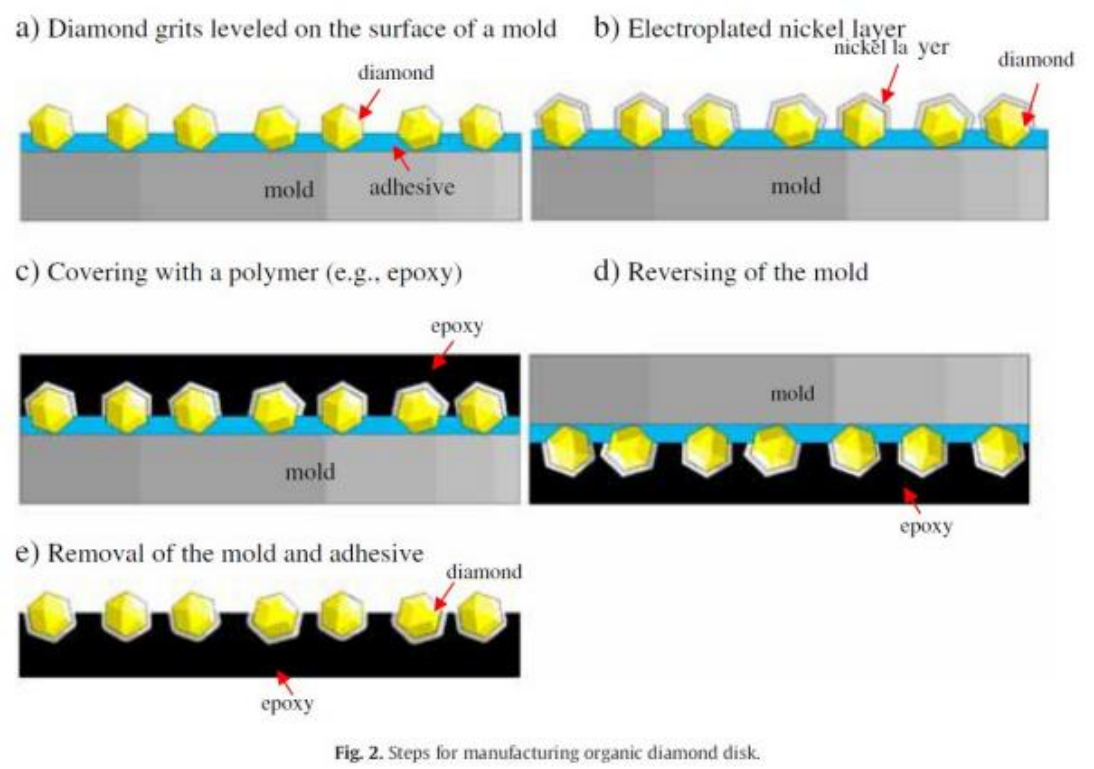
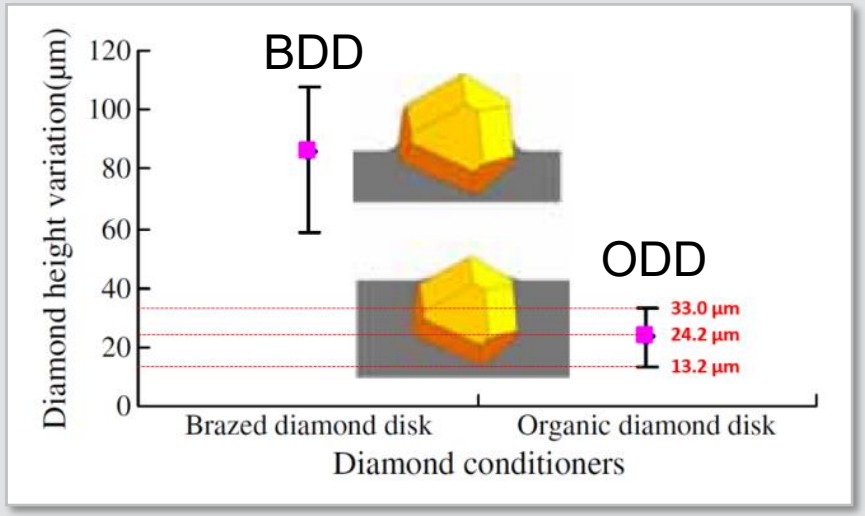


Fig. 2. Steps for manufacturing organic diamond disk.



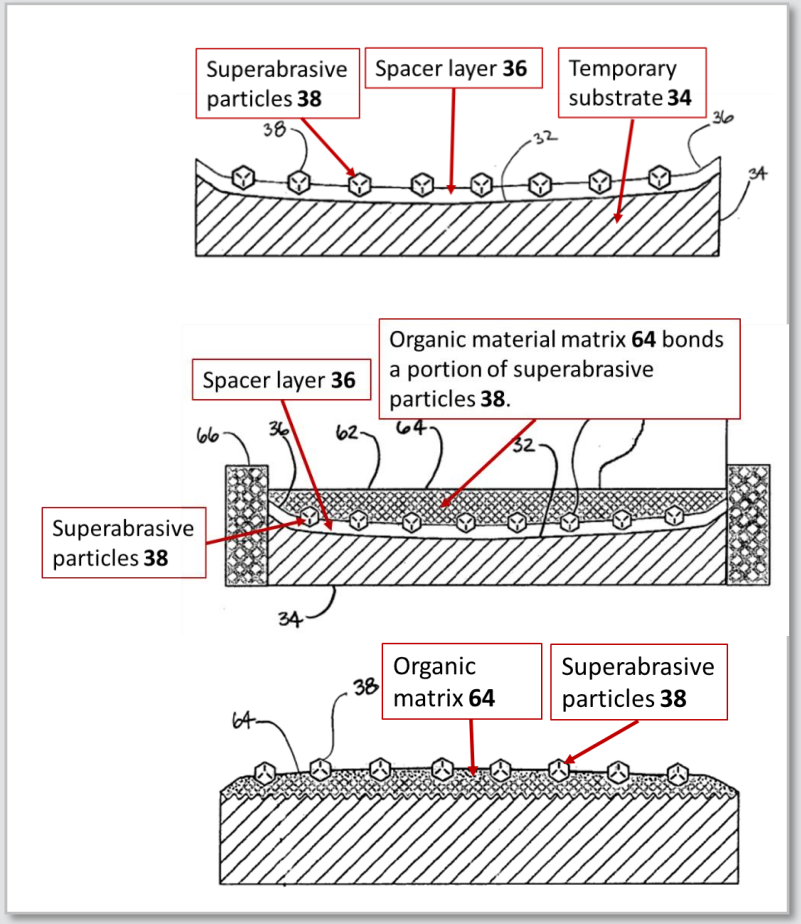
Pet. at 27-29; Ex. 1004, Figs. 2, 6, 5:3-6:6

Overview of Sung'026

[0083] Various reverse casting methods may be utilized to manufacture the CMP pad dresser of the present invention.

- Same reverse casting method to make CMP pad dressers
- "[T]ips vary from the designated profile by from about 1 micron to about 150 microns"

such, in one aspect a majority of the plurality of superabrasive particles are arranged such that their tips vary from the designated profile by from about 1 micron to about 150 microns. In another aspect, the plurality of superabrasive



Pet. at 56-57, 62, 70, 78; Ex. 1005, [0052], [0056], [0083]-[0084], Figures 2, 5-6

Outline

A Overview of the ‘802 Patent

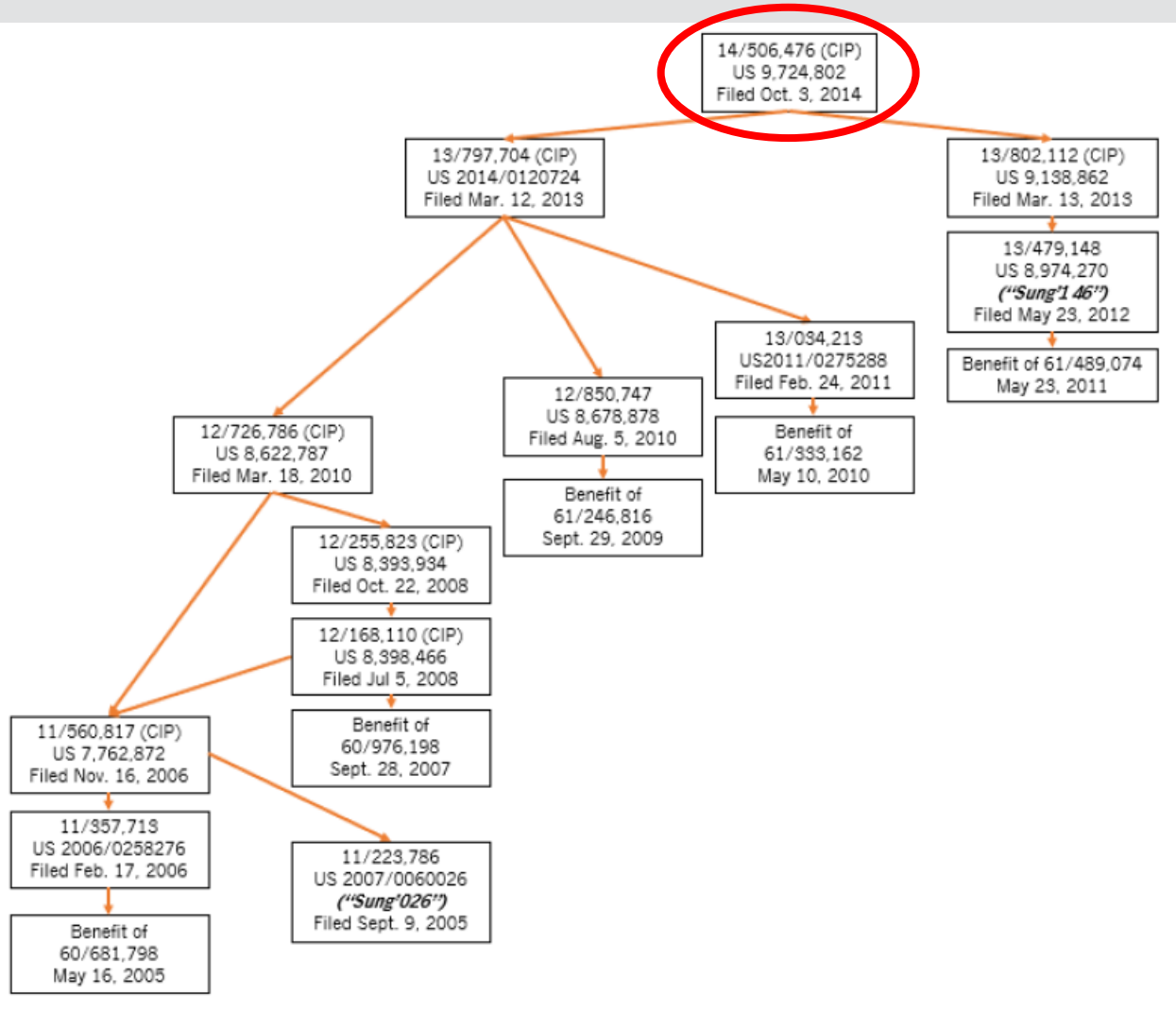
B Overview of the Prior Art

C The Disputed Issues

The ‘802 Patent Specific Disputed Issues

1. Whether Tsai, Sung’026, and Sung’146 are prior art based on lack of priority to earlier filed applications
2. Grounds IA/IB: Whether Tsai teaches the claimed tip height variation and designated profile (limitations [1D]-[1F])
3. Grounds IA/IB: Whether Tsai teaches equal spacing across the CMP pad dresser (claims 2-5 and 20-21)
4. Ground II: Whether Tsai teaches and/or Tsai and Sung’026 render obvious working superabrasive particles (claims 8-12)

The ’802 Patent’s Proper Priority Date Is Its October 3, 2014 Filing Date



Pet. at 16-22

1. Dr. Sung's Prior Litigation Against Kinik Regarding The '802 Patent

- Dispute between Kinik and Dr. Sung regarding ownership of the '802 Patent

15. In July 2013, three months before the expiration of the JV Agreements, Kinik brought an action in a Taiwanese court seeking ownership interests of, and the right to practice, some of my patents without payment of royalties as required by the JV Agreements. As recent as August 15, 2019, the Supreme Court of Taiwan remanded the case back to the second instance of IP court, seeking clarification on whether Kinik has breached the JV Agreements by failing to comply with its obligations to pay the required royalties to me.

16. In August 2014, Kinik brought a second action in a Taiwanese court seeking ownership interests of, and the right to practice, three of my patents without payment of royalties as required by the JV Agreements. As recent as July 1, 2020, the Supreme Court of Taiwan reversed the second instance of IP court's decision to affirm Kinik's right to practice these three

- Judge Andrews held "Plaintiff clearly stated that he only claims priority to October 3, 2014"

time of the joint venture. The present patent may have new material, but Plaintiff did not represent in the briefing that he does not claim priority back to the time of the joint venture.[4] Subsequent to the briefing, however, Plaintiff has clearly stated that he only claims priority to October 3, 2014. (D.I. 25; *see also* D.I. 1-1 at 2 of 23).

Pet. at 19; Reply at 14; Ex. 1011, ¶¶ 15, 16; Ex. 1012, 2

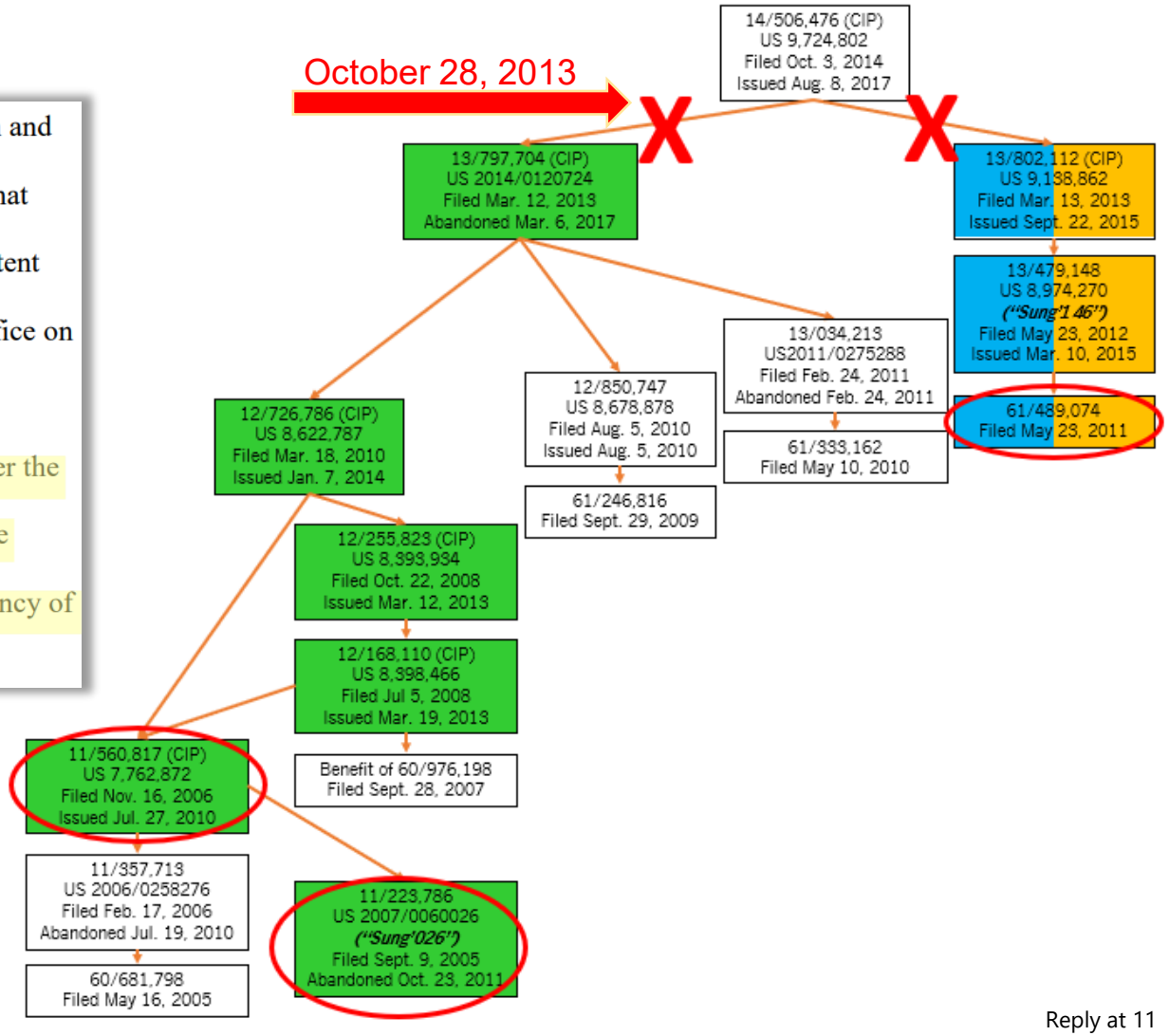
1. Dr. Sung Disclaimed Earlier Priority Dates To Avoid Joint Ownership With Kinik

- Dr. Sung's declaration from Kinik Litigation

17. After the joint venture terminated, I continued to conduct my own research and development in CMP disk technology. During this period, I invented the subject matter that forms the basis of the patent application (the "'802 Application") from which the '802 Patent issued. I then filed the '802 Application with the United States Patent and Trademark Office on October 3, 2014.

18. I invented this new subject matter, which is claimed in the '802 Patent, after the joint venture with Kinik ended Oct. 28, 2013. This invention is not disclosed in any of the patents or patent applications to which the '802 Patent claims priority or during the pendency of the joint venture.

Pet. at 16; Ex. 1011 at 5



Reply at 11

1. Dr. Sung's Counsel Disclaimed Earlier Priority Dates

Kinik Litigation: Dated: July 27, 2020

After the JV Agreements expired, Dr. Sung continued to conduct extensive research and development in CMP disk technology on his own. (*Id.* at ¶ 17.) During this period, ***after*** expiration of the JV agreements, Dr. Sung invented the subject matter that forms the basis of the patent application (the "'802 Application") from which the '802 patent issued. (*Id.*) After this

DEVLIN LAW FIRM LLC

/s/ Timothy Devlin
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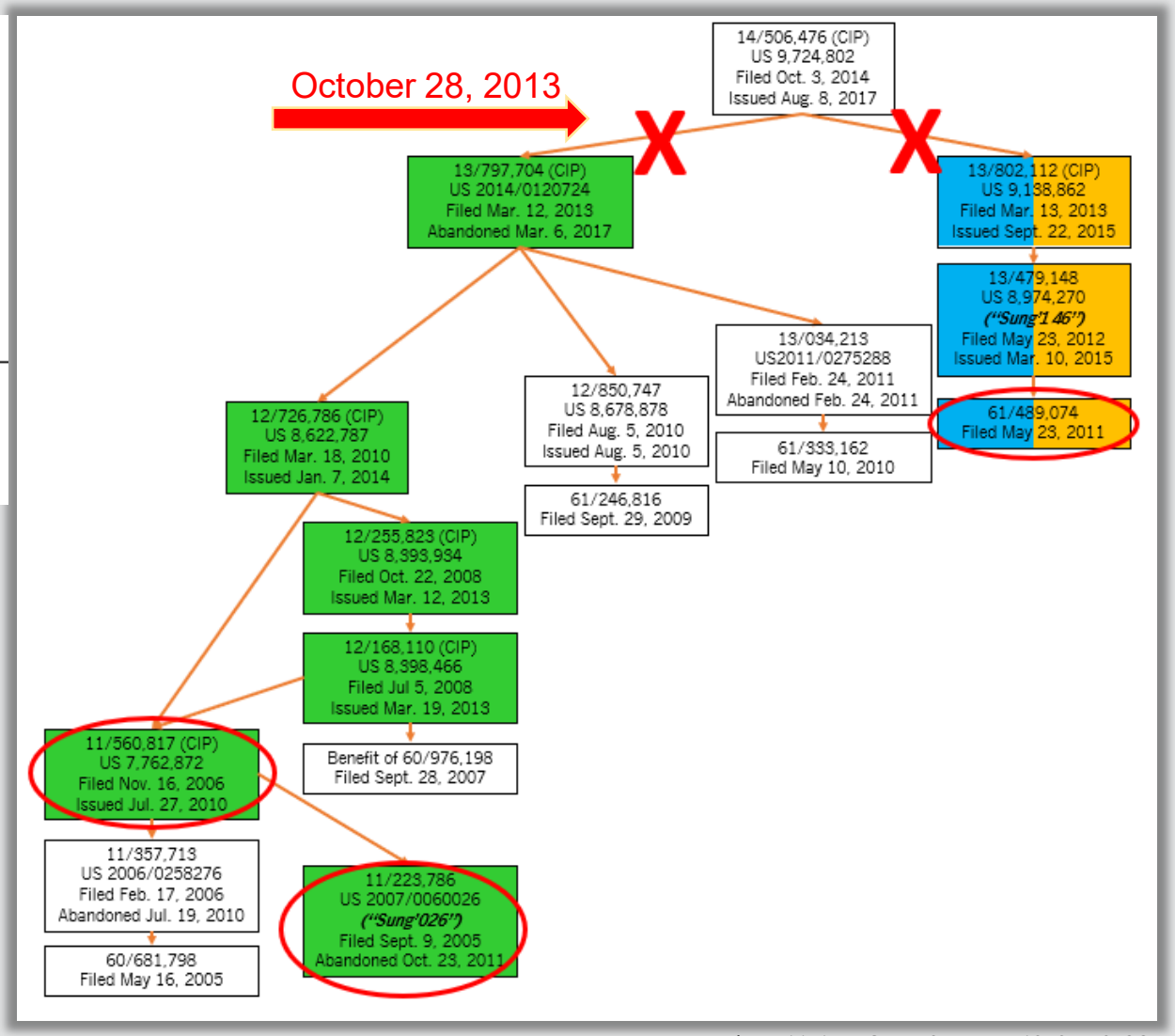
tdevlin@devlinlawfirm.com
Alex Chan (Admitted *pro hac vice*)
achan@devlinlawfirm.com

Instant IPR: Dated: December 11, 2024

A. Claim 1 Has Written Support from Sung '026, Sung '817 and Sung '074 and Is Thus Entitled to a Priority Date of Sept. 9, 2005, Nov. 16, 2006 and May 23, 2011, Respectively

Independent claim 1 of the '802 Patent is fully supported by Sung '026 and Sung '817, as reflected in the chart below. Accordingly, claim 1 is entitled to a

/ Alex Chan /
Alex Chan
Reg. No. 52,713
DEVLIN LAW FIRM LLC



Reply at 11-15; POR at 8, 55; Ex. 1059 at 8, 26

2. Co-Pending Application Requirement Never Demonstrated

- Board specifically requested analysis on this issue in the Institution Decision

In the event Patent Owner continues to rely on one or more of the '074 Provisional, the '817 Application, and the '786 Application as providing a priority filing date for the '802 patent's claims during the trial instituted by this Decision, we encourage both parties to address whether there are the requisite intervening application(s) per *Hollmer* and related case law. For example, so far as we can tell from the preliminary record, of all the intervening applications leading from the '817 Application and the '786 Application to the '802 patent, only the '704 Application was ever copending with the '802 patent. Yet, Dr. Sung's Declaration from the Kinik Litigation stated the '704 Application does not "disclose the claimed subject matter of the '802 Patent." Ex. 1011 ¶ 22.

DI at 48-49

- Patent Owner distinguished *Hollmer* based on facts of the case only

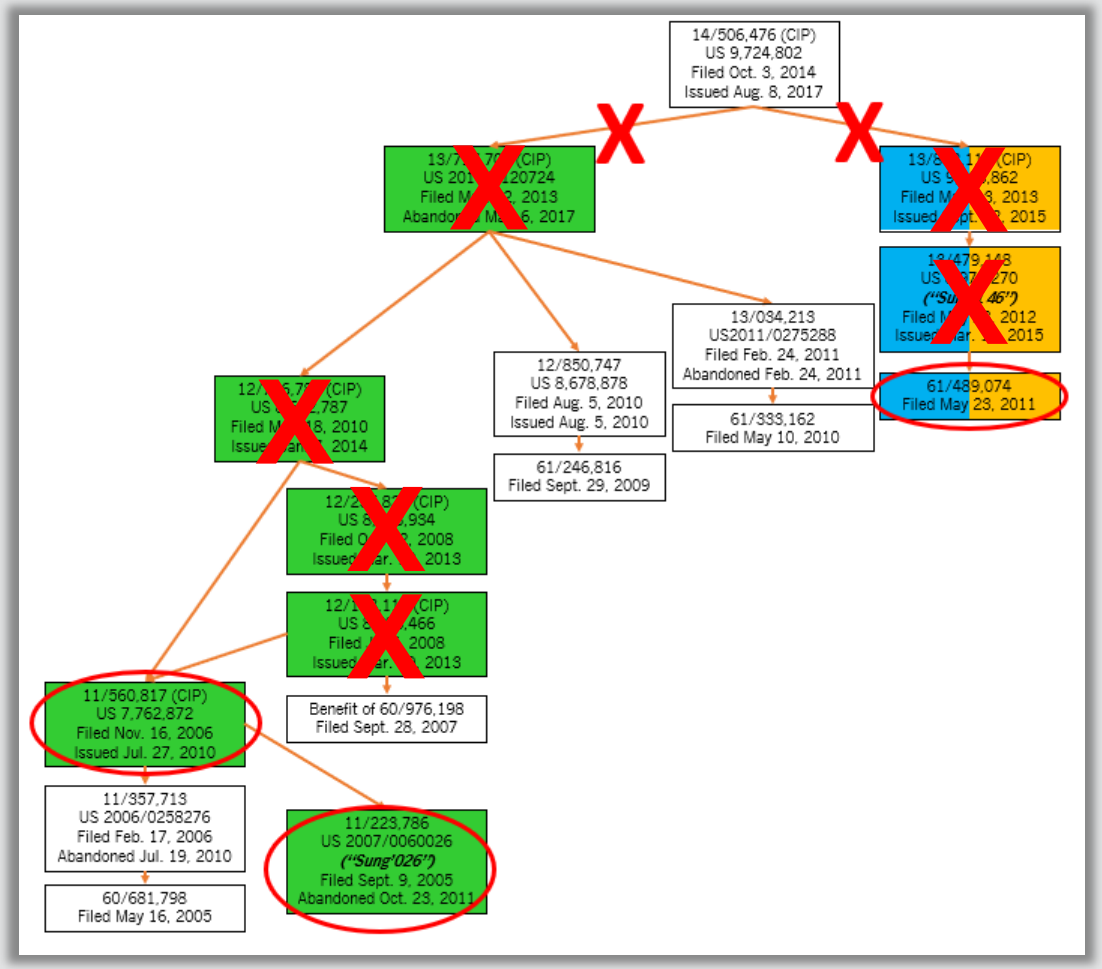
Hollmer does not change the result here. In *Hollmer*, the priority claim for the '880 patent at issue was based on new matter that had been *incorporated by reference* from the '579 application, an application from *outside* of the chain of applications to which the '880 patent claimed priority—critical facts that are absent here. *Hollmer*, 681 F.3d at 1353. What is more, several of the intervening applications lacked any reference to the '579 application. *Id.* at 1354. Consequently, the Federal Circuit found that the intervening applications were not "copending" with the '579 application, depriving the '880 patent of the benefit of the earlier priority date of the first application in the chain. *Id.* at 1358. Here, by contrast, there is: 1) a direct chain of priority between each of the applications leading to the '802 patent; 2) no break in the priority chain of the kind at issue in *Hollmer* and 3) no new matter was incorporated from outside of family of applications to which the '802 patent claims priority.

POR at 34

Reply at 6-9

2. Co-Pending Application Requirement Never Demonstrated

- Patent Owner did not attempt to show that any of the intervening applications satisfy the co-pending application requirement



Reply at 5-9

2. Co-Pending Application Requirement Never Demonstrated

"[C]laims in a patent or patent application are not entitled to priority under § 120 at least until the ***patent owner proves*** entitlement to the PTO, the Board, or a federal court."

Natural Alternatives, Inc. v. Iancu, 904 F.3d 1375, 1380 (Fed. Cir. 2018) (citing *PowerOasis, Inc. v. T-Mobile, USA, Inc.*, 522 F.3d 1299, 1305-06 (Fed. Cir. 2008))

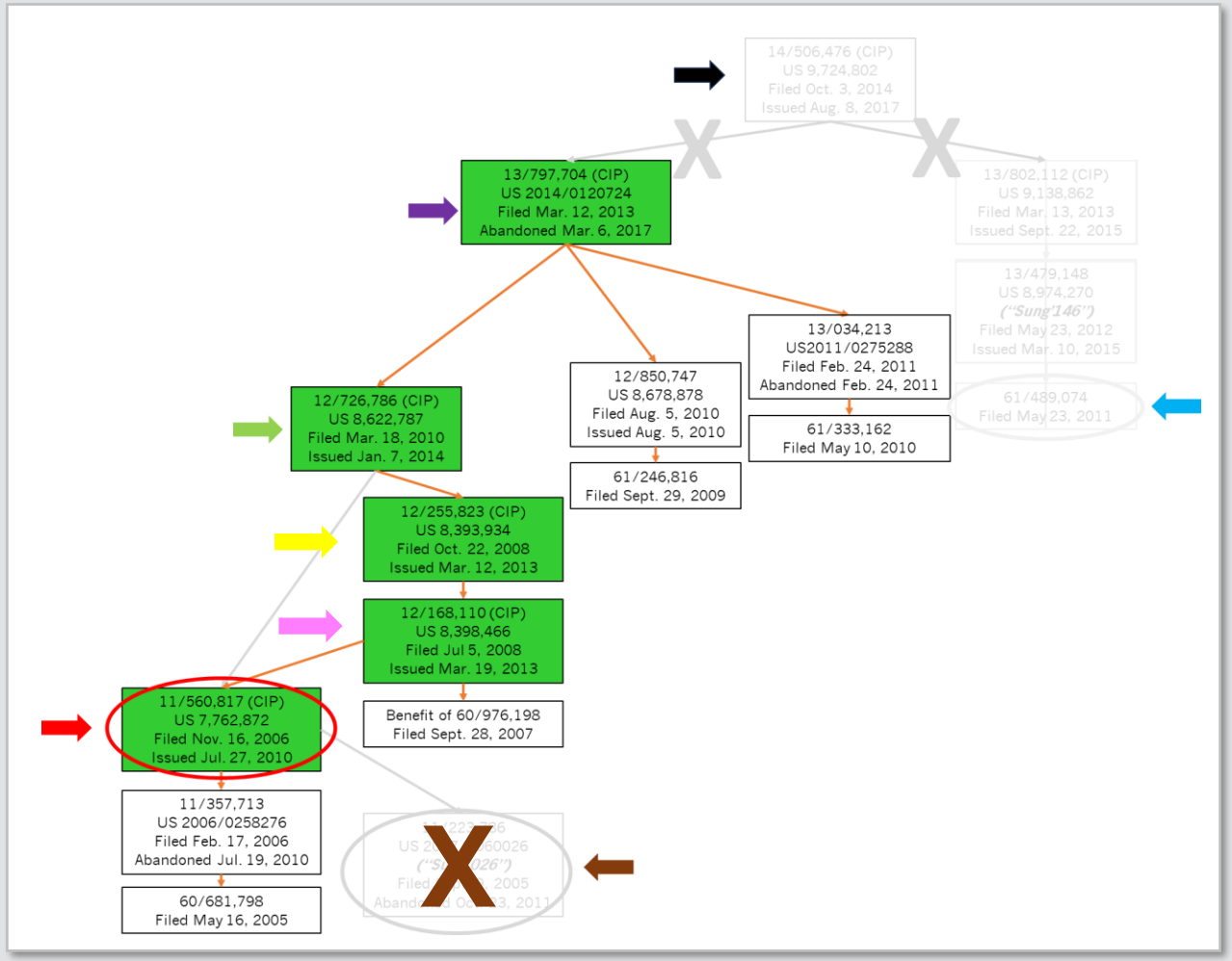
"[W]hen a patent owner attempts to antedate an asserted prior art reference [in an IPR proceeding,] ***the patent owner assumes a temporary burden of production***."

Parus Holdings, Inc. v. Google LLC, 70 F.4th 1365, 1371 (Fed. Cir. 2023)

POR at 34; Reply at 6-7

2. Co-Pending Application Requirement Never Demonstrated

- **'6786 App** issue date: Jan. 7, 2014
- **'802 Patent** filing date: Oct. 3, 2014
- So **'704 App** priority claim must allow continuous priority chain to **'786 App**
- But **'704 App** never made a continuous chain of priority back to the **'786 App**



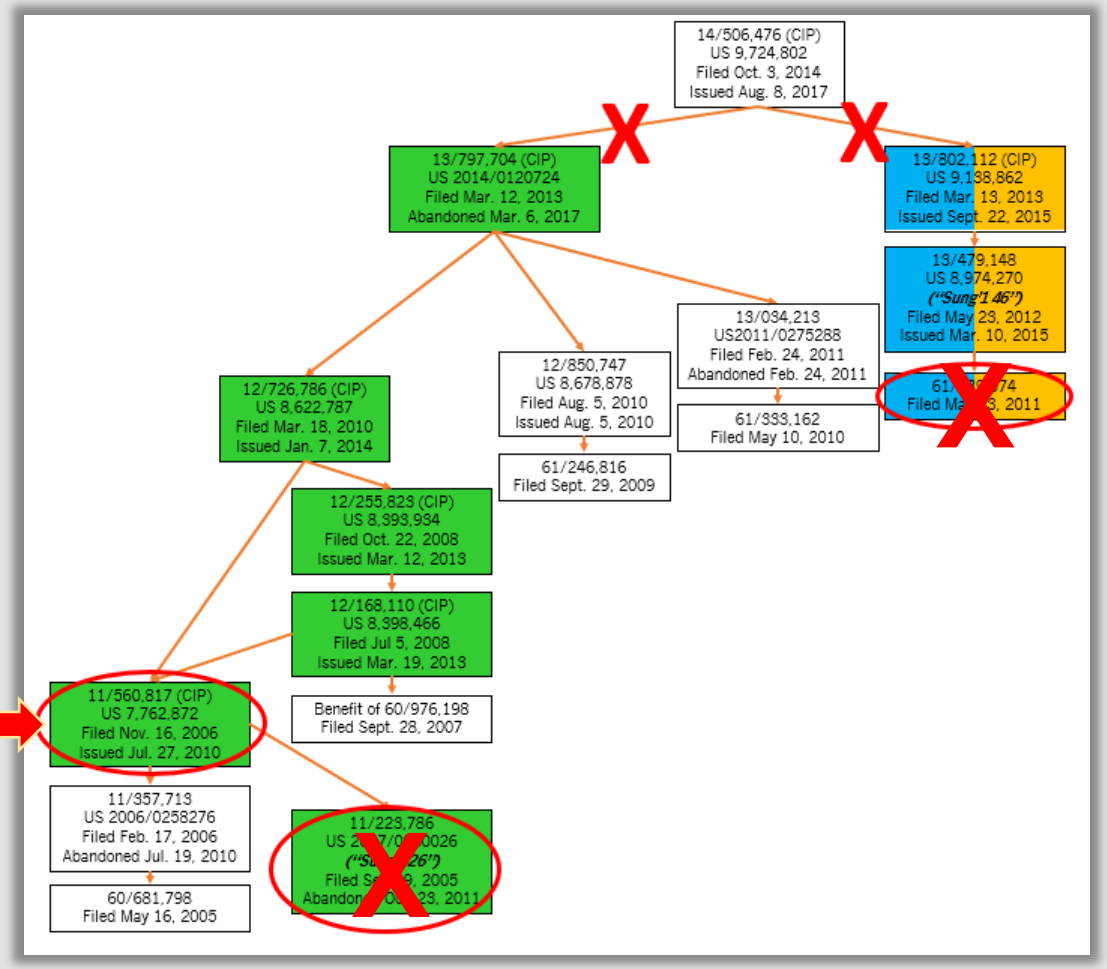
Reply at 6-9; Ex. 1057, 2-4

3. ’817 Application Fails to Provide Support For [1E] & [1F]

“35 U.S.C. §120 requires an applicant to meet the disclosure requirement of §112, ¶1 in a ***single*** parent application in order to obtain an earlier filing date for individual claims.”

Studiengesellschaft Kohle, M.B.H. v. Shell Oil Co., 112 F.3d 1561, 1564 (Fed. Cir. 1997)

- [1E]: “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”
- [1F]: “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”



Reply at 6-13; Ex. 2001, 1

3. ’817 Application Fails to Provide Support For [1E] & [1F]

- ‘817 Application never ***specifically*** discusses protrusion distance (1E) between the highest and second highest protruding tip or (1F) between the highest 1% of the protruding tips

- [1E]: “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”

- [1F]: “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”

For example, for a difference in protrusion distance of 0-50 microns, Sung ’817 discloses:

- 14:14-15:4

As another example, for a difference in protrusion distance of 10-20 microns, Sung ’817 discloses:

- 14:29-15:1

As another example, for a difference in protrusion distance of 20-50 microns, Sung ’817 discloses:

- 14:24-26

Sung ’817 at 14:14-21.

POR at 11, 13

As such, in one aspect a majority of the plurality of cutting elements is arranged such that the tips vary from the designated profile by from about 1 micron to about 150 microns. In another aspect, 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. In yet another aspect, the plurality of cutting elements are arranged such that their tips vary from the designated profile by from about 10 microns to about 75 microns. In a further aspect, 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. In another aspect, they

profile by less than about 20 microns. In another aspect, they are arranged such that their tips vary from the designated profile by less than about 10 microns. In yet another aspect,

vary from the designated profile by from about 20 microns to about 100 microns. In a further aspect, they are arranged such that their tips vary from the designated profile by from about 20 microns to about 50 microns.

POR at 11, 13; Ex. 2001 at 14:14-15:1

3. ’817 Application Fails to Provide Support For [1E] & [1F]

“There is therefore no force to Purdue’s argument that the written description requirement was satisfied because the disclosure revealed a ***broad invention*** from which the [later-filed] claims ***carved out a patentable portion***.”

Purdue Pharma L.P. v. Faulding Inc., 230 F.3d 1320, 1328 (Fed. Cir. 2000);
see also Regents of the Univ. of Minnesota v. Gilead Scis., Inc., 61 F.4th 1350, 1356-58 (Fed. Cir. 2023)

Pet. at 16-22; Reply at 12

3. ’817 Application Fails to Provide Support For [1E] & [1F]

- Patent Owner cites to ’817 Application as allegedly providing support for [1E] and [1F]

- [1E]: “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”

- [1F]: “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”

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Sung ’817 at 14:14-21.

POR at 11, 13

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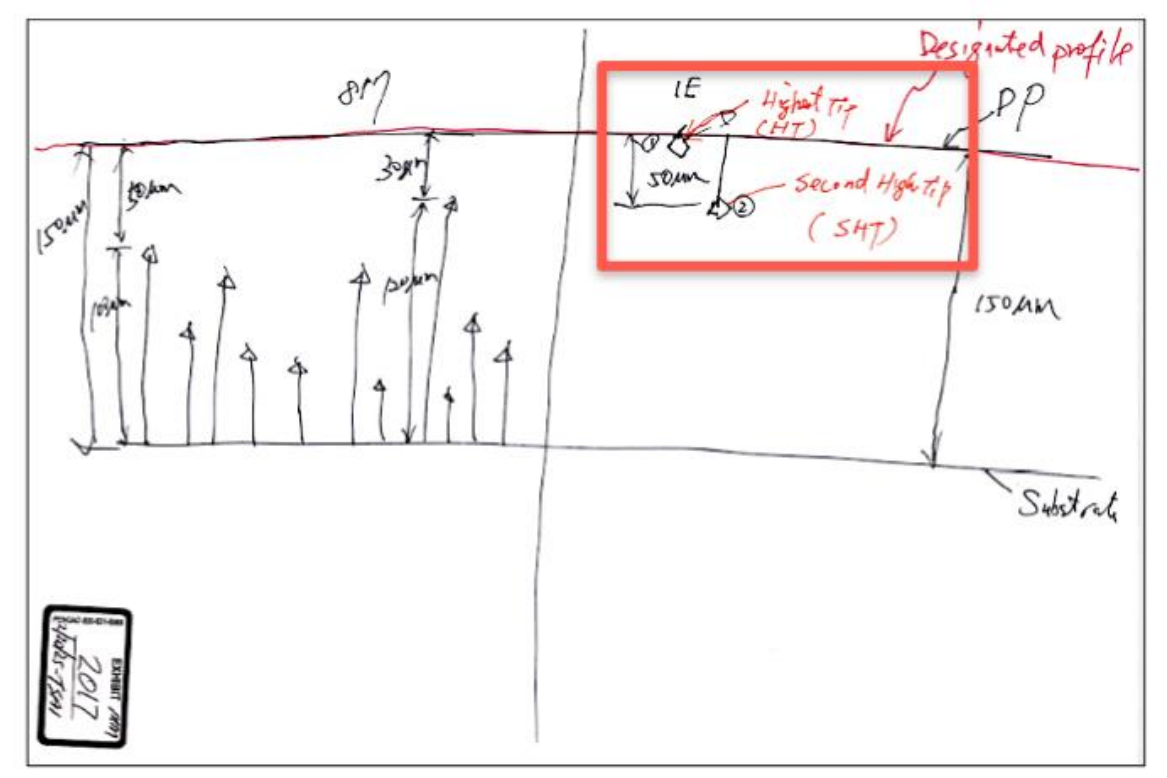
profile by less than about 20 microns. In another aspect, they are arranged such that their tips vary from the designated profile by less than about 10 microns. In yet another aspect,

vary from the designated profile by from about 20 microns to about 100 microns. In a further aspect, they are arranged such that their tips vary from the designated profile by from about 20 microns to about 50 microns.

POR at 11, 13; Ex. 2001 at 14:14-15:1

3. '817 Application Fails to Provide Support For [1E] & [1F]

- Patent Owner's assertion in the Sur-Reply:
  - "designated profile" = "highest protruding tip"
  - So "difference in protrusion distance" from "highest protruding tip" is taught



the same range up to 150 microns. That Sung '817 refers to the "designated profile" as opposed to "the difference in protrusion distance" is of no consequence since Dr. Tsai testified that a POSA would know that Sung '817's designated profile refers to the same point of reference recited in Limitation [1E]/[1F] (i.e., "highest protruding tip") of claim 1 of the '802 patent.

As such, in one aspect a majority of the plurality of cutting elements is arranged such that the tips vary from the designated profile by from about 1 micron to about 150 microns. In another aspect, 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. In yet another aspect, the plurality of cutting elements are arranged such that their tips vary from the designated profile by from about 10 microns to about 75 microns. In a further aspect, 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. In another aspect, they

Sur-Reply at 3, 6; Ex. 2017; Ex. 1055, 180:18-186:6

3. ’817 Application Fails to Provide Support For [1E] & [1F]

- Dr. Tsai did not even apply the definition of “profile” in interpreting “designated profile”

As used herein, the term “profile” and “geometric profile” can be used interchangeably, and refer to a predetermined contour above a support substrate to which a plurality of superabrasive particles or other cutting elements are intended to align. 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.

Reply at 21; Ex. 1001, 6:21-28

Dr. Tsai
PO’s Expert

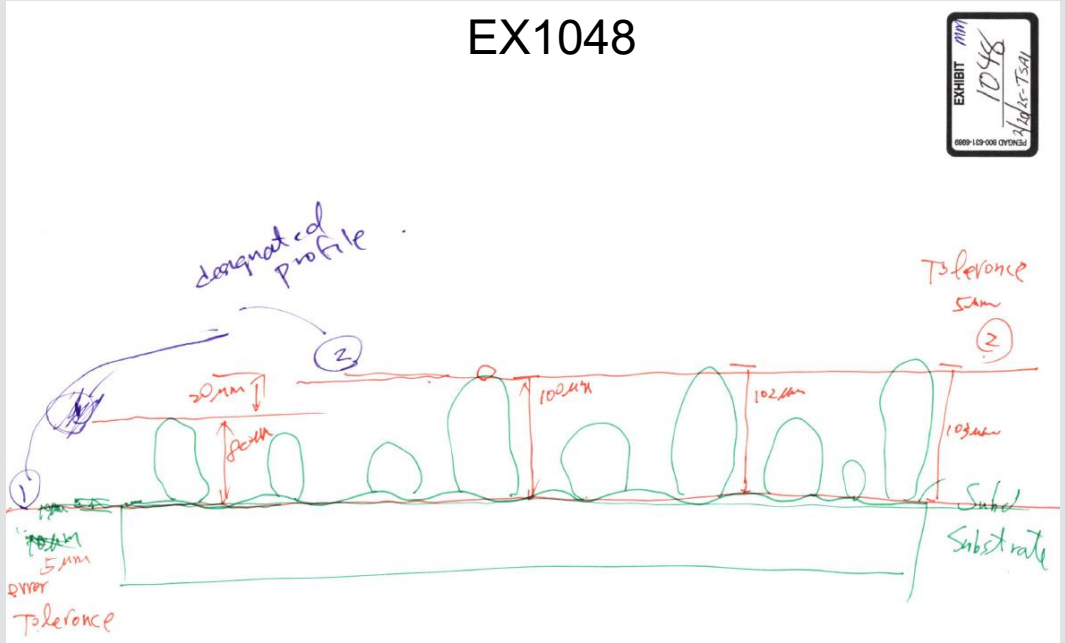
Q: Did you apply that understanding of the term “profile” as written in column 6, lines 21 through 25, when you read the term “designated profile” in Claim 1?

A: *No*. Those definitions I just talked about are frequently seen during research or measurement. In other words, you need to do the research and measurement. You need to define it first. Just like if you run 100 meters on the running, then you need to have a starting point.

Reply at 21; Ex. 1055, 15:17-16:7

3. ’817 Application Fails to Provide Support For [1E] & [1F]

- During ***cross***, Dr. Tsai testified designated profile refers to either (1) the highest protruding tip ***or*** (2) the substrate



’802 Patent’s
“designated profile”

Dr. Tsai
PO’s Expert

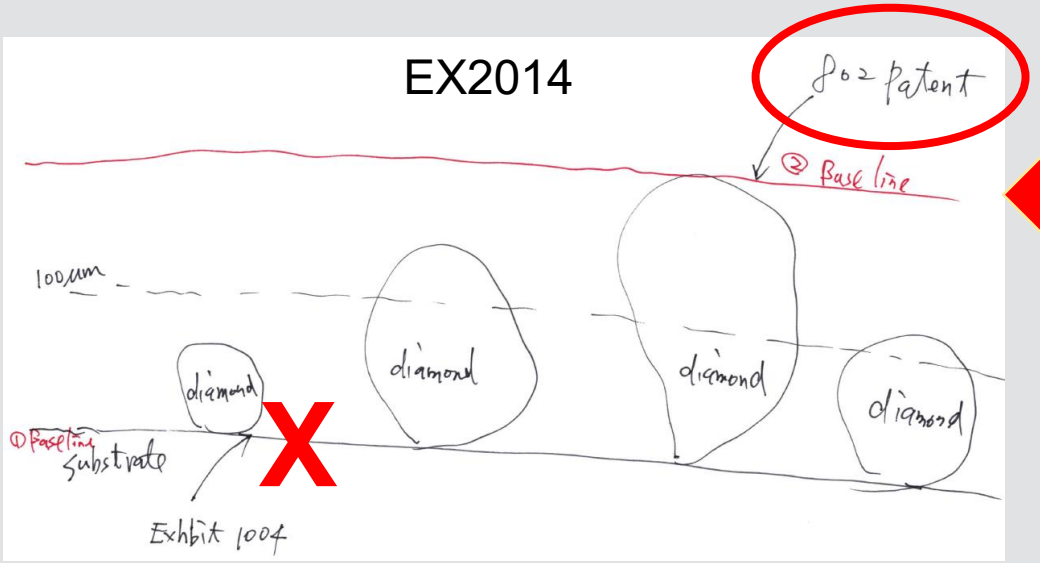
Q: When you read the ’802 patent, Claim 1, the word ‘*designated profile*,’ you were thinking *either the substrate or the highest protruding tip*, is that right?

A: Yes.

Reply at 19-20; Ex. 1048; Ex. 1055, 14:11-16

3. '817 Application Fails to Provide Support For [1E] & [1F]

- '802 Patent's "designated profile" is only the "highest protruding tip" comes from Dr. Tsai's ***re-direct*** testimony



'802 Patent's
"designated profile"

Dr. Tsai
PO's Expert

Q: Can you please clarify for the record which one is the accurate reflection of what you believe to be the *designated profile* for the *'802 patents* and Exhibit 1004?

A: This [Exhibit 2014] here…

Reply at 22-23; Ex. 2014; Ex. 1055, 156:13-19

3. ’817 Application Fails to Provide Support For [1E] & [1F]

- ‘817 Application never ***specifically*** discusses protrusion distance (1E) between the highest and second highest protruding tip or (1F) between the highest 1% of the protruding tips

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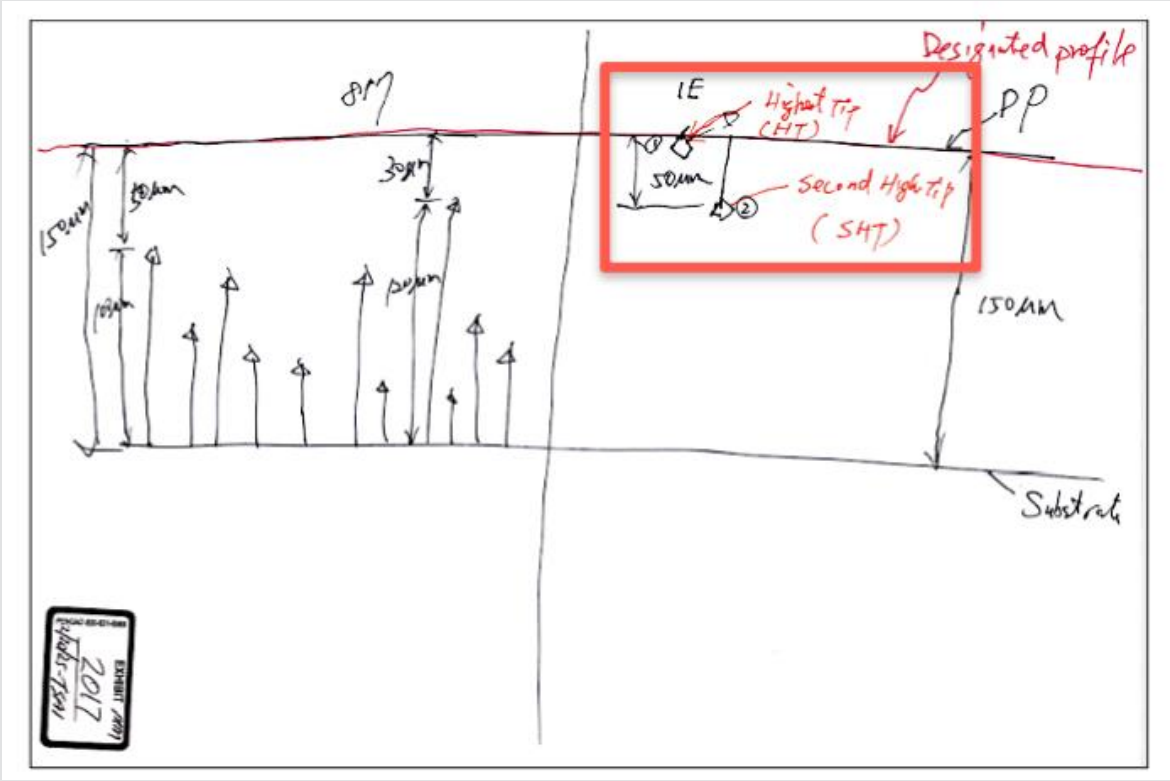
POR at 11, 13; Ex. 2001 at 14:14-15:1

3. ’817 Application Fails to Provide Support For [1E] & [1F]



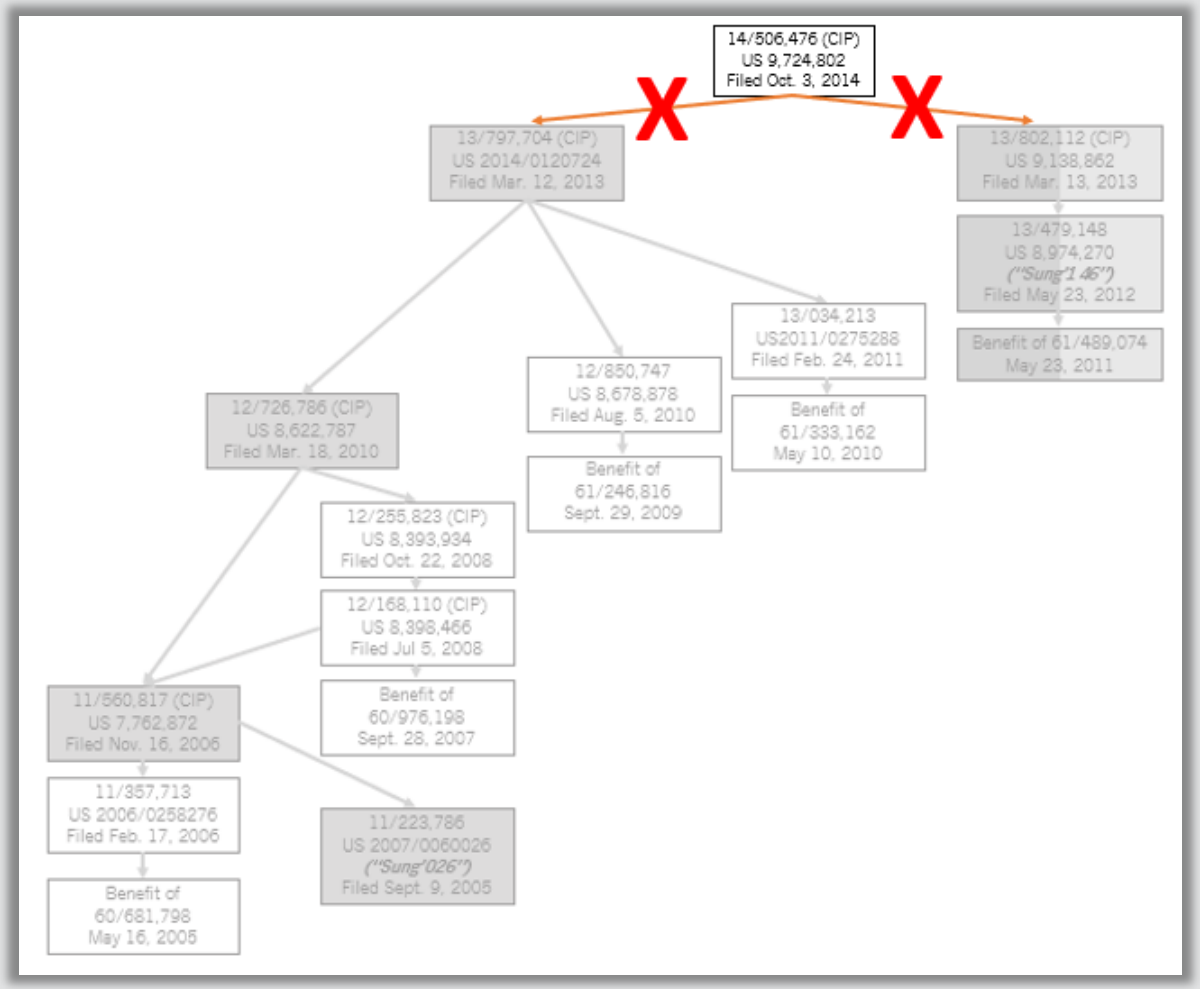
profile by less than about 20 microns. In another aspect, they are arranged such that their tips vary from the designated profile by less than about 10 microns. In yet another aspect,

- [1E]: “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”
- [1F]: “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”

Sur-Reply at 3, 6; Ex. 2017; Ex. 1055, 180:18-186:6

Conclusion: Tsai, Sung'026, And Sung'146 Are Prior Art

- '802 Patent Priority Date: ***Oct. 3, 2014***



- Tsai: ***2012***

Diamond & Related Materials 23 (2012) 144–149

- Sung'026: ***2007***

(19) **United States**
(12) **Patent Application Publication** (10) **Pub. No.: US 2007/0060026 A1**
Sung (43) **Pub. Date: Mar. 15, 2007**

- Sung'146: ***2012***

(19) **United States**
(12) **Patent Application Publication** (10) **Pub. No.: US 2012/0302146 A1**
Sung (43) **Pub. Date: Nov. 29, 2012**

Pet. at 3-4, 16-22; Reply at 5

The Disputed Issues

1. Whether Tsai, Sung'026, and Sung'146 are prior art based on lack of priority to earlier filed applications

2. Grounds IA/IB: Whether Tsai teaches the claimed designated profile and tip height variation (limitations [1D]-[1F])

3. Grounds IA/IB: Whether Tsai teaches equal spacing across the CMP pad dresser (claims 2-5 and 20-21)

4. Ground II: Whether Tsai teaches and/or Tsai and Sung'026 renders obvious working superabrasive particles (claims 8-12)

Claims 1-5, 13, 15, And 19-21 Are Unpatentable Under Grounds IA/IB

Ground	Challenged Claims	References
IA/IB (102/103)	1-5, 13, 15, 19-21	Tsai
II	1-3, 6-14, 16-18	Tsai with Sung'026
III	1-7, 13-21	Sung'146 with Sung'026

Diamond & Related Materials 23 (2012) 144–149

Contents lists available at SciVerse ScienceDirect

Diamond & Related Materials

journal homepage: www.elsevier.com/locate/diamond

Organic diamond disk versus brazed diamond disk for dressing a chemical–mechanical polishing pad ☆

M.Y. Tsai [a,*], P.H. Li [a], J.C. Sung [b]

[a] Department of Mechanical Engineering, National Chin-Yi University of Technology, No. 35 Lane 215 Chung-Shan Rd. Sec. 1 Taiping City, Taichung County 411, Taiwan
[b] Kinik Company, 64, Chung-San Rd., Ying-Kuo, Taipei Hsien 239, Taiwan

Pet. at 6; Ex. 1004

[1E]/[1F]: Tsai "Tip-to-Tip Variation" Meets [1E] And [1F]

- Tsai teaches or suggest the tip-to-tip variations that meets [1E] and [1F] for two independent reasons

than 50 µm. However, as shown in Fig. 6, in the case of the ODD, the diamond tips of the ODD can be leveled to less than 15 µm because the diamond tips are already leveled. The better-leveled ODD has more cutters that can dress the pad, and thus, they share an equal dressing load.

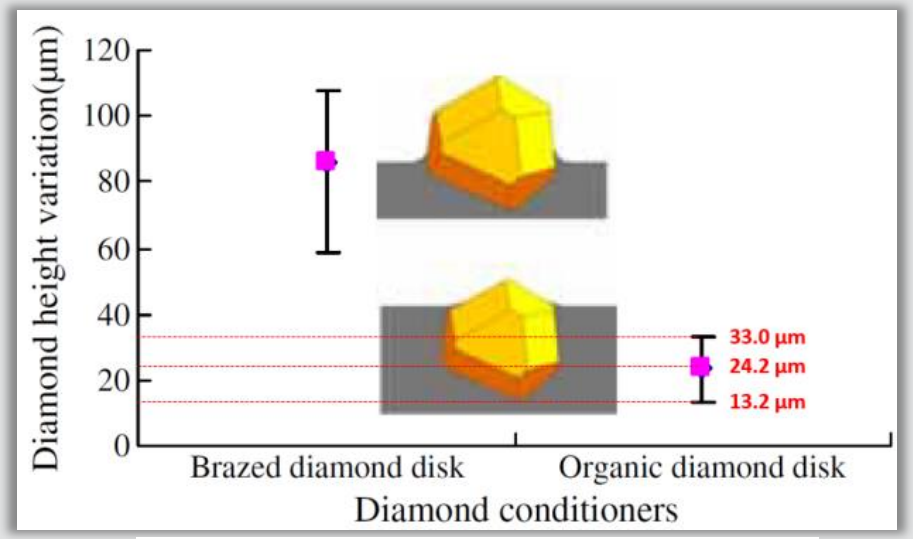


Fig. 6. Height variation in tips for diamond conditioners.

Pet. at 28-29, 36-40; Ex. 1004, Fig. 6, 8:14-24; Ex. 1002, ¶¶81-85, 131-135

[1E]/[1F]: No Dispute Tsai's "Tip-to-Tip Variation" Meets [1E] And [1F]

- POR repeats ***verbatim*** the arguments the Board previously rejected in the DI

> **C. Tsai Teaches Or Suggests The Claimed Highest Protruding Tip, Second Highest Protruding Tip, The Highest 1% Of The Protruding Tips, And Difference In Protrusion Distance**
>
> PO repeats ***verbatim*** the same arguments that were previously raised in the POPR, and rejected by the Board. *Compare* POPR, 46-48 with POR, 43-45; DI, 66-70.

- Sur-Reply does not address limitations [1E]/[1F]

Reply at 25

[1D]: Patent Owner Argues No "Designated Profile"

- Patent Owner's argument:
  - "tip variation" cannot be taught because Tsai does not teach a ***designated profile***

> Because Tsai does not teach or disclose a designated profile, it follows that Tsai also does not teach or suggest a tip variation from a designated profile, as elaborated above.

POR at 43

- Sur-Reply focuses only on purported lack of "***designated profile***" in Tsai

> Dr. Tsai, the author of the Tsai article (Ex. 1004), is unequivocal that his experiment as reflected in this article does not disclose or use the claimed "designated profile," which this Board recognizes to be a profile along which tips align (Institution Decision at 58, 63). This is because in Dr. Tsai's experiment, he

Sur-Reply at 14

[1D]: Tsai Teaches "Designated Profile"

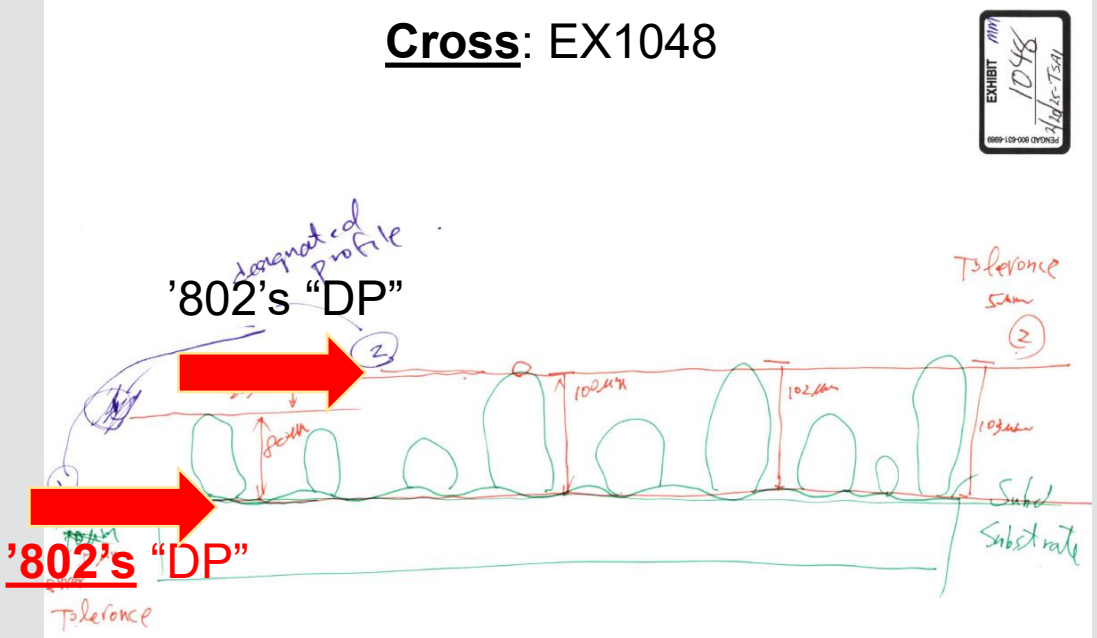
- Dr. Tsai, as a co-author of Tsai, declares "***there is <u>no</u> designated profile in Tsai***"

Dr. Tsai
PO's Expert

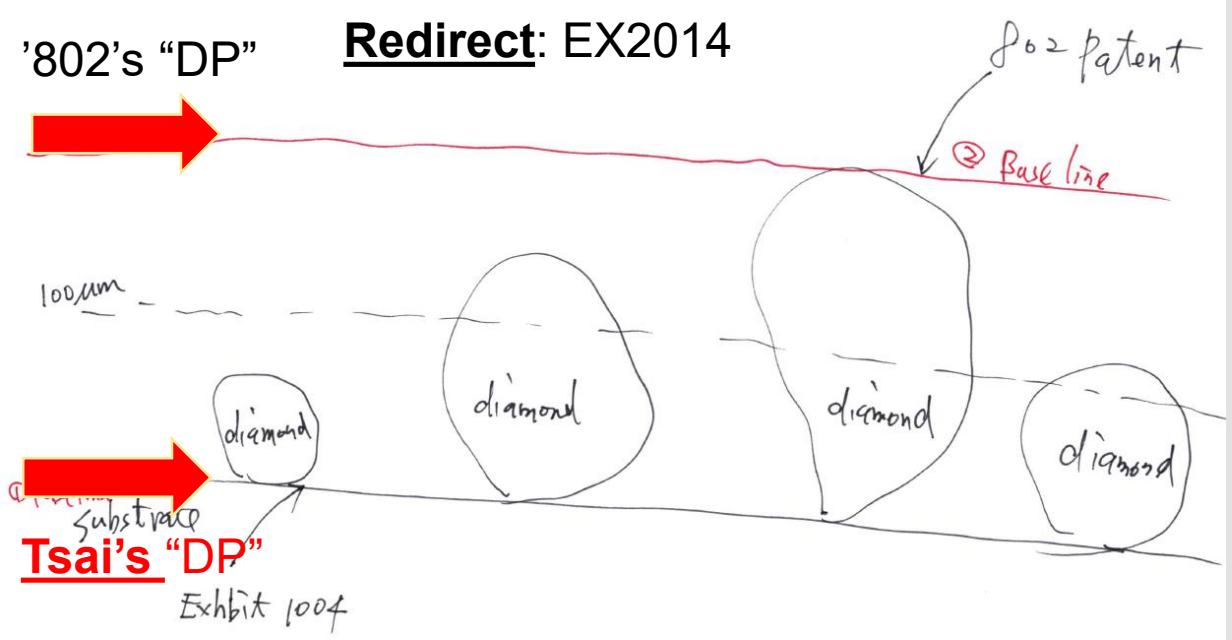
Prof. Ming-Yi Tsai, the lead author of this reference and Patent Owner's expert, confirms under oath that there is ***no designated profile in Tsai,*** ***nor any mention of a profile or contour***. (Ex. 2011 at ¶ 31, 33.) Samsung's and its

POR at 36; Ex. 1004

[1D]: Dr. Tsai's Understanding Of "Designated Profile" Changes



Reply at 20; Ex. 1048



Reply at 23; Ex. 2014

Q: When you read the '802 patent, Claim 1, the word 'designated profile,' you were thinking *either the substrate or the highest protruding tip*, is that right?

A: Yes.

Dr. Tsai
PO's Expert

Q: Can you please clarify for the record which one is the accurate reflection of what you believe to be the *designated profile* for the *'802 patents* and *[Tsai] Exhibit 1004*?

A: This [Exhibit 2014] here…

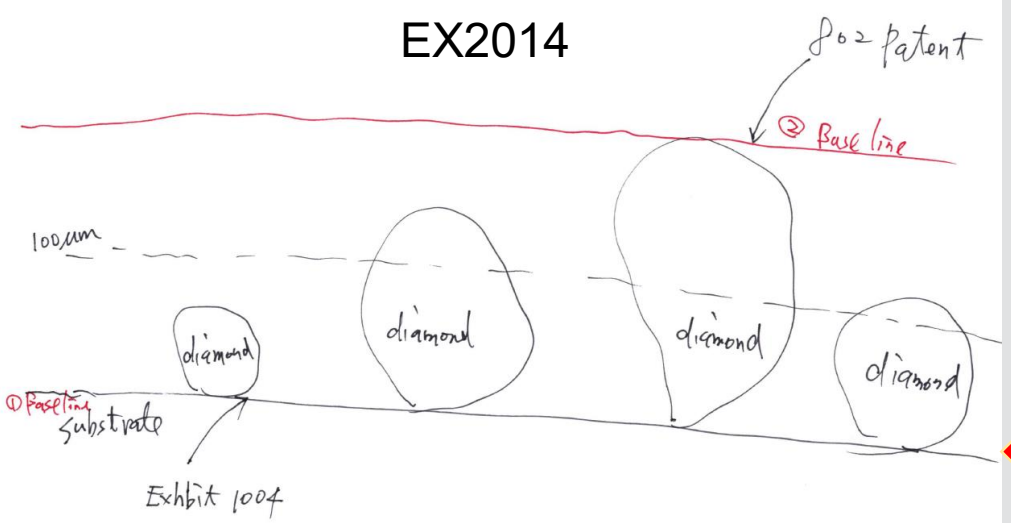
Reply at 19-24; Ex. 1055, 14:11-16, 156:13-19

[1D]: Dr. Tsai's Understanding Of "Designated Profile" During Direct

Redirect

Dr. Tsai
PO's Expert

EX2014



Tsai's "DP"

Reply at 23; Ex. 2014; Ex. 1069

Direct

Prof. Ming-Yi Tsai, the lead author of this reference and Patent Owner's expert, confirms under oath that there is ***no designated profile in Tsai, nor any mention of a profile or contour***. (Ex. 2011 at ¶ 31, 33.) Samsung's and its

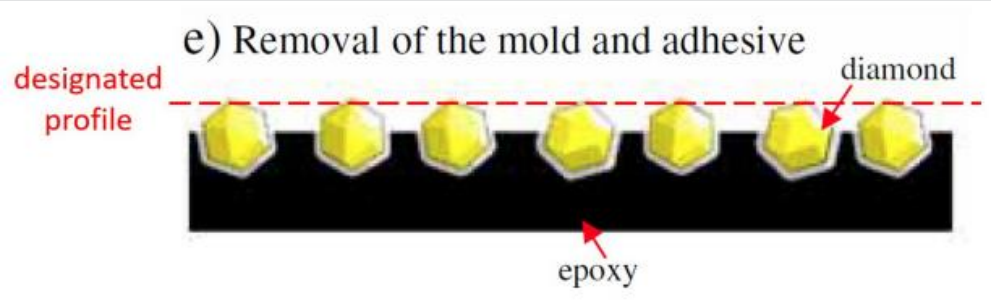
POR at 36

[1D]: Purpose of Tsai Was To Make Leveled CMP Pad Dresser

Tsai (EX1004)

Tsai et al. [8] proposed a novel advanced diamond disk (ADD) that contains diamond grits with equal heights and identically shaped tips. They indicated that the dressing rate of the ADD reduced by approximately 30% and the polishing rate of the ADD was higher than that of a conventional diamond disk. However, a major disadvantage of the ADD was its manufacturing cost that increased by more than threefolds. In this paper, a novel design of a diamond conditioner, i.e., an organic diamond disk (ODD), is proposed. This design remarkably improves the leveling of diamond tips and markedly reduces the CMP

Tsai (EX1004)



Advanced Diamond Disk (ADD)

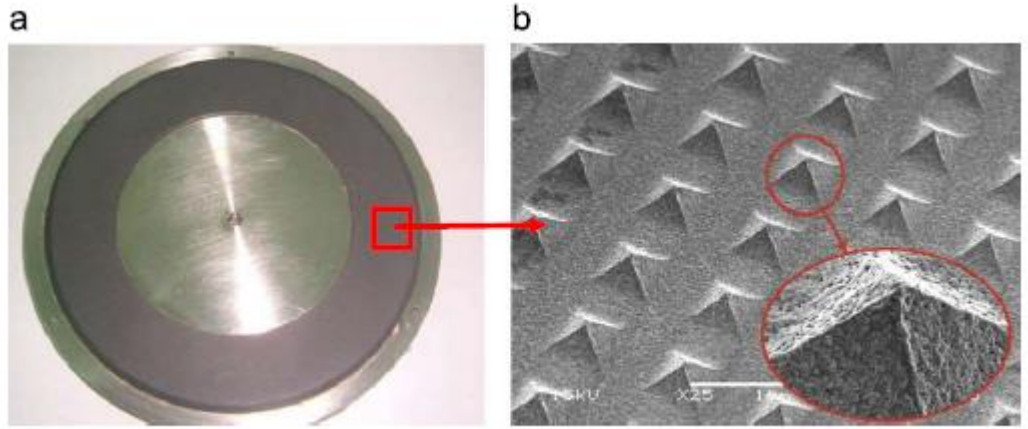


Fig. 3. (a) Advanced diamond dresser (ADD) and (b) an SEM image of cutting pyramids formed on the surface of a polycrystalline diamond.

Organic Diamond Disk (ODD)

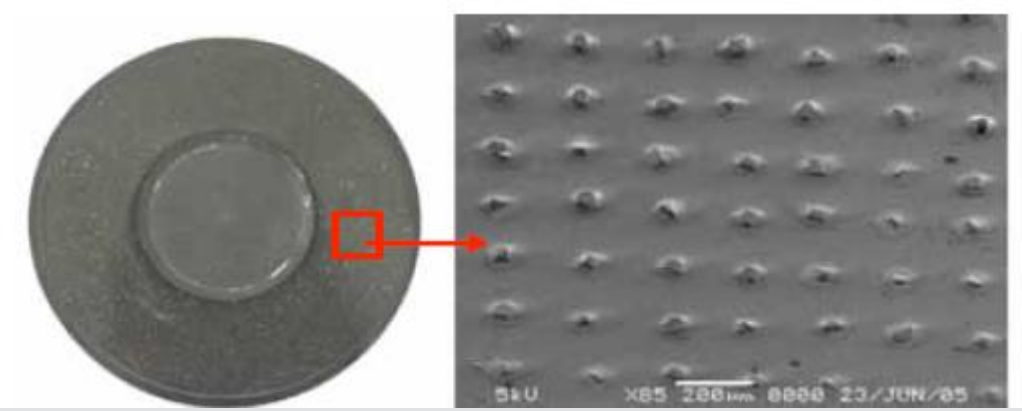
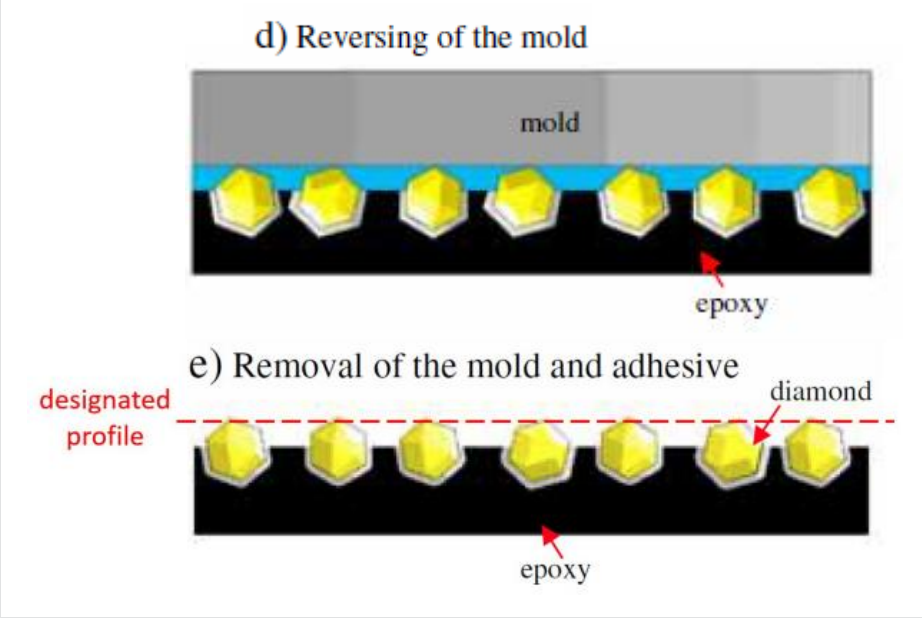


Fig. 3. Outer appearance of the organic diamond disk. Note that each diamond is covered with nickel.

Pet. 26, Reply at 24; Ex. 1004, Fig. 2e, Fig. 3, 3:1-10; Ex. 1049, Fig. 3

[1D]: Purpose of Tsai Was To Make Leveled CMP Pad Dresser

Tsai et al. [8] proposed a novel advanced diamond disk (ADD) that contains diamond grits with equal heights and identically shaped tips. They indicated that the dressing rate of the ADD reduced by approximately 30% and the polishing rate of the ADD was higher than that of a conventional diamond disk. However, a major disadvantage of the ADD was its manufacturing cost that increased by more than three-folds. In this paper, a novel design of a diamond conditioner, i.e., an organic diamond disk (ODD), is proposed. This design remarkably improves the leveling of diamond tips and markedly reduces the CMP



Dr. Tsai
PO's Expert

Q: So ODD was really trying to mimic ADD, but trying to make it at a lower cost, is that fair?

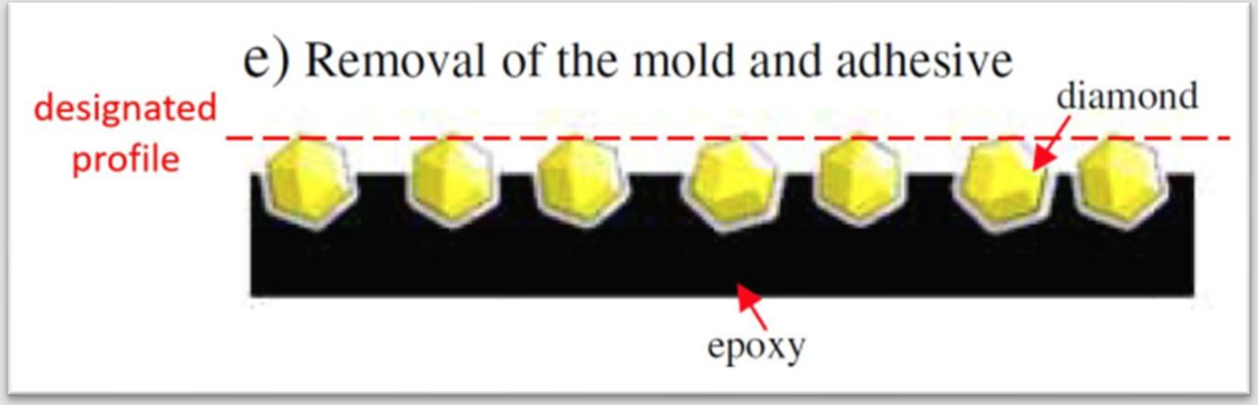
A: *That was what we intend to try* using different approaches to first of all reducing the cost and also *to minimizing the differences of the tip heights to try to make them into equal height.*

Pet. at 27-28, 36-42; Reply at 16-17; Ex. 1004, Fig. 2, 3:1-10; Ex. 1055, 40:15-21

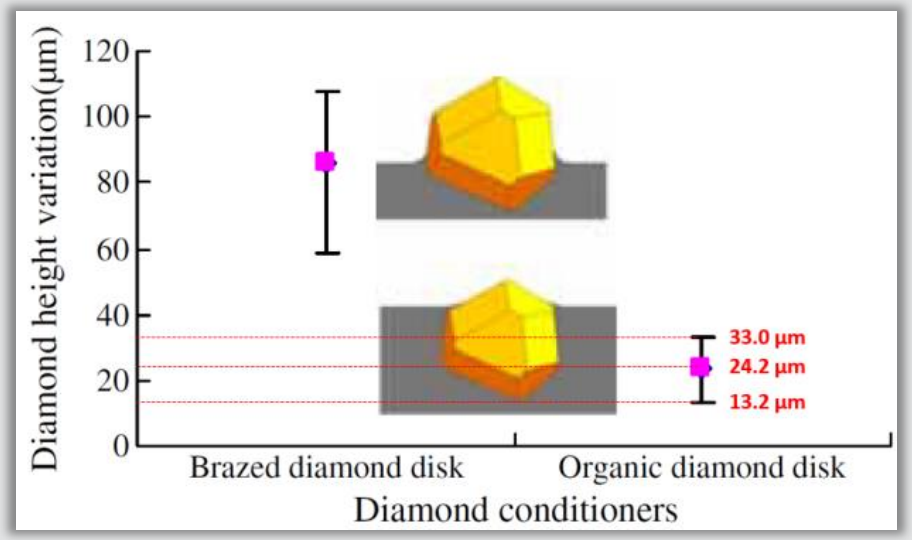
[1D]: Tsai Teaches A "Designated Profile"

- Tsai "designates a flat contour above the epoxy resin to which each of the tips of the diamond particles is intended to align."

Pet. at 36 (citing Ex. 1004, 6:8-10, 5:23-24, 8:22-24, 8:14-16)



Pet. at 37; Ex. 1004, Fig. 2e



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1. Whether Tsai, Sung'026, and Sung'146 are prior art based on lack of priority to earlier filed applications

2. Grounds IA/IB: Whether Tsai teaches the claimed designated profile and tip height variation (limitations [1D]-[1F])

3. Grounds IA/IB: Whether Tsai teaches equal spacing across the CMP pad dresser (claims 2-5 and 20-21)

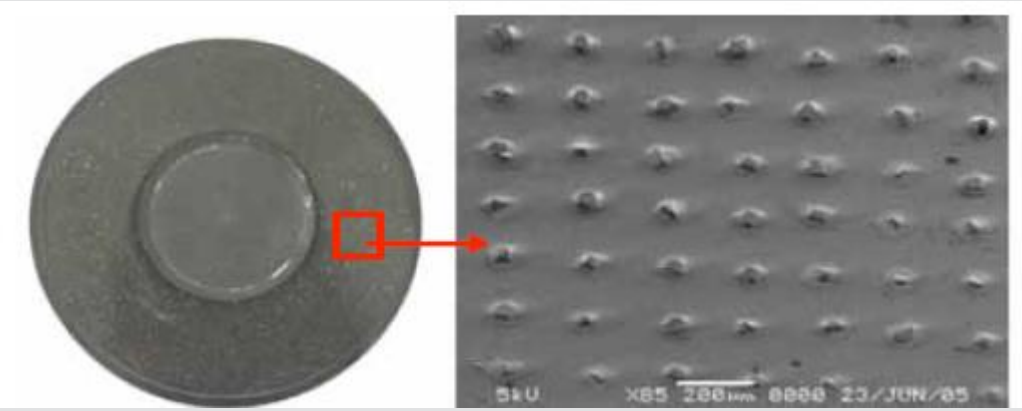
4. Ground II: Whether Tsai teaches and/or Tsai and Sung'026 renders obvious working superabrasive particles (claims 8-12)

Claims 2-5 And 20-21 Are Unpatentable Under Grounds IA/IB

- Patent Owner argues partial segments of Tsai's pad conditioner is not representative of the entire CMP pad dresser

1. Claims 2-5

Lacking any personal experience in the measurement and fabrication of CMP pad conditioners, Dr. Shanfield assumes a degree of precision in Tsai's disclosures which was never intended by its author and which ignores the realities of CMP pad conditioner fabrication. Even with "regular" tip spacing, the number of particles will vary from one section of the ODD to another. (*Id.* at ¶ 42.) And the total number of particles can only be determined by counting all of the grits on a disk. (*Id.* at ¶ 42.)



2. Claims 20-21

Dr. Shanfield relies on the same images of partial segments of Tsai's pad conditioners to argue that Tsai's reverse casting "results in a predetermined pattern (e.g., a grid) across the epoxy resin support substrate" (Ex. 1002 at ¶ 165), and that "the superabrasive particles on Tsai's CMP pad dressers are arranged in a grid with even inter-diamond spacing." (*Id.* at ¶ 166.) However, as discussed above, Dr. Shanfield's assumption that tip spacing will be uniform across the face of a pad conditioner was not contemplated by Tsai and runs contrary to the realities of CMP pad conditioner fabrication. (*Id.* at ¶ 166.) And without any proof that the inter-diamond spacing of Figures 3, 5, and 8 was maintained in other segments of the disk, Samsung cannot show that there was even distribution of particles, let alone one within the precise range of spacing from about 100 microns to about 800 microns.

POR at 45-48; Reply at 25

Patent Owner's Expert Confirmed Tsai Teaches Equal Spacing

Dr. Tsai
PO's Expert

Q: For the mesh that you utilized to make the ODD shown in Figure 5B, does the *spacing of the holes* on the right side of this new exhibit we're generating [EX1051] approximately equal to the spacing of the holes on the left side of the image?

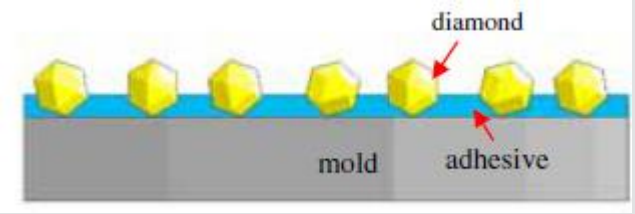
A: *We would do our best to make them equal.*

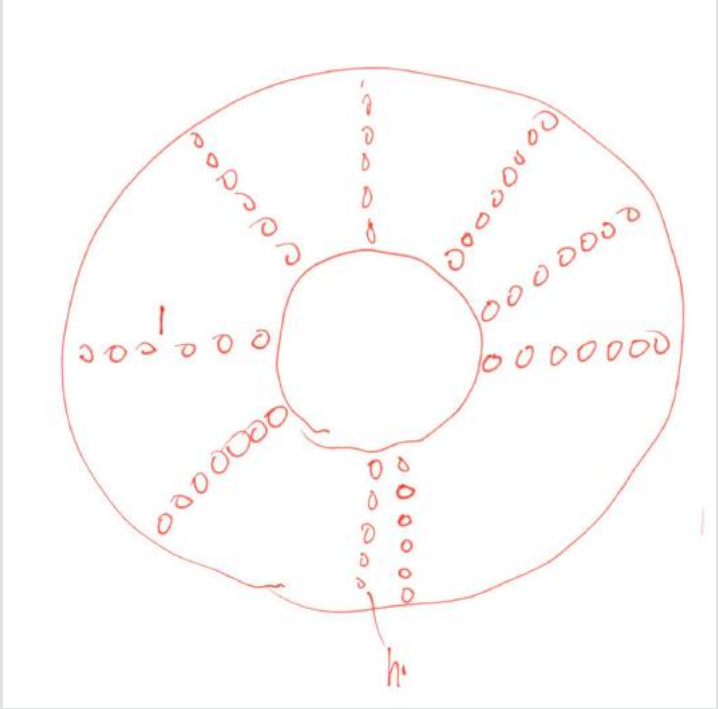
Q: And that's true on the top and the bottom portion of the image as well, correct?

A: *We will do our best to make them the same.*

Q: And in fact, that's true across the entire concentric circle of this image, correct?

A: *We will try to do our best to make them the same.*





Pet. at 27-29; Reply 25-26; Ex. 1004, Fig. 2; Ex. 1051; Ex. 1055, 82:7-83:2

The Disputed Issues

1. Whether Tsai, Sung'026, and Sung'146 are prior art based on lack of priority to earlier filed applications

2. Grounds IA/IB: Whether Tsai teaches the claimed designated profile and tip height variation (limitations [1D]-[1F])

3. Grounds IA/IB: Whether Tsai teaches equal spacing across the CMP pad dresser (claims 2-5 and 20-21)

4. Ground II: Whether Tsai teaches and/or Tsai and Sung'026 render obvious working superabrasive particles (claims 8-12)

All Claims (Except 8-12) Unpatentable Under Grounds II And III

Ground	Challenged Claims	References
IA/IB (102/103)	1-5, 13, 15, 19-21	Tsai
II	1-3, 6-14, 16-18	Tsai with Sung'026
III	1-7, 13-21	Sung'146 with Sung'026

- Except for claims 8-12 in Ground II, no substantive arguments raised by Patent Owner other than to argue that Tsai, Sung'026, and Sung'146 are not prior art

Pet. at 6; Reply at 15-16

Patent Owner Argues Working Superabrasive Particles Not Taught

- Patent Owner's sole argument
  - No "working superabrasive particles" because no evidence that "all particles" are "***cutting***" the CMP pad

B. Tsai and Sung '026 Do Not Render Obvious Claims 8-12

Dr. Shanfield's erroneous opinion that "Tsai discloses that all the diamond particles on the CMP pad dressers are cutters and share an equal dressing load when conditioning CMP pads" (Ex. 1002 at ¶ 189) is based on nothing more than his conjecture. The view that "all" superabrasive particles are working superabrasive particles that cut into a CMP pad finds no support in Tsai. As Dr. Shanfield has

Similarly, Sung 026's disclosure that "[t]he protruding superabrasive particles 12 ***can*** cut into the CMP pad to a depth that is essentially the distance of the protrusion" does not dictate that all particles of all protrusion depths actually do cut into the CMP pad.

Dr. Tsai
PO's Expert

particles." (*Id.* at 209:12-20.) This is not surprising since Dr. Tsai testified that the ***only*** way to accurately determine the number of working diamonds is through the use of the claimed designated profile (which he did not use), and that if he were to use his baseline approach for this purpose, it would be "time consuming" and introduce "a lot of errors," rendering it "not possible to do." (*Id.* at 120:17-121:2 and 115:25-116:6; *see also* 153:7-10 and 208:11-19.)

POR at 49-54; Ex. 1001, claims 8-12

1. Sung'026 Teaches "Cutting Depth"

- Sung'026 teaches cutting
  - Claim 3: "***majority*** of the plurality of superabrasive particles protrudes to ***a predetermined height***"
  - Claim 4: "***<u>the</u> predetermined height*** produces a ***cutting*** depth"

> **3.** The method of claim 1, wherein a majority of the plurality of superabrasive particles protrudes to a predetermined height above the solidified organic material layer.
>
> **4.** The method of claim 3, wherein the predetermined height produces a cutting depth of less than about 20 microns when used to abrade a work piece.

Pet. at 64-66; Reply at 18; Ex. 1005, claims 3-4, [0051]

1. Tsai's ODD Has More Than ~1,000 Cutters

- Typical diamond disk (BDD) contains about ~1,000 "cutters"

> leveled to the same height. A typical diamond disk contains over 10,000 grits; however, less than 10% of the diamond grits are engaged in cutting the polishing pad. The rest of the grits remain unused on the disk. In addition, the diamond grits are easily chipped by the im-

Reply at 17; Ex. 1004, 2:14-16

- Tsai's ODD has more cutters than BDD

> the pad is minimal. The height variation in the diamond tips of the ODD is significantly smaller than that in the diamond tips of the BDD. In the case of the BDD, the diamond tips are leveled to more than 50 μm. However, as shown in Fig. 6, in the case of the ODD, the diamond tips of the ODD can be leveled to less than 15 μm because the diamond tips are already leveled. The better-leveled ODD has more cutters that can dress the pad, and thus, they share an equal dressing load.

Pet. at 64; Ex. 1004, 8:19-26

Dr. Tsai
PO's Expert

Q: All you know here is that the ODD has more cutters than the BDD, correct?

A: Yes.

Reply at 17; Ex. 1055, 57:21-23

2. Tsai's Particles *Deform* the CMP Pad

- Patent Owner fails to address definition of "working superabrasive particles" include superabrasive particles that "***otherwise deform***" a CMP pad during dressing

> As used herein, "working superabrasive particles" are superabrasive particles that cut or otherwise deform a CMP pad during a dressing or conditioning procedure. This action

Reply at 17; Ex. 1001, 4:46-48

- Patent Owner's expert admits "many, many types" of "deformations" will occur when particle presses down to the CMP pad

Dr. Tsai
PO's Expert

Q: So it's your testimony when a hard diamond particle is rubbed against a polyurethane, a very soft material, you cannot opine whether deformations of the polyurethane will occur?

A: You are talking about deformation. *There are many, many types*. Of course, *when this particle presses down to the soft material, that material will be pressed down*.

Reply at 18; Ex. 1052, 33:7-15

2. Sung'026 Particles Deform The CMP Pad

- Sung'026 teaches the superabrasive particles can be "configured to uniformly distribute frictional forces across ***substantially each*** superabrasive particles"

[0051] Accordingly, one aspect of the present invention provides a method of improving retention of superabrasive particles held in a solidified organic material layer of an abrading tool having a portion of the superabrasive particles protruding out of the solidified organic material layer. The method can include securing a plurality of superabrasive particles in the solidified organic material layer in an arrangement that minimizes mechanical stress impinging on the protruding portion of any individual superabrasive particle when used to abrade a work piece. Though various methods of minimizing mechanical stress are possible, in one aspect the arrangement of the plurality of superabrasive particles may be configured to uniformly distribute frictional forces across substantially each superabrasive particle. Such a uniform distribution of frictional force prevents any individual superabrasive particle from being overstressed and pulling out of the solidified organic material layer.

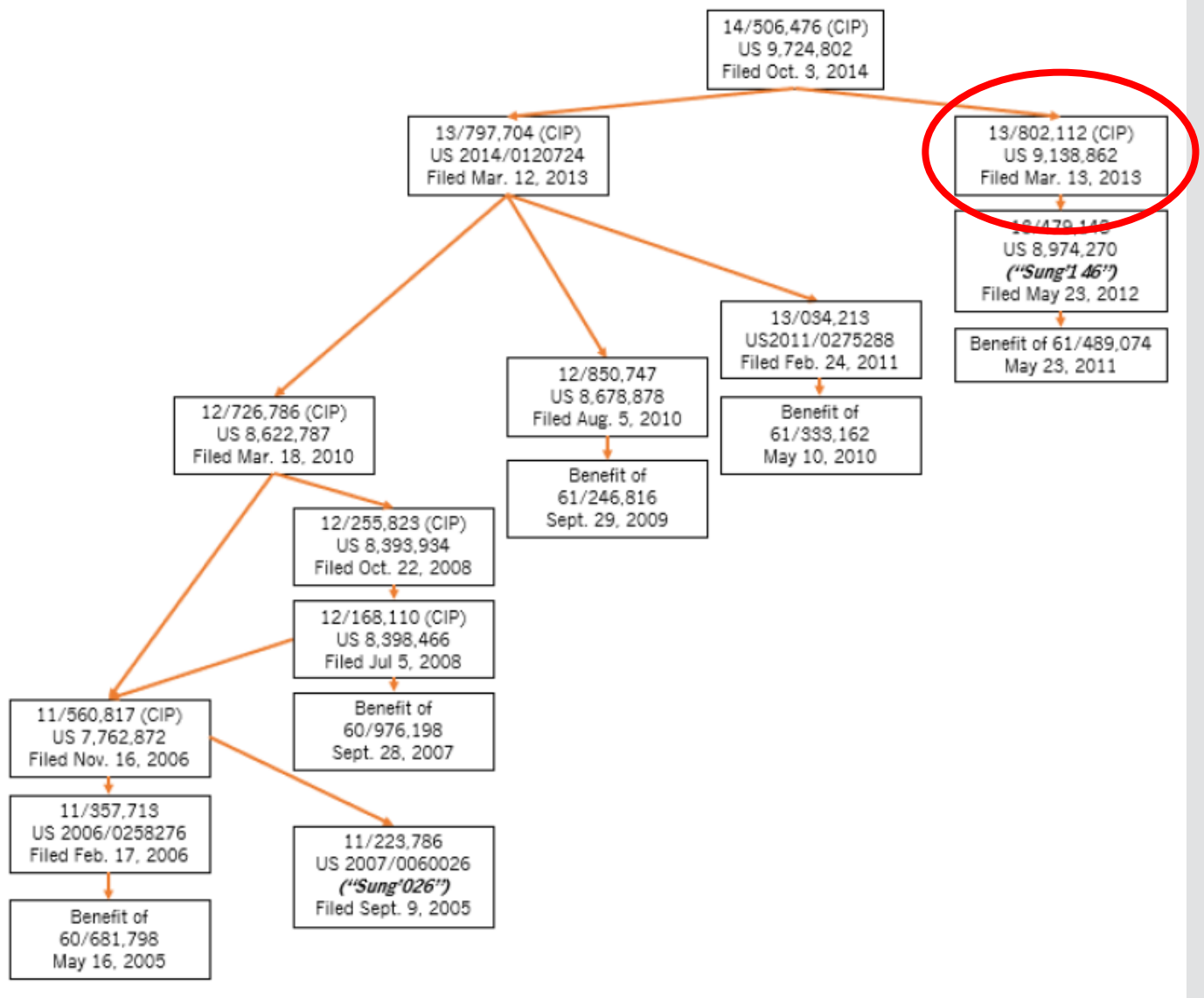
Pet. at 64-66; Reply at 18; Ex. 1005, claims 3-4, [0051]

IPR2024-00534
U.S. Patent No. 9,138,862

SAMSUNG

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The '862 Patent



IPR2024-00535, Pet. at 13

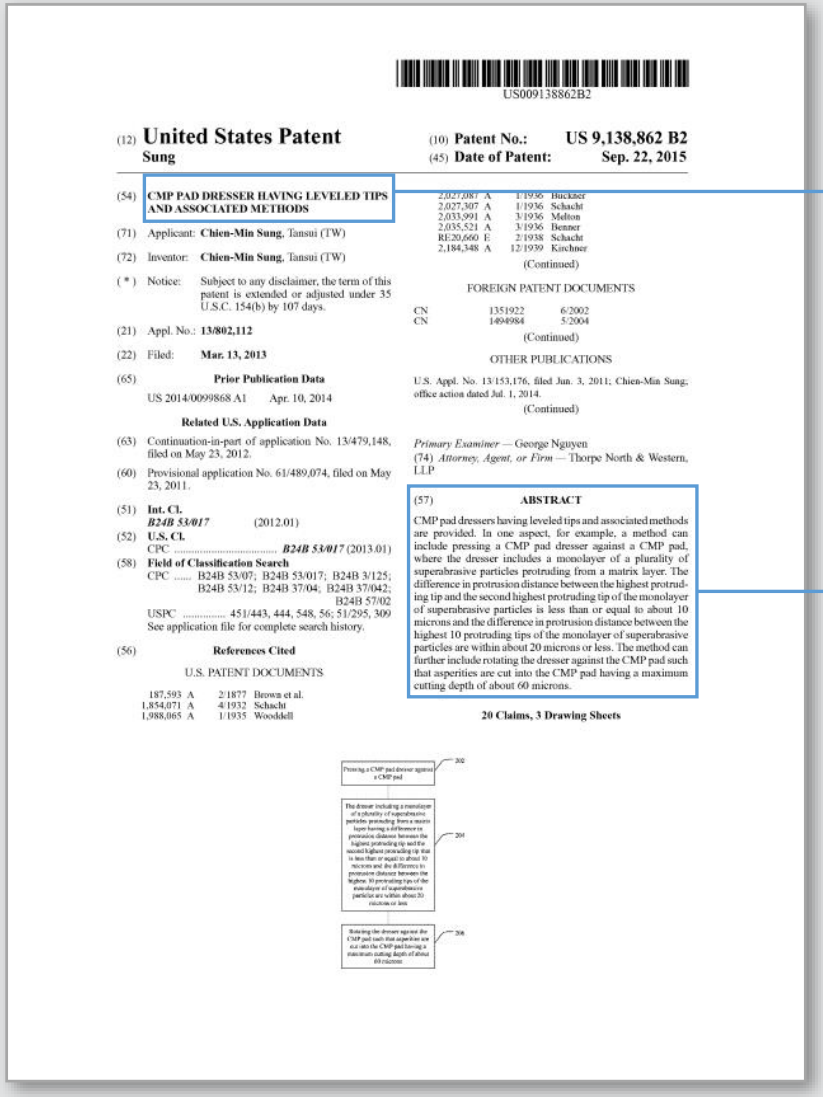
Outline

A Overview of the ’862 Patent

B Overview of the Prior Art

C The Disputed Issues

The ’862 Patent



US009138862B2

(12) **United States Patent**
Sung

(10) **Patent No.: US 9,138,862 B2**
(45) **Date of Patent: Sep. 22, 2015**

(54) **CMP PAD DRESSER HAVING LEVELED TIPS AND ASSOCIATED METHODS**

(71) Applicant: **Chien-Min Sung**, Tansui (TW)

(72) Inventor: **Chien-Min Sung**, Tansui (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 107 days.

(21) Appl. No.: **13/802,112**

(22) Filed: **Mar. 13, 2013**

(65) **Prior Publication Data**

US 2014/0099868 A1 Apr. 10, 2014

Related U.S. Application Data

(63) Continuation-in-part of application No. 13/479,148, filed on May 23, 2012.

(60) Provisional application No. 61/489,074, filed on May 23, 2011.

(51) **Int. Cl.**
B24B 53/017 (2012.01)

(52) **U.S. Cl.**
CPC ***B24B 53/017*** (2013.01)

(58) **Field of Classification Search**
CPC B24B 53/07; B24B 53/017; B24B 3/125; B24B 53/12; B24B 37/04; B24B 37/042; B24B 57/02
USPC 451/443, 444, 548, 56; 51/295, 309
See application file for complete search history.

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(Continued)

Primary Examiner — George Nguyen
(74) *Attorney, Agent, or Firm* — Thorpe North & Western, LLP

(57) **ABSTRACT**

CMP pad dressers having leveled tips and associated methods are provided. In one aspect, for example, a 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. 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. The 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.

20 Claims, 3 Drawing Sheets

CMP PAD DRESSER HAVING LEVELED TIPS AND ASSOCIATED METHODS

(57) **ABSTRACT**

CMP pad dressers having leveled tips and associated methods are provided. In one aspect, for example, a 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. 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. The 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.

Ex. 1001

Overview of the ‘862 Patent:

- Method of conditioning CMP pads:
  - **Pressing a CMP pad dresser against a CMP pad**
  - **Rotating the dresser against the CMP pad**
- CMP pad dresser having diamond tips:
  - **Two highest tip height difference ≤ 10 microns**
  - **Ten highest tip height difference ≤ 20 microns**
  - **Maximum cutting depth ≈ 60 microns**

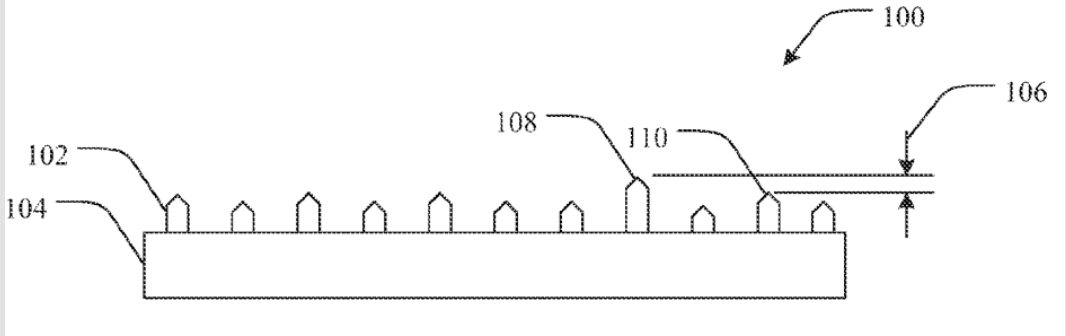


FIG. 1

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.

Pet. at 12-13; Ex. 1001, Fig. 1, claim 1

Overview of the ‘862 Patent:

- Reverse casting is one exemplary technique to fabricate the claimed CMP pad dresser

Additionally, so-called “reverse casting” methods can be used to accurately orient and attach the dressing segments to the rigid support. Such methods can include initially securing the plurality of dressing segments to a substrate using a “mask” material. The portions of the dressing segments protruding from the mask material can then be attached to the rigid support using the methods discussed herein, after which (or during which), the masking material can be removed.

Pet. at 13-14; 35; Ex. 1001, 17: 8-15

Outline

A Overview of the ‘862 Patent

B Overview of the Prior Art

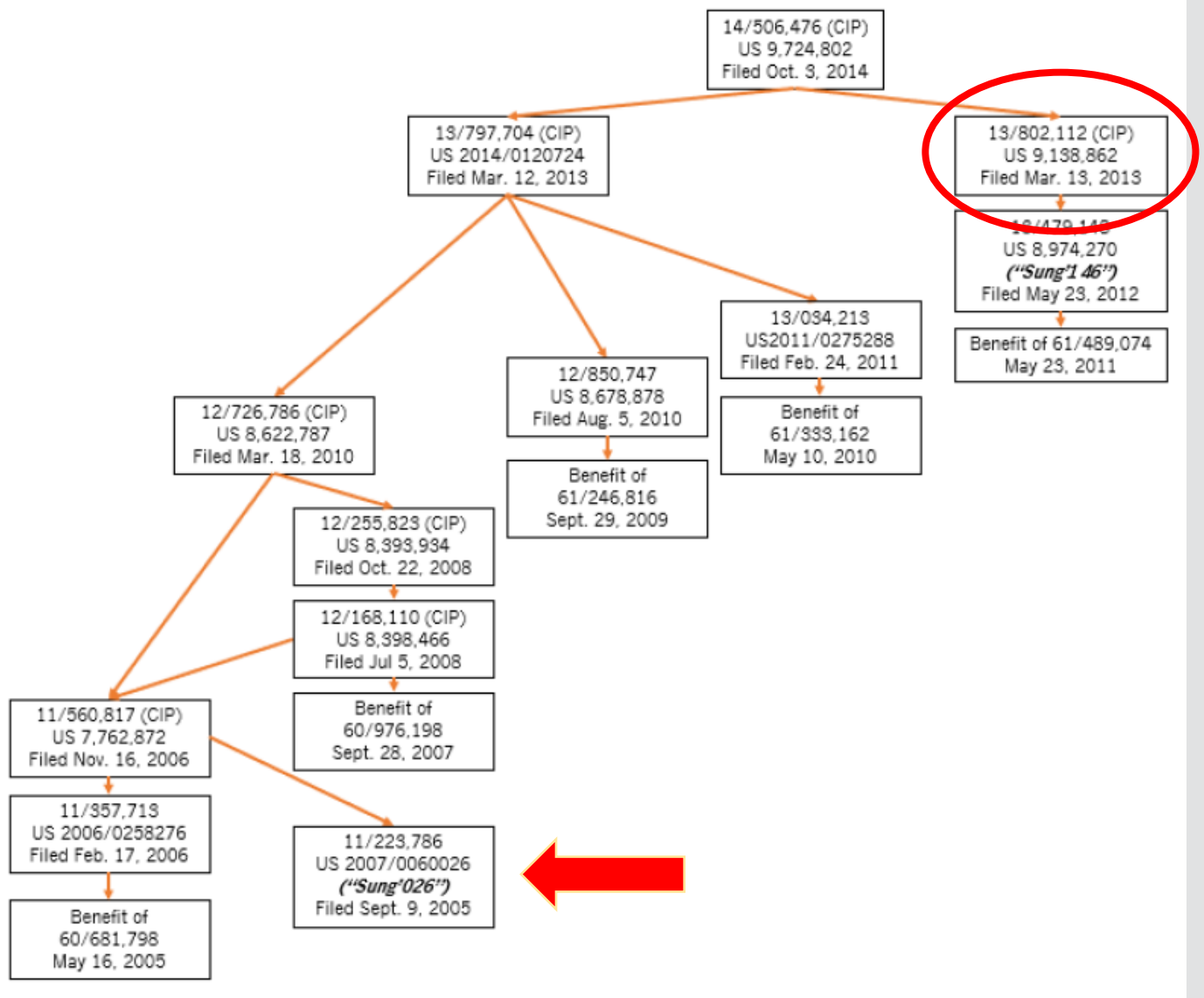
C The Disputed Issues

Prior Art References Relied Upon

Ground	Challenged Claims	References
IA/IB (102/103)	1-6, 9-12, 20	Sung'026
II	5-10	Sung'026 with SungICPT
III	13, 17-19	Sung'026 with Nishioka
IV	14	Sung'026 with Lin
V	15	Sung'026 with Kim
VI	16	Sung'026 with Koyama

Pet. at 6

Sung'026 And The '862 Patent

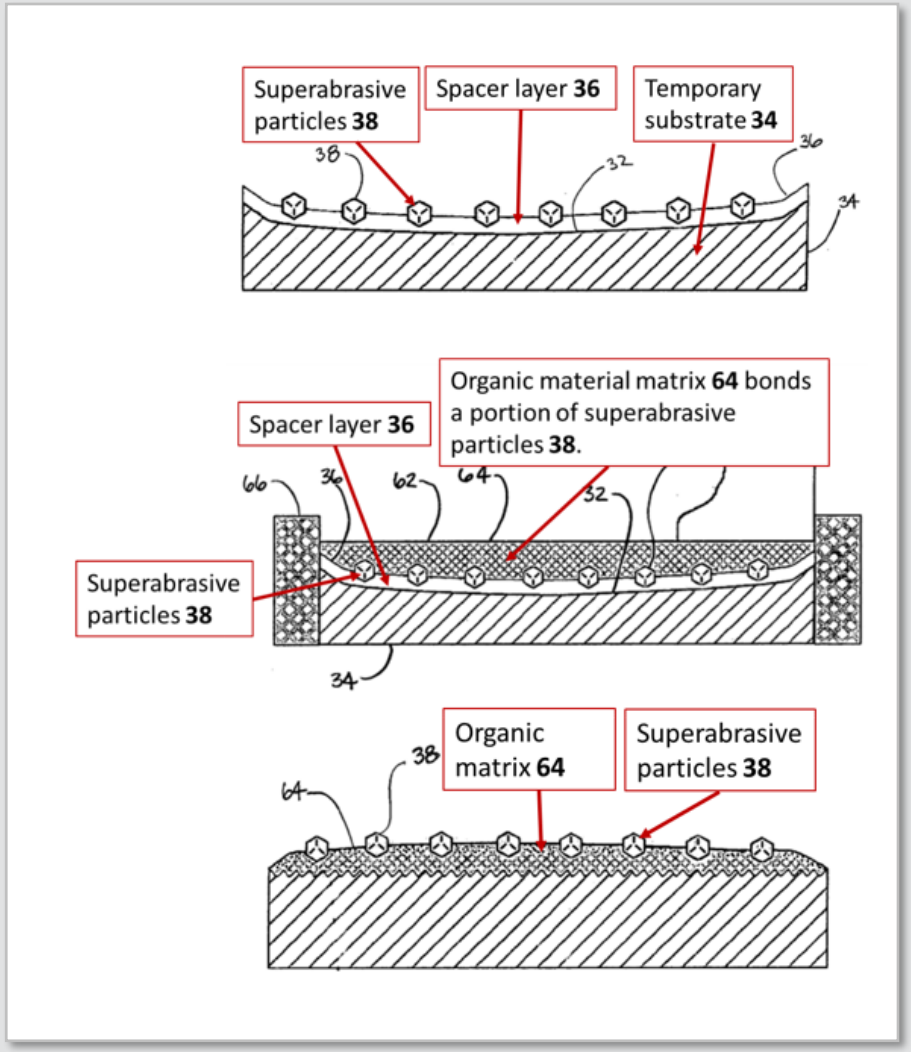


IPR2024-00535, Pet. at 13

Overview of Sung'026

- Describes the same reverse casting method to make CMP pad dressers

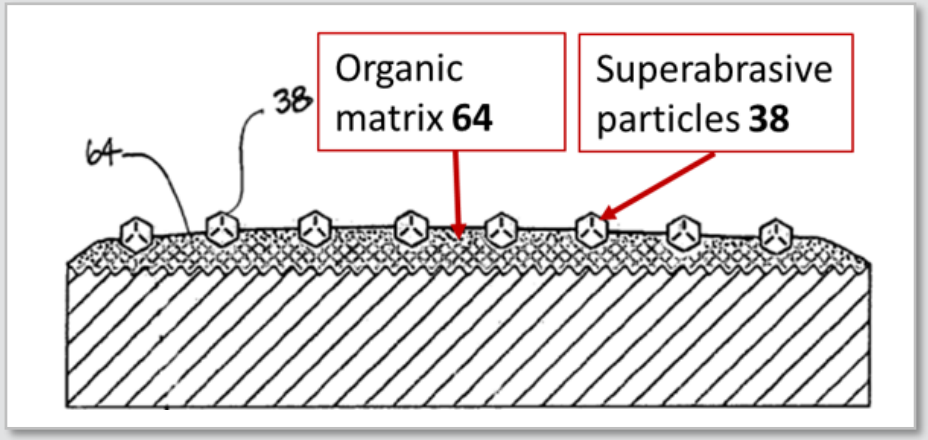
[0083] Various reverse casting methods may be utilized to manufacture the CMP pad dresser of the present invention.



Pet. at 18-21, 29, 35, 61; Ex. 1004, [0083]-[0084], Figs. 2, 5-6

Overview of Sung'026

- Tip variation: <1 μm from designated profile
  - Designated profile: a plane



- Cutting depth: 1–20 microns

[0053] It may also be beneficial for the superabrasive particles to protrude from the solidified organic material layer to a predetermined height or series of heights that is/are along a designated profile. Numerous configurations for designated profiles are possible, depending on the particular use of the abrading tool. In one aspect, the designated profile may be a plane. In planar profiles, the highest protruding

[0056] As has been mentioned herein, while it is intended that the tips of the superabrasive particles align along the designated profile, some level of deviation may occur. These 5 microns. In yet another aspect, the plurality of superabrasive particles are arranged such that their tips vary from the designated profile by less than about 1 microns. In a further

[0010] Various methods are contemplated for minimizing the mechanical stress impinging on the superabrasive particles held in the abrading tool. One example may include superabrasive particle arrangement according to protrusion height. As such, each of the plurality of superabrasive particles may protrude to a predetermined height above the solidified organic material layer. In one aspect, the predetermined height may produce a cutting depth of greater than about 20 microns when used to abrade a work piece. In another aspect, the predetermined height may produce a cutting depth of from about 1 micron to about 20 microns when used to abrade a work piece. In yet another aspect, the

Pet. at 18-21, 30-32, 35-38, 62; Ex. 1004, [0010], [0052], [0053], [0056], Figs. 2, 5-6

Outline

A Overview of the ‘862 Patent

B Overview of the Prior Art

C The Disputed Issues

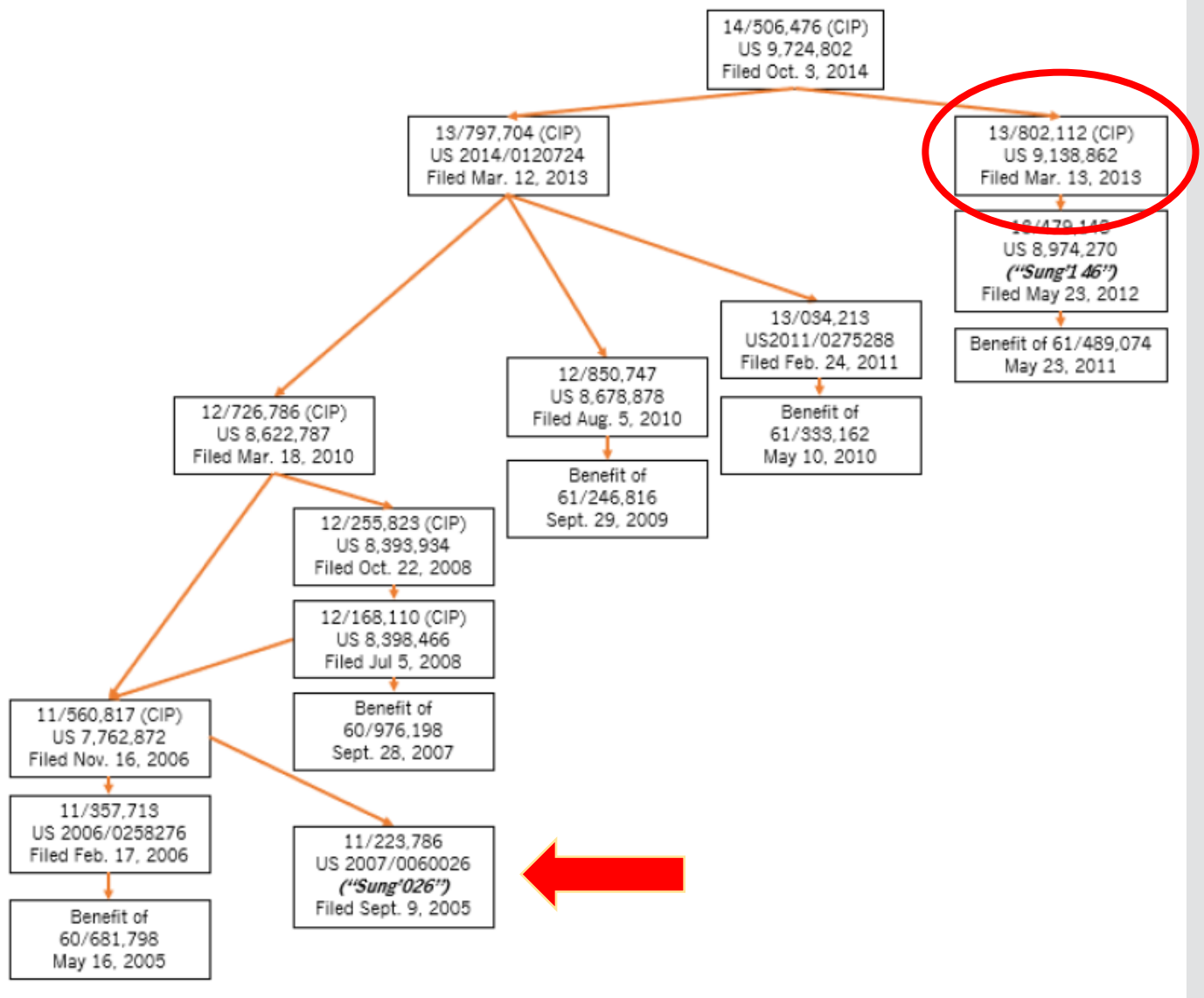
The Disputed Issues

1. Whether a POSITA would have understood that Sung'026 teaches **pressing a CMP pad dresser against a CMP pad**

2. Whether Sung'026 teaches/renders obvious the claimed **protrusion height differences (limitation 1C)** of the monolayer of superabrasive particles (limitation 1B) and the claimed **cutting depth (limitation 1D)**

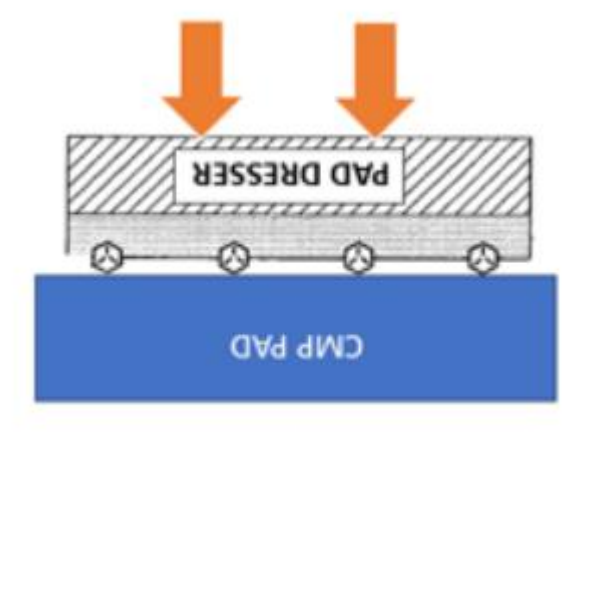
3. Whether Sung'026 and SungICPT renders obvious CMP pad dresser with superabrasive particles located at a **peripheral location** of the dresser (claims 5-10)

Sung'026 And The '862 Patent



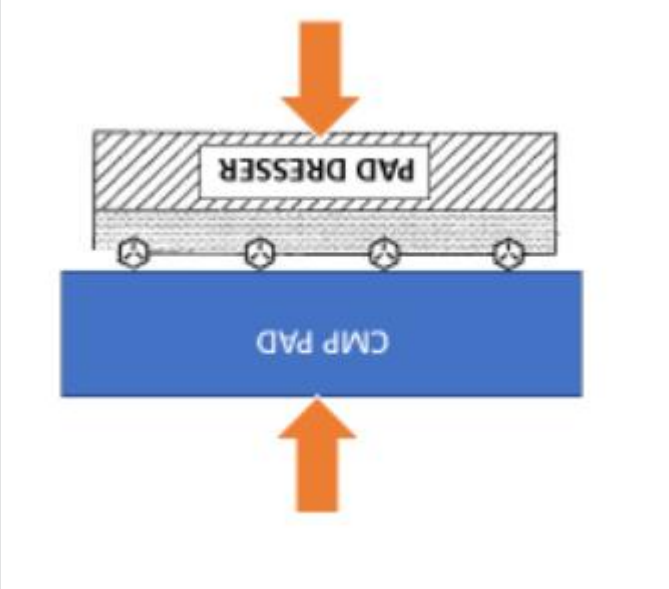
IPR2024-00535, Pet. at 13

Patent Owner Argues Only Scenarios (i) And (iii) Read On "Pressing A CMP Pad Dresser Against A CMP Pad"



Scenario (i)

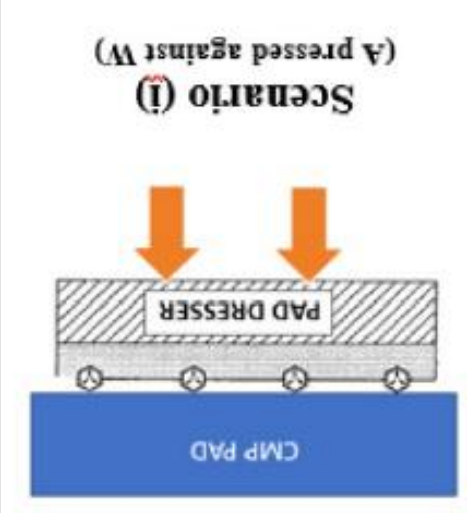
Scenario (ii)



Scenario (iii)

POR at 19; Ex. 2011, ¶50

Patent Owner's Expert Admits Scenario (i) Is How CMP Pad Dressing *Ordinarily* Occurs To Meet "Pressing A CMP Pad Dresser Against A CMP Pad"



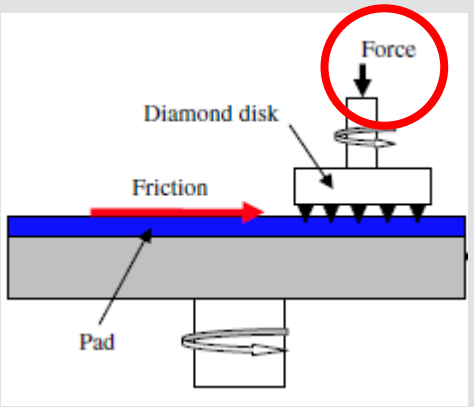
Scenario (i)
(A pressed against W)

POR, 19

Int J Adv Manuf Technol (2011) 55:253–262
DOI 10.1007/s00170-010-3055-y

Reply at 5; Ex. 1045, Fig. 4

Int J Adv Manuf Technol (2011) 55:253–262
DOI 10.1007/s00170-010-3055-y



Reply at 6; Ex. 1014, Fig. 4

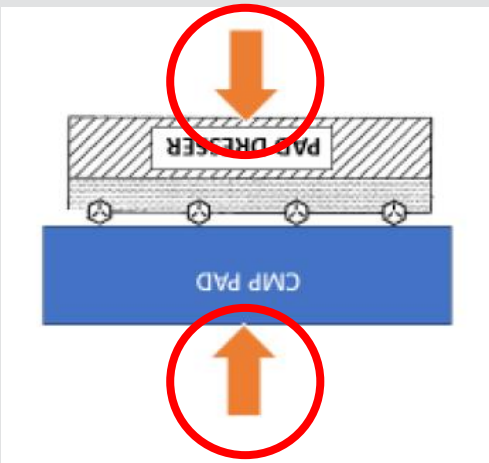
Dr. Tsai
PO's Expert

Q: Did manufacturers press the CMP pad upward against the CMP pad dresser?

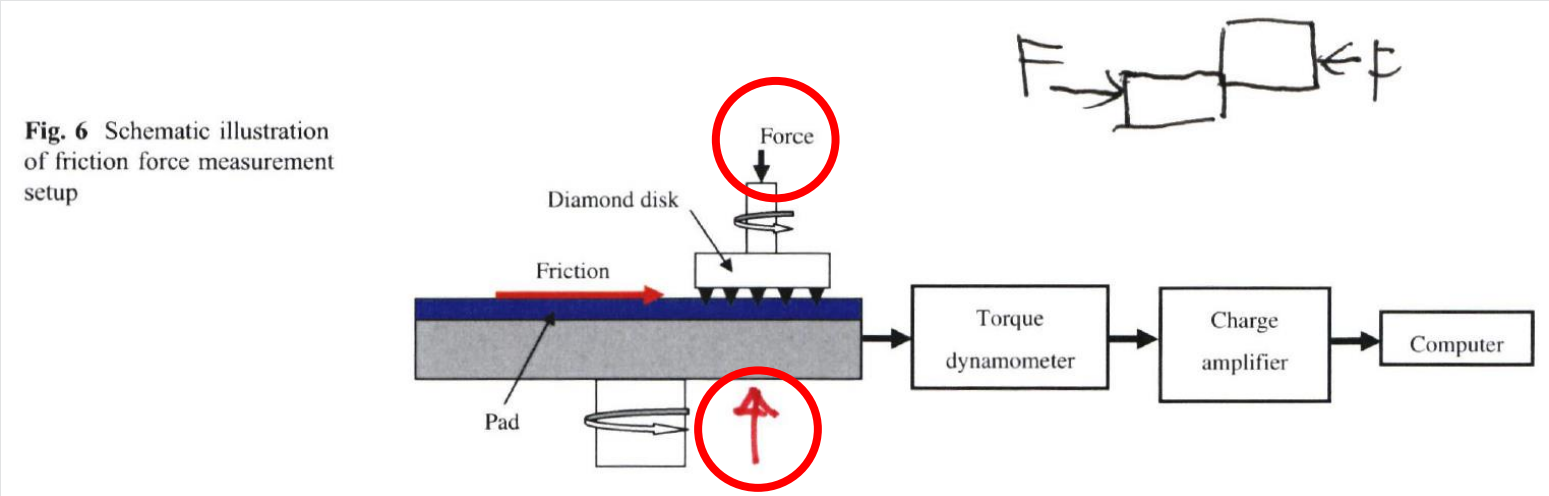
A: The first way is the ordinary way where you have the pad at the bottom, the diamond tips at the top and *presses down to the pad*."

Reply at 5; Ex. 1049, 72:11-15

Simple Physics Regarding Equal And Opposite Forces Means Scenario (iii) Also Occurs To Meet **"Pressing A CMP Pad Dresser Against A CMP Pad"**



POR, 19



Reply at 6; Ex. 1045, Fig. 6

Dr. Tsai
PO's Expert

Q: And based on Newton's third law of motion, will there be an equal and opposite force that is acting against the force that's shown here in Figure 6?

A: *Just like I said, in theory it's okay*, but in reality, there are many factors to be considered.

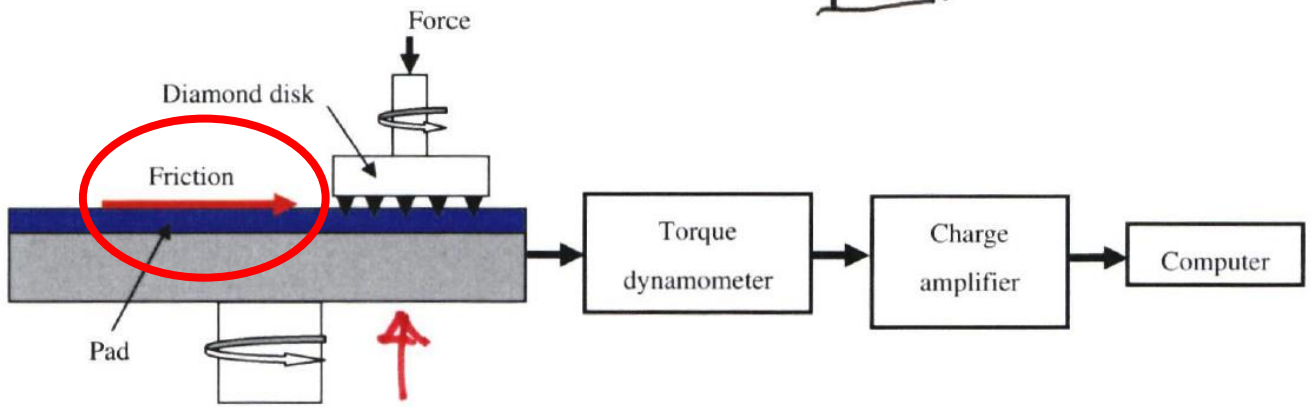
Reply at 6; Ex. 1049, 31:19-25

Simple Physics Regarding Equal And Opposite Forces Means Scenario (iii) Also Occurs To Meet "Pressing A CMP Pad Dresser Against A CMP Pad"

91. Since frictional forces on the CMP pad dresser described by Sung'026 can only be the result of the CMP pad being pressed against another object (e.g., a CMP pad dresser), Sung'026 discloses pressing a CMP pad dresser against a CMP pad.

Pet. at 27-28

Fig. 6 Schematic illustration of friction force measurement setup



Reply at 6; Ex. 1045, Fig. 6

Frictional Forces Across Superabrasive Particles During CMP Pad Dressing Means Sung'026 Teaches **"Pressing A CMP Pad Dresser Against A CMP Pad"**

[0051] Accordingly, one aspect of the present invention provides a method of improving retention of superabrasive particles held in a solidified organic material layer of an abrading tool having a portion of the superabrasive particles protruding out of the solidified organic material layer. The method can include securing a plurality of superabrasive particles in the solidified organic material layer in an arrangement that minimizes mechanical stress impinging on the protruding portion of any individual superabrasive particle when used to abrade a work piece. Though various methods of minimizing mechanical stress are possible, in one aspect the arrangement of the plurality of superabrasive particles may be configured to uniformly distribute frictional forces across substantially each superabrasive particle. Such a uniform distribution of frictional force prevents any individual superabrasive particle from being overstressed and pulling out of the solidified organic material layer.

Pet. at 27; Ex. 1004, [0051]

"[T]he dispositive question is whether a skilled artisan would 'reasonably understand or infer' from a prior art reference that every claim limitation is disclosed in that single reference."

Acoustic Technology, Inc. v. Itron Networked Solutions., 949 F.3d 1366, 1373 (Fed. Cir. 2020)

Reply at 4-5

The Disputed Issues

1. Whether a POSITA would have understood that Sung'026 teaches **pressing a CMP pad dresser against a CMP pad**

2. Whether Sung'026 teaches/renders obvious the claimed **protrusion height differences (limitation 1C)** of the monolayer of superabrasive particles (limitation 1B) and the claimed **cutting depth (limitation 1D)**

3. Whether Sung'026 and SungICPT renders obvious CMP pad dresser with superabrasive particles located at a **peripheral location** of the dresser (claims 5-10)

Limitations [1B] Through [1D]

- [1B]: monolayer of superabrasive particles in a matrix layer
- [1C]: specific superabrasive particle tips have specified tolerance levels
  - Highest vs. second-highest ≤ 10μm
  - Highest ten tips within 20μm
- [1D]: rotating tool that produces maximum cutting depth is about 60μm

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.

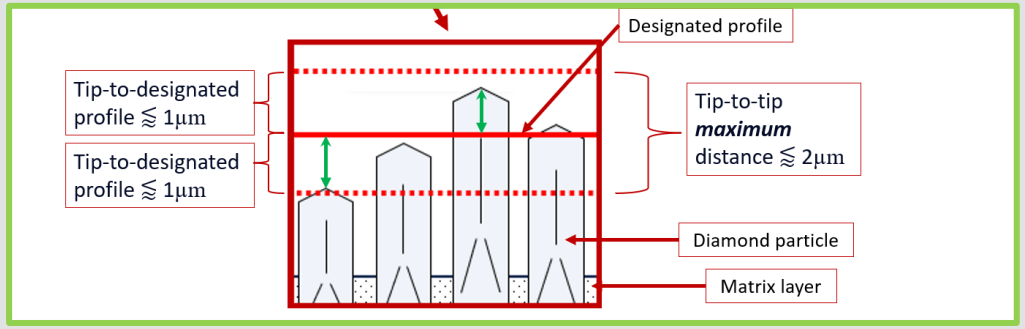
Pet. at 12-13; Ex. 1001, claim 1

There is No Dispute that Sung'026 Teaches Limitations [1B]-[1D] *Individually*

- [1B]: Sung'026 teaches a monolayer of superabrasive particles in a matrix layer
- [1C]: Sung'026 teaches diamond tips are aligned within 1μm from a planar profile
  - Highest vs. second-highest ≤ 10μm
  - Highest ten tips within 20μm
- [1D]: Sung'026's CMP pad dresser is a rotating tool that produces cutting depth of <60μm

[0074] One example of a tool incorporating a single layer of superabrasive particles in an organic material matrix is a CMP pad dresser. As recited herein, traditional metal matrix

Pet. at 28; Ex. 1004, [0074]-[0075]; *see* DI at 40



Pet. at 31; Ex. 1004, [0056], Ex. 1002, ¶100; DI at 41

scope, in one specific aspect the predetermined height may produce a cutting depth of less than about 20 microns when used to abrade a work piece. In another specific aspect, the predetermined height may produce a cutting depth of from about 1 micron to about 20 microns when used to abrade a work piece. In yet another specific aspect, the predetermined height may produce a cutting depth of from about 10 micron to about 20 microns when used to abrade a work piece. It

Pet. at 36; DI at 44-45; EX1004, [0052]; Ex. 1002, ¶111

Patent Owner's Three Assertions

- A POSITA would not have combined "separate aspects"

B. The Reply Confirms that Sung '026 Did Not Disclose Combining Its Separate "Aspects" As Specifically Required by Limitations [1C] and [1D]

- There is no reasonable expectation of success to combine the "separate aspects"

III. PETITIONERS' ATTORNEY ARGUMENT IN REPLY CANNOT SHOW A REASONABLE EXPECTATION OF SUCCESS

- Sung'026 did not provide an enabling disclosure

(3) Sung '026 Did Not Provide an Enabling Disclosure for Claim Limitation [1D] Have Enabled a POSITA Says Nothing About What Asperity Cutting Depth Would Result from Using a Dresser Satisfying Claim Limitations [1B] and [1C]

POR at 28; Sur-Reply at 11, 18

1. Even The Claims of Sung'026 Combined Allegedly Different Aspects

Aspect	Sung'026 Specification	Sung'026 Claims
3	[0073] For example, in one aspect each of the plurality of superabrasive particles may protrude to a predetermined height above the solidified organic material layer.	1. A method of improving retention of superabrasive particles held in a solidified organic material layer of an abrading tool, a portion of each of said superabrasive particles protruding out of the solidified organic material layer … 30. A superabrasive tool … comprising… a plurality of superabrasive particles secured in the solidified organic material layer in an arrangement as recited in claim 1.
		31. The tool of claim 30, wherein each of the plurality of superabrasive particles protrude to a predetermined height above the solidified organic material layer.
1	[0053] It may also be beneficial for the superabrasive particles to protrude from the solidified organic material layer to a predetermined height or series of heights that is/are along a designated profile. … In one aspect, the designated profile may be a plane.	3. The method of claim 1, wherein a majority of the plurality of superabrasive particles protrudes to a predetermined height above the solidified organic material layer. 7. The method of claim 3, wherein the superabrasive particles protrude to a predetermined height that is along a designated profile. 8. The method of claim 7, wherein the designated profile is a plane. 36. The tool of claim 31, wherein the plurality of superabrasive particles protrude to a predetermined height is along a designated profile. 37. The tool of claim 36, wherein the designated profile is a plane.
2	[0056] In yet another aspect, the plurality of superabrasive particles are arranged such that their tips vary from the designated profile by less than about 1 microns.	12. The method of claim 7, wherein a majority of the plurality of superabrasive particles are arranged such that their tips vary from the designated profile to less than about 10% of the average size of the superabrasive particles. 16. The metho of claim 1, wherein the plurality of superabrasive particles are of substantially the same size. 41. The tool of claim 31, wherein the plurality of superabrasive particles are arranged such that their tips protrude to about 10% of the average size of the superabrasive particles.
4	[0073] In a further aspect the variation from the predetermined height may be from about 10 microns to about 20 microns.	33. The tool of claim 31, wherein variation from the predetermined height is from about 1 micron to about 20 microns.
5	[0010] As such, each of the plurality of superabrasive particles may protrude to a predetermined height above the solidified organic material layer. … In yet another aspect, the predetermined height may produce a cutting depth of from about 10 micron[s] to about 20 microns when used to abrade a work piece." [0052] As such, in one aspect, a majority of the plurality of superabrasive particles may protrude to a predetermine height above the solidified organic material layer. … In yet another specific aspect, the predetermined height may produce a cutting depth of from about 10 micron[s] to about 20 microns when used to abrade a work piece.	3. The method of claim 1, wherein a majority of the plurality of superabrasive particles protrudes to a predetermined height above the solidified organic material layer. 6. The method of claim 3, wherein the predetermined height produces a cutting depth of from about 10 micron to about 20 microns when used to abrade a work piece.

Reply at 10-12

1. Patent Owner's Own Expert Admits That Sung'026 Intended To Combine Aspects Recited In [1B]-[1D]

Dr. Tsai
PO's Expert

Q. So [Sung]'026 intends to make a diamond disk that has all the protrusions with identical heights and with the same orientation, *which combines the three different aspects you described in paragraph 69, is that correct*?

A. *In addition, it also intends to control the depths of penetrating into the pad.* For example, if I want to penetrate 10 micron into the pad, then the protrusion height should be at least 10 micron.

Q. *And just to be clear, it's not the '862 patent, it's the Sung'026 that's trying to combine all of these three together, correct?*

A. *Well, that's right, for [Sung]'026, to achieve that, I personally think that they should achieve those conditions.* But I don't know how other people do it. But for me, if I want to achieve a very perfect diamond disk, that is the way I would do.

Reply at 8-9; Ex. 1049, 50:5–51:23

1. A POSITA Would Have Been Able To "At Once Envisage" The Claims

"However, a reference can anticipate a claim even if it 'd[oes] not expressly spell out' all the limitations arranged or combined as in the claim, ***if a person of skill in the art, reading the reference, would 'at once envisage' the claimed arrangement or combination***."

Kennametal, Inc. v. Ingersoll Cutting Tool Co., 780 F.3d 1376, 1381 (Fed. Cir. 2015)

"[W]hen a reference discloses elements in different locations in the disclosure, the relevant question is whether the reference is sufficiently clear in disclosing the combinability of those elements such that ***a skilled artisan would 'at once envisage' the claimed combination***."

Chamberlain Grp., Inc. v. Techtronic Indus. Co., 935 F.3d 1341, 1350 (Fed. Cir. 2019)

Reply at 8

2. Use of Reverse Casting To Achieve Tip-To-Tip Variation Means A POSITA Would Have Had A Reasonable Expectation Of Success

2. A POSITA Would Have Had A Reasonable Expectation Of Success To Make The Proposed Modification In Limitation [1C]

Patent Owner's argument that "Petitioner fails to argue (let alone support) that a POSITA would have had a reasonable expectation of success" in making the modification (POR, 41) is contradicted by the record. For example, Petitioner explained that Sung'026, just like the '862 Patent, discloses a "reverse casting" process to level of the diamond particles and form the claimed CMP pad dresser. Petition, 35 (citing EX1004, [0083] and EX1001, 17:8-15). Moreover, the Petition articulated a reasonable expectation of success relying on Sung'026's teaching "that tip-to-tip variation across all diamond particles can be controlled to be less than 2 μm using the reverse casting process." Petition, 35-36.

Reply at 13

3. Patent Owner's Expert Admits Cutting Depth Is Enabled Based On Protrusion Height

Dr. Tsai
PO's Expert

Q. So '026 intends to make a diamond disk that has all the protrusions with identical heights and with the same orientation, which combines the three different aspects you described in paragraph 69, is that correct?

A. In addition, it also intends to control the depths of penetrating into the pad. *For example, if I want to penetrate 10 micron into the pad, then the protrusion height should be at least 10 micron.*

Q. And just to be clear, it's not the '862 patent, it's the Sung'026 that's trying to combine all of these three together, correct?

A. Well, that's right, for '026, to achieve that, I personally think that they should achieve those conditions. But I don't know how other people do it. But for me, if I want to achieve a very perfect diamond disk, that is the way I would do.

Reply at 8-9; Ex. 1049, 50:5–51:23

The Disputed Issues

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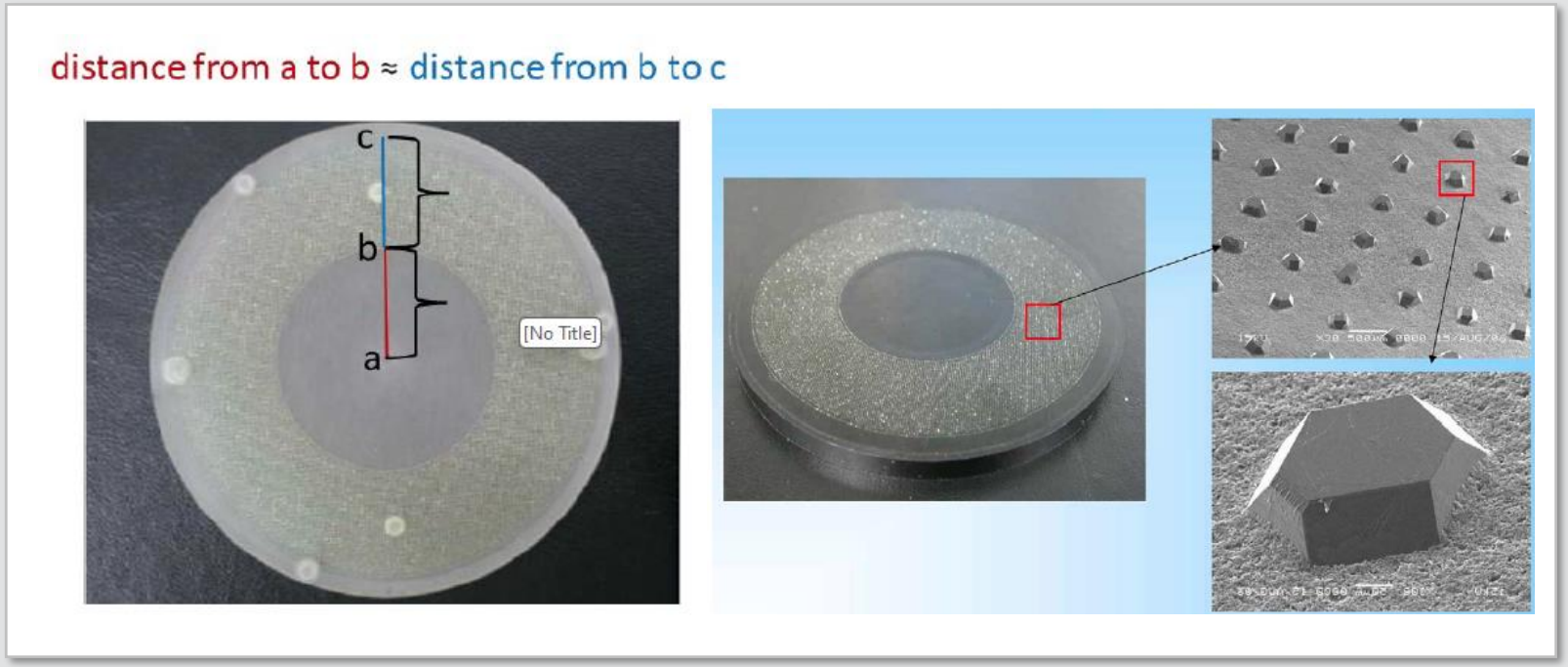
2. Whether Sung'026 teaches/renders obvious the claimed **protrusion height differences (limitation 1C)** of the monolayer of superabrasive particles (limitation 1B) and the claimed **cutting depth (limitation 1D)**

3. Whether Sung'026 and SungICPT renders obvious CMP pad dresser with superabrasive particles located at a **peripheral location** of the dresser (claims 5-10)

SungICPT Teaches CMP Pad Dresser With No Diamond Particles In Central Region

- Patent Owner argues that Petitioner "assumes from the lack of information" that there are no superabrasive particles within radius ab

POR at 47



Pet. at 11, 21, 51, 61, 62; Ex. 1005, 1:9-11, 2:2-3, Fig. 1, 3

Dr. Tsai
PO's Expert

Q. Are there diamond particles in the central ring, or region of that ODD disk [in Figure 1 of EX1005]?

A: Based on my profession, <u>there's no diamond at the center part of it.</u>

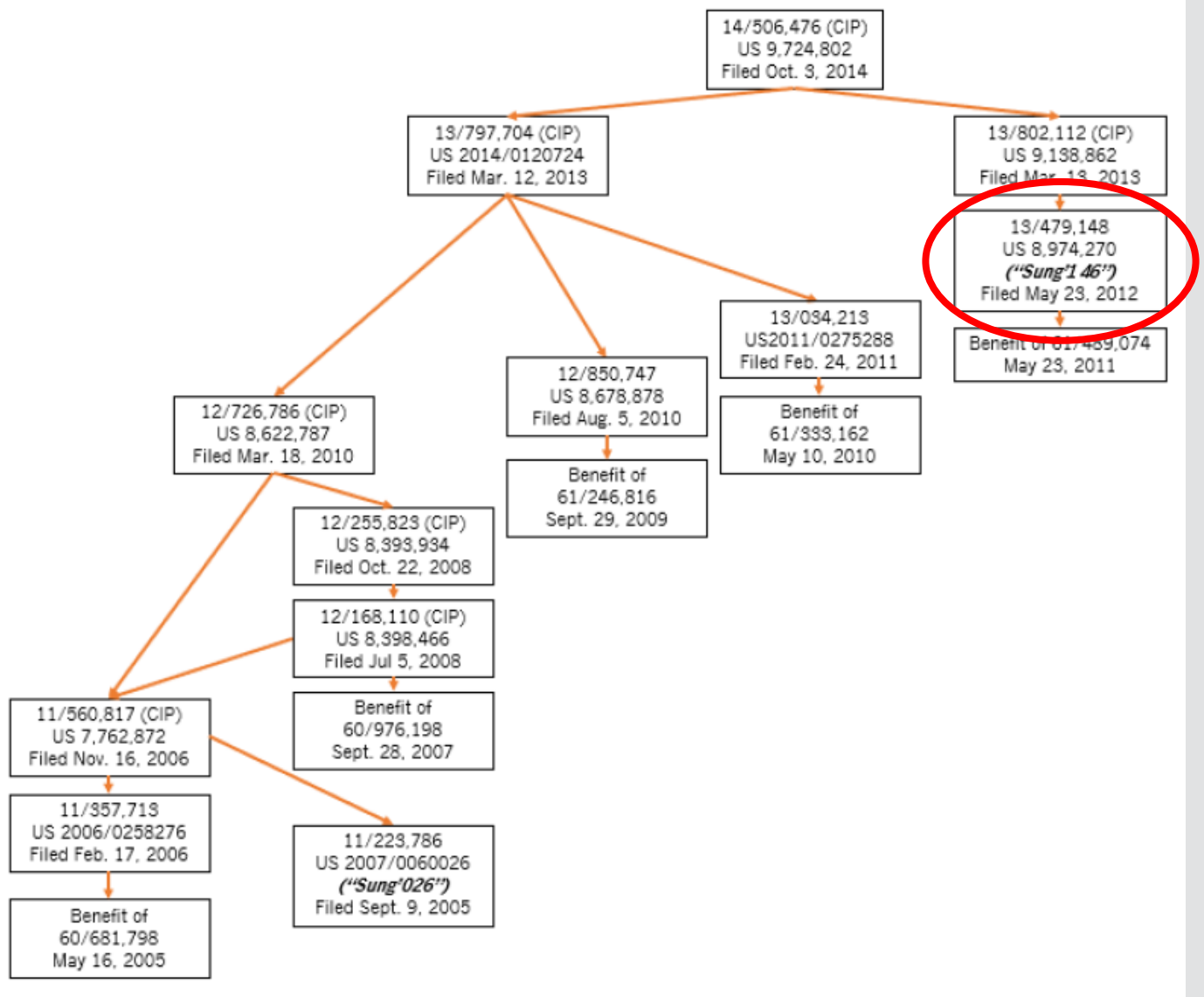
Reply at 22; Ex. 1049, 55:10-13

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

SAMSUNG

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The '270 Patent



IPR2024-00535, Pet. at 13

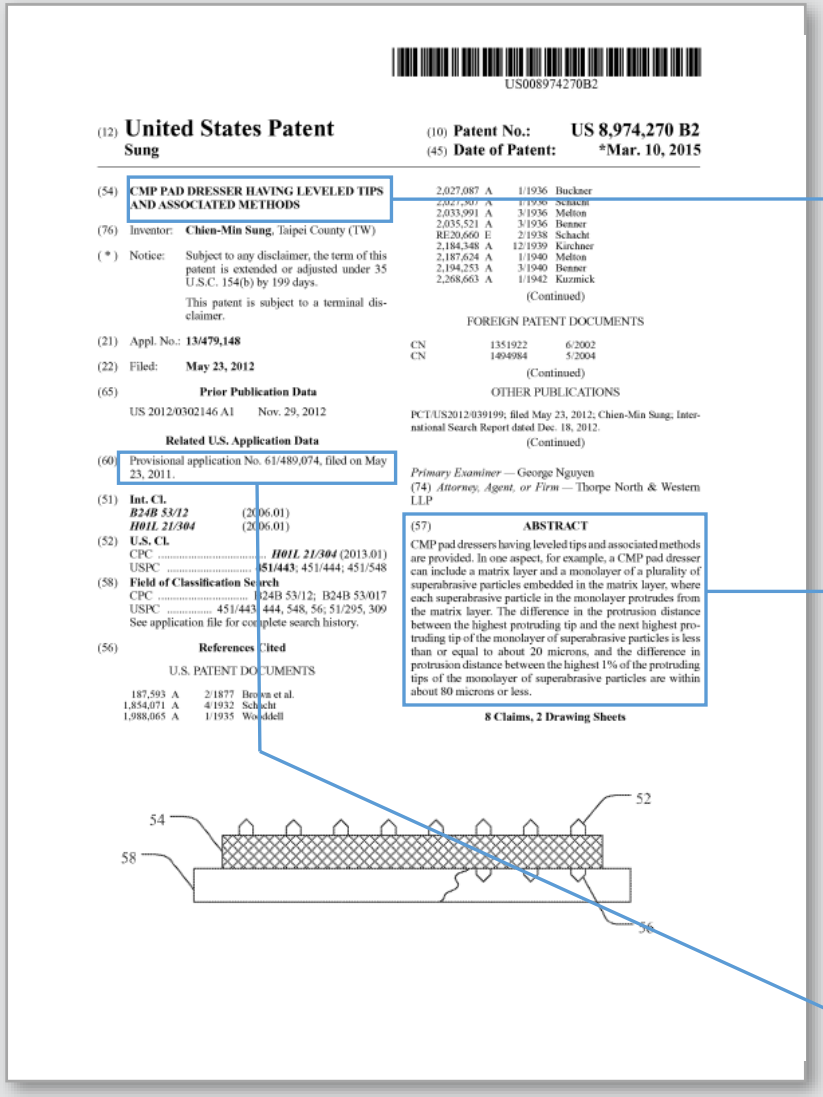
Outline

A Overview of the ’270 Patent

B Overview of the Prior Art

C The Disputed Issues

The ’270 Patent



US008974270B2

(12) **United States Patent**
Sung

(10) **Patent No.: US 8,974,270 B2**
(45) **Date of Patent: *Mar. 10, 2015**

(54) **CMP PAD DRESSER HAVING LEVELED TIPS AND ASSOCIATED METHODS**

(76) Inventor: **Chien-Min Sung**, Taipei County (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 199 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/479,148**

(22) Filed: **May 23, 2012**

(65) **Prior Publication Data**

US 2012/0302146 A1 Nov. 29, 2012

Related U.S. Application Data

(60) Provisional application No. 61/489,074, filed on May 23, 2011.

(51) **Int. Cl.**
B24B 53/12 (2006.01)
H01L 21/304 (2006.01)

(52) **U.S. Cl.**
CPC ***H01L 21/304*** (2013.01)
USPC **451/443**; 451/444; 451/548

(58) **Field of Classification Search**
CPC B24B 53/12; B24B 53/017
USPC 451/443, 444, 548, 56; 51/295, 309
See application file for complete search history.

(56) **References Cited**

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(Continued)

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(Continued)

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(Continued)

Primary Examiner — George Nguyen
(74) *Attorney, Agent, or Firm* — Thorpe North & Western LLP

(57) **ABSTRACT**

CMP pad dressers having leveled tips and associated methods are provided. In one aspect, for example, a CMP pad dresser can include 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. 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.

8 Claims, 2 Drawing Sheets

CMP PAD DRESSER HAVING LEVELED TIPS AND ASSOCIATED METHODS

(57) **ABSTRACT**

CMP pad dressers having leveled tips and associated methods are provided. In one aspect, for example, a CMP pad dresser can include 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. 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.

Provisional application No. 61/489,074, filed on May 23, 2011.

Ex. 1001

Overview of the ’270 Patent

- CMP pad dresser having superabrasive particles:
  - On both sides of a metal support layer
  - Tip height variation ≤ 50 microns between the two highest tips
  - Substantially the same distribution of tips on both sides

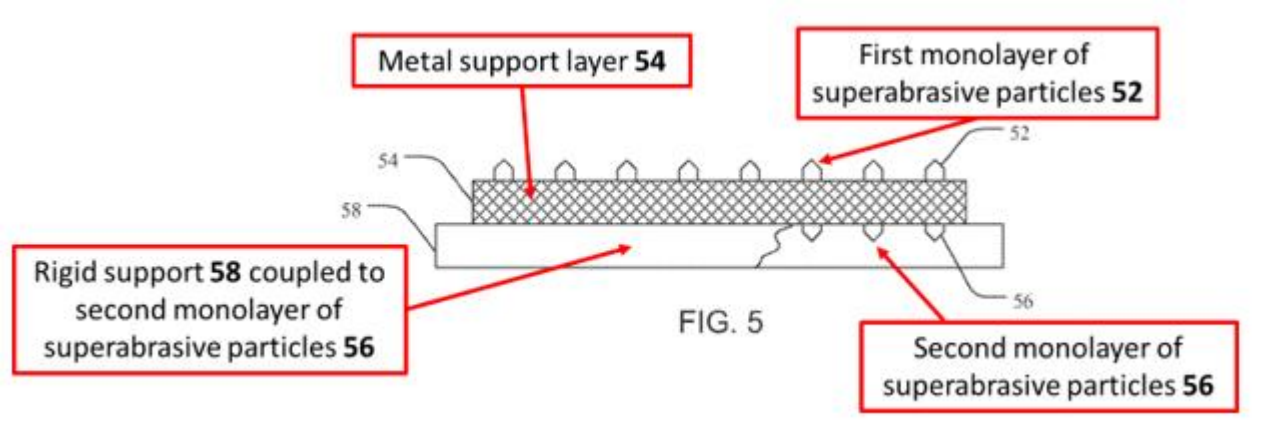


FIG. 5

Pet. at 12; Ex. 1001, Fig. 5 (annotated);

1. A CMP pad dresser, comprising:

a first monolayer of superabrasive particles disposed on and protruding from one side of a metal support 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 50 microns;

a second monolayer of superabrasive particles disposed on the metal support layer on an opposite side from the first monolayer, wherein the superabrasive particles of the second monolayer are positioned to have substantially the same distribution as the superabrasive particles of the first monolayer; and

a rigid support coupled to the second monolayer of superabrasive particles opposite the first monolayer.

Pet. at 13-14; Ex. 1001, claim 1

Prosecution History

- Filed a terminal disclaimer to overcome an obviousness-type double patenting against claims that eventually issued as US Patent No. 8,777,699 Patent

Claim 1 of the '270 Patent	Claim 1 of the '699 Patent
A CMP pad dresser, comprising:	A CMP pad dresser, comprising:
a first monolayer of superabrasive particles disposed on and ***protruding from*** one side of a metal support layer,	a first monolayer of superabrasive particles disposed on and ***coupled to*** one side of a metal support 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;	
a second monolayer of superabrasive particles disposed on the metal support	a second monolayer of superabrasive particles disposed on ***and coupled to*** the

Claim 1 of the '270 Patent	Claim 1 of the '699 Patent
layer on an opposite side from the first monolayer,	metal support layer on an opposite side from the first monolayer,
wherein the superabrasive particles of the second monolayer are positioned to have substantially the same distribution as the superabrasive particles of the first monolayer; and	wherein the superabrasive particles of the second monolayer are positioned to have substantially the same distribution as the superabrasive particles of the first monolayer; and ***further comprising***
a rigid support coupled to the second monolayer of superabrasive particles opposite the first monolayer.	A rigid support coupled to the second monolayer of superabrasive particles opposite the first monolayer.

Pet. at 13-14

IPR2014-01523 Against The '699 Patent

VII. Summary of IPR2014-01523 Against U.S. Patent No. 8,777,699

Kinik challenged the patentability of U.S. Patent No. 8,777,699 (the "'699 Patent") in IPR2014-01523 and the Board found claims 1-12 and 17-19 of the '699 Patent to be unpatentable. *See Kinik Co. v. Chien-Min Sung*, IPR2014-01523 ("'699 Kinik IPR"), Paper 26 ("'699 Kinik IPR FWD"). Specifically, the Board found on November 4, 2015 that "claims 1-3, 5, 6, 8-12, and 17-19 [of the '699 Patent] are anticipated by Chou."[4] *Id*, 23.

The instant Petition relies on Chou for the limitations that are substantially identical to claim 1 of the '699 Patent.

Pet. at 14-15

Outline

A Overview of the ‘270 Patent

B Overview of the Prior Art

C The Disputed Issues

Prior Art References Relied Upon

Ground	Challenged Claims	References
I	1, 3-8	Chou with Sung'479
II	6-7	Chou with Sung'479 and SungECS
III	2	Chou with Sung'479 and Goers

Pet. at 6

Chou + Sung'479

The instant Petition relies on Chou for the limitations that are substantially identical to claim 1 of the '699 Patent.

Claim 1 of the '270 Patent	Claim 1 of the '699 Patent	
A CMP pad dresser, comprising:	A CMP pad dresser, comprising:	Chou
a first monolayer of superabrasive particles disposed on and ***protruding from*** one side of a metal support layer,	a first monolayer of superabrasive particles disposed on and ***coupled to*** one side of a metal support layer; and	Chou
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;		Chou + Sung'479
a second monolayer of superabrasive particles disposed on the metal support layer on an opposite side from the first monolayer,	a second monolayer of superabrasive particles disposed on ***and coupled to*** the metal support layer on an opposite side from the first monolayer,	Chou
wherein the superabrasive particles of the second monolayer are positioned to have substantially the same distribution as the superabrasive particles of the first monolayer; and	wherein the superabrasive particles of the second monolayer are positioned to have substantially the same distribution as the superabrasive particles of the first monolayer; and ***further comprising***	Chou
a rigid support coupled to the second monolayer of superabrasive particles opposite the first monolayer.	A rigid support coupled to the second monolayer of superabrasive particles opposite the first monolayer.	Chou

Pet. at 13-15, 28-39

Overview of Sung'479

- Describes superabrasive tools made using low-melting point **braze** that can be leveled to within 1 microns using a "reverse casting" technique

[0072] As has been mentioned herein, while it is intended that the tips of the superabrasive particles align along the designated profile, some level of deviation may occur. These

5 microns. In yet another aspect, the plurality of superabrasive particles is arranged such that their tips vary from the designated profile by less than about 1 microns. In a further

[0082] Various reverse casting methods may be utilized to manufacture the superabrasive tools, and particularly the CMP pad dressers according to aspects of the present invention. As shown in FIG. **7**, a spacer layer **32** may be

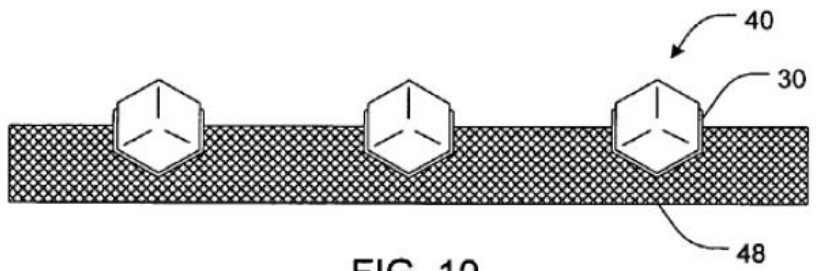


FIG. 10

Pet. at 17-19; Reply at 11; Ex. 1005, [0050], [0072], [0082], Fig. 10

Outline

A Overview of the ‘270 Patent

B Overview of the Prior Art

C The Disputed Issues

The Disputed Issues

1. Whether Chou and Sung'479 teaches and enable the claimed **protrusion height differences**
2. Whether Chou and Sung'479 would have been combined
3. Whether collateral estoppel appl

Patent Owner Argues Sung'479 Does Not Enable Limitation [1B]

2. 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"

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.

Dr. Tsai
PO's Expert

POR at 20; Ex. 2004, ¶63

Dr. Tsai's Opinion Regarding Alleged Non-Enablement Is Not Credible

- No understanding of the underlying facts: "***RA values***"

Dr. Tsai
PO's Expert

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

Q: Let's turn back to paragraph 63 [of your declaration]. … What's an RA value?

A: (In English) I'm not sure. I need to check. (In Chinese) I need to check that '479 patent.

Q: I'm handing you Exhibit 1005 which is a copy of Sung'479. …

A: I don't quite remember this RA value.

Reply at 7-8; Ex. 2004, ¶63; Ex. 1050, 126:21-128:4

Dr. Tsai's Opinion Regarding Alleged Non-Enablement Is Not Credible

- "***RA values***" is well-known in the art—as explained in the Petition, which Dr. Tsai did not review

> [9] Sung'479 also describes a similar concept in which "the tips of the superabrasive particles may be leveled to an RA value of less than about 10 μm." EX1005, [0067]; *see also* EX1011, 5:63-65 ("'RA' refers to a measure of the roughness of a surface as determined by the difference in height between a peak and a neighboring valley."). EX1002, ¶112.

Petition at 31, footnote 9

Dr. Tsai
PO's Expert

Q: You did not read the petition [for the '270 patent] prior to drafting your '270 declaration?

A: No.

Q: This is the first time you've seen the '270 petition, is that correct?

A: Yes, I see this the first time.

Reply at 15-16; Ex. 1050, 20:7-16

Dr. Tsai's Opinion Regarding Alleged Non-Enablement Is Not Credible

- "***RA values***" is claimed in Sung'479 itself

Sung'479, [0067]	Sung'479, claim 28
[0067] "… upon the formation of the superabrasive tool, the plurality of superabrasive particles have been leveled by the leveling surface to an RA value of less than about 40 μm."	28. "… said plurality of coated superabrasive particles having tips leveled to an RA value of less than about 40 μm."

Dr. Tsai
PO's Expert

Q: Is the subject matter that you're discussing in paragraph 63 of your declaration related to claim 28 of Sung'479?

A: Yes. They are related.

Q: Are you aware of a key requirement under U.S. Patent law that in order for you to have a patent claim, the patent claim has to be enabled?

A: I'm not sure.

Q: So who is more right? Is Dr. Sung correct that he believes this claim – that claim 28 is enabled or your opinion that claims 28 is not enabled?

A: I don't know.

Reply at 8; Ex. 1050, 132:5-8, 132:19-24, 133:25-134:4

Dr. Tsai's Opinion Regarding Alleged Non-Enablement Is Not Credible

- No understanding of the underlying law

Dr. Tsai
PO's Expert

Q: So you don't understand the legal understanding sections in your declarations, correct?

A: For those, indeed, I don't have much understanding.

Reply at 15; Ex. 1050, 18:14-18

Patent Owner Takes Contradictory Positions In IPR2024-00535

- For the identical limitation, relied on nearly identical teachings as allegedly providing priority (hence enabled)

IPR2024-00533 ('270 Patent)	IPR2024-00535 ('802 Patent)
[1B] 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;	[1E] 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,
Sung'479, [0072]: "Also, when referring to the designated profile, it should be noted that the term 'tip' is intended to include the highest protruding point of a superabrasive particle …" Sung'479, [0072]: "In yet another aspect, the plurality of superabrasive particles is arranged such that their tips vary from the designated profile by less than about 1 microns..."	'786 Application, 12:20-22: "Also, when referring to the designated profile, it should be noted that the term 'tip' is intended to include the highest protruding point of a superabrasive particle, …." '786 Application, 13:3-4 "In another aspect, the plurality of superabrasive particles are arranged such that their tips vary from the designated profile by from about 20 microns to about 40 microns."

Reply at 9-10

Patent Owner Takes Contradictory Positions In IPR2024-00535 Regarding Alleged Non-Enablement

- Patent Owner argues ODD ('786 Application) vs. BDD (Sung'479) require "vastly different manufacturing processes"

¶¶50-52, 64; Pet. at 17-18). As detailed in the POR, organic diamond disks ("ODDs") (focus of '786 Application) and brazed diamond disks ("BDDs") (focus of Sung'479) require vastly different manufacturing processes and have vastly differing results, to the point that, circa 2005-2007 when Sung'479 was filed, ODDs could be manufactured such that diamond tips could be leveled to a height variation within 20μm (POR, 11-12; EX2005, 1:30-2:3). Also, it was not practically

Sur-Reply at 11

Patent Owner Takes Contradictory Positions In IPR2024-00535 Regarding Alleged Non-Enablement

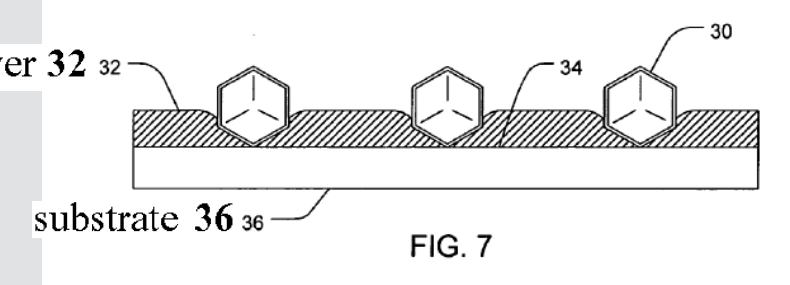
- Both '786 Application and Sung'479 utilize "reverse casting method" as suitable manufacturing processes

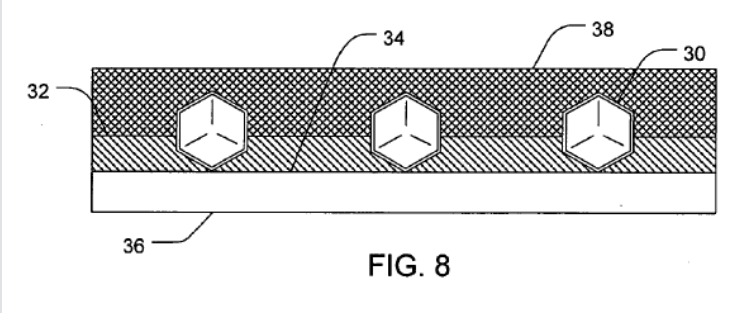
EX1005 (Sung'479)	EX1053 ('786 Application)
[0082] Various reverse casting methods may be utilized to manufacture the superabrasive tools, and particularly the CMP pad dressers according to aspects of the present invention. *See also* EX1005 (Sung'479), [0083]-[0089].	22:18-19: Various reverse casting methods may be utilized to manufacture the CMP pad dresser of the present invention. *See also* EX1053 ('786 Application), 22:19-26:14.

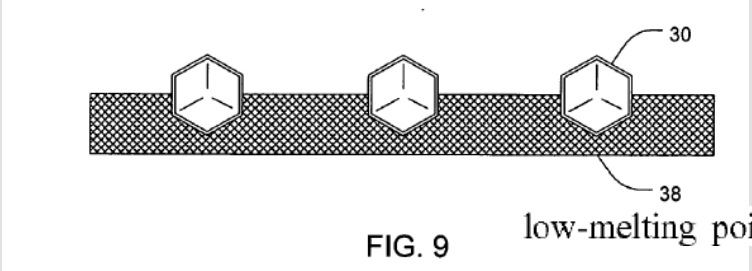
Reply at 11

Patent Owner Takes Contradictory Positions In IPR2024-00535 Regarding Alleged Non-Enablement

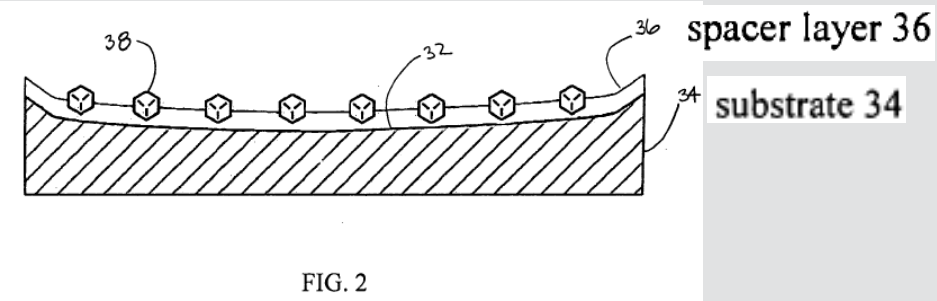
- Sung'479's reverse casting

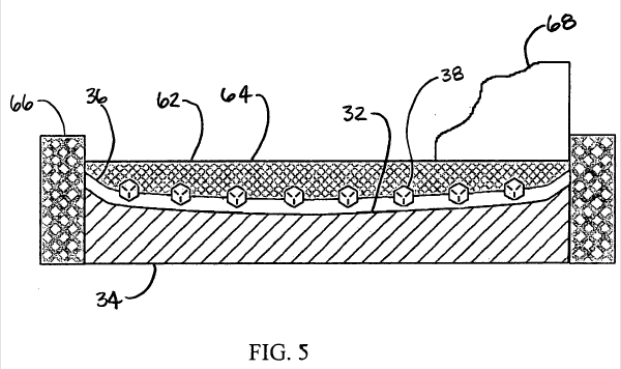


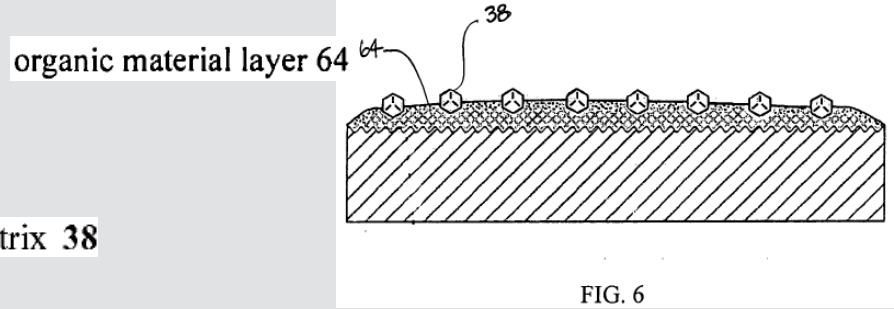




- '786 Application's reverse casting







Sur-Reply at 11; Ex. 1005, Figs. 7-9; Ex. 1053, Figs. 2, 5, 6

The Disputed Issues

1. Whether Chou and Sung'479 teach and enable the claimed **protrusion height differences**
2. Whether Chou and Sung'479 would have been combined
3. Whether collateral estoppel applies

The Petition Relied On Combination Of Chou And Sung'479

- Chou

[0017] In the method for fabricating a grinding tool according to the present invention, the binder can make the working surface of the grinding plate fit precisely and be retained on the adjustment surface of the mold by a heating process in the step (B). Accordingly, the curvature of the working surface of the grinding plate can accord with that of the adjustment surface of the mold. Herein, the grinding plate can fit precisely on the adjustment surface of the mold due to the flexibility of the grinding plate. Accordingly, the precision of the grinding plate can be controlled well and the height of the abrasive particles can be adjusted so as to ensure the performance of all abrasive particles in machining. Thereby, the machining efficiency of the working surface and precision can be significantly enhanced, so that the grinding tool according to the present invention is especially suitable for precision machining.

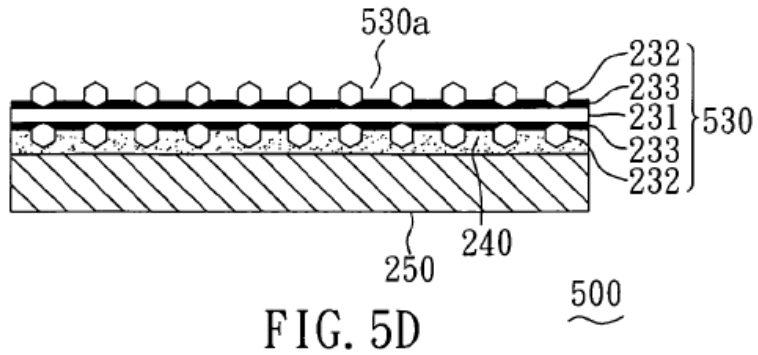


FIG. 5D

Pet. at 29-30; Ex. 1004, [0017]

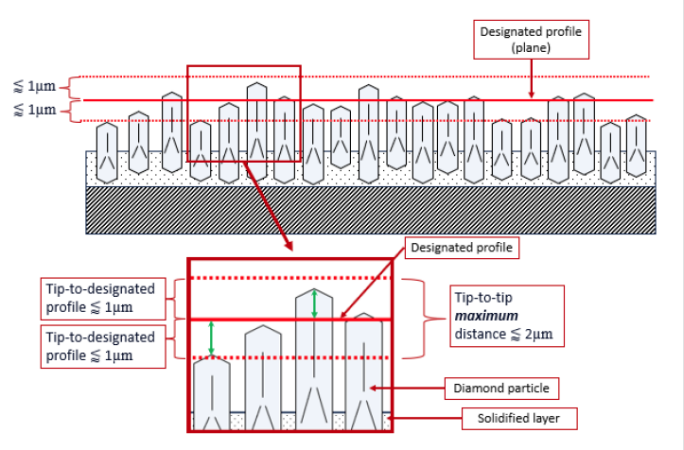
- Sung'479

[0072] As has been mentioned herein, while it is intended that the tips of the superabrasive particles align along the designated profile, some level of deviation may occur. These deviations may be a result of the design or manufacturing process of the tool. Given the wide variety of sizes of superabrasive particles that may potentially be utilized in a given tool, such deviations may be highly dependent on a particular application. Also, when referring to the designated profile, it should be noted that the term "tip" is intended to include the highest protruding point of a superabrasive particle, whether that point be an apex, an edge, or a face. As

5 microns. In yet another aspect, the plurality of superabrasive particles is arranged such that their tips vary from the designated profile by less than about 1 microns. In a further

Pet. at 30-34; Ex. 1005, [0069], [0072]

[0069] It 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. Numerous configurations for designated profiles are possible, depending on the particular use of the superabrasive tool. In one aspect, the designated profile may be a plane. In planar profiles, the highest protruding points of the superabrasive particles are intended to be substantially level. It is important to point out that, though it is preferred



- Petition also included 6-page analyses of "Reason To Combine Chou With Sung'479" specifically in Limitation [1B]

a. Reasons To Combine Chou With Sung'479

Pet. at 34-39

POSITA Would Have Recognized Benefits Of Having Leveled Heights

- Leveled tip heights, within the ranges taught in Sung'479, would have provided improvements

Regarding the reasons to combine Chou and Sung '479, Petitioner explains sufficiently, for the purposes of institution, that a "POSITA would have been motivated to combine references that recognize benefits of having leveled height of abrasive particles." Pet. 34–35 (citing Ex. 1004 ¶ 17; Ex. 1005 ¶¶ 3, 66–67, 72; Ex. 1002 ¶¶ 119–120). Patent Owner contends that Petitioner has not explained how Chou combined with Sung '479 would lead to the benefits of a leveled height of abrasive particles. Prelim. Resp. 35. Yet, Sung '479 expressly teaches specific parameters for the tip height level of superabrasive particles that provide improved machining, which Petitioner and Dr. Shanfield explain Chou does not expressly disclose. Ex. 1005 ¶¶ 66–67, 69, 72; *see* Ex. 1002 ¶¶ 119–120. Thus, the disclosures in Chou and Sung '479, and Dr. Shanfield's testimony support Petitioner's position that a "POSITA would have considered leveling the height of the superabrasive particles to the level taught by the prior art references, such as a tip-to-tip variation that is less than about 2 microns." Pet. 35.

DI at 21

Both Chou And Sung'479 Utilize Brazing

- Both Chou and Sung'479 utilize brazing, demonstrating reasonable expectation of success
  - Alleged differences in braze temperatures is irrelevant

Patent Owner further contends that Petitioner has not explained how the two different brazing methods in Chou and Sung '479 demonstrate that a POSITA would be able to combine their teachings with a reasonable expectation of success. Prelim. Resp. 37. Patent Owner assert "Petitioners give no indication how a POSITA would combine the 'designated profile' aspects of Sung '479 with Chou's two-sided grinding tool or why the results of the combination would be predictable." *Id.* But, Petitioner relies on the testimony of Dr. Shanfield, who testifies that

> Chou and Sung'479 use a similar brazing method for attaching abrasive particles to the metal substrate. Therefore, *a POSITA would have been able to combine the disclosures with a reasonable expectation of success*. EX1004, [0039] ("Herein, the grinding plate 330 comprises: a soft substrate 231 having a working surface 231a and a non-working surface 231b and a plurality of abrasive particles 232 formed on the working surface 231 a and the non-working surface 231 b of the soft substrate 231 by brazing."); EX1005, [0013] ("The superabrasive tool may include a plurality of superabrasive particles coated with an intermediate layer and bonded together with a braze...").

Ex. 1002 ¶ 124 (emphasis added). Based on the preliminary record, Dr. Shanfield's testimony appears to be supported by the cited disclosures in Chou and Sung '479. Nevertheless, the parties may further develop the record on this issue after institution.

DI at 21-22

The Disputed Issues

1. Whether Chou and Sung'479 teach and enable the claimed **protrusion height differences**
2. Whether Chou and Sung'479 would have been combined
3. Whether collateral estoppel applies

Collateral Estoppel Issue Is Moot

XII. Collateral Estoppel Should Apply For At Least [1Pre] And [1D]

Sung is collaterally estopped from re-litigating the issue of whether the Chou reference discloses at least [1Pre] and [1D] of the '270 Patent. "Under collateral

Petition at 57-59

More practically, however, POR concedes that Chou discloses [1Pre] and [1D], because PO only argues against [1B] of claim 1. *See* POR, 26-33.

Reply at 5

Who Qualifies As A POSITA?

IPR2024-00533; U.S. Patent No. 8,974,270
IPR2024-00534; U.S. Patent No. 9,138,862
IPR2024-00535; U.S. Patent No. 9,724,802

SAMSUNG

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Petitioner's Definition Of A POSITA Is Consistent

VIII. Level Of Ordinary Skill In The Art

A person having ordinary skill in the art (POSITA) would have had, as of the earliest claimed priority date of October 3, 2014, at least 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. A higher level of education or specific skill might make up for less experience, and vice versa. EX1002, ¶79.

IPR2024-00535, Pet. at 23

IX. Level Of Ordinary Skill In The Art

A person having ordinary skill in the art ("POSITA") would have had, as of the earliest claimed priority date of May 23, 2011, 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. A higher level of education or specific skill might make up for less experience, and vice versa. EX1002, ¶63.

IPR2024-00533, Pet. at 19

VIII. Level Of Ordinary Skill In The Art

A person having ordinary skill in the art ("POSITA") would have had, as of the earliest claimed priority date of May 23, 2011, a bachelor's degree in material science, mechanical engineering, electrical engineering, or physics, and a minimum of two to three years of experience in the field of integrated circuit processing and fabrication techniques. A higher level of education or specific skill might make up for less experience, and vice versa. EX1002, ¶¶60-62.

IPR2024-00534, Pet. at 22

Patent Owner's Definition Of A POSITA Is Inconsistent

III. PERSON OF ORDINARY SKILL IN THE ART

A POSITA for purposes of the '862 patent would have at least two years of experience in developing CMP technology including some specific experience with the design and development of CMP pad dressers. (Ex. 2011 at ¶ 21.) PO contends that Dr. Shanfield's lack of that specialized experience (*see* Ex. 1002, App'x A.) disqualifies him as a POSITA. At most, Dr. Shanfield states that he has generally worked with CMP systems at facilities where he worked (*id.* ¶¶ 3-5), but he does not profess any experience related to the design and development of pad dressers.

IPR2024-00534, POR at 3

E. Person of Ordinary Skill in the Art ("POSITA")

Patent Owner contends that a POSITA for purposes of the '802 patent would have at least two years of experience in developing CMP technology including experience with the design and development of CMP pad dressers. (Ex. 2011 at ¶¶ 21.) Patent Owner contends that Dr. Shanfield is not qualified as a POSITA because he lacks such experience. (*See* Ex. 1002 at Appendix A.) At best Dr. Shanfield states that he has worked with CMP systems (*id.* at ¶¶ 3-5), but he does not profess any experience related to the design and development of pad dressers.

IPR2024-00535, POR at 5

III. LEVEL OF ORDINARY SKILL IN THE ART

A POSITA for purposes of the '270 patent would have had at least a bachelor's degree in mechanical engineering or other related 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. (Ex. 2004 at ¶29.) Petitioner's definition is overly broad as it merely requires experience "in the field of integrated circuit processing and fabrication techniques," as opposed to any specific experience with the design and development of CMP pad dressers.

IPR2024-00533, POR at 3

PO's Expert Did Not Even Properly Articulate Requisite Education Level

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.

IPR2024-00533, Ex. 2004

Q: So is a bachelor in mechanical engineering sufficient or not sufficient to meet the level of a POSITA?

A: Well, personally, to my opinion, such a professional technology, I think it would take at least a master degree or Ph.D. degree. Then this person may have a better chance, but still no guarantee of that, but that would be my opinion.

IPR2024-00533, Reply at 2-3; Ex. 1052, 107:18-25
IPR2024-00534, Reply at 2; Ex. 1047, 107:18-25
IPR2024-00535, Reply at 2-3; Ex. 1052, 107:18-25

Dr. Tsai
PO's Expert

Q: And I'm just trying to make sure that the record is clear, so it's just a very simple question. Do you want to <u>change</u> this from "at least a <u>*bachelor's*</u> degree in mechanical engineering" to "at least a <u>*master's*</u> degree in materials science?

A: <u>*I'm not sure. I'm not sure. I'm not sure. I'm not sure.*</u>

IPR2024-00533, Reply at 3; Ex. 1052, 109:2-8
IPR2024-00534, Reply at 2-3; Ex. 1047, 109:2-8
IPR2024-00535, Reply at 3; Ex. 1052, 109:2-8

PO's Expert Did Not Even Properly Articulate Requisite Education Level

Accordingly, I believe a POSITA for purposes of the '802 patent would have at least two years of experience in developing CMP technology including experience with the design and development of CMP pad dressers.

IPR2024-00535, Ex. 2011, ¶16

specialized branch of semiconductor manufacturing. Accordingly, I believe a POSITA for purposes of the '862 patent would have at least two years of experience in developing CMP technology, including experience with the design and development of CMP pad dressers.

IPR2024-00534, Ex. 2011, ¶29

Dr. Tsai
PO's Expert

Q: Do you want to add any statement about 'a POSITA would have had at least a master's in the field of material science' to this sentence here?

A: (In English) *I'm not sure. I'm not sure.*

IPR2024-00533, Reply at 3; Ex. 1052, 109:2-8
IPR2024-00534, Reply at 2-3; Ex. 1047, 109:2-8
IPR2024-00535, Reply at 3; Ex. 1052, 109:2-8

PO Provides No Objective Rationale Regarding Alleged Requisite Skill

‘802 Patent’s POR

E. Person of Ordinary Skill in the Art (“POSITA”)

Patent Owner contends that a POSITA for purposes of the ’802 patent would have at least two years of experience in developing CMP technology including experience with the design and development of CMP pad dressers. (Ex. 2011 at ¶¶ 21.) Patent Owner contends that Dr. Shanfield is not qualified as a POSITA because he lacks such experience. (*See* Ex. 1002 at Appendix A.) At best Dr. Shanfield states that he has worked with CMP systems (*id.* at ¶¶ 3-5), but he does not profess any experience related to the design and development of pad dressers.

IPR2024-00535, POR at 5

Dr. Tsai’s Declaration

21. I believe that Samsung misunderstands Tsai and specifically, what is meant by the terms “leveling” and “leveled” in my article.

16. In addition, I note that Dr. Shanfield’s definition of a POSITA lacks any specific reference to CMP technology, which is a specialized branch of semiconductor manufacturing. Some understanding of the context in which the microscopic structures on a CMP pad conditioner are manufactured and the factors that affect diamond tip height and distribution and pad conditioning is necessary to evaluate the teachings of the ’802 patent and the references asserted by Samsung. Accordingly, I believe a POSITA for purposes of the ’802 patent would have at least two years of experience in developing CMP technology including experience with the design and development of CMP pad dressers.

IPR2024-00535, Ex. 2011, ¶¶21, 16

For corresponding cites to IPR2024-00333 and -00334, please see slidess 144-147

Objective Evidence Demonstrates "Integrated Circuit Experience" Is Correct

Dr. Tsai further contends that "***experience in the field of integrated circuit processing and fabrication techniques***," (Pet., 23), should be replaced by "***experience in developing CMP technology including experience with the design and development of CMP pad dressers***." EX2011, ¶16. But Dr. Tsai articulates no objective rationale why the requisite experience must be so limited. *See* EX2011, ¶¶13-17. In fact, the references overcome during prosecution explain how CMP technology is relevant in the field of integrated circuit processing and fabrication, supporting Petitioner's broader definition of POSITA. *See* EX1003, 126-131, 205. US 2010/002485995 ("Dinh-Ngoc") explains that "***[i]n the fabrication of electronic devices,*** …. [c]hemical mechanical planarization (CMP) is a common technique used to planarize or polish workpieces such as semiconductor wafers." EX1010, [0005]. US 2004/0048557 ("Nabeya") explains that "***[i]n the process of manufacturing a semiconductor silicon wafer substrate or a minute electronic circuit, such as an integrated circuit,*** on a silicon wafer substrate, CMP is generally performed in order to remove asperities and crystal defects present on the surface of the substrate." EX1056, [0002].

BACKGROUND

[0002] 1. Field of the Disclosure

[0003] The following application is directed to an abrasive tool, and more particularly to an abrasive tool for use as a chemical mechanical planarization pad conditioner.

[0004] 2. Description of the Related Art

[0005] In the fabrication of electronic devices, multiple layers of various types of material are deposited including for example conducting, semiconducting, and dielectric materials. Successive deposition or growth and removal of various layers results in a non-planar upper surface. A wafer surface that is not sufficiently planar will result in structures that are poorly defined, with the circuits being nonfunctional or exhibiting less than optimum performance. Chemical mechanical planarization (CMP) is a common technique used to planarize or polish workpieces such as semiconductor wafers.

[0002] In the process of manufacturing a semiconductor silicon wafer substrate or a minute electronic circuit, such as an integrated circuit, on a silicon wafer substrate, CMP is generally performed in order to remove asperities and crystal defects present on the surface of the substrate. In the CMP, a wafer substrate is polished with an abrasive cloth formed of, for example, expanded polyurethane fixed on a surface plate of a polishing machine while an abrasive liquid called slurry is supplied to the abrasive cloth and both the wafer and the abrasive cloth are rotated, with the wafer substrate pressed against the abrasive cloth at a predetermined load.

For corresponding cites to IPR2024-00333 and -00334, please see slidess 144-147

IPR2024-00535, Reply at 3-4

Dr. Shanfield Qualifies Even Under PO's Proposed POSITA

Patent Owner's Alleged POSITA

Accordingly, I believe a POSITA for purposes of the '802 patent would have at least two years of experience in developing CMP technology including experience with the design and development of CMP pad dressers.

IPR2024-00535, Ex. 2011, ¶16

Dr. Shanfield
Petitioner's Expert

Q: … [A]re you an expert in CMP equipment design…?

A: I am very familiar with the design of CMP equipment…

Q: Would you call yourself an expert in CMP pad dressers themselves?

A: … I have familiarity with CMP dressers from multiple experiences of either watching the operation or actually performing the operation of CMP.

Q: Have you ever been involved in the manufacture of CMP pad dressers?

A: Yes.

IPR2024-00533 Opp. To MTEE at 5; Ex. 2003, 18:5-12, 19:8-12, 19:16-20:9
IPR2024-00535 Opp. To MTEE at 5; Ex. 2004, 18:5-12, 19:8-12, 19:16-20:9

QUESTIONS?

‘802 PATENT BACKUP SLIDES

Dr. Sung's Prior Litigation Against Kinik Regarding The '802 Patent

Judge Andrews' Findings

time of the joint venture. The present patent may have new material, but Plaintiff did not represent in the briefing that he does not claim priority back to the time of the joint venture.[4] Subsequent to the briefing, however, Plaintiff has clearly stated that he only claims priority to October 3, 2014. (D.I. 25; *see also* D.I. 1-1 at 2 of 23).

[4] I thought the briefing was ambiguous on this point. Plaintiff's brief says that the "subject matter added by the '802 patent is neither disclosed nor claimed in any family member." (D.I. 17 at 3; *see also* D.I. 18 at 5). I sought clarification. (D.I. 24). Plaintiff claims a priority date of October 3, 2014; no earlier. (D.I. 25). I do not think this necessarily means that there will be no dispute over the priority date, only that there is a possibility of the infrequent posture that the alleged infringer will be the one arguing for the earlier priority date.

Pet. at 19; Reply at 14, Ex. 1011, ¶15, Ex. 1012, 2

3a. ’817 Application Fails to Provide Support For [1E] & [1F]

“The difference between ‘***claim-supporting disclosures***’ and ‘***claim-anticipating disclosures***’ was dispositive … ‘the description of a single embodiment of broadly claimed subject matter constitutes a description of the invention for anticipation purposes…, whereas the same information in a specification might not alone be enough to provide a description of that invention for purposes of adequate disclosure.”

Vas-Cath Inc. v. Mahurkar, 935 F.2d 1555, 1562 (Fed. Cir. 1991)

Pet. at 22

‘862 PATENT BACKUP SLIDES

Sung'026 Can Enable The Claims But Still Fail To Provide Written Description Support

"[I]t is possible for a specification to *enable* the practice of the invention as broadly as it is claimed, and still not *describe* that invention" for the purposes of §112 support

Vas-Cath Inc. v. Mahurkar, 935 F.2d 1555, 1561 (Fed. Cir. 1991)

Reply at 17

Sung'026 Is Presumptively Enabling

"[B]oth claimed and unclaimed materials disclosed in a patent are presumptively enabling."

In re Antor Media Corp., 689 F.3d 1282, 1288 (Fed. Cir. 2012)

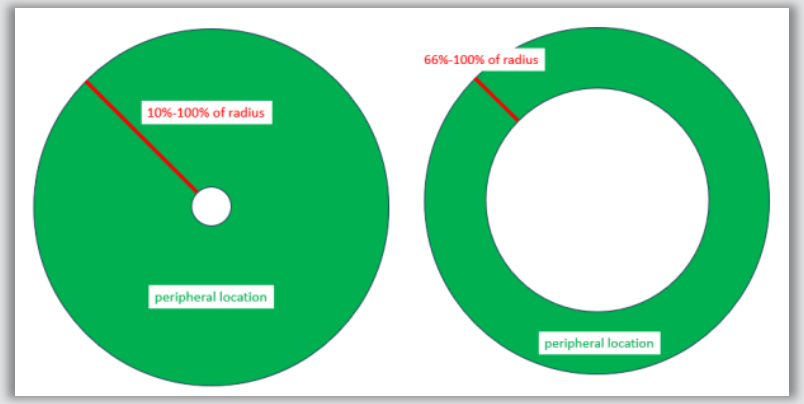
"[T]he scope of enablement, in turn, is that which is disclosed in the specification plus the scope of what would be known to one of ordinary skill in the art without undue experimentation."

Nat'l Recovery Techs., Inc. V. Magnetic Separation Sys., 166 F.3d 1190, 1196 (Fed. Cir. 1999)

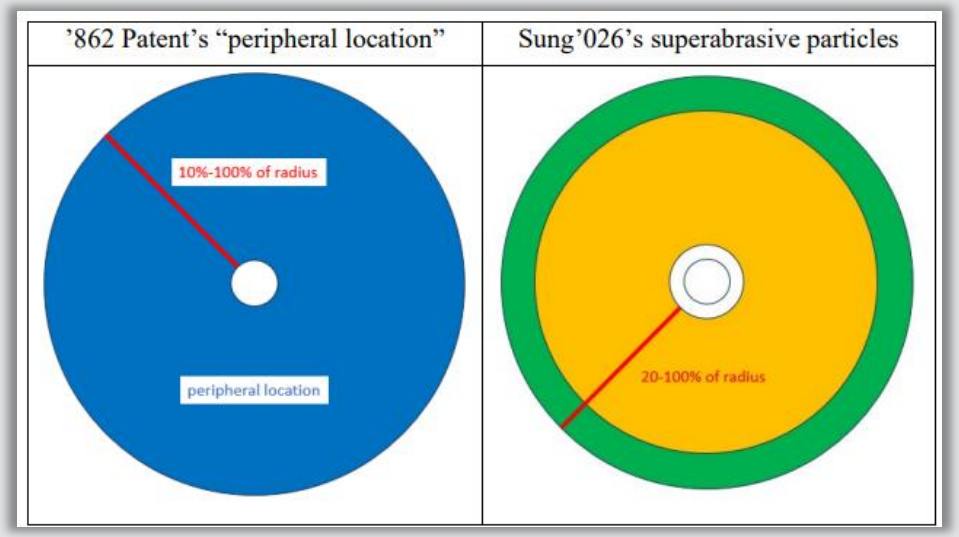
Reply at 17-18

Sung'026 Teaches Peripherally Located Particles

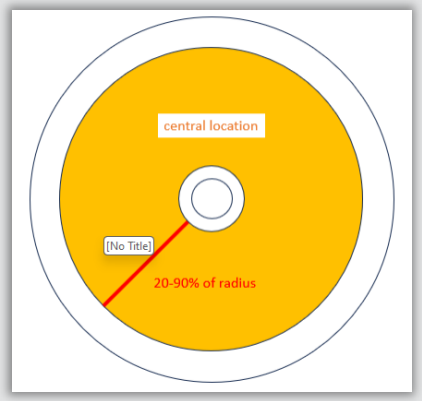
- Sung'026 teaches peripheral location of the disk is the annulus that extends outwardly from at least about 10% to 100% or from about 66% to 100% of the radius.



Pet. at 43; Ex. 1002, ¶125; Ex. 1004, [0037]



- Sung'026 teaches "central location" can mean an "area [that] may extend outwardly from about 20% to about 90% of the radius."



Pet. at 43; Ex. 1002, ¶125; Ex. 1004, [0036]

128. Putting this together, and because "central location" is generally thought of as an area that is inside a "peripheral location," Sung'026 provides an embodiment where the superabrasive particles are located in the area that extends outwardly from 20% to 100% of the radius of the CMP pad dresser. In other words, Sung'026 teaches regions colored in orange and green that have superabrasive particles and are encompassed by the claimed "peripheral location," which, as I explained above in Paragraph 123, ranges from about 10% to 100% of the radius.

Pet. at 44-45; Ex. 1002, ¶128-129

No Opinion on Grounds III-VI

Dr. Tsai
PO's Expert

Q. And do you see that grounds 2 to 6 rely on one additional prior art reference in combination with Sung'026?

A: Yes.

…

Q. Okay. So you provided no opinion regarding any of the references directed to SungICPT, Nishioka, Lin, Kim or Koyama, correct?

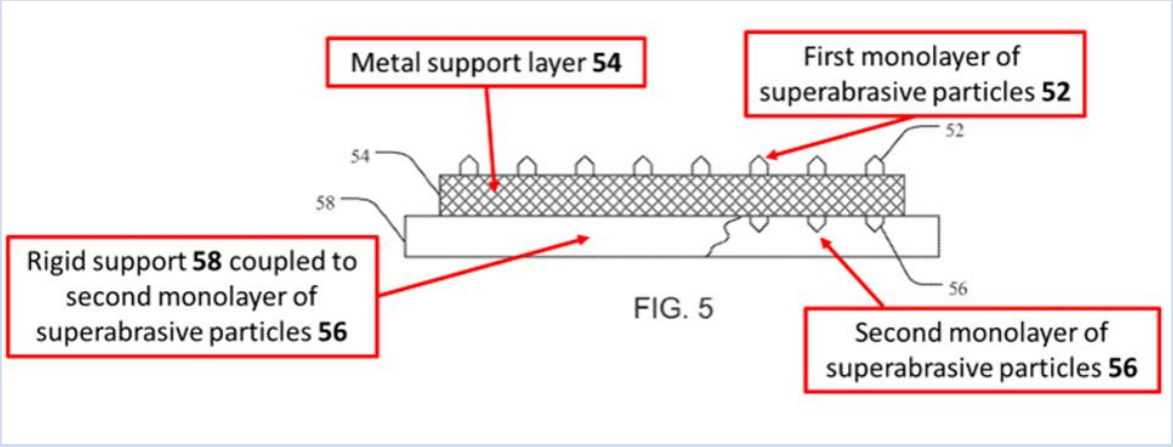
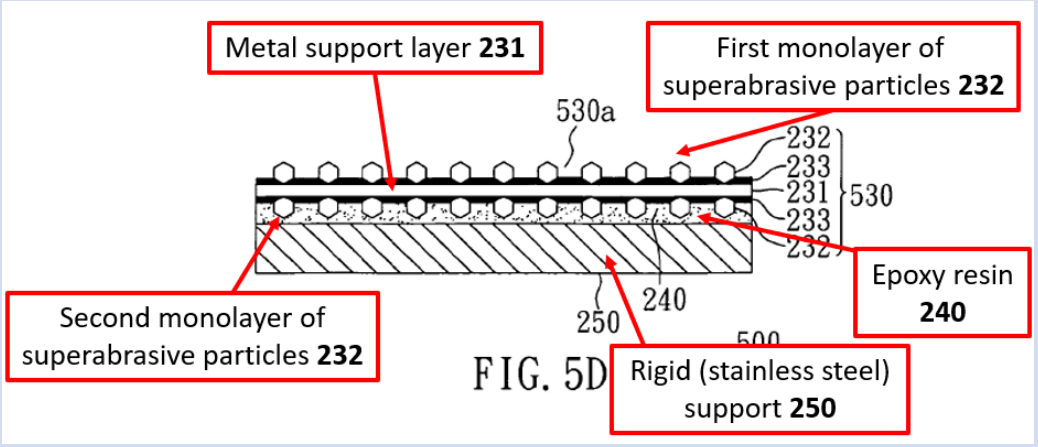
A. Correct.

Reply at 23; Ex. 1049, 67:7-24

‘270 PATENT BACKUP SLIDES

Overview of Chou

- Describes an abrasive tool with superabrasive particles
  - On both sides of a metal support layer to minimize warping

’270 Patent	Chou
	**[0024]** Accordingly, by the method for fabricating a grinding tool according to the present invention, the height of the abrasive particles can be precisely controlled, and thereby each of the abrasive particles can efficiently perform machining so as to enhance the machining efficiency and precision of the grinding tool. Meanwhile, the method according to the 
Pet. at 13; Ex. 1001, Fig. 5	Pet. at 15-17; Ex. 1004, Fig. 5D

The Petition Relied On Combination Of Chou And Sung'479

- PO argues Petition relied solely on Sung'479 for limitation [1B]

Claim 1 of the '270 Patent
A CMP pad dresser, comprising:
a first monolayer of superabrasive particles disposed on and ***protruding from*** one side of a metal support 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 50 microns;
a second monolayer of superabrasive particles disposed on the metal support

1. Sung'479 Is Not Enabling to Teach the Claim Language

Petitioners avoid discussing enablement by alleging that the Petition "relied on the combination of Chou and Sung'479" instead of exclusively on Sung'479 to disclose claim element [1B]. (Reply, 5.) However, the Petition speaks for itself: "Chou, however, ***does not explicitly teach*** that the difference in protrusion distance between the two highest protruding tips is less than or equal to about 50 microns." (Pet., 28-29 (emphasis added)). Sung'479 stands alone for claim element [1B] and is not enabling as required under *Raytheon Techs. Corp. v. GE*, 993 F.3d 1374 (Fed. Cir. 2021). (POR, Section VII.A.2 at 20-26.)

Pet. at 13; Sur-Reply at 7

Obviousness vs. Enabling Disclosure Of Individual References

"[T]o argue, as does [the patentee], that the sufficiency of each prior art teaching must be tested under the strict standard requiring an enabling disclosure is to shift the emphasis from obviousness in light of the prior art, taken as a whole, to the sufficiency of each prior art teaching separately considered."

Raytheon Techs. Corp. v. GE, 993 F.3d 1374, 1381 (Fed. Cir. 2021)

Reply at 6

DR. TSAI'S CREDIBILITY

Dr. Tsai is Biased Towards Dr. Sung

Key Engineering Materials Vol 329 (2007) pp 151-156 — *Online: 2007-01-15*
© (2007) Trans Tech Publications, Switzerland
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Single Diamond Dressing Characteristics of CMP Polyurethane Pad

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IPR2024-00534, Reply at 24; Ex. 1050

Advanced Materials Research Vols 76-78 (2009) pp 201-206 — *Online 2009-06-24*
© (2009) Trans Tech Publications, Switzerland
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Dressing Behaviors of PCD Conditioners on CMP Polishing Pads

M. Y. Tsai[1a], J. C. Sung[2b]

IPR2024-00534, Reply at 24; Ex. 1052

ECS Transactions, 27 (1) 575-580 (2010)
10.1149/1.3360677 ©The Electrochemical Society

Mosaic Diamond Pad Conditioners for Improved CMP Performance

James C. Sung[a,b,c,d,e], Ming-Yi Tsai[f], Yang-Liang Pai[a], Cheng-Shiang Chou[a] Chih-Chung Chou[a], Zongqing Yang[g], Ying-Tung Chen[h], and Michael Sung[d,e]

IPR2024-00534, Reply at 24; Ex. 1053

Advanced Materials Research Vols 126-128 (2010) pp 1013-1018 — *Online: 2010-08-11*
© (2010) Trans Tech Publications, Switzerland
doi:10.4028/www.scientific.net/AMR.126-128.1013

The CMP by Polishing with GiP Dressed by BODD

James C. Sung[1,2,3,a], Ming-Yi Tsai[4,b], Cheng-Shiang Chou[1,c], Pei-Lum Tso[5,d] and Ying-Tung Chen[6,e]

IPR2024-00534, Reply at 24; Ex. 1055

Int. J. Abrasive Technology, Vol. 1, Nos. 3/4, 2008 — 327

PCD pad conditioners for low pressure chemical mechanical planarisation of semiconductors

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IPR2024-00534, Reply at 24; Ex. 1051

ECS Transactions, 27 (1) 581-586 (2010)
10.1149/1.3360678 ©The Electrochemical Society

The Black Pad with Graphite Impregnation for CMP

James C. Sung[a,b,c,d,e], Ming-Yi Tsai[f], and Michael Sung[d,e]

IPR2024-00534, Reply at 24; Ex. 1054

104 — *M. Y. Tsai and Y. S. Liao*

point-cutting removes less amount of the pad. It also results in a higher but less variation of polishing rate during the CMP process.

ACKNOWLEDGMENT

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Reply at 24; Ex. 2002

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International Journal of Machine Tools & Manufacture

journal homepage: www.elsevier.com/locate/ijmactool

Novel diamond conditioner dressing characteristics of CMP polishing pad

Ming-Yi Tsai[a,*], Shun-Tong Chen[b], Yunn-Shiuan Liao[c], James Sung[d]

IPR2024-00534, Reply at 24; Ex. 2003

Diamond & Related Materials 23 (2012) 144–149

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journal homepage: www.elsevier.com/locate/diamond

Organic diamond disk versus brazed diamond disk for dressing a chemical–mechanical polishing pad☆

M.Y. Tsai[a,*], P.H. Li[a], J.C. Sung[b]

IPR2024-00534, Reply at 24; Ex. 1056

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Vol. 38, No. 3, 322 331, http://dx.doi.org/10.1080/02533839.2014.970387

Taylor & Francis

Development of a novel cooling system-assisted minimum quantity lubrication method for improvement of milling performance

Jihng Kuo Ho[a], Che Hsiung Tsai[a], Ming Yi Tsai[b*], Ming Xim Tu[b] and James C. Sung[a]

IPR2024-00534, Reply at 24; Ex. 1057

IPR2024-00535, Reply at 28; Ex. 1004, 1061-1067, 2010
IPR2024-00533, Reply at 16; Ex. 1042-1049, 2006-2007

Dr. Tsai is Biased Towards Dr. Sung

Q. And without Kinik's funding and tools, you could not have published many of your papers, correct?

A. Well, then, it would be pretty difficult for me to do so.

Dr. Tsai
PO's Expert

Q. And you testified – and this is your own words – 'In academic field, you need to publish papers in order to be promoted.' Correct?

A. That's correct, generally we need to publish papers in order to be promoted.

Q. So these papers did in fact help you get promoted?

A. Some papers offered the help, but some not.

Q. So by thanking Dr. Sung, you were hoping that Kinik will provide more future financial support?

A. That's a typical Chinese way to do so in the hope that the company can give us further support in the future.

IPR2024-00534, Reply at 24-25; Ex. 1048, 184:13-185:25, 226:21-25, 227:9-17; Ex. 1047, 60:13-23
IPR2024-00533, Reply at 16-17; Ex. 1051, 184:13-185:25, 226:21-25, 227:9-17; Ex. 1050, 60:13-23
IPR2024-00535, Reply at 28-29; Ex. 1053, 184:13-185:25, 226:21-25, 227:9-17; Ex. 1052, 60:13-23

Dr. Tsai Lacks Credibility

Q. So you don't understand the legal understanding sections in your declarations, correct?

A. For those, indeed, I don't have much understanding.

Dr. Tsai
PO's Expert

Q. I'm going to hand you a copy of the petition that was filed in this proceeding. Have you seen this petition before?

A. No.

Q. You have never seen the petition prior to submitting your declaration in this proceeding, Dr. Tsai?

A. (In English) No.

Q. Did you *specifically* review columns 20 to 21 of the '862 patent [that contains the claims] before rendering your opinion?

A. I *generally* reviewed them.

IPR2024-00534, Reply at 23-24; Ex. 1047, 18:14-18, 84:21-23; Ex. 1049, 66:1-8
IPR2024-00533, Reply at 15-16; Ex. 1050, 18:14-18, 20:7-1684:21-23
IPR2024-00535, Reply at 27-28; Ex. 1055, 97:14-99:5, 126:1-4, 124:22-25; Ex. 1054, 38:19-23, 69:23-70:4

POSITA

PO Provides No Objective Rationale Regarding Alleged Requisite Skill

POR

III. PERSON OF ORDINARY SKILL IN THE ART

A POSITA for purposes of the '862 patent would have at least two years of experience in developing CMP technology including some specific experience with the design and development of CMP pad dressers. (Ex. 2011 at ¶ 21.) PO contends that Dr. Shanfield's lack of that specialized experience (*see* Ex. 1002, App'x A.) disqualifies him as a POSITA. At most, Dr. Shanfield states that he has generally worked with CMP systems at facilities where he worked (*id.* ¶¶ 3-5), but he does not profess any experience related to the design and development of pad dressers.

IPR2024-00534, POR at 3

Dr. Tsai's Declaration

21. 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.

28. 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.

29. It is my opinion that Dr. Shanfield's definition of a POSITA is deficient because lacks any specific reference to CMP technology, which is a specialized branch of semiconductor manufacturing. Accordingly, I believe a POSITA for purposes of the '862 patent would have at least two years of experience in developing CMP technology, including experience with the design and development of CMP pad dressers.

IPR2024-00534, Ex. 2011, ¶¶21, 28, 29

PO Provides No Objective Rationale Regarding Alleged Requisite Skill

POR

III. LEVEL OF ORDINARY SKILL IN THE ART

A POSITA for purposes of the '270 patent would have had at least a bachelor's degree in mechanical engineering or other related 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. (Ex. 2004 at ¶29.) Petitioner's definition is overly broad as it merely requires experience "in the field of integrated circuit processing and fabrication techniques," as opposed to any specific experience with the design and development of CMP pad dressers. (Ex. 2004 at ¶28.) The '270 Patent states upfront that "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. (Ex. 2004 at ¶28.)

IPR2024-00533, POR at 3

Dr. Tsai's Declaration

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.

IPR2024-00533, Ex. 2004, ¶¶27-29

Objective Evidence Demonstrates "Integrated Circuit Experience" Is Correct

Dr. Tsai further contends that "***experience in the field of integrated circuit processing and fabrication techniques***," (Pet., 23), should be replaced by "***experience in developing CMP technology including experience with the design and development of CMP pad dressers***." EX2011, ¶29. But Dr. Tsai articulates no objective rationale why the requisite experience must be so limited. EX2011, ¶¶26-30. In fact, the references overcome during prosecution explain how CMP technology is relevant in the field of integrated circuit processing and fabrication, supporting Petitioner's broader definition of POSITA. *See* EX1003, 892. US2010/0248595 ("Dinh-Ngoc") explains that "***[i]n the fabrication of electronic devices***, …. [c]hemical mechanical planarization (CMP) is a common technique used to planarize or polish workpieces such as semiconductor wafers." EX1058, [0005]. US2008/0292869 ("Sung'869") explains that "the ***computer manufacturing industry*** relies heavily on CMP processes for polishing wafers of ceramics, silicon, glass, quarts and metals." EX1012, [0002]. Accordingly, Petitioner's proposed definition of a POSITA should be adopted.

Reply at 3

BACKGROUND

[0002] 1. Field of the Disclosure

[0003] The following application is directed to an abrasive tool, and more particularly to an abrasive tool for use as a chemical mechanical planarization pad conditioner.

[0004] 2. Description of the Related Art

[0005] In the fabrication of electronic devices, multiple layers of various types of material are deposited including for example conducting, semiconducting, and dielectric materials. Successive deposition or growth and removal of various layers results in a non-planar upper surface. A wafer surface that is not sufficiently planar will result in structures that are poorly defined, with the circuits being nonfunctional or exhibiting less than optimum performance. Chemical mechanical planarization (CMP) is a common technique used to planarize or polish workpieces such as semiconductor wafers.

BACKGROUND OF THE INVENTION

[0002] Many industries utilize a chemical mechanical polishing (CMP) process for polishing certain work pieces. Particularly, the computer manufacturing industry relies heavily on CMP processes for polishing wafers of ceramics, silicon, glass, quartz, and metals. Such polishing processes generally entail applying the wafer against a rotating pad made from a durable organic substance such as polyurethane. A chemical slurry is utilized that contains a chemical capable of breaking down the wafer substance and an amount of abrasive particles which act to physically erode the wafer surface. The slurry is continually added to the rotating CMP pad, and the dual chemical and mechanical forces exerted on the wafer cause it to be polished in a desired manner.

Objective Evidence Demonstrates "Integrated Circuit Experience" Is Correct

Second, Dr. Tsai contends that "***experience in the field of integrated circuit processing and fabrication techniques***," (Pet., 19), should be replaced by "***experience in developing CMP technology, including some specific experience with the design and development of CMP pad dressers***." EX2004, ¶29. But Dr. Tsai articulates no objective rationale why the requisite experience must be so limited. In fact, the '270 Patent itself begins by noting that "[t]he 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." EX1001, 1:12-14. As another example, the references overcome during prosecution explain how CMP technology is relevant in the field of integrated circuit processing and fabrication. *See* EX1003, 207-213. US 2010/002485995 ("Dinh-Ngoc") explains that "***[i]n the fabrication of electronic devices***, …. [c]hemical mechanical planarization (CMP) is a common technique used to planarize or polish workpieces such as semiconductor wafers." EX1052, [0005].

IPR2024-00533, Reply at 3-4

BACKGROUND OF THE INVENTION

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. Known techniques to manufacture smooth and even-surfaced silicon wafers are plentiful. 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. 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.

BACKGROUND

[0002] 1. Field of the Disclosure

[0003] The following application is directed to an abrasive tool, and more particularly to an abrasive tool for use as a chemical mechanical planarization pad conditioner.

[0004] 2. Description of the Related Art

[0005] In the fabrication of electronic devices, multiple layers of various types of material are deposited including for example conducting, semiconducting, and dielectric materials. Successive deposition or growth and removal of various layers results in a non-planar upper surface. A wafer surface that is not sufficiently planar will result in structures that are poorly defined, with the circuits being nonfunctional or exhibiting less than optimum performance. Chemical mechanical planarization (CMP) is a common technique used to planarize or polish workpieces such as semiconductor wafers.