

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

Petitioner

v.

CHIEN-MIN SUNG
Patent Owner

Case IPR2024-00535

U.S. Patent No. 9,724,802
TITLE: CMP PAD DRESSERS HAVING LEVELED TIPS AND ASSOCIATED
METHODS
Issue Date: Aug. 8, 2017

PETITION FOR *INTER PARTES* REVIEW OF
U.S. PATENT NO. 9,724,802
CHALLENGING CLAIMS 1-21
UNDER 35 U.S.C. § 312 AND 37 C.F.R. § 42.104

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PETITIONER’S EXHIBIT LIST

Petitioner Exhibit No.	DESCRIPTION
1001	U.S. Patent No. 9,724,802 (“’802 Patent”)
1002	Declaration of Dr. Stanley Shanfield
1003	File History of the ’802 Patent
1004	Tsai et al., “Organic diamond disk versus brazed diamond disk for dressing a chemical-mechanical polishing pad,” <i>Diamond & Related Materials</i> , 23, 2012, 144-149 (“Tsai”)
1005	U.S. Patent Application Publication No. 2007/0060026 (“Sung’026”)
1006	“The Organic Diamond Disk (ODD) for Dressing of Polishing Pads of Chemical Mechanical Planarization”, International Conference on Planarization / CMP Technology, 25-27 October 2007 (“SungICPT”)
1007	Fenna, Donald. “Hardness Numbers,” <i>A Dictionary of Weights, Measures, and Units</i> , 1st ed., Oxford University Press, 2004.
1008	Tsai et al., “Effect of CMP conditioner diamond shape on pad topography and oxide wafer performances,” <i>Int. J. Adv. Manuf. Technology</i> , 55: 253-262 (2011)
1009	U.S. Patent Application Publication No. 2008/0292869 (“Sung’869”)
1010	U.S. Patent Application Publication No. 2010/0248595
1011	Declaration of Dr. [Chien-Min] James Sung In Support of Plaintiff’s Answering Brief In Opposition To Defendant’s Motion To Stay in <i>Chien-Min Sung v. Kinik Co.</i> , 1:20-cv-00247-RGA
1012	Order Denying Stay in <i>Chien-Min Sung v. Kinik Co.</i> , 1:20-cv-00247-RGA
1013	Ishizuka et al. “PCD Dressers for Chemical Mechanical Planarization with Uniform Polishing”, Proceedings of International Conference on Leading Edge Manufacturing in 21 st Century: LEM21, 2007, Volume 2007.4
1014	U.S. Patent No. 5,036,015
1015	Pysher et al. “Design, Characteristics and Performance of Diamond Pad Conditioners”, Materials Research Society Symposium Procedures, Vol. 1249, 2010 (“Pysher”)

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Petitioner Exhibit No.	DESCRIPTION
1016	<i>Design, Characteristics and Performance of Diamond Pad Conditioners</i> . SpringerLink. https://link.springer.com/article/10.1557/PROC-1249-E02-04
1017	Exhibit 4 of Complaint in <i>Sung v. Samsung Electronics Co., Ltd. et al</i> , 4-23-cv-00752
1018	U.S. Patent No. 9,138,862 (“’862 Patent”)
1019	Scheduling Order in <i>Sung v. Samsung Electronics Co., Ltd. et al</i> , 4-23-cv-00752
1020	Electronic Copy of Tsai obtained from publisher (Elsevier)
1021	Electronic Copy of Tsai2011 obtained from publisher (Springer)
1022	Webpage of Diamond and related materials vol. 23, archived on May 9, 2012, by Internet Archive, available at https://web.archive.org/web/20120509185427/http://www.sciencedirect.com/science/journal/09259635/23 , accessed and obtained on February 11, 2024
1023	List of citations to Tsai, obtained from Google Scholar
1024	Library copy of Tsai2011 obtained from Linda Hall Library
1025	Bibliographic and MARC records for <i>International Journal of Advanced Manufacturing Technology</i> that contains Tsai2011, available at https://catalog.lindahall.org/permalink/01LINDAHALL_INST/19lda7s/alma992717493405961 from the online catalog of the Linda Hall Library, accessed and obtained on February 11, 2024
1026	List of citations to Tsai2011, obtained from Google Scholar
1027	Webpage of Linda Hall Library online catalog archived on January 7, 2011, by Internet Archive, available at https://web.archive.org/web/20110107125151/http://leonardo.lindahall.org/ipac20/ipac.jsp?profile=lhlopen , accessed and obtained on February 18, 2024
1028	Declaration of Dr. Ingrid Hsieh-Yee
1029	U.S. Patent Application Publication No. 2012/0302146 (“Sung’146”)
1030	EDTX Caseload Profile (December 31, 2023)

I. Introduction

Samsung Electronics Co., Ltd., Samsung Electronics America, Inc., Samsung Semiconductor, Inc., and Samsung Austin Semiconductor, LLC, collectively the “Petitioner,” respectfully requests *inter partes* review of claims 1-21 of U.S. Patent No. 9,724,802 (the “’802 Patent”) (EX1001).

II. Mandatory Notices

A. Real Parties-in-Interest

Petitioner identifies itself as a real party-in-interest (“RPI”).

B. Related Matters

Petitioner is concurrently filing petitions for *inter partes* review of U.S. Patent Nos. 8,974,270 and 9,138,862. The ’802 Patent is currently asserted against Petitioner by Patent Owner in *Sung v. Samsung Electronics Co. Ltd. et al*, No. 4:23-cv-52 (EDTX).

C. Counsel

Petitioner is filing a Power of Attorney appointing the practitioners associated with Customer Number 132,593. Petitioner designates the following lead and back-up counsels:

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III. Fees

Petitioner is concurrently electronically submitting the required fees for this Petition. The Board is authorized to charge Desmarais LLP's deposit account, No. 50-6822, for any fee deficiency.

IV. Certification Of Grounds For Standing

Petitioner certifies that the '802 Patent is available for *inter partes* review and that Petitioner and its RPIs are not estopped or barred from requesting this *inter partes* review.

V. Identification Of Challenge And Relief Requested

Petitioner requests *inter partes* review and cancellation of claims 1-21 of the '802 Patent.

A. Identification Of Prior Art

The following references are pertinent to the grounds of unpatentability explained below and are prior art under AIA 35 U.S.C. §102(a)(1)¹:

1. Tsai et al., “Organic diamond disk versus brazed diamond disk for dressing a chemical-mechanical polishing pad”, *Diamond & Related Materials*, 23, 2012, 144-149 (“Tsai”) (EX1004), published on January 10, 2012.

2. U.S. Patent Application Publication No. 2007/0060026 (“Sung’026”) (EX1005), published on March 15, 2007.

¹ As more fully explained in Section VII.C [Priority Date], the earliest possible effective filing date of the '802 Patent is October 3, 2014. Accordingly, this Petition applies the AIA provisions of 35 U.S.C. §§ 102 and 103.

3. U.S. Patent Application Publication No. 2012/0302146 (“Sung’146”) (EX1029), published on November 29, 2012.

1. Public Accessibility of Tsai

Tsai was publicly available at least since January 10, 2012, which is more than one year before the earliest possible priority date of the ’802 Patent (*i.e.*, October 3, 2014). *See* EX1028, ¶¶42-52.

For instance, the publisher (Elsevier) made the article available online on January 10, 2012, as listed on the front page of Tsai. *See* EX1004, p. 1; EX1028, ¶¶35-41. Indeed, “the indicia on the face of a reference, such as printed dates and stamps, are considered as part of the totality of the evidence.” *Hulu, LLC, v. Sound View Innovations, Inc.*, IPR2018-01039, Paper 29, at 17-18 (precedential).

Additionally, the journal volume containing Tsai was archived by Internet Archive on May 9, 2012. EX1028, ¶¶43-47. Prior art obtained via the Wayback Machine® sets forth a *prima facie* case that the art was publicly accessible at the date and time provided in the time stamp. *See Valve Corp. v. Ironburg Inventions Ltd.*, 8 F.4th 1364, 1374-75 (Fed. Cir. 2021) (finding that reliance on Wayback Machine “is highly persuasive evidence of public accessibility ... by that date”); *see also* MPEP §2128.II.E (instructing the examiners that “[p]rior art obtained via the Wayback Machine sets forth a *prima facie* case that the art was publicly accessible at the date and time provided in the time stamp”).

Moreover, Tsai was cited by other articles at least twice before October 3, 2014, further demonstrating the public accessibility and actual usage of Tsai before October 3, 2014. *See Blue Calypso, LLC v. Groupon, Inc.*, 815 F.3d 1331, 1348 (Fed. Cir. 2016) (“a published article with an express citation to the potentially invalidating reference would similarly provide the necessary guidance.”); *see also Unified Patents, LLC v. Mirror Imaging, LLC*, IPR2022-00184, Paper 9, at 6 (finding the fact that a prior art reference “has been cited by multiple articles in trade journals” as one of the factors that demonstrate public accessibility). EX1028, ¶48.

For at least these reasons, Tsai was “disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art, exercising reasonable diligence, [could] locate it” more than a year before the claimed priority date of the ’862 Patent. *In re Wyer*, 655 F.2d 221, 210 (CCPA 1981); MPEP §2128.I.

B. Statutory Grounds Of Unpatentability

Petitioner requests cancellation of claims 1-21 based on the following Grounds.²

² Petitioner reserves the right to challenge the claims under 35 U.S.C. §112 in other proceedings.

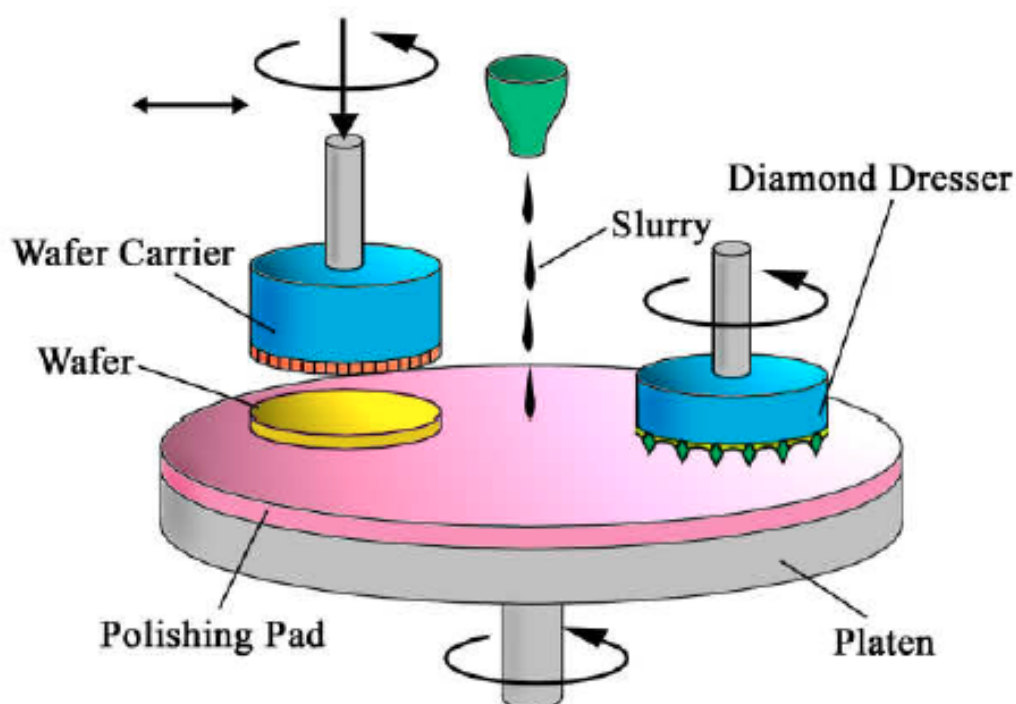
Ground	35 U.S.C.	Claims	Prior Art Reference(s) Relied Upon
I	§102/§103	1-5, 13, 15, 19-21	Tsai
II	§103	1-3, 6-14, 16-18	Tsai with Sung'026
III	§103	1-7, 13-21	Sung'146 with Sung'026

This Petition demonstrates that there is a reasonable likelihood that Petitioner would prevail with respect to at least one of the challenged claims. *See* 35 U.S.C. § 314(a).

VI. Technology Background

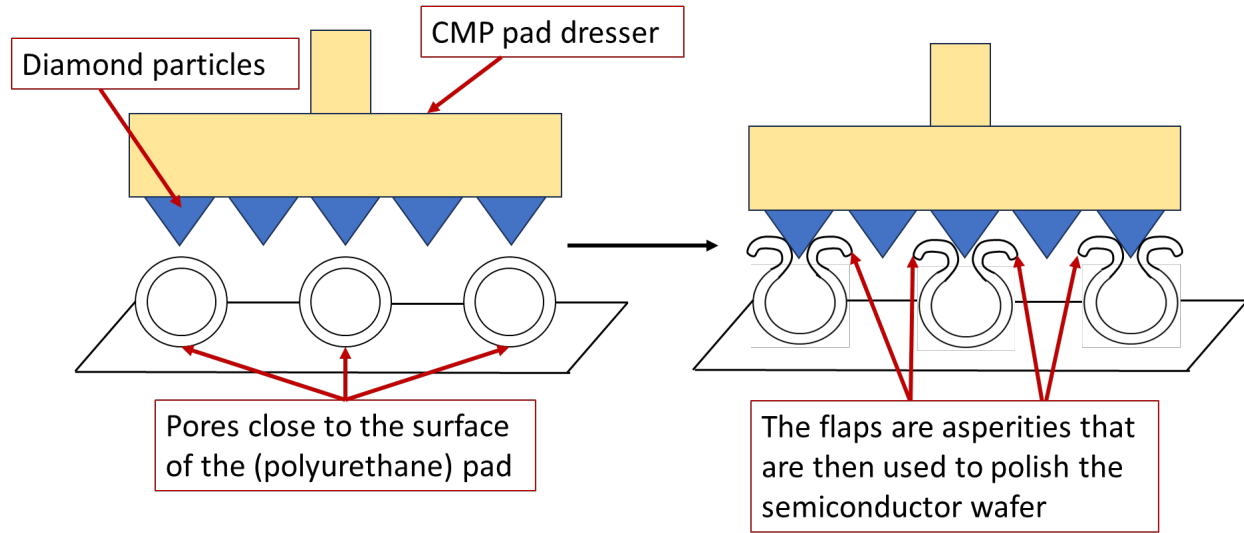
A. Chemical Mechanical Planarization (CMP)

Chemical mechanical planarization (“CMP”) has been used since the 1990s to make semiconductor wafer surfaces planar. As shown below, a chemical slurry is applied to a CMP pad (“polishing pad”) as the wafer is mechanically pressed onto a rotating CMP pad.



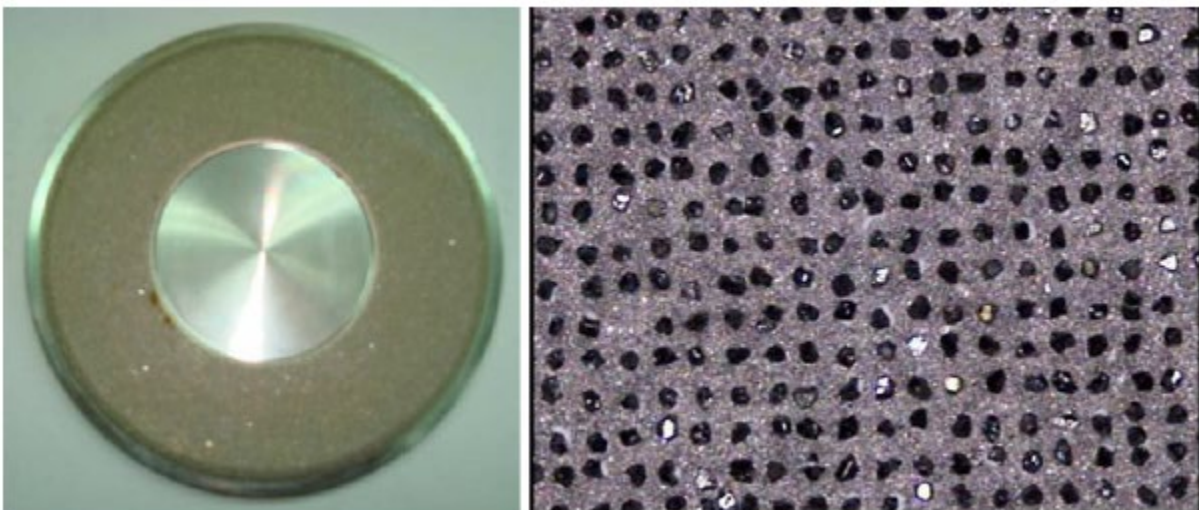
EX1013, Fig. 2; *see also id.*, 1:17-28; EX1014, 1:13-48. The pad is typically made of a soft polymeric material, such as polyurethane, and contains micron-sized asperities that can hold the slurry. EX1014, 1:44-46; EX1013, 1:17-18. Over time, the asperities become dulled, and the pad must be reconditioned to regenerate the asperities for optimal performance. EX1005, [0004]. EX1002, ¶¶38-40.

A CMP pad dresser (or “conditioner” or “diamond dresser”) is used to “cut” the surface of the CMP “polishing” pads and generate new asperities using superabrasive (*e.g.*, diamond) particles. EX1005, [0004]; EX1009, [0004].



EX1002, ¶41.

A typical CMP pad dresser is shown below. As shown in the zoomed-in image on the right, the diamond particles are arranged over a portion of a circular disk. See EX1008, 255 (“The conventional [“DG”] diamond pad conditioner ... contained single-crystal diamond grits (120 μm). The diameter of the DG disk was 108 mm, with a diamond spacing (cutting pitch) of 500 μm ..., as shown in Fig. 3”), 258 (“DG contained approximately 12,000 diamond grits...”).



EX1008, Figure 3. EX1002, ¶¶43-45.

CMP pad dressers with substantially level tips were well-known in the art. For example, Pysher shows below a two-dimensional surface profile of two CMP pad dressers where the diamond tips were leveled within 50 μm . EX1015, 3:40-43.

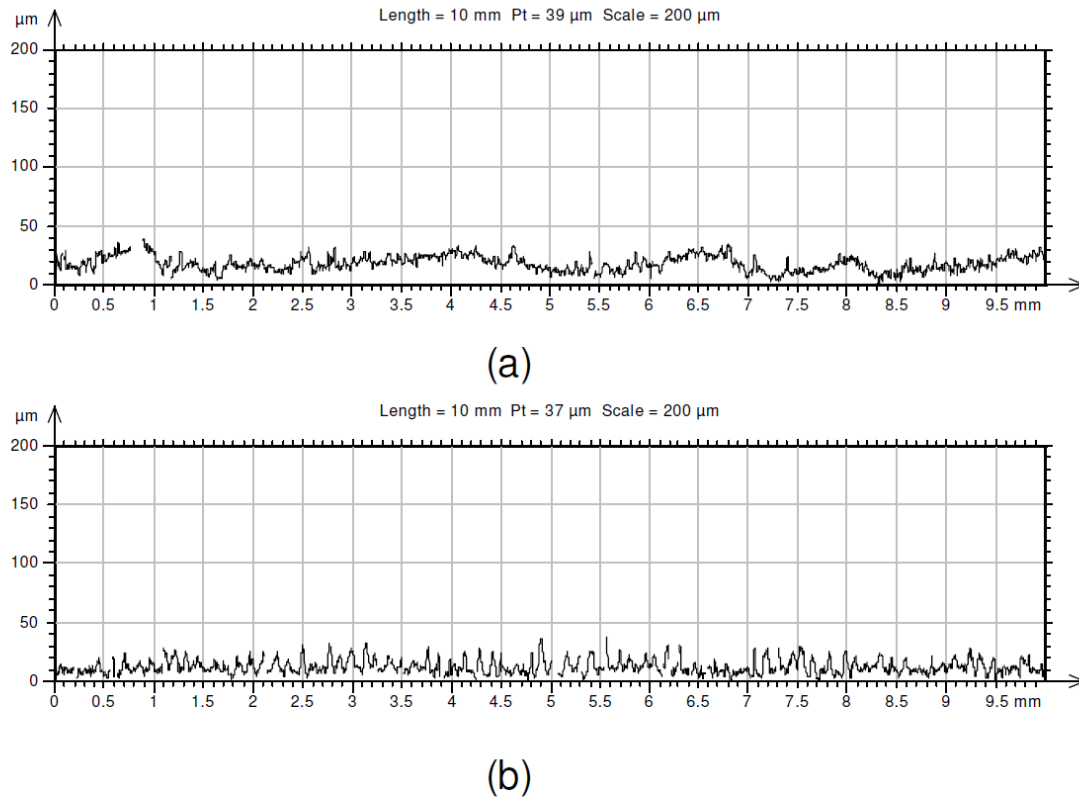


Figure 4. Surface profiles showing flatness of a) current and b) improved fine-finish disk designs.

EX1015, Fig. 4. EX1002, ¶¶52-53.

In 2007, Sung presented a paper (“SungICPT”) directed to an “Organic Diamond Disk (ODD)” that was made “by reversing the diamond attaching process ... with an organic matrix (e.g., epoxy).” EX1006, 1:30-2:3. In this “reverse casting” process: (1) “[t]he diamond grits are first leveled to a mold surface” (2)

“cover[ed] with a polymer,” and (3) finally exposed by removing the mold. EX1006, 2:1-2, Fig. 3. The resulting tip “height variation is within 20 microns.” EX1006, 2:2-3.

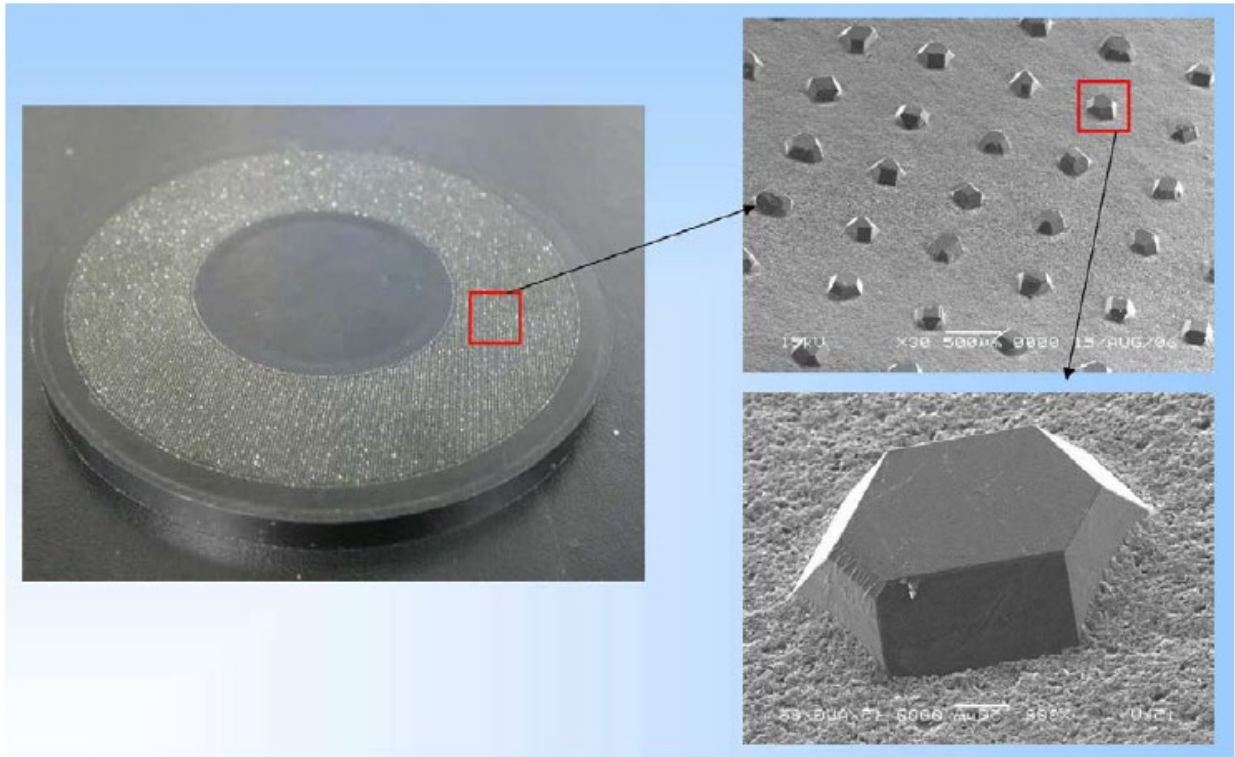


Fig. 3: The bonding conditions of diamond in the epoxy matrix.

EX1006, Fig. 3. EX1002, ¶¶46-48, 51.

In 2012, Sung published another paper (“Tsai”) graphically showing the same reverse casting technique. See EX1004, 5:20-6:20.

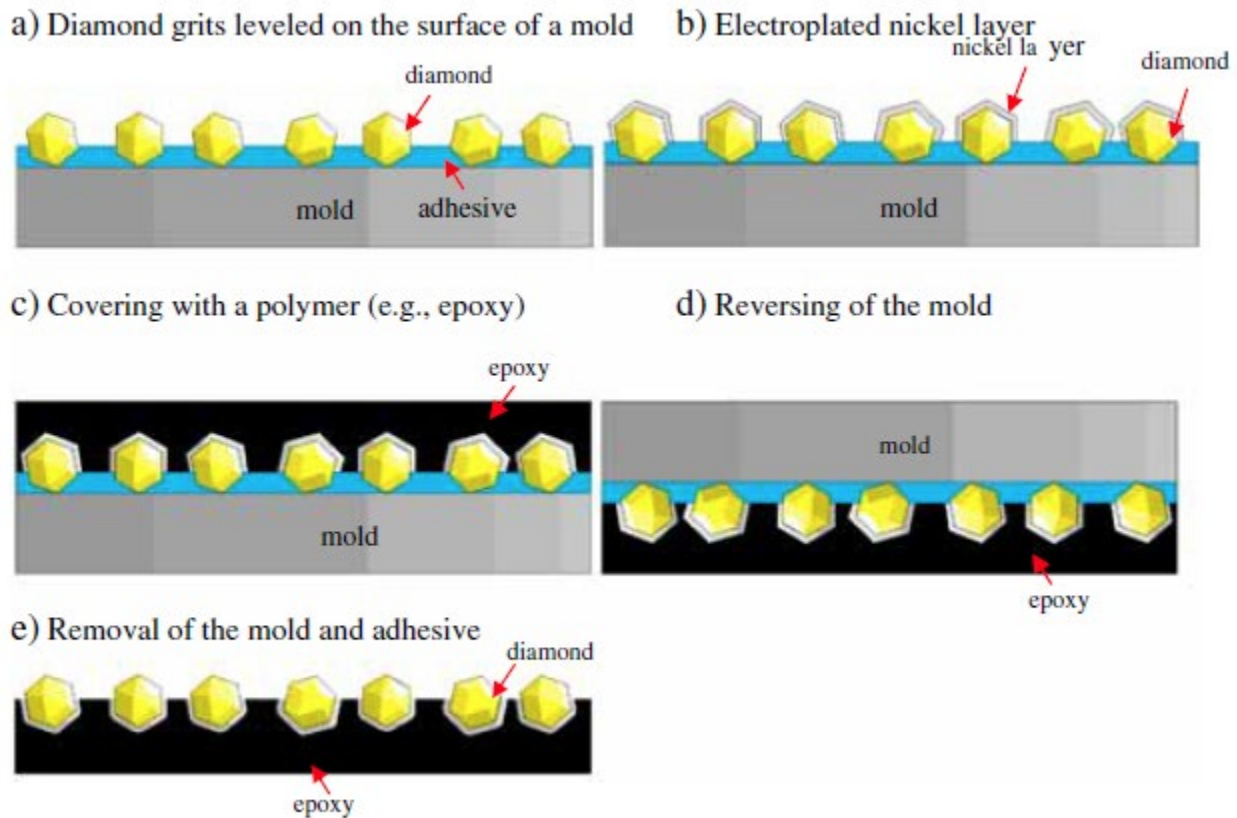


Fig. 2. Steps for manufacturing organic diamond disk.

EX1004, Fig. 2. Here, tips were “leveled to less than 15 μm .” EX1004, Abstract, 8:22-24. EX1002, ¶¶49-51.

VII. Overview Of The '802 Patent

A. Purported Invention Of The '802 Patent

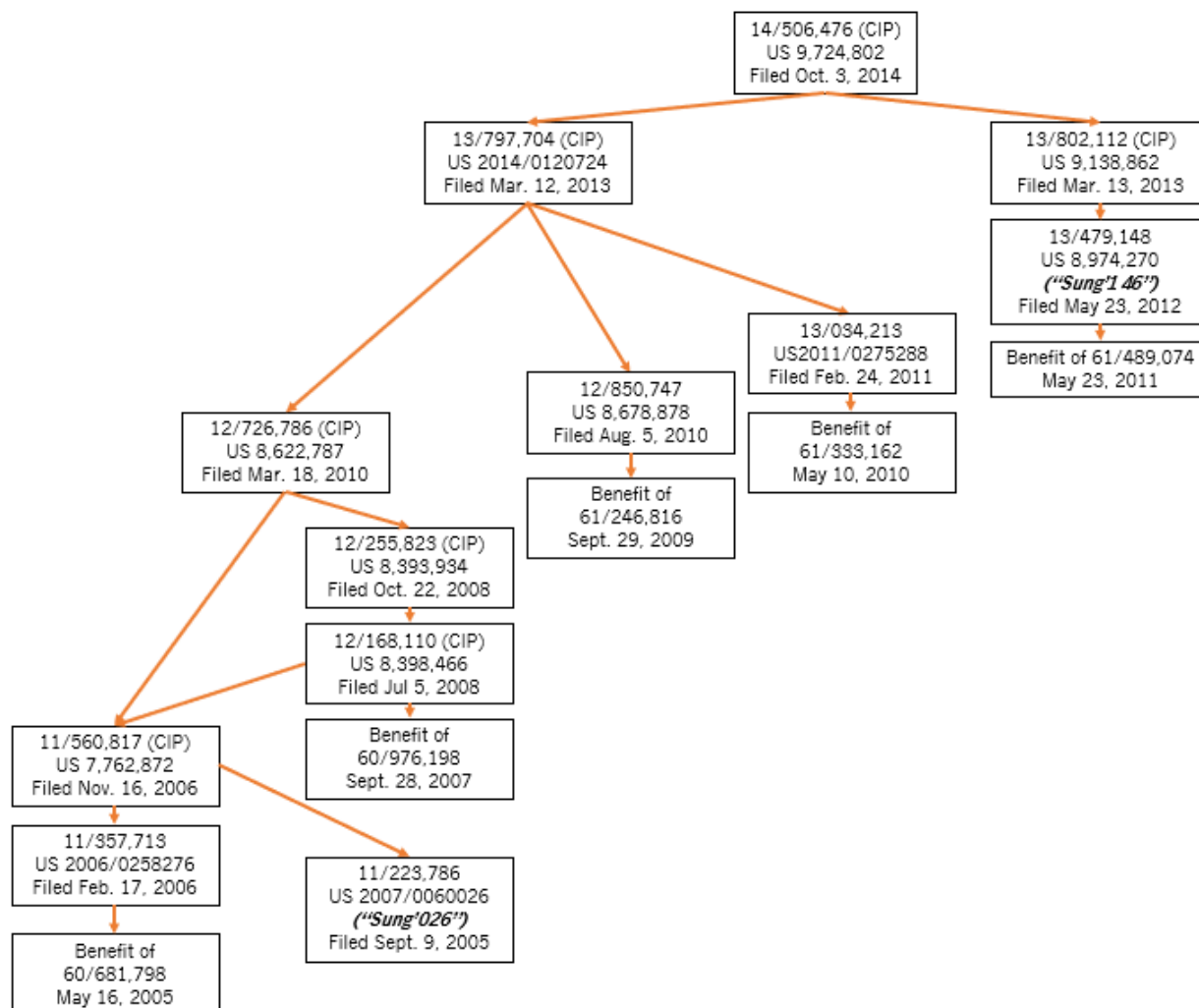
The '802 Patent is directed to a CMP pad dresser having substantially leveled tips. EX1001, 9:30-33. The '802 Patent describes the same “reverse casting” method described by Tsai and SungICPT. Specifically, the method includes first securing superabrasive particles “to a substrate using a ‘mask’ material.” EX1001, 25:14-18. The superabrasive particles not covered by the masking material “can

then be attached to the rigid support.” EX1001, 25:18-22. For example, organic matrix materials, such as epoxy, can be used as the rigid support. EX1001, 25:23-27, 25:63-65. Finally, “the masking material can be removed” “to accurately orient and attach the dressing segments to the support substrate.” EX1001, 25:18-22, 25:14-16. EX1002, ¶¶55-57.

B. Prosecution History Of The ’802 Patent

The ’802 Patent issued from U.S. Patent Application No. 14/506,476 (the “’476 Application”), filed on October 3, 2014. The ’802 Patent was filed as a continuation-in-part (CIP), claiming priority to number of applications, summarized below:

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EX1003, 2-4.

This overview focuses on originally filed claims 11-22, because originally filed claims 1-10 and 23-24 were canceled during prosecution.³ See EX1003, 235-241.

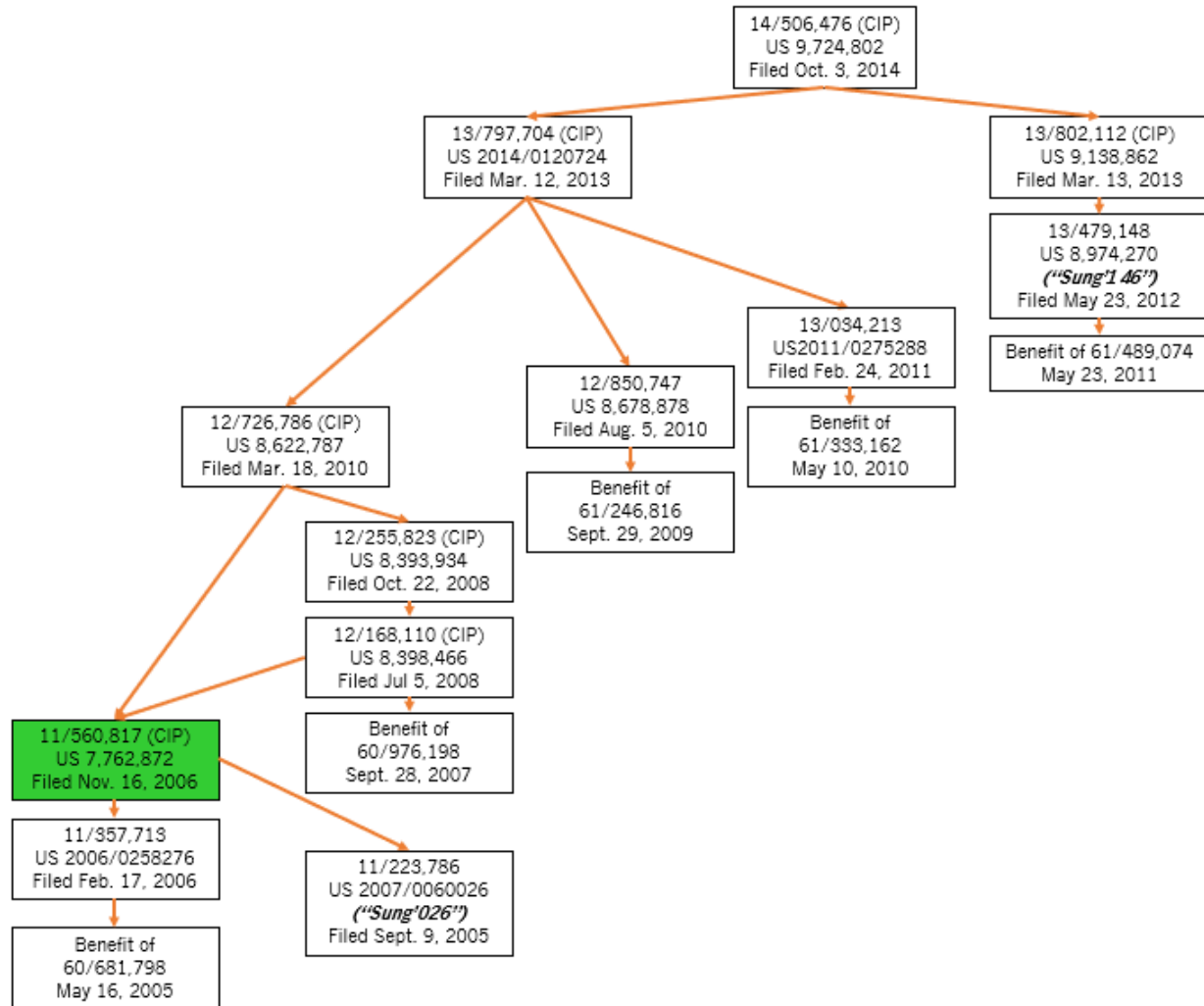
³ The applicant also added new claims 25-33 that depend on claim 11, which later issued as claims 13-21.

In a first Non-Final Rejection, the Examiner rejected claims 11-15 as obvious over U.S. Patent Publication No. 2010/0248595 (“Dinh-Ngoc”) (EX1010) in view of U.S. Patent Publication No. 2008/0292869 (*i.e.*, Sung’869). EX1003, 129-131.

In response, Applicant amended claim 11 to recite “**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.**” Applicant argued that “this claim limitation is fully supported in the ’817 [11/560,817] application [green below], from which the current application claims priority” and “pre-dates both Dinh-Ngoc and Sung[’869].” EX1003, 194.⁴

⁴ Sung later changed course during his litigation against Kinik, declaring that the ’802 Patent’s invention “is not disclosed in any of its parents or patent applications to which the ’802 Patent claims priority.” EX1011, ¶¶17-21. *See infra*, Section VII.C.

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The Examiner then indicated claims 11-15 are allowable, noting: (1) “Applicant’s arguments ... with respect to the rejection(s) ... under Dinh-Ngoc’595 have been fully considered and are persuasive,” without any analysis of the proper priority date. EX1003, 207.

Applicant then canceled claims 1-10 and 23-24, amended claim 16 to depend from claim 11, and added new claims 25-33 that depend from claim 11. See EX1003, 235-241.

The ’802 Patent issued on August 8, 2017. EX1001, Cover; EX1003, 338.

C. Priority Date Of The '802 Patent

The earliest possible priority date of the '802 Patent is its actual filing date—namely October 3, 2014.

Sung disclaimed any claim to an earlier filing date. Specifically, during his litigation against Kinik, Patent Owner (Sung) declared:

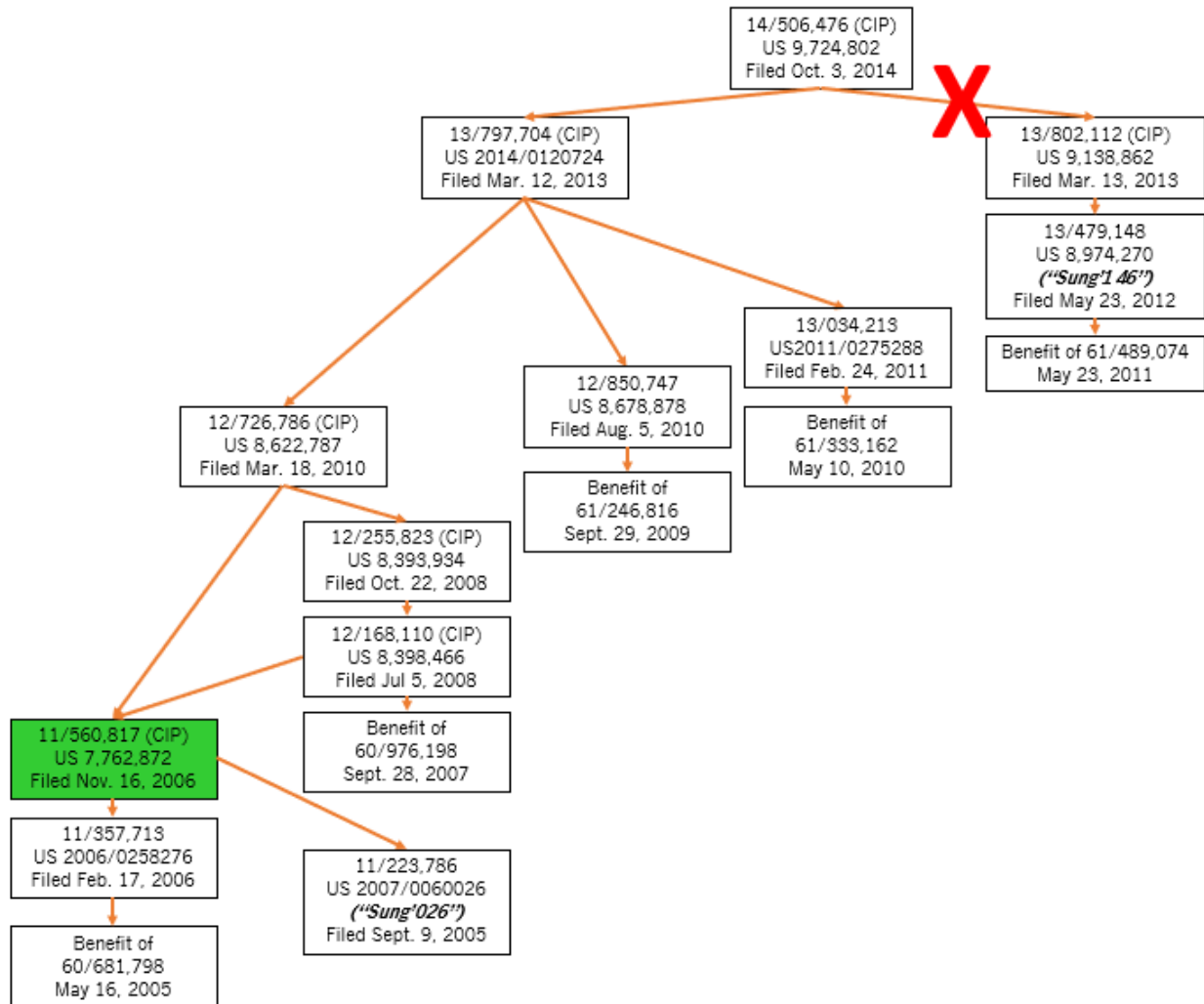
After the joint venture [with Kinik] terminated, I continued to conduct my own research and development in CMP disk technology. During this period, I invented the subject matter that forms the basis of the patent application (the "'802 Application") from which the '802 Patent issued. ... *I invented this new subject matter, which is claimed in the '802 Patent, after the joint venture with Kinik ended October 28, 2013. This invention is not disclosed in any of the patents or patent applications to which the '802 Patent claims priority.* ... For example, neither the '862 Patent nor the '270 Patent discloses a designated profile with a tip variation associated with the superabrasive particles or a tip variation at, for example, about 100 microns,^[5] all of which was discovered by me after the joint venture had terminated.

EX1011, ¶¶17-21 (emphases and coloring added); *see also id.*, ¶24 (declaring "these statements are made with the knowledge that willful false statements and the like so

⁵ *See also supra* Section VII.B (previously contrarily arguing that this limitation was "fully supported in the '817 application [highlighted in green below]").

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Claims 1-21

made are punishable by fine or imprisonment, or both.”). Indeed, as graphically illustrated below using a red X, Sung intentionally disclaimed any claim to an earlier priority date off the ’862 and ’270 Patents’ priority chain.



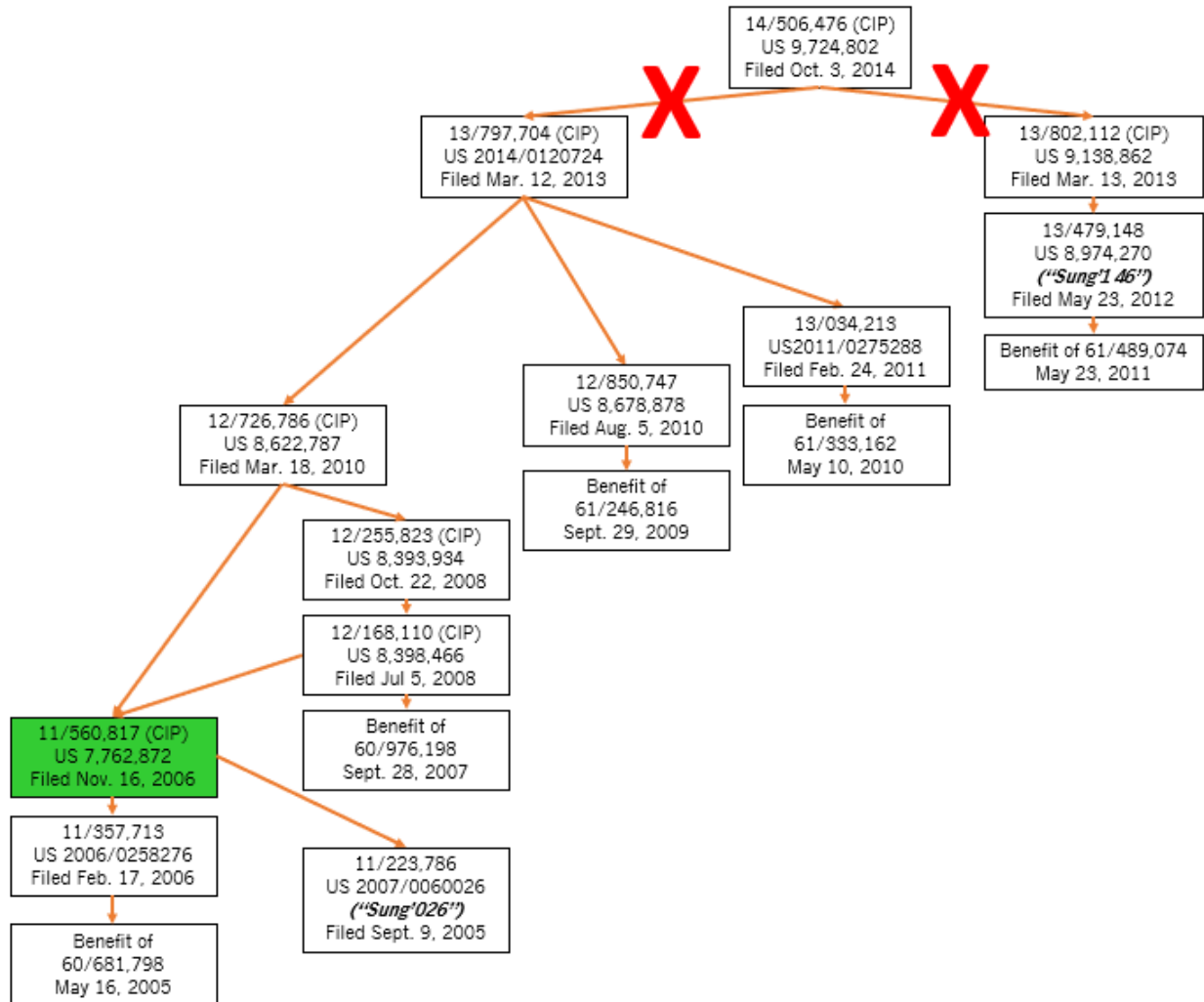
Sung further declared that a break in priority exists between the ’802 Patent and its immediate remaining parent (*i.e.*, U.S. Application No. 13/797,704). Specifically, Sung declared:

Further, I am the inventor of ... U.S. Application No.
13/797,704 (“’704 Application”). ... *[T]he* ’704

***Application [does not] disclose the claimed subject matter
of the '802 Patent.***

EX1011, ¶¶22-23. In other words, Sung intentionally disclaimed the benefit to the '704 Application effectively “deleting” the benefit to the remaining priority chain. *See Natural Alternatives Int'l, Inc. v. Iancu*, 904 F.3d 1375, 1383 (Fed. Cir. 2018) (finding that “by deleting the benefit claim in a CIP application, ... the CIP application and its children become vulnerable to rejections based on a larger pool of prior art—including former parent applications in some cases.”); *see also Santarus, Inc. v. Par Pharm., Inc.*, 694 F.3d 1344, 1352 (Fed. Cir. 2012) (finding that “[d]ue to breaks in the chain of priority,” the “[parent] patent [was] prior art for some of the asserted claims”).

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Claims 1-21



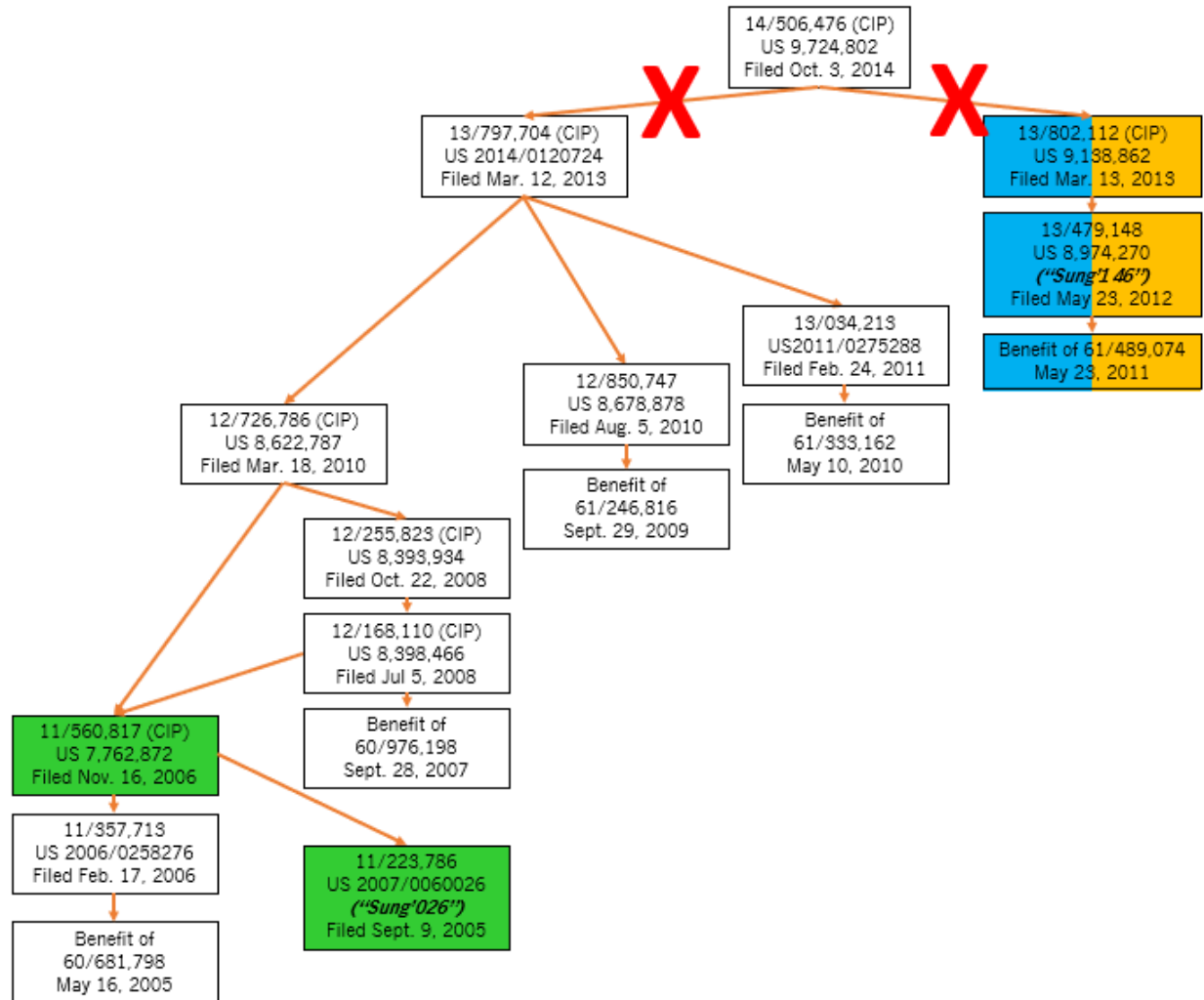
And the court acknowledged the Patent Owner's renunciation of any earlier priority claim. *See* EX1012, 2 ("Plaintiff has clearly stated that he only claims priority to October 3, 2014."). These intentional disclaimers, in an effort to sidestep his then-pending disputes over the ownership of the '802 Patent between Sung and Kinik, bar Sung from attempting to reclaim an earlier priority date. *See also* MPEP §211.02(a) (explaining that if an applicant intentionally waived the benefit claim to

prior applications, the Office will reject applicants' later attempts to reclaim the earlier priority benefit).

Indeed, the '802 Patent is the first application that supports *all* limitations of claim 1. See *Studiengesellschaft Kohle, M.B.H. v. Shell Oil Co.*, 112 F.3d 1561, 1564 (Fed. Cir. 1997) ("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."); *id.*, 1562, 1564. For example, written description support for the following limitations of claim 1 is found only in different applications that are highlighted below using the corresponding colors.

- [1D]: "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"
- [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"

Petition for *Inter Partes* Review of U.S. Patent No. 9,724,802
Claims 1-21



EX1002, ¶¶71-74.

Taking [1D] as an example, Sung’026 discloses that the “[p]lurality of superabrasive particles are arranged such that their tips vary from the designated profile by from about 5 microns to about 100 microns.” EX1005, [0056]. However, such disclosure in Sung’026 does not provide written description support for either [1E] or [1F]. Nor do Sung’026’s additional disclosures such as those identified below:

In yet another aspect, the plurality of superabrasive particles are arranged such that their tips vary from the designated profile by from about 10 microns to about 75 microns[,]... by from about 10 microns to about 50 microns[,] ... by from about 20 microns to about 50 microns[,] ... by less than about 1 micron[.]

EX1005, [0056].⁶ EX1002, ¶¶72-73.

In sum, the earliest possible priority date of the '802 Patent is the actual filing date of the '802 Patent (*i.e.*, October 3, 2014).

D. Summary of IPR2021-00638 Against The '802 Patent

Kinik challenged the patentability of the '802 Patent in *Kinik Co. v. Sung*,

⁶ But to be clear, these disclosures *can* anticipate [1E] and/or [1F] because disclosures such as “they are arranged such that their tips vary from the designated profile by less than about 1 micron” are species within the more broadly claimed genus. *See Vas-Cath Inc. v. Mahurkar*, 935 F.2d 1555, 1562 (Fed. Cir. 1991) (“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. ...’”).

IPR2021-00638 (“Kinik IPR”), raising a number of challenges to the patentability of the claims of the ’802 Patent based on the fact that “Sung expressly disclaimed all claim of priority to the Parent Patents.” Kinik IPR, Paper 1, 15.

Sung did not (and could not) challenge the priority date in his Patent Owner’s Preliminary Response in the Kinik IPR. *See* Kinik IPR, Paper 6. Shortly thereafter, and before any institution decision, the IPR was terminated pursuant to a joint motion to dismiss the petition. *See* Kinik IPR, Papers 8 and 9.

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.

IX. Claim Construction

The claims should be construed “in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” 37 C.F.R. § 42.100(b); *see also Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (*en banc*). The Patent Owner

can act as his own lexicographer. *See In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). Moreover, the Board “need[s] only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy.’” *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor, Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).⁷

While the Board may not need to construe the following terms for the purposes of this instant IPR proceeding, Patent Owner has acted as his own lexicographer for the following terms in the ’802 Patent.

A. “superabrasive”

Claims 1, 6, 8-18, and 20-21 recite “superabrasive.” The ’802 Patent notes that “[a]s used herein, ‘superabrasive’ may be used to refer to any crystalline, or polycrystalline material, or mixture of such materials that has a Moh[']s hardness of about 8 or greater.” EX1001, 4:13-16. Some examples of “suitable superabrasive material examples include ... diamond, polycrystalline diamond (PCD), ...” EX1001, 4:19-24. EX1002, ¶97.

⁷ Petitioner reserves the right to raise other/additional claim construction arguments in any other/parallel proceedings.

B. “particle”

Claims 1, 6, 8-18, and 20-21 recite “particle.” The ’802 Patent notes that “[a]s used herein, ‘particle’ refers, when used in connection with superabrasive particles, to a particulate form of superabrasive particle.” EX1001, 4:33-38. EX1002, ¶98.

C. “working superabrasive particle”

Claims 6 and 8-12 recite “working superabrasive particle.” The ’802 Patent notes that “[a]s used herein, ‘working superabrasive particles’ are superabrasive particles that cut or otherwise deform a CMP pad during a dressing or conditioning procedure.” EX1001, 4:46-48. EX1002, ¶99.

D. “profile”

Claims 1, 13-15, and 19 recite “profile.” The ’802 Patent notes that “[a]s used herein, the term ‘profile’ ... refer[s] to a predetermined contour above a support substrate to which a plurality of superabrasive particles or other cutting elements are intended to align.” EX1001, 6:21-25. EX1002, ¶100.

E. “support substrate”

Claims 1, 12, and 20 recite “support substrate.” The ’802 Patent notes that “[a]s used herein, the term[] ... ‘support substrate’ ... refer to a portion of a pad conditioner that supports superabrasive materials, and to which abrasive materials and/or superabrasive segments that carry abrasive materials may be affixed.” EX1001, 7:59-63. EX1002, ¶101.

F. “tip”

Claims 1-5 and 13-15 recite “tip.” The ’802 Patent notes that “[a]s used herein, cutting ‘tip’ refers to a portion of a cutting element or particle that protrudes the greatest distance from the support substrate, ...” EX1001, 5:9-12. EX1002, ¶102.

G. “protrusion”

Claims 1-5 and 16-18 recite “protrusion.” The ’802 Patent notes that “for the purposes of the present disclosure, the term ‘protrusion’ refers to the height of a particle relative to some reference point.” EX1001, 16:24-26. EX1002, ¶103.

H. “about”

Claims 1-7, 10-18, and 21 recite “about.” The ’802 Patent notes that “[a]s used herein, the term ‘about’ is used to provide flexibility to a numerical range endpoint by providing that a given value may be ‘a little above’ or ‘a little below’ the endpoint.” EX1001, 8:29-32. EX1002, ¶104.

X. Specific Grounds For Challenge

The sections below, as supported by Dr. Shanfield’s Declaration, demonstrate how the claims are unpatentable. 37 C.F.R. §42.104(b)(4)-(5).

A. Ground I: Tsai Anticipates And/Or Renders Obvious Claims 1-5, 13, 15, And 19-21

1. Overview Of Tsai

Tsai published in 2012 naming Chien-Min Sung as a co-author. Tsai is titled “Organic diamond disk [“ODD”] versus brazed diamond disk [“BDD”] for dressing a chemical-mechanical polishing pad.” EX1004, Title. Tsai discloses using “reverse casting” to fabricate the ODD CMP pad dressers that have leveled diamond tips. EX1004, Abstract. Specifically, Tsai explains the reverse casting manufacturing process in Figure 2 (reproduced below). “First, [as shown in Figure 2a),] the diamond grits^[8] are leveled on the surface of a mold for their regular distribution.” EX1004, 5:23-24. Then, as shown in Figure 2b), “an electroplated nickel layer is attached to the diamond grits.” *Id.*, 5:24-25. Next, as shown in Figures 2c) and 2d), “the diamond grits are cast by covering with a polymer ... buried at a depth of more than twice the height of the exposed part of the grit. Then, the mold is reversed.” *Id.*, 5:27-6:4. “Finally, [as shown in Figure 2e),] the mold and the adhesive are removed ... followed by curing and cleaning to complete the fabrication of the ODD.” *Id.*, 6:4-6.

⁸ The terms “grit” and “particle” are used interchangeably in the art, as well as in Tsai. *See, e.g.*, EX1005, [0033] (“As used herein, ‘particle’ and ‘grit’ may be used interchangeably...”); *see also* EX1004, 5:5-18. EX1002, ¶¶86, 88, 118.

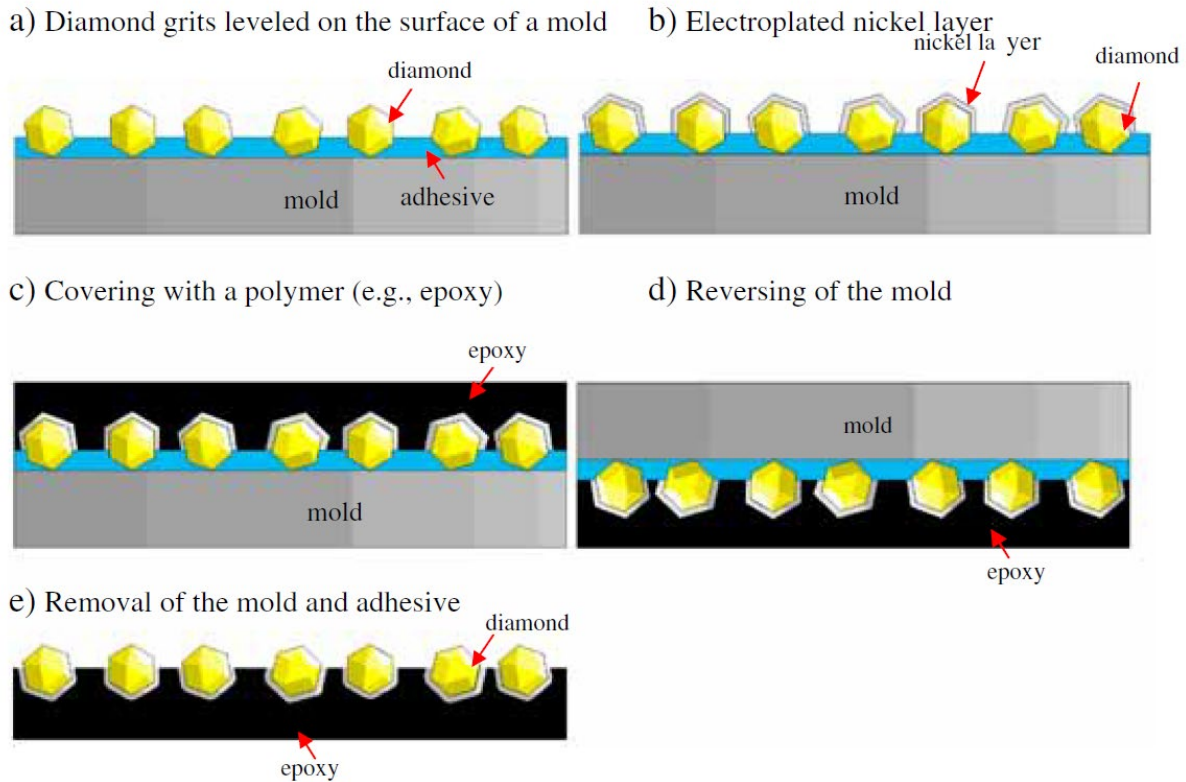
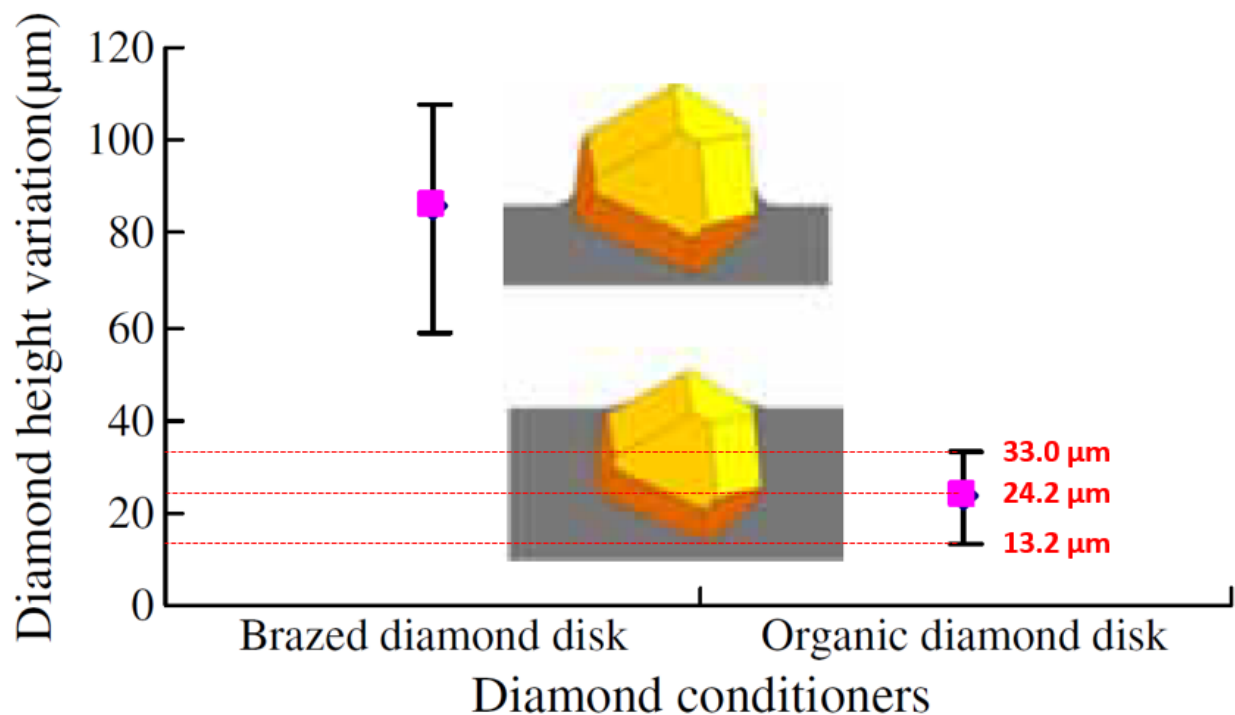


Fig. 2. Steps for manufacturing organic diamond disk.

EX1004, Fig. 2. EX1002, ¶¶81-84.

The ODD formed by Tsai has a protrusion height of “approximately 30 μm ” which “can be leveled to less than 15 μm .” EX1004, 8:14-24. In particular, the specific example shown in Fig. 6 has an average protrusion height of about 24.2 μm with a protrusion height that ranges from 13.2 μm and 33.0 μm , as determined using the y-axis scale bar and specific datapoints and error bars shown therein.



EX1004, Fig. 6 (annotated). In other words, the tip-to-tip variation shown in the example of Figure 6 is about 19.8 μm. EX1002, ¶85.

2. Independent Claim 1 And Dependent Claims 13 And 15

i. [1Pre] A CMP pad dresser, comprising:

To the extent limiting, Tsai discloses [1Pre]. Tsai discloses an organic diamond disk (ODD) “for dressing a chemical-mechanical polishing [CMP] pad.”

EX1004, Title; *see also id.*, Abstract:4-6. EX1002, ¶108.

ii. [1A] a rigid support substrate; and

At the outset, as discussed in Section IX [Claim Construction], the ’802 Patent notes that “[a]s used herein, the term[] ... ‘*support substrate*’ ... refer[s] to a portion of a pad conditioner that supports superabrasive materials, and to which abrasive

materials and/or superabrasive segments that carry abrasive materials may be affixed.” EX1001, 7:59-63. Even assuming this is a lexicographic definition that must be applied, Tsai discloses [1A].

Tsai teaches a portion of the pad conditioner made of an epoxy resin that supports superabrasive diamond particles after they have been affixed to the epoxy material. *See* EX1004, 5:20-21 (“We propose a novel design of a diamond disk by reversing the process of attaching diamonds using an organic matrix (e.g. epoxy).”). More specifically, Tsai explains the manufacturing process of the ODD in Figure 2 (reproduced below). As shown below, the polymer is applied to the diamond particles and cured to form a rigid epoxy. *See* EX1004, 5:23-6:6 (“***Next, the diamond grits are cast by covering with a polymer.*** ... Then, the mold is reversed. Finally, the mold and the adhesive are removed and ***polymer-bonded diamond grits are obtained. This step is followed by curing*** and cleaning to complete the fabrication of the ODD.”).

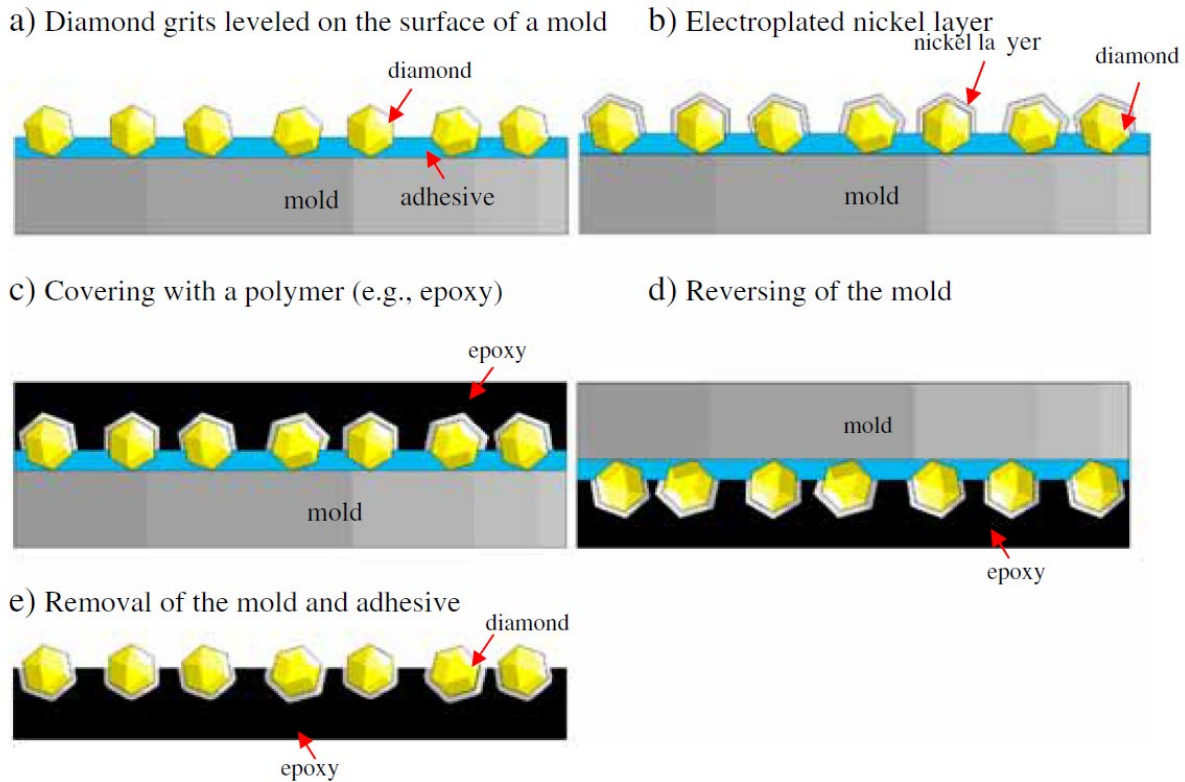


Fig. 2. Steps for manufacturing organic diamond disk.

EX1004, Fig. 2. EX1002, ¶¶111-112.

Indeed, the '802 Patent itself explains that epoxy can serve as a rigid support substrate. For example, the '802 Patent notes that some “[e]xamples of typical substrate materials include ... relatively hard polymers or other organic materials...” EX1001, 8:2-5; *see also* EX1001, 24:64-25:19 (“Various organic materials are contemplated for use as a *support substrate* ... In one specific aspect, the organic material can be an *epoxy resin*.”), 25:23-32. EX1002, ¶113.

iii. **[1B] a monolayer of a plurality of superabrasive particles coupled to the support substrate,**

At the outset, as discussed in Section IX [Claim Construction], the '802 Patent notes that “[a]s used herein, ‘*superabrasive*’ may be used to refer to any crystalline, or polycrystalline material, or mixture of such materials which has a Mohs hardness of about 8 or greater.” EX1001, 4:13-17. “Suitable superabrasive material examples can include ... diamond, polycrystalline diamond (PCD), ...” EX1001, 4:19-25.

In addition, as discussed in Section IX, the '802 Patent notes that “[a]s used herein, ‘*particle*’ refers, when used in connection with superabrasive particles, to a particulate form of superabrasive particle.” EX1001, 4:33-38.

Moreover, as discussed in Section IX, the '802 Patent notes that “[a]s used herein, the term ‘*about*’ is used to provide flexibility to a numerical range endpoint by providing that a given value may be ‘a little above’ or ‘a little below’ the endpoint.” EX1001, 8:29-32.

Even assuming these are lexicographic definitions that must be applied, Tsai discloses [1B].

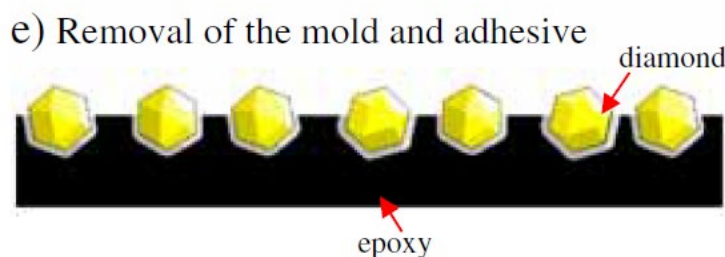
Tsai discloses diamond grit coupled to the epoxy resin. *See* EX1004, 5:23-6:5 (“Finally, the mold and the adhesive are removed and polymer-bonded diamond grits are obtained.”). EX1002, ¶119.

Diamond grit is a diamond particle. *See* EX1004, 5:5-11 (explaining that the

“first-generation diamond pad conditioners contained randomly distributed ***diamond grits***” that experienced displacement from the matrix and explaining that the “loss of ***diamond particles*** during the CMP process affected the wafer performance.”); *see also* EX1005, [0033] (“As used herein, ‘particle’ and ‘grit’ may be used interchangeably...”). EX1002, ¶118.

Diamond is superabrasive because it has a Mohs hardness of about 8.0 or greater. *See* EX1007 (showing a Mohs hardness of 10 for diamond). Indeed, the ’802 Patent itself lists diamond as a suitable superabrasive material. *See* EX1001, 4:20-21. EX1002, ¶117.

Finally, Tsai discloses a monolayer of diamond particles coupled to the epoxy resin. For example, as shown in Figure 2e below, a single layer of diamond particles is coupled to the epoxy resin. *See also In re Mraz*, 455 F.2d 1069, 1072 (CCPA 1972) (holding that drawings and pictures can anticipate claims if they clearly show the structure which is claimed).



EX1004, Fig. 2e; *see also* Figs. 3, 5b, and 8 (showing SEM images (Figures 3 and 8) and a contour map (Figure 5) of the surface of the ODD that all demonstrate a

monolayer of superabrasive diamond particles). Indeed, the “reverse casting” manufacturing steps shown in Figure 2 explain that “each diamond grit is buried at a depth of more than twice the height of the exposed part of the grit,” and the “mold and the adhesive are removed,” resulting in “polymer-bonded diamond grits.” EX1004, 6:1-6. Hence, any diamond particles that are not buried in the epoxy are removed when the mold and adhesive are removed, leading to the observed monolayer of diamond particles.

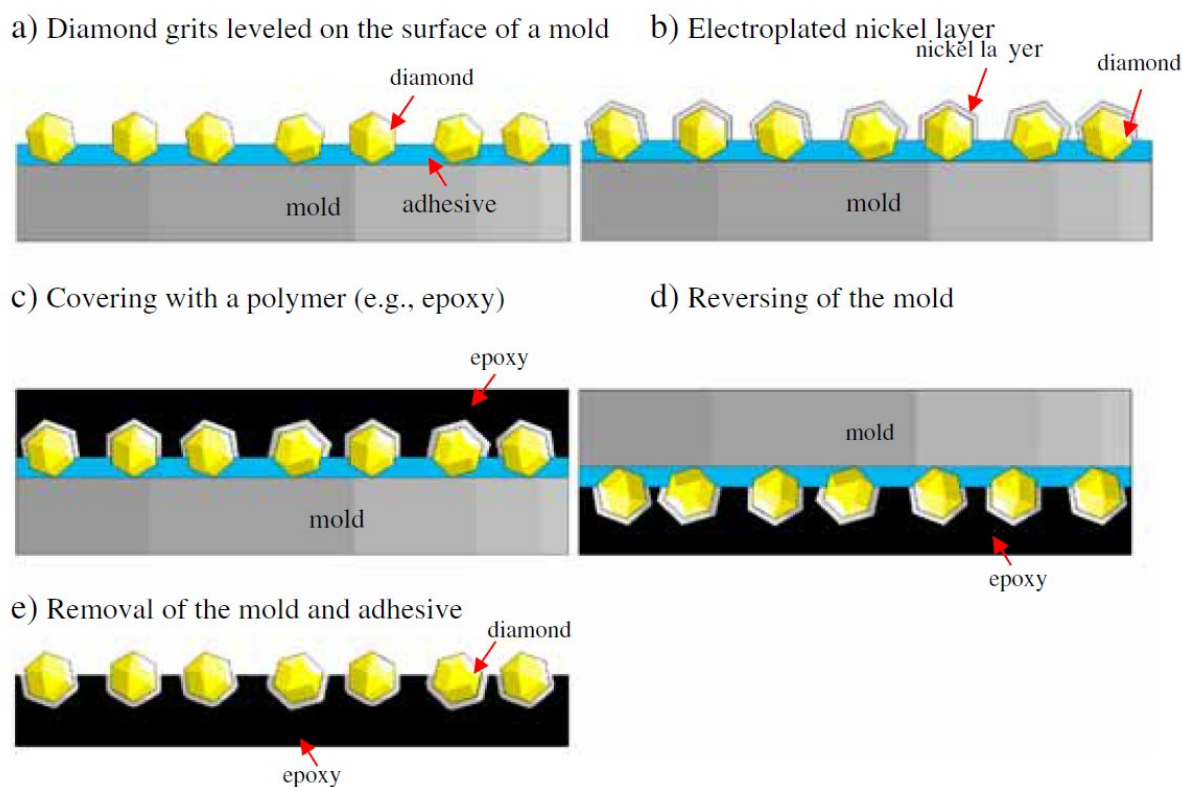


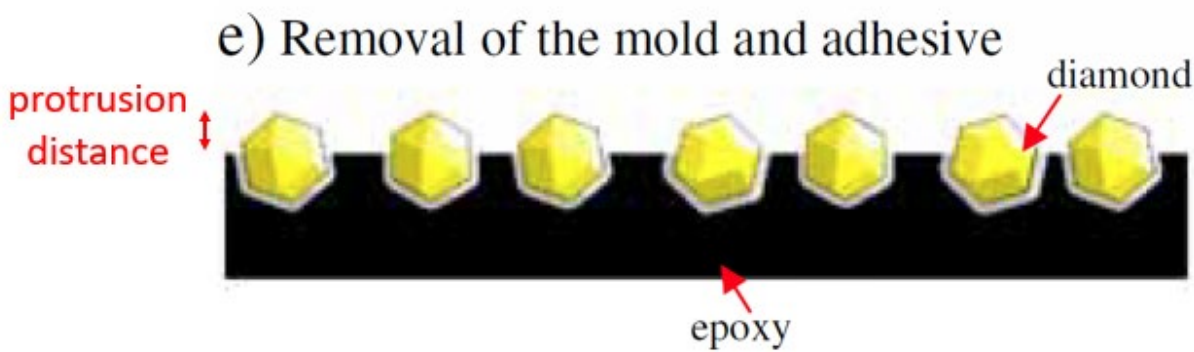
Fig. 2. Steps for manufacturing organic diamond disk.

EX1004, Fig. 2; EX1002, ¶¶119-122.

- iv. **[1C] wherein each superabrasive particle in the monolayer extends away from the support substrate to a protrusion distance,**

At the outset, as discussed in Section IX [Claim Construction], the '802 Patent notes that “for the purposes of the present disclosure, the term ‘*protrusion*’ refers to the height of a particle relative to some reference point.” EX1001, 16:24-26. Even assuming this is a lexicographic definition that must be applied, Tsai discloses [1C].

As shown in Figure 2e below, Tsai shows each superabrasive diamond particle in the monolayer extending away from the epoxy resin to a protrusion distance (*i.e.*, a height relative to the top surface of the epoxy resin). EX1002, ¶124.



EX1004, Fig. 2e (annotated); *see also id.*, Figs. 3, 5, and 8 (showing images of the surface demonstrating that each diamond particle in the monolayer extends away from the epoxy to a height above the top surface of the epoxy resin). More specifically, Tsai discloses that the protrusion distance is approximately 30 μm . *See* EX1004, 8:14-16 (“In addition, the protrusion height (approximately 30 μm) of the diamonds for the ODD”). EX1002, ¶¶124-126.

- v. **[1D] 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,**

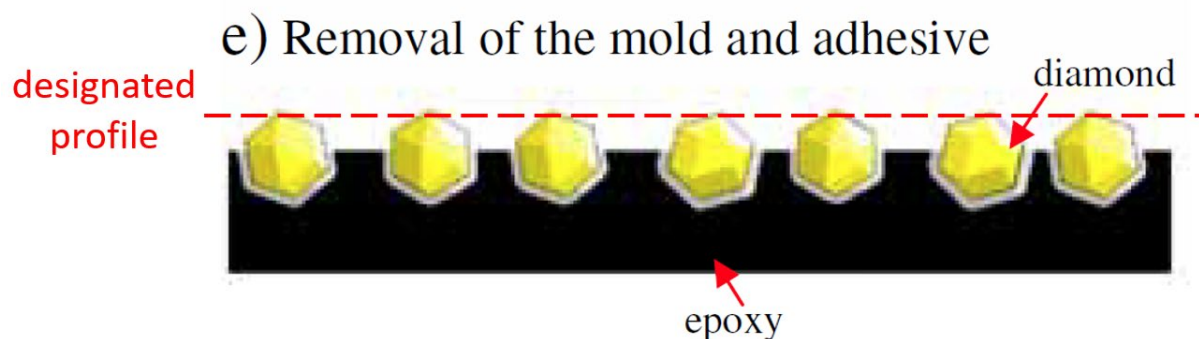
At the outset, as discussed in Section IX [Claim Construction], the '802 Patent notes that “[a]s used herein, cutting ‘*tip*’ refers to a portion of a cutting element or particle that protrudes the greatest distance from the support substrate.” EX1001, 5:9-12.

Moreover, as discussed in Section IX, the '802 Patent notes that “[a]s used herein, the term ‘*profile*’ ... refer[s] to a predetermined contour above a support substrate to which a plurality of superabrasive particles or other cutting elements are intended to align.” EX1001, 6:21-25.

Even assuming these are lexicographic definitions that must be applied, Tsai discloses and/or renders obvious [1D].

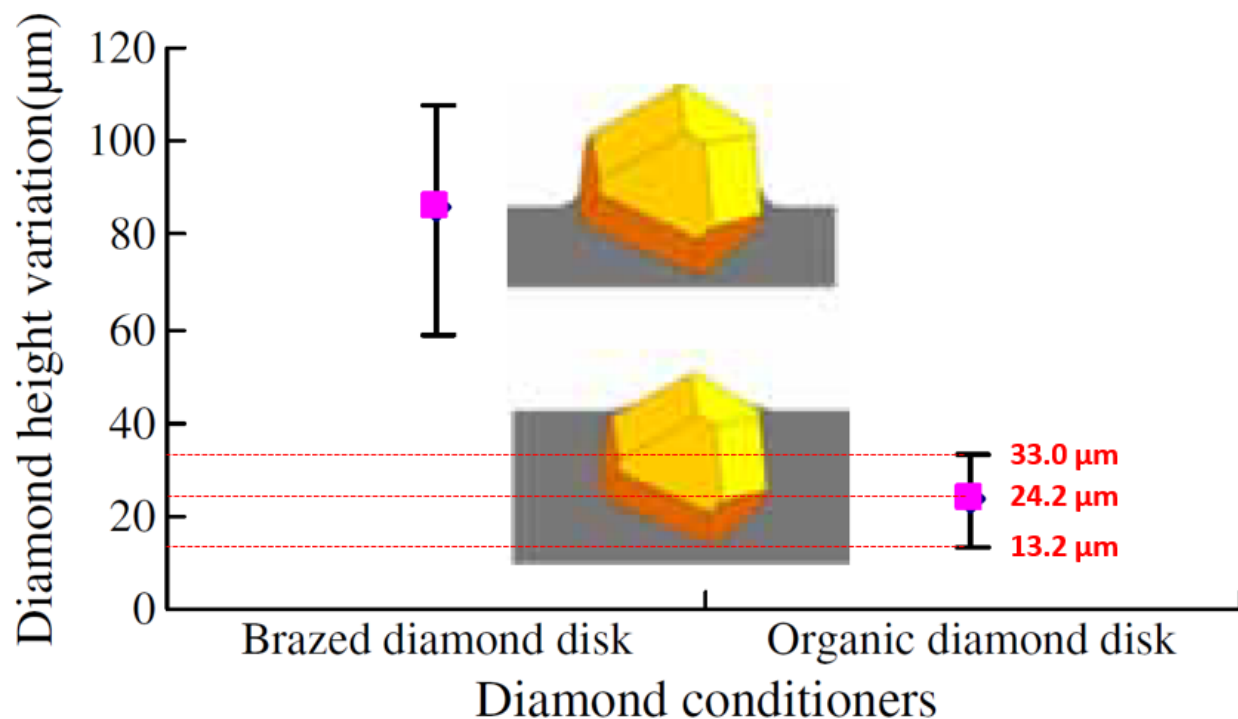
Tsai discloses that “a tip of each of the plurality of superabrasive particles aligns along a designated profile.” Tsai explains that it designates a flat contour above the epoxy resin to which each of the tips of the diamond particles is intended to align. See EX1004, 6:8-10 (“In this case, the diamond tips can be leveled by compressing the disk with a flat plate to reduce the variation in the heights of the diamond tips.”), 5:23-24 (“First, the diamond grits are leveled on the surface of a mold for their regular distribution...”), 8:22-24 (“...the diamond tips of the ODD can be leveled to less than 15 μm because the diamond tips are already leveled.”),

8:14-16 (“In addition, the protrusion height (approximately 30 μm) of the diamonds for the ODD is smaller than that (approximately 80 μm) for the BDD.”). For example, as shown below using a red dotted line, a flat contour can be designated above the epoxy resin substrate to which the tips of the diamond particles are intended to align (*e.g.*, the average protrusion distance of the diamond tips) and leveled. As expected, some tips can protrude above or below that flat “designated profile.”



EX1004, Fig. 2e (annotated); *see also id.*, Figure 5b. EX1002, ¶¶131-132.

Tsai’s Figure 6 also discloses “with a tip variation of from about 5 microns to about 100 microns.” For example, as annotated below, the average protrusion distance of the diamond particles is about 24.2 μm and the highest and smallest protruding tips are about 13.2 μm and 33.0 μm , respectively.



EX1004, Fig. 6 (annotated). Hence, the tip-to-tip variation for the example shown in Figure 6 is about 19.8 μm . And taking the average protrusion distance to be the designated profile, the tip-to-designated profile variation is about 8.8 μm (33.0-24.2) or 11 μm (24.2-13.2). Hence, regardless of whether the claimed “tip variation” requires a tip-to-tip variation or tip-to-designated profile variation, the specific example of Figure 6 discloses [1D]. Accordingly, Tsai’s tip-to-tip and tip-to-designated profile variations shown in Figure 6 of Tsai disclose the claimed “about 5 microns to about 100 microns” range. See *Ineos USA LLC v. Berry Plastics Corp.*, 783 F.3d 865, 869 (Fed. Cir. 2015) (“When a patent claims a range, as in this case, that range is anticipated by a prior art reference if the reference discloses a point within the range.”) (citing *Titanium Metals Corp. v. Banner*, 778 F.2d 775, 782 (Fed.

Cir. 1985); *see also In re Geisler*, 116 F.3d 1465, 1469-71 (Fed. Cir. 1997). EX1002, ¶¶132-134.

Tsai provides a second independent basis for anticipating “with a tip variation of from about 5 microns to about 100 microns.” It notes that “in the case of the ODD, the diamond tips of the ODD *can be leveled to less than 15 μm.*” EX1004, 8:22-24. In other words, Tsai teaches that even better leveling can be achieved over that specific example shown in Figure 6. Because Tsai’s disclosed range of “less than 15 μm” overlaps with the claimed range of “from about 5 microns to about 100 microns,” it is a prima facie case of anticipation, which can only be rebutted by the patentee establishing that the claimed range is critical to the operability of the claimed invention. *UCB, Inc. v. Actavis Laboratories UT, Nc.*, 65 F.4th 679, 687 (Fed. Cir. 2023) (“[O]nce the patent challenger has established, through overlapping ranges, its prima facie case of anticipation, the court must evaluate whether the patentee has established that the claimed range is critical to the operability of the claimed invention.”) (quotation marks and citation omitted). EX1002, ¶135.

There is nothing in the ’802 Patent that shows “the claimed range is critical to the operability of the claimed invention” to rebut the prima facie case of anticipation. *Id.* at 687. For example, there is nothing in the ’802 Patent, such as examples comparing and contrasting CMP pad dressers that fall within and outside the claimed range to demonstrate any kind of criticality. In fact, there is no criticality to the

claimed endpoints because “the term ‘about’ is used to provide flexibility ... that a given value may be ‘a little above’ or ‘a little below’ the endpoint.” EX1001, 8:29-32.⁹ Hence, even Tsai’s disclosed range of “less than 15 μm ” anticipates the claimed range of “with a tip variation of from about 5 microns to about 100 microns” as it overlaps the claimed range that has no criticality. EX1002, ¶135.

At a minimum, even if Patent Owner contends that some criticality exists, the overlapping range of “less than 15 μm ” renders obvious the claimed “tip variation of from about 5 microns to about 100 microns.” *See UCB*, 65 F.4th at 689 (“A presumption of obviousness applies where a claimed range overlaps with a range disclosed in the prior art.”) (quotation marks omitted). Indeed, Patent Owner cannot overcome this presumption of obviousness because the Patent Owner cannot show that the “prior art teaches away from the claimed range, ... the claimed range produces new and unexpected results,” or other evidence demonstrates non-obviousness of the claimed range. *Id.* at 689-90 (citation omitted). EX1002, ¶135.

Even if the Board were to assume that the presumption of obviousness did not apply in this case, Tsai still renders “tip variation of from about 5 microns to about 100 microns” obvious. A POSITA would have been motivated to obtain tip variation

⁹ These discussions regarding the lack of criticality of the claimed ranges applies to all limitations of the challenged claims that claim a range of values.

values that overlap with the claimed ranges because Tsai explains that if “the tips of the diamond grits are not leveled to the same height” (EX1004, 2:13-14), a number of disadvantages arise. First, poorly leveled diamond particles will result in only 10% (among about 10,000 particles) being “engaged in cutting the polishing pad. The rest of the grits remain unused on the disk.” *Id.*, 2:14-17. Second, Tsai explains that “the few tall diamond grits can cut 50% of the pad consumed during dressing; this shortens the pad lifespan and increases the running costs.” *Id.*, 2:20-22. Hence, a POSITA would have been motivated to achieve a tip variation of the plurality of superabrasive particles within the claimed “about 5 microns to about 100 microns” to improve performance. EX1002, ¶136.

Obtaining slightly different tip variations would have been a routine optimization that was well-within the skill of a POSITA. For example, a POSITA would have recognized that such tip variation could be achieved by modifying one part of the “reverse casting” process described by Tsai—a technique that the ’802 Patent itself explains to be a suitable embodiment. *See* EX1001, 25:14-22. Specifically, Tsai teaches that as one of the first steps of the reverse casting process, “the diamond grits are leveled on the surface of a mold for their regular distribution.” EX1004, 5:23-24. Similarly, Tsai teaches that “the diamond tips can be leveled by compressing the disk with a flat plate to reduce the variation in the heights of the diamond tips.” EX1004, 6:8-10. Accordingly, a POSITA would have been able to

readily obtain different tip variation values by merely changing the compression taught by Tsai. EX1002, ¶¶135-138.

Hence, a POSITA would have been able to achieve the claimed tip variation of “from about 5 microns to about 100 microns” with a reasonable expectation of success. EX1002, ¶¶135-138.

vi. **[1E] 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**

[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.

[13] The dresser of claim 1, wherein the highest protruding tip of each of the plurality of superabrasive particles align along the designated profile with a tip variation of from about 10 microns to about 50 microns.

[15] The dresser of claim 1, wherein the highest protruding tip of each of the plurality of superabrasive particles align along the designated profile with a tip variation of less than about 20 microns.

Tsai discloses [1E], [1F], [13], and [15]. As explained above in Section X.A.2.v [1D], Tsai discloses in Figure 6 that the *tip-to-tip variation* for all superabrasive diamond particles is about 19.8 μm (and a more generalized teaching that the tip-to-tip variation “can be less than about 15 μm ”). See EX1004, 8:22-24,

Figs. 5 and 6. And assuming that the claimed “tip variation” of claims 13 and 15 refer to a ***tip-to-tip*** variation, Tsai teaches [1E], [1F], [13], and [15]. *See Ineos*, 783 F.3d at 869 (Fed. Cir. 2015). EX1002, ¶140.

Specifically, for [1E], because Tsai’s ***tip-to-tip variation*** for the superabrasive diamond particles in Figure 6 is about 19.8 μm (and a more generalized teaching that the tip-to-tip variation “can be less than about 15 μm ”), the difference in protrusion distance between the highest protruding tip and the second highest protruding tip of the monolayer of superabrasive particles must also be about 19.8 μm (or less than 15 microns), which is within the claimed “less than or equal to about 50 microns.” EX1002, ¶141.

As for [1F], because Tsai’s ***tip-to-tip variation*** for the superabrasive diamond particles in Figure 6 is about 19.8 μm (and a more generalized teaching that the tip-to-tip variation “can be less than about 15 μm ”), the difference in protrusion distance between the highest 1% of the protruding tips of the monolayer of superabrasive particles must also be about 19.8 μm (or less than 15 microns), which is within the claimed “about 80 microns or less.” EX1002, ¶142.

As for [13] and [15], Tsai discloses that “the highest protruding tip of each of the plurality of superabrasive particles align along the designated profile” for the same reasons as discussed in Section X.A.2.v [1D]. EX1002, ¶¶143-144

Moreover, to the extent [13] and [15] are directed to a ***tip-to-tip variation***, because Tsai's tip-to-tip variation for the superabrasive diamond particles in Figure 6 is about 19.8 μm (and a more generalized teaching that the tip-to-tip variation "can be less than about 15 μm "), the highest protruding tip of each of the plurality of superabrasive particles must also align along the designated profile with a tip-to-tip variation of about 19.8 μm (or less than 15 microns), which is within the claimed "from about 10 microns to about 50 microns" and "less than about 20 microns." EX1002, ¶¶143-145.

Furthermore, to the extent [15] is directed to a ***tip-to-designated profile variation***, because Tsai's tip-to-designated profile variation for the superabrasive diamond particles in Figure 6 is 8.8 μm (33.0-24.2) (and a more generalized teaching of the tip-to-designated profile variation of less than 7.5 μm), the highest protruding tip of each of the plurality of superabrasive particles must also align along the designated profile with a tip-to-designated profile variation of about 8.8 μm (33.0-24.2) (or less than 7.5 microns), which is within the claimed "less than about 20 microns." EX1002, ¶145.

To the extent Patent Owner argues that Tsai does not explicitly disclose [1E], [1F], [13], and [15], a POSITA would have found the claimed ranges obvious for the same reasons discussed in Section X.A.2.v [1D]. Specifically, the disclosed "less than 15 μm " range overlaps the claimed ranges and renders these limitations

obvious. *See UCB*, 65 F.4th at 689 (“A presumption of obviousness applies where a claimed range overlaps with a range disclosed in the prior art.”) (quotation marks omitted). Indeed, Patent Owner cannot overcome this presumption of obviousness because the Patent Owner cannot show that the “prior art teaches away from the claimed range, ... the claimed range produces new and unexpected results,” or other evidence demonstrates non-obviousness of the claimed range. *Id.* at 689-90. EX1002, ¶146.

3. Dependent Claims 2 And 3

- i. **[2] The dresser of claim 1, wherein the difference in protrusion distance between the highest protruding tip and the second highest protruding tip is less than or equal to about 10 microns.**
- [3] The dresser of claim 1, wherein the difference in protrusion distance between the highest protruding tip and the second highest protruding tip is less than about 10 microns.**

Tsai renders obvious [2] and [3]. Specifically, Tsai teaches that “in the case of the ODD, the diamond tips of the ODD can be leveled to *less than 15 μ m.*” EX1004, 8:22-24. And because Tsai teaches that the tips can be leveled to a range that is less than 15 μ m, the highest and second protruding tips can also be leveled to a value that is less than about 15 microns, which encompasses the claimed “less than [or equal to] about 10 microns.” *See In re Peterson*, 315 F.3d 1325, 1330 (Fed. Cir. 2003) (“[A] prior art reference that discloses a range encompassing a somewhat

narrower claimed range is sufficient to establish a prima facie case of obviousness.”).

EX1002, ¶¶148-150.

Moreover, as explained in Section X.A.2.v [1D], there is nothing inventive or critical about the claimed ranges of “less than [or equal to] about 10 microns.” Hence, Patent Owner cannot overcome this presumption of obviousness because the Patent Owner cannot show that the “prior art teaches away from the claimed range, ... the claimed range produces new and unexpected results,” or other evidence demonstrates non-obviousness of the claimed range. *UCB* at 689-90. EX1002, ¶¶148-150.

4. Dependent Claims 4 And 5

- i. **[4] The dresser of claim 1, wherein the difference in protrusion distance between the highest protruding tip and the 10th highest protruding tip is less than or equal to about 20 microns.**

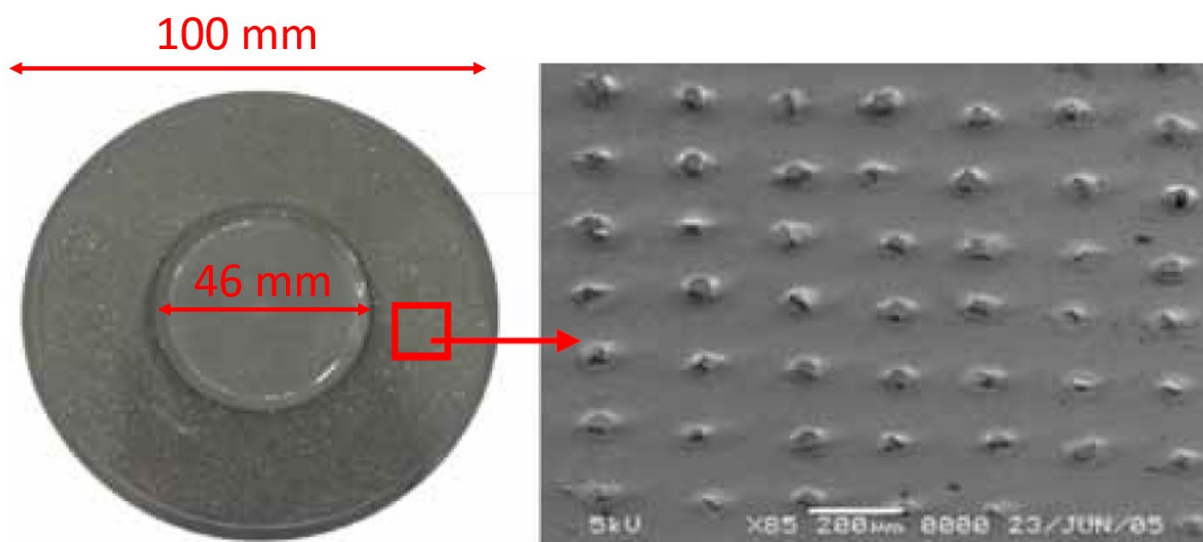
[5] The dresser of claim 1, wherein the difference in protrusion distance between the highest protruding tip and the 100th highest protruding tip is less than or equal to about 40 microns.

Tsai discloses [4] and [5]. As explained in Section X.A.2.v [1D], Tsai discloses that the tip-to-tip variation and tip-to-designated profile variation for the superabrasive diamond particles in Figure 6 are about 19.8 μm and 8.8 μm , respectively (and a more generalized teaching that the tip-to-tip variation “can be

less than 15 μm ” and hence a tip-to-designated profile variation is less than 7.5 μm).

See EX1004, 8:22-24, Figs. 5 and 6. EX1002, ¶152.

Additionally, as explained below, Tsai’s CMP pad dressers contain significantly more than 100 tips. See EX1004, 2:14-15 (“A typical diamond disk contains over 10,000 grits.”). Tsai discloses that the diameter of the CMP pad dresser is 100 mm. EX1004, 6:19-20 (“The diameter and thickness of the ODD are 100 mm and 5 mm, respectively.”), 7:10-11. Knowing that the outer diameter of the CMP pad dresser is 100 mm, the inner diameter of the region that is free of diamond particles shown in Figure 3 below is measured to be about 46 mm.



EX1004, Fig. 3 (annotated). EX1002, ¶153.

Moreover, the superabrasive particles in Figure 3 are arranged in a grid, spaced at a distance of about 200 microns (*see* scale bar). EX1004, 3:10-4:01, 5:20-6:05; *see also* Section X.A.5.ii [20, 21]. EX1002, ¶155.

An inter-diamond spacing of about 200 microns in a square pattern means the pad dresser includes about 1 diamond grit per about 0.04 mm^2 . The total area of the disk with a diameter of 100mm is about $7,854 \text{ mm}^2$.¹⁰ The area of the disk that the diamond particles is about $7,854 - 1,662 = 6,193 \text{ mm}^2$. Accordingly, the CMP pad dresser of Tsai includes about $6,193/0.04 = 154,800 \text{ particles}$. EX1002, ¶¶154-155.

¹⁰ The area of the diamond disk can be calculated using a formula for the area of the circle, which is $A=\pi r^2$, where r is the radius of the disk, *i.e.*, $\frac{1}{2}$ of the diameter.

EX1002, ¶154.

$$A_{outer} = \pi r^2 = \pi \left(\frac{100}{2} \text{ mm} \right)^2 = 7,854 \text{ mm}^2$$

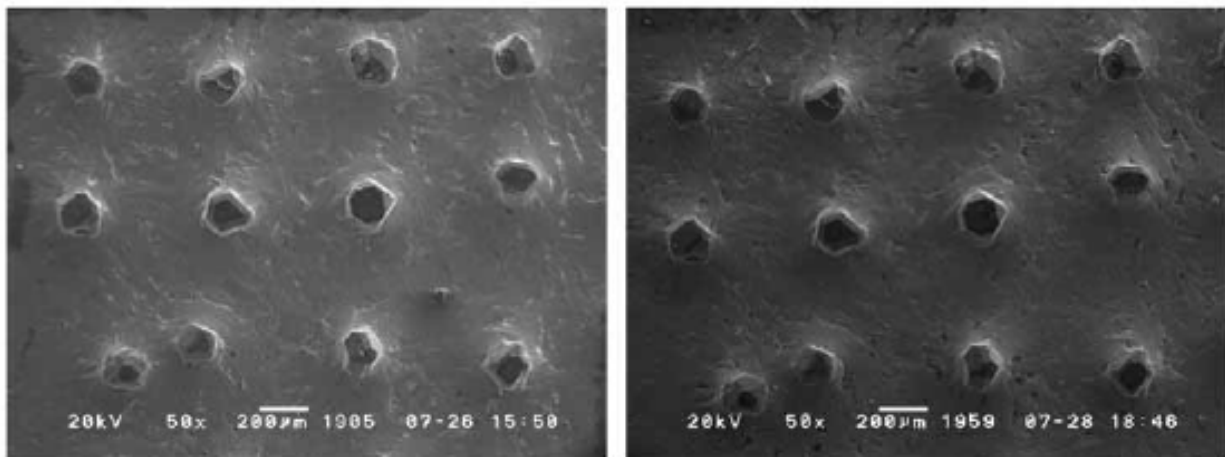
$$A_{inner} = \pi r^2 = \pi \left(\frac{46}{2} \text{ mm} \right)^2 = 1,662 \text{ mm}^2$$

$$\frac{1 \text{ particle}}{(\text{particle spacing})^2} \times (A_{outer} - A_{inner}) =$$

$$\frac{1 \text{ particle}}{0.2 \text{ mm} \times 0.2 \text{ mm}} (7,854 \text{ mm}^2 - 1,662 \text{ mm}^2) =$$

$$\underline{\underline{154,800 \text{ particles}}}$$

Similar calculations can be performed for the CMP pad dresser shown in Figures 5 and 8, assuming a similar diameter and peripheral configuration to that shown in Figure 3.



particles). EX1002, ¶¶156-157.

$$A_{outer} = \pi r^2 = \pi \left(\frac{100}{2} \text{ mm} \right)^2 = 7,854 \text{ mm}^2$$

$$A_{inner} = \pi r^2 = \pi \left(\frac{46}{2} \text{ mm} \right)^2 = 1,662 \text{ mm}^2$$

$$\frac{1 \text{ particle}}{(\text{particle spacing})^2} \times (A_{outer} - A_{inner}) =$$

$$\frac{1 \text{ particle}}{0.5 \text{ mm} \times 0.5 \text{ mm}} (7,854 \text{ mm}^2 - 1,662 \text{ mm}^2) =$$

$$\underline{\underline{24,768 \text{ particles}}}$$

In short, regardless of the specific CMP pad dresser described by Tsai, they all contain a significantly larger number of diamond particles than the claimed 10th highest and 100th highest protruding tips.

Hence, for [4], because the tip-to-tip variation for the superabrasive diamond particles in Figure 6 is about 19.8 μm (and a more generalized teaching that the tip-to-tip variation “can be less than 15 μm ”), the difference in protrusion distance between the highest protruding tip and the 10th highest protruding tip (among the about 154,800 diamond particles) must also be less than 19.8 microns (or less than

15 microns), which is within the claimed “less than or equal to about 20 microns.”
EX1002, ¶¶158-159.

As for [5], because the tip-to-tip variation for the superabrasive diamond particles in Figure 6 is about 19.8 μm (and a more generalized teaching that the tip-to-tip variation “can be less than 15 μm ”), the difference in protrusion distance between the highest protruding tip and the 100th highest protruding tip (among about 154,800 diamond particles) must also be less than about 19.8 microns (or less than 15 microns), which is within the claimed “less than or equal to about 40 microns.”
EX1002, ¶¶158, 160.

To the extent Patent Owner argues that Tsai does not explicitly disclose [4] and [5], a POSITA would have found it obvious to obtain a tip variation of the superabrasive particles in the manner claimed in [4] and [5] with a reasonable expectation of success for the same reasons as explained in Section X.A.2.vi [1E, 1F, 13, 15]. There is nothing inventive or critical about the claimed ranges. EX1002, ¶161.

5. Dependent Claims 19-21

- i. **[19] The dresser of claim 1, wherein the designated profile includes a configuration selected from the group consisting of a plane, a slope, a curved shape, a dome shape, and combinations thereof.**

Tsai discloses [19]. As explained above in Section X.A.2.v [1D], Tsai discloses the tips of the superabrasive diamond particles that are aligned along a

“flat” profile, which meets the claimed “plane” configuration. *See* EX1004, 6:8-10

(“In this case, the diamond tips can be leveled by compressing the disk with a flat plate to reduce the variation in the heights of the diamond tips.”). EX1002, ¶163.

- ii. **[20] The dresser of claim 1, wherein the plurality of superabrasive particles is arranged across the support substrate in a predetermined pattern.**

[21] The dresser of claim 20, wherein the predetermined pattern includes an even distribution of the plurality of superabrasive particles spaced at a distance of from about 100 microns to about 800 microns.

Tsai discloses [20] and [21]. As shown in Figures 3, 5, and 8 below, the superabrasive diamond particles are arranged across the epoxy resin in a predetermined grid pattern in an even distribution. EX1004, Figs. 3, 5, and 8 (which show the even distribution of superabrasive particles in a grid pattern across the support substrate); *see also id.*, 3:10-4:1, 5:20-6:5 (“First, the *diamond grits are leveled on the surface of a mold for their regular distribution...*”), Fig. 2 (showing the manufacturing of the ODD using a mold).

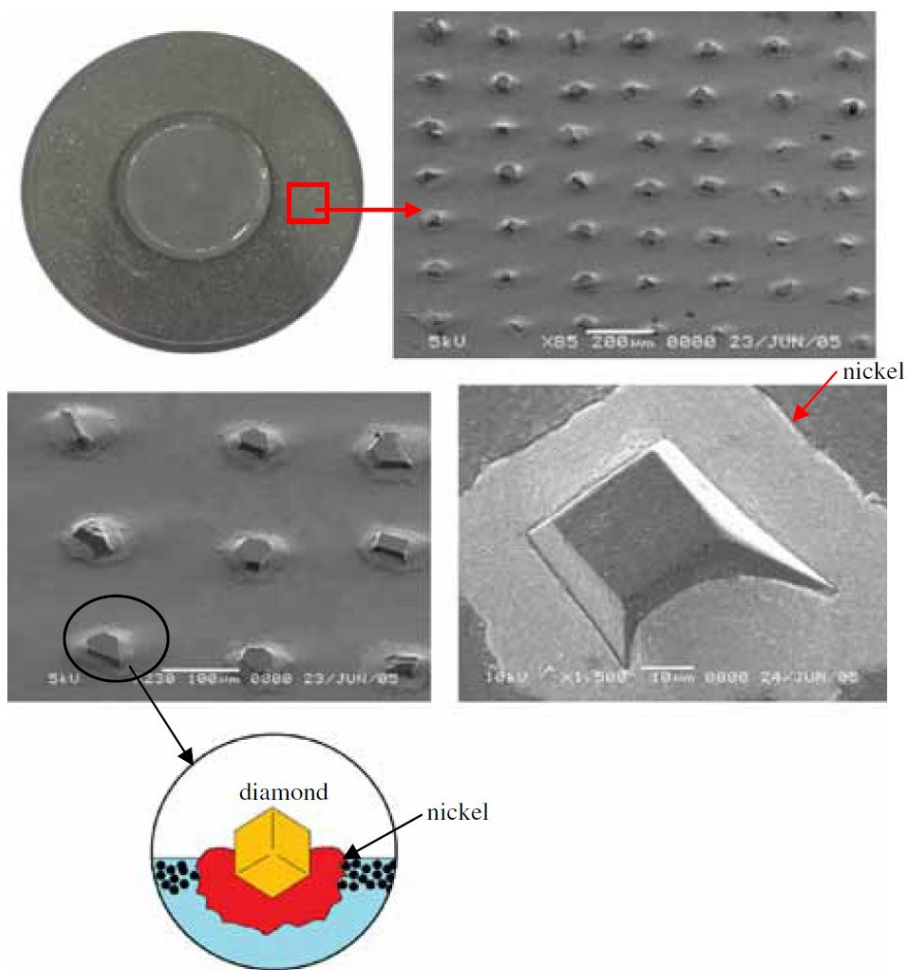
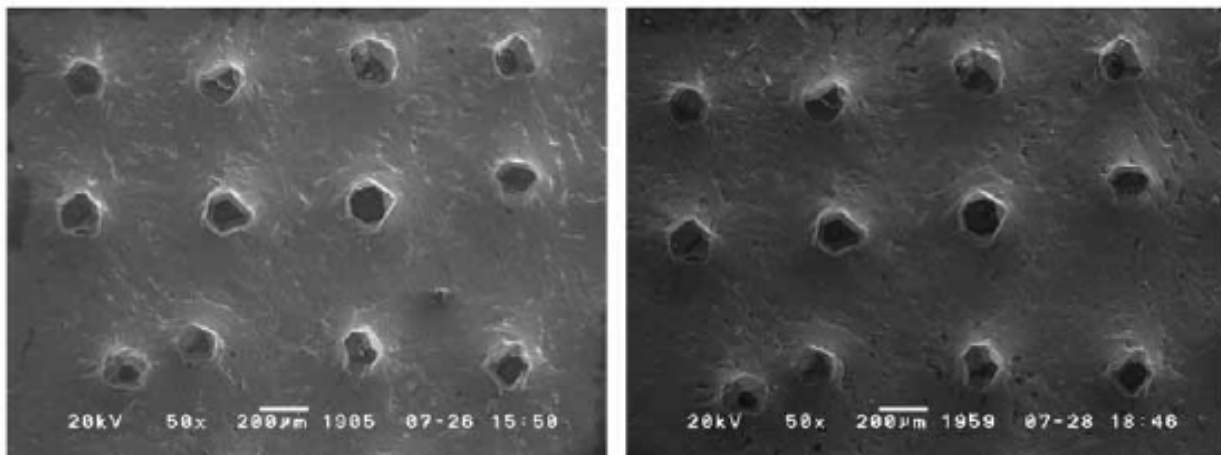
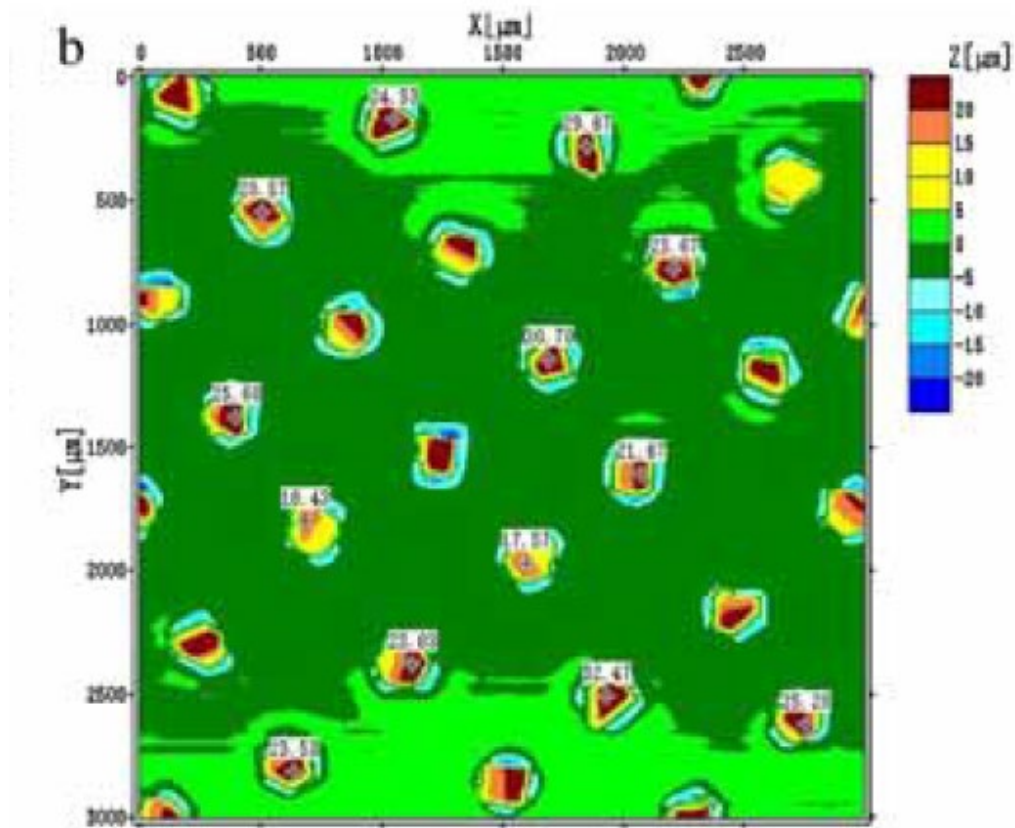


Fig. 3. Outer appearance of the organic diamond disk. Note that each diamond is covered with nickel.



EX1004, Figs. 3, 5b, 8c, 8d. EX1002, ¶¶165-166.

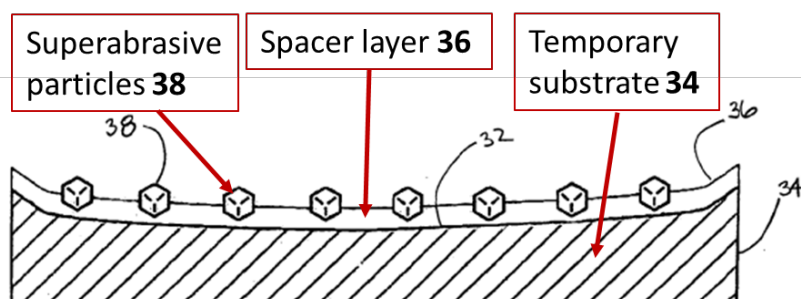
Moreover, the exemplary CMP pad dressers shown in Figures 3, 5, and 8 each show an even spacing between the superabrasive diamond particles. For example, Figure 3 shows an even spacing of about 200 microns, and Figures 5 and 8 show an

even spacing of about 400-500 microns. Hence, any one of these CMP pad dressers shown in Figures 3, 5, and 8 meets the claimed range of “from about 100 microns to about 800 microns.” See *Ineos*, 783 F.3d at 869 (Fed. Cir. 2015). EX1002, ¶167.

B. Ground II: Tsai In Combination With Sung’026 Renders Obvious Claims 1-3, 6-14, And 16-18¹¹

1. Overview Of Sung’026

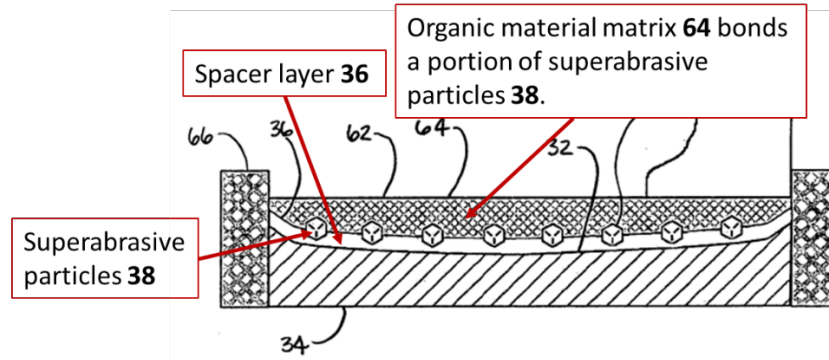
Like Tsai, Sung’026 is directed to CMP pad dressers with superabrasive particles in which “reverse casting methods may be utilized to manufacture the CMP pad dresser.” EX1005, [0001], [0009], [0083]. Specifically, much like the ’802 Patent and Tsai, the superabrasive particles are first “disposed into a spacer layer,” as shown below in Fig. 2. *Id.* at [0084].



EX1005, FIG. 2 (annotated). EX1002, ¶¶87-90.

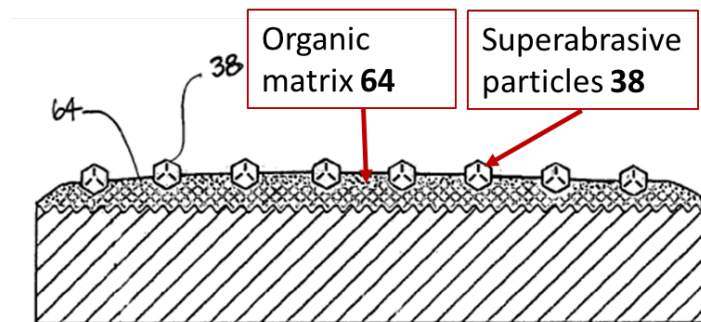
Then, an uncured organic material is applied to the spacer layer, and upon curing, the organic material matrix bonds “at least a portion of each superabrasive particle.” EX1005, [0087].

¹¹ Reasons to combine Tsai with Sung’026 are discussed in Section X.B.6 below.



EX1005, FIG. 5 (annotated). EX1002, ¶91.

Subsequently, the spacer layer is removed from the organic matrix. Thereby, the “distance of the protrusion of the superabrasive particles 38 from the organic material layer 64” is “approximately equal to the thickness of the now removed spacer layer,” as shown in Figure 6, below. EX1005, [0088].



EX1005, FIG. 6 (annotated). EX1002, ¶92.

1. Independent Claim 1

- i. **[1D] 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,**

Tsai teaches or suggests claim 1. *See* Section X.A.2 [Ground I, Clam 1]. To the extent Patent Owner argues that Tsai’s Figure 6 or Tsai’s disclosure of “less than

15 μm ” discussed in Ground I does not teach or suggest [1D], Sung’026 teaches [1D]. Specifically, Sung’026 teaches that “the plurality of superabrasive particles are arranged such that their tips vary from the designated profile by from about 5 microns to about 100 microns.” EX1005, [0056]; *see also id.*, [0011], [0053]. EX1002, ¶169.

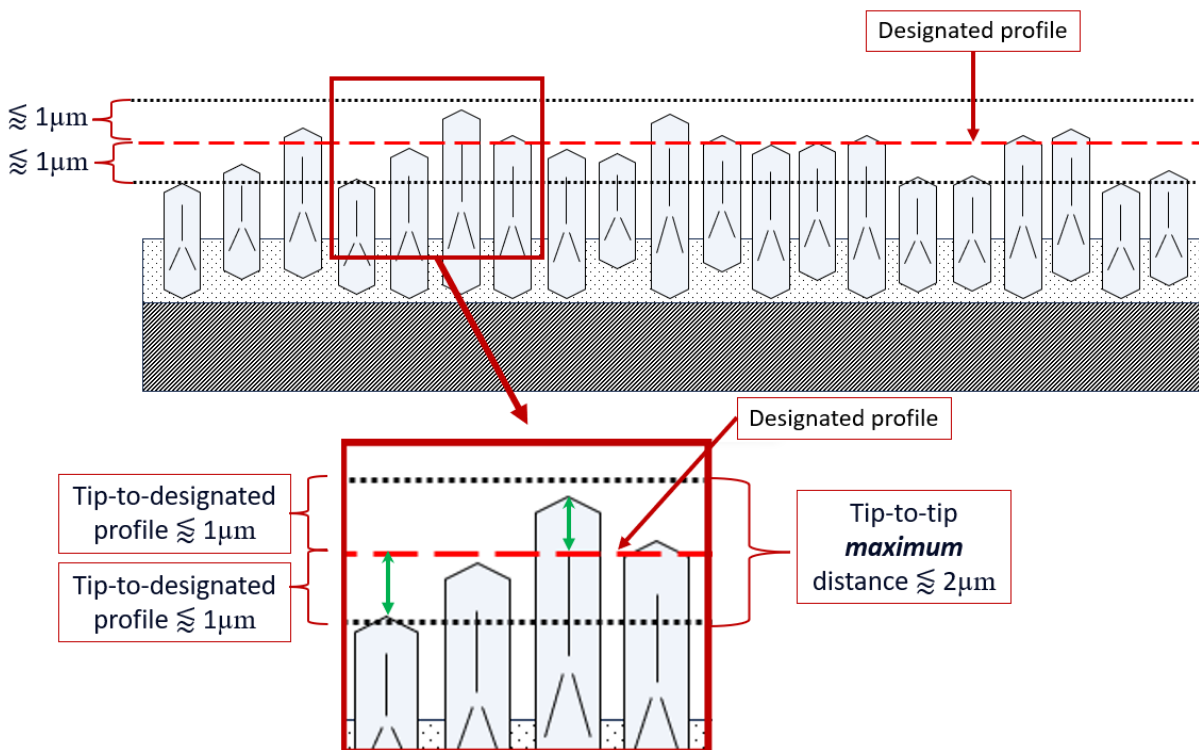
2. Dependent Claims 2 And 3

- i. **[2] The dresser of claim 1, wherein the difference in protrusion distance between the highest protruding tip and the second highest protruding tip is less than or equal to about 10 microns.**

[3] The dresser of claim 1, wherein the difference in protrusion distance between the highest protruding tip and the second highest protruding tip is less than about 10 microns.

Tsai and Sung’026 render obvious [2] and [3]. Tsai does not explicitly disclose that the difference in protrusion distance between the highest protruding tip and the second highest protruding tip is less than or equal to about 10 microns. However, Sung’026 teaches CMP pad dressers—made using the same “reverse casting” technique—that have superabrasive particles arranged such that their tip-to-designated profile distance varies by less than about 1 micron. *See* EX1005, [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.*”), [0010], [0052], [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.”), [0083], claims 33-35, 37. And because the tip-to-designated profile variation for all superabrasive diamond particles is less than about 1 micron, the difference in protrusion distance between the highest protruding tip and the least protruding tip is less than about 2 microns (*see below*). Accordingly, the difference in protrusion distance between the highest protruding tip and the second highest protruding tip must also be less than about 2 microns, which is within the claimed “less than about 10 microns.” EX1002, ¶¶171-177.



3. Dependent Claims 6, 7, And 16-18

- i. **[6A] The dresser of claim 1, wherein the plurality of superabrasive particles includes a plurality of working superabrasive particles,**

At the outset, as discussed in Section IX [Claim Construction], the '802 Patent notes that “[a]s used herein, ‘*working superabrasive particles*’ are superabrasive particles that cut or otherwise deform a CMP pad during a dressing or conditioning procedure.” EX1001, 4:46-48. Even assuming this is a lexicographic definition that must be applied, Tsai teaches [6A].

Tsai explains that the diamond particles act as cutters and share an equal dressing load during the dressing or conditioning procedure. *See* EX1004, 8:13-14 (“[T]he ODD has regular diamond cutters.”), 8:24-26 (“The better-leveled ODD has *more cutters that can dress the pad*, and thus, they *share an equal dressing load*.”), Fig. 5b (showing the “cutting tips” of ODD). Tsai explains that the ODD is an improvement over conventional diamond conditioner that typically contain “over 10,000 grits; however, less than 10% of the diamond grits are engaged in cutting the polishing pad.” EX1004, 2:14-16. Hence, Tsai’s monolayer of diamond grits in the ODD “includes a plurality of working superabrasive particles.” EX1002, ¶180.

- ii. **[6B] such that rotating the dresser against a CMP pad cuts asperities into the CMP pad having a cutting depth of less than or equal to about 50 microns.**

[7] The dresser of claim 6, wherein the cutting depth is from about 10 microns to about 50 microns.

[16] The dresser of claim 1, wherein the protrusions of the plurality of superabrasive particles produce cutting depths of less than about 20 microns when used to abrade a CMP pad.

[17] The dresser of claim 1, wherein the protrusions of the plurality of superabrasive particles produce cutting depths of from about 1 micron to about 20 microns when used to abrade a CMP pad.

[18] The dresser of claim 1, wherein the protrusions of the plurality of superabrasive particles produce cutting depths of from about 10 microns to about 20 microns when used to abrade a CMP pad.

Tsai and Sung'026 render obvious [6B], [7], and [16]-[18].

Tsai teaches that CMP pad dressers rotate against the CMP pad. EX1004, 6:22-7:02 (“The *diamond pad conditioner* was attached via a connecting holder to a *rotating* head spinning at 10 rpm. A *polyurethane pad* was mounted on a table disk that rotated at a speed of 40 rpm.”). EX1002, ¶182.

Tsai further explains that the diamond particles cut asperities into the CMP pad. See EX1004, 2:4-9 (“For the CMP process to continue and to regenerate the asperity structure of the pad...”), 8:13-14, 8:24-26, Fig. 5b. EX1002, ¶183.

Tsai does not explicitly discuss the cutting depth. However, Sung’026 teaches that the CMP pad dresser can “produce[] a cutting depth of from about 1 micron to about 20 microns when used to abrade a work piece.” EX1005, claim 5; *see also id.*, [0010], [0052], claim 4 (“... produces a cutting depth of less than about 20 microns...”), and claim 6 (“... produces a cutting depth of from about 10 micron[s] to about 20 microns...”). This disclosure of Sung’026 teaches the “cutting depth” of [6B], [7], and [16]-[18]. *See Ineos*, 783 F.3d at 869 (Fed. Cir. 2015). EX1002, ¶¶184-185.

4. Dependent Claims 8-12

- i. **[8] The dresser of claim 6, wherein the plurality of working superabrasive particles includes at least 100 working superabrasive particles.**
[9] The dresser of claim 6, wherein the plurality of working superabrasive particles includes at least 1000 working superabrasive particles.

Tsai teaches or Tsai and Sung’026 render obvious [8] and [9].

To briefly restate the reasons stated in Sections X.A.4.i [4, 5] and X.B.3.i [6a], the total number of diamond particles that are on the CMP pad dresser shown in Figure 3 can be calculated using a simple calculation, as shown below, showing approximately *154,800 particles*:

$$A_{outer} = \pi r^2 = \pi \left(\frac{100}{2} \text{ mm} \right)^2 = 7,854 \text{ mm}^2$$

$$A_{inner} = \pi r^2 = \pi \left(\frac{46}{2} \text{ mm} \right)^2 = 1,662 \text{ mm}^2$$

$$\frac{1 \text{ particle}}{(\text{particle spacing})^2} \times (A_{outer} - A_{inner}) =$$

$$\frac{1 \text{ particle}}{0.2 \text{ mm} \times 0.2 \text{ mm}} (7,854 \text{ mm}^2 - 1,662 \text{ mm}^2) =$$

$$\underline{\underline{154,800 \text{ particles}}}$$

As for the CMP pad dresser shown in Figs. 5b, 8c, and 8d, by taking the diamond-to-diamond particle spacing to be roughly 500 microns, the total number of diamond particles on the CMP pad dresser can be calculated as shown below (*i.e.*, approximately **24,768 particles**).

$$A_{outer} = \pi r^2 = \pi \left(\frac{100}{2} \text{ mm} \right)^2 = 7,854 \text{ mm}^2$$

$$A_{inner} = \pi r^2 = \pi \left(\frac{46}{2} \text{ mm} \right)^2 = 1,662 \text{ mm}^2$$

$$\frac{1 \text{ particle}}{(\text{particle spacing})^2} \times (A_{outer} - A_{inner}) =$$

$$\frac{1 \text{ particle}}{0.5 \text{ mm} \times 0.5 \text{ mm}} (7,854 \text{ mm}^2 - 1,662 \text{ mm}^2) =$$

$$\underline{\underline{24,768 \text{ particles}}}$$

EX1002, ¶¶187-188.

Tsai further explains that the diamond particles act as cutters and share an equal dressing load during the dressing or conditioning procedure. *See* EX1004, 8:13-14 (“[T]he ODD has regular diamond cutters.”), 8:24-26 (“The better-leveled ODD has *more cutters that can dress the pad*, and thus, they *share an equal dressing load.*”), Fig. 5b (showing the “cutting tips” of ODD). Hence, Tsai’s CMP pad dressers all teach the claimed “at least 100” or “at least 1000 working superabrasive particles” of [8] and [9]. EX1002, ¶189.

Tsai and Sung’026 alternatively render obvious [8] and [9]. Sung’026’s

“arrangement of the plurality of superabrasive particles may be configured to uniformly distribute frictional forces across substantially each superabrasive particle[, and that s]uch a uniform distribution of frictional force prevents any individual superabrasive particle from being overstressed and pulling out of the solidified organic material layer.” EX1005, [0051]; *see also id.*, [0075], claim 2. In other words, because each of the superabrasive particles experiences frictional forces against the CMP pad, all of Sung’026 superabrasive particles are contributing to cutting asperities and meet the claimed “working superabrasive particles.” EX1002, ¶191.

At a minimum, Sung’026 discloses that “a **majority** of the plurality of superabrasive particles may protrude to a predetermined height above the solidified organic material layer” and that such “predetermined height may produce a cutting depth of from about 1 micron to about 20 microns when used to abrade a work piece.” EX1005, [0052]; *see also id.* [0076], claims 3-6. Therefore, more than half (*i.e.*, “majority”) to almost all of the diamond particles in the CMP pad dresser cut asperities into the CMP pad as the dresser is rotated and function as a “working superabrasive particle.” EX1002, ¶¶192-193.

Hence, at a minimum, more than half (*i.e.*, “majority”) of the diamond particles present on Tsai’s CMP pad dressers contribute to cutting asperities into the CMP pad, which would still be tens of thousands of working superabrasive particles,

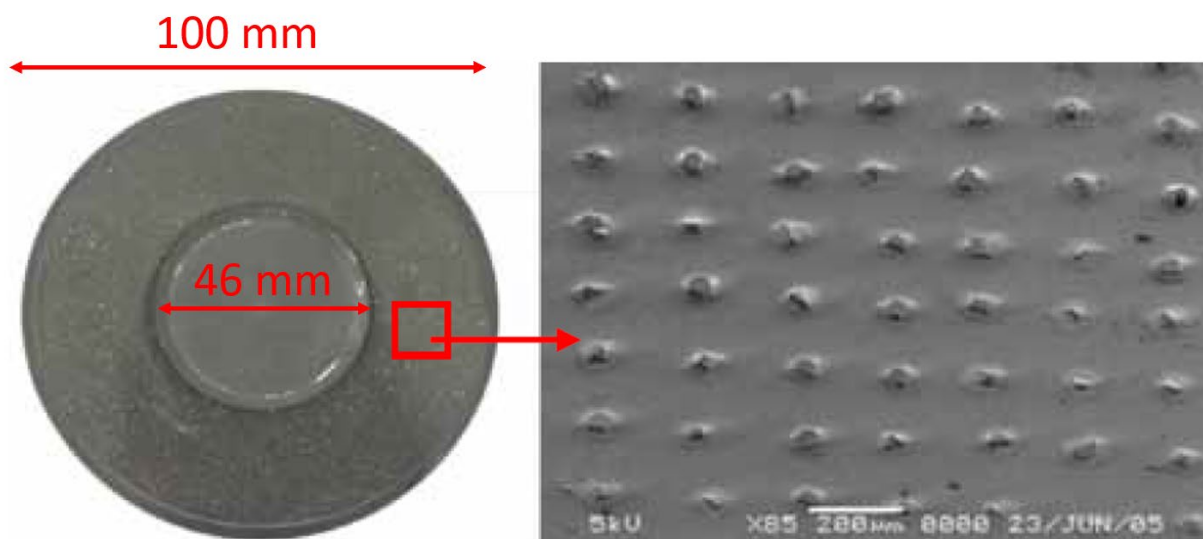
and many orders of magnitude larger than the claimed “at least 100” or “at least 1000 working superabrasive particles” of [8] and [9]. EX1002, ¶193.

i. **[10] The dresser of claim 6, wherein the plurality of working superabrasive particles includes from about 1000 to about 6000 working superabrasive particles.**

[11] The dresser of claim 6, wherein the plurality of working superabrasive particles includes from about 2000 to about 5000 working superabrasive particles.

Tsai in combination with Sung’026 renders obvious [10] and [11] because a POSITA would have found it obvious to try different pad conditioners that meet the claimed number of particles based on the range of fabrication values disclosed in Tsai and Sung’026. EX1002, ¶194.

As explained in Sections X.A.4.i [4, 5] and X.B.4.i [8, 9], Tsai made exemplary CMP pad dressers that have an outer diameter of about 100 mm with diamond particles with an inner diameter of about 46 mm that is free of diamond particles. As a result, there were tens of thousands of diamond particles on the CMP pad dresser.



EX1004, Fig. 3 (annotated). EX1002, ¶195.

However, Sung’026 explains that a wide range of diamond particle sizes and diamond-to-diamond particle spacing is possible. *See, e.g.,* EX1005, [0012] (“Any superabrasive particle size ... are considered to be within the present claim scope.”), [0052] (“Various configuration or arrangements are contemplated”). For example, Sung’026 explains that “the plurality of superabrasive particle may be from about 30 microns to about **250 microns in size.**” EX1005, [0012]. In addition, Sung’026 explains that “[t]he arrangement or distribution of superabrasive particle along the surface of an abrading tool may also function to effectively distribute mechanical forces ... In one embodiment, ... the plurality of superabrasive particles may be evenly spaced at a distance of from about 3 times to about **5 times the average size of the superabrasive particles.**” EX1005, [0014]. Taking the endpoints of these disclosed ranges, a POSITA would have readily found it obvious

to try a diamond-to-diamond spacing up to 1250 microns (5 x 250 microns).

EX1002, ¶¶196-198.

And by applying the diamond-to-diamond spacing of 1250 microns to the same CMP pad configuration having an outer diameter of 100 mm and inner diameter of 46 mm, the total number of diamond particles is about **3,963** diamond particles.

$$A_{outer} = \pi r^2 = \pi \left(\frac{100}{2} \text{ mm} \right)^2 = 7,854 \text{ mm}^2$$

$$A_{inner} = \pi r^2 = \pi \left(\frac{46}{2} \text{ mm} \right)^2 = 1,662 \text{ mm}^2$$

$$\frac{1 \text{ particle}}{(\text{particle spacing})^2} \times (A_{outer} - A_{inner}) =$$

$$\frac{1 \text{ particle}}{1.25 \text{ mm} \times 1.25 \text{ mm}} (7,854 \text{ mm}^2 - 1,662 \text{ mm}^2) =$$

$$\underline{\underline{\mathbf{3,963 \text{ particles}}}}$$

The claimed ranges of “about 1000 to about 6000” and “about 2000 to about 5000 working superabrasive particles” are obvious ranges that a POSITA would have

been able to readily achieve by simple changes in the geometry of the arrangement of the particles. There is nothing inventive about these claimed ranges. In short, Tsai and Sung'026 also render obvious [10] and [11]. EX1002, ¶¶199-200.

- ii. **[12] The dresser of claim 6, wherein the plurality of working superabrasive particles include at least about 1000 working superabrasive particles that protrude from the rigid support substrate to distances within about 30 microns of one another.**

Tsai teaches [12]. As discussed in Section X.B.4.i [8, 9], Tsai teaches, or Tsai and Sung'026 render obvious, “the plurality of working superabrasive particles include at least about 1000 working superabrasive particles.” EX1002, ¶202.

Tsai further teaches that the superabrasive particles “protrude from the rigid support substrate to distances within about 30 microns of one another.” As explained above in Sections X.A.2.iv [1C] and X.A.2.v [1D], Tsai discloses and/or renders obvious that all superabrasive particles of the CMP pad dresser protrude from the rigid support to distances that is less than 15 microns of each other. EX1004, 8:22-24, Fig. 6. EX1002, ¶203.

5. Dependent Claims 13 and 14

- i. [13] The dresser of claim 1, wherein the highest protruding tip of each of the plurality of superabrasive particles align along the designated profile with a tip variation of from about 10 microns to about 50 microns.

[14] The dresser of claim 1, wherein the highest protruding tip of each of the plurality of superabrasive particles align along the designated profile with a tip variation of from about 20 microns to about 40 microns.

Tsai and Sung’026 render obvious [13] and [14].

If Patent Owner asserts that “tip variation” of [13] and [14] require the *tip-to-designated profile* variation (and not *tip-to-tip* variation as explained above in Section X.A.2.vi for [13] in Ground I) be “from about 10 microns to about 50 microns” and “from about 20 microns to about 40 microns,” respectively, Tsai and Sung’026 render obvious [13] and [14]. EX1002, ¶¶205-208.

Such tip-to-designated profile variations were well-known and there is nothing inventive or critical about the claimed ranges. For example, Sung’026’s CMP pad dressers—made using the same “reverse casting” technique described in Tsai—have superabrasive particles arranged such that their tip-to-designated profile vary “from about 1 micron to about 150 microns,” such as “from about 10 microns to about 50 microns” and “from about 20 microns to about 40 microns.” See EX1005, [0056] (“In yet another aspect, the plurality of superabrasive particles are

arranged such that their tips vary from the designated profile by from ***about 10 microns to about 50 microns. ... about 20 microns to about 40 microns.***”), [0052], [0073], claims 33-35. And because the tip-to-designated profile variation of the superabrasive diamond particles is from about 10 microns to about 50 microns or from about 20 microns to about 40 microns, the highest protruding tip of each of the plurality of superabrasive particles must also align along the designated profile with a tip-to-designated profile variation of from about 10 microns to about 50 microns or about 20 microns to about 40 microns. EX1002, ¶208.

The proposed modification amounts to nothing more than a simple substitution of different tip-to-designated profile variation values taught in the art (e.g., 8.8 microns or less than 7.5 microns in Tsai’s examples vs. the claimed 10-50 microns or the 20-40 microns range taught in Sung’026) to provide CMP pad dressers that have acceptable conditioning characteristics. Tsai teaches that as one of the first steps of the reverse casting process, “the diamond grits are leveled on the surface of a mold for their regular distribution.” EX1004, 5:23-24. A POSITA would have been able to provide different degrees of leveling of the diamond grits on the surface of the mold. EX1002, ¶¶209-211.

As another example, Tsai teaches that “the diamond tips can be leveled by compressing the disk with a flat plate to reduce the variation in the heights of the diamond tips.” EX1004, 6:8-10. A POSITA would have been able to readily obtain

different tip variation values by merely changing the compression taught by Tsai. Moreover, a POSITA would have recognized that a leveling difference of a few microns would still provide similar characteristics for pad conditioning. Simultaneously, making CMP pad dressers have a slightly larger tip variation may make the fabrication easier (*i.e.*, with slightly relaxed tolerance requirements). EX1002, ¶210.

At a minimum, it would been obvious to try from the finite number of identified tip-to-designated profile variations enumerated in Sung’026 to produce a suitable CMP pad dresser with a reasonable expectation of success. EX1002, ¶212.

6. Reasons To Combine Tsai With Sung’026

A POSITA would have had numerous reasons to combine Tsai with Sung’026 and would have made the combination with a reasonable expectation of success.

First, both Tsai and Sung’026 are in the analogous art as the claimed CMP pad dressers. *See* EX1004, Title; EX1005, [0009]; EX1001, claim 1. EX1002, ¶214.

Second, both Tsai and Sung’026’s CMP pad dressers are made by a “reverse casting” process—the same technique the ’802 Patent discusses. *See* EX1004, 3:10 (“The ODD is manufactured by **reverse casting** polymers.”), 5:20-21; EX1005, [0083] (“Various **reverse casting** methods may be utilized to manufacture the CMP pad dresser of the present invention.”), [0075]; EX1001, 25:14-22 (“Additionally, so-called ‘**reverse casting**’ methods can be used to accurately orient and attach the

dressing segments to the support substrate.”). Hence, a POSITA would have recognized that the teachings of Tsai and Sung’026 would have been equally applicable to one another. For example, Sung’026’s teaching that the “arrangement of the plurality of superabrasive particles may be configured to uniformly distribute frictional forces across substantially each superabrasive particle,[and that]such a uniform distribution of frictional force prevents any individual superabrasive particle from being overstressed and pulling out of the solidified organic material layer,” (EX1005, [0051]), would equally be applicable to the CMP pad dressers made by Tsai. EX1002, ¶215.

Third, a POSITA would have been motivated to make CMP pad dressers that have a tip-to-designated profile variation that is small (*e.g.*, less than about 1 micron) because both Tsai and Sung’026 disclose that the superabrasive tools perform better if the superabrasive particles are leveled. *See* EX1004, 3:08-10 (“This design remarkably improves the leveling of diamond tips and markedly reduces the CMP cost.”), 8:22-26 (“The better-leveled ODD has more cutters that can dress the pad, and thus, they share an equal dressing load.”); EX1005, [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.”), [0011], [0006] (“Further, the smaller size of the superabrasive particles means that the particle tip height must be precisely leveled in order to uniformly dress the pad.”). EX1002, ¶216.

On the other hand, a POSITA would have recognized that other tip-to-designated profile variations are acceptable (*e.g.*, from about 10 microns to about 50 microns or from about 20 microns to about 40 microns), taking into account different considerations such as cost of manufacturing, ease of processing conditions, and the like. Indeed, Sung’026 contemplates different tip-to-designated profile variation that range “from about 1 micron to about 150 microns,” such as “from about 10 microns to about 50 microns” and “from about 20 microns to about 40 microns.” EX1005, [0056]. As such, a POSITA would have considered leveling the height of the superabrasive particles to the various levels taught by Sung’026 to arrive at an optimum set of conditions that balance ease of fabrication and improved conditioning performance. At a minimum, it would have been obvious to try from the finite number of identified tip-to-designated profile variations enumerated in Sung’026 to achieve predictable solutions. EX1002, ¶217.

And having made the combination of Tsai with Sung’026 with the specific tip variations as taught by Sung’026, a POSITA would have readily recognized that the cutting depth taught by Sung’026 would be equally achievable in the combination of Tsai with Sung’026, as they would be expected to dress similar polyurethane CMP pads. Hence, a POSITA would have been able to make the combination to achieve the claimed cutting depths of the CMP pads with routine experimentation by combining the teachings of Tsai with Sung’026. EX1002, ¶218.

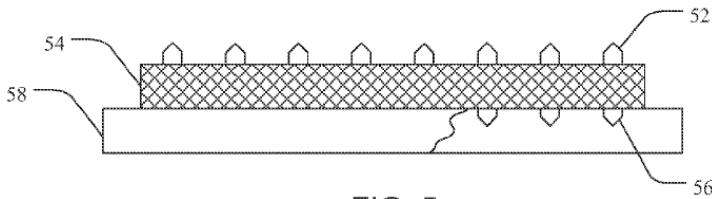
Finally, a POSITA would have been able to make such CMP pad dressers having a tip variation that is less than about 1 micron (or other suitable values) with a reasonable expectation of success because the methods of making the CMP pad dressers are the same “reverse casting” process, as described above. For example, Tsai teaches that as one of the first steps of the reverse casting process, “the diamond grits are leveled on the surface of a mold for their regular distribution.” EX1004, 5:23-24. A POSITA would have been able to provide different degrees of leveling of the diamond grits on the surface of the mold. EX1002, ¶219.

As another example, Tsai teaches that “the diamond tips can be leveled by compressing the disk with a flat plate to reduce the variation in the heights of the diamond tips.” EX1004, 6:8-10. A POSITA would have been able to readily obtain different tip variation values by merely changing the compression taught by Tsai. In fact, given the similarity of the methods, such a modification would have been trivial. At a minimum, a POSITA would have found it obvious to try to combine the disclosures of Sung’026 with Tsai to achieve a relatively uniform tip variation with a reasonable expectation of success. EX1002, ¶220.

C. Ground III: Sung’146 In Combination With Sung’026 Renders Obvious Claims 1-7 And 13-21

As explained in Section VII.C, the earliest possible priority date of the ’802 Patent is October 3, 2014. Hence, each of the parent applications that the ’802 Patent claims priority to, if published more than a year before October 3, 2014, are available

as prior art. The claim chart below identifies the specific portions of Sung'146 and Sung'026 that render obvious claims 1-7 and 13-21 of the '802 Patent. EX1002, ¶¶221-223.

'802 Patent Claims	Sung'146 (EX1029) and Sung'026 (EX1005)
[1Pre]	“A CMP pad dresser, comprising: ...” (EX1029, claim 1); “the tool is a CMP pad dresser.” (EX1005, claim 65)
[1A] and [1B]	“In one specific aspect, a rigid support is coupled to the matrix layer.” (EX1029, [0003]) “In yet another aspect, as is shown in FIG. 5, a CMP pad dresser can include a <i>first monolayer of superabrasive particles 52</i> and a second monolayer of superabrasive particles 56 <i>coupled to a metal support layer 54</i>. The superabrasive particles can be coupled to the metal support layer directly or via a bonding material.” (EX1029, [0069])  FIG. 5
[1C]	“wherein each superabrasive particle in the monolayer protrudes from the matrix layer” (EX1029, claim 1)
[1D]	“In another aspect, the plurality of superabrasive

	particles are arranged such that their tips vary from the designated profile by from about 5 microns to about 100 microns.” (EX1005, [0056])
[1E] and [1F]	“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.” (EX1029, claim 1)
[2] and [3]	“In another aspect, the difference in protrusion distance between the highest protruding tip and the second highest protruding tip is less than or equal to about 10 microns.” (EX1029, [0004])
[4]	“The dresser of claim 2, wherein the difference in protrusion distance between the highest protruding tip and the 10th highest protruding tip is less than or equal to about 20 microns.” (EX1029, claim 3)
[5]	“The dresser of claim 3, wherein the difference in protrusion distance between the highest protruding tip and the 100th highest protruding tip is less than or equal to about 40 microns.” (EX1029, claim 4)
[6]	“Though any predetermined height that would be useful in an abrading tool would be considered to be within the presently claimed scope, in one specific

	aspect the predetermined height may produce a cutting depth of less than about 20 microns when used to abrade a work piece.” (EX1005, [0052]) “The protruding superabrasive particles 12 can cut into the CMP pad to a depth that is essentially the distance of the protrusion.” (EX1005, [0076])
[7] and [16]-[18]	“[I]n 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.” (EX1005, [0052]) “The protruding superabrasive particles 12 can cut into the CMP pad to a depth that is essentially the distance of the protrusion.” (EX1005, [0076])
[13]-[15]	“In a further aspect, the plurality of superabrasive particles are arranged such that their tips vary from the designated profile by from about 10 microns to about 50 microns. ... 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. Additionally, in one aspect, the plurality of superabrasive particles are arranged such that their tips vary from the designated profile by less than about 20 microns.” (EX1005, [0056])
[19]	“In one aspect, the designated profile may be a plane. In another aspect, the designated profile may have a slope. In yet another aspect, the designated profile may have a curved shape. In a further aspect, the designated profile may have a dome shape.” (EX1005, [0011])
[20]	“In one aspect, the superabrasive particles can be arranged into a predetermined pattern.” (EX1029, [0058])
[21]	“In yet another aspect, the plurality of superabrasive particles may be evenly space at a distance of from about 100 microns to about 800 microns.” (EX1005, [0060]).

A POSITA would have had numerous reasons to combine the teachings of Sung’146 and Sung’026 with a reasonable expectation of success. EX1002, ¶224.

First, both Sung’146 and Sung’026 are in the analogous art as the claimed CMP pad dressers. *See* EX1029, claim 1; EX1005, claim 65; EX1001, claim 1. EX1002, ¶225.

Second, both Sung’146 and Sung’026’s CMP pad dressers are made by a “reverse casting” process—the same technique the ’802 Patent discusses. *See* EX1029, [0073] (“Additionally, so-called ‘**reverse casting**’ methods can be used....”); EX1005, [0083] (“Various **reverse casting** methods may be utilized....”), [0075]; EX1001, 25:14-22 (“Additionally, so-called ‘**reverse casting**’ methods can be used”). Hence, a POSITA would have recognized that the teachings of Sung’146 and Sung’026 would have been equally applicable to one another. EX1002, ¶226.

Finally, a POSITA would have been able to make such CMP pad dressers with a reasonable expectation of success because the methods of making the CMP pad dressers are the same “reverse casting” process, as described above. A POSITA would have been able to provide different degrees of leveling of the diamond grits on the surface of the mold described by either Sung’146 and/or Sung’026. EX1002, ¶227.

XI. Discretionary Factors Favor Institution

The discretionary factors the Board employs for its institution decisions favor institution.

A. Advanced Bionics Factors Favor Institution

The Board uses a two-prong test to determine whether it will deny institution under 35 U.S.C. § 325(d): (1) whether the same or substantially the same art or

arguments were previously presented to the Office; and (2) if first part is satisfied, whether the Office erred in a manner material to the patentability of challenged claims. *See Advanced Bionics LLC v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 (precedential).

At the outset, Tsai was never considered during prosecution of the '802 Patent and does not meet the first prong of *Advanced Bionics*.

Sung'026 and Sung'146 are listed on the cover of the '802 Patent. EX1001, Cover; EX1003, 129-131. However, given Applicant's representation to the Examiner that the "claim limitation is fully supported in the '817 application" and "pre-dates both Dinh-Ngoc and Sung['869]," EX1003, 194, the Examiner would not have considered Sung'026 or Sung'146 to be prior art as it is a parent application to the '817 application.

Moreover, Sung'026 and Sung'146 were merely two of about 469 documents submitted to the Examiner during the examination spanning 10 separate IDS submissions. EX1003, 77-90, 91-96, 136-149, 171-176, 177, 178, 210, 234, 292, 308. Sung'026/Sung'146 were never highlighted to the Office nor were there any substantive discussion of Sung'026/Sung'146 in the file history. Moreover, neither Sung'026 nor Sung'146 was relied upon in any substantive rejections by the Office during the original prosecution of the '802 Patent. Indeed, Grounds based on references cited in an IDS but not considered at any length should not serve as the

basis for denying institution under 35 U.S.C. § 325(d). The Board has repeatedly instituted IPRs where the relied-on references had been merely cited by the applicant among numerous references submitted in IDSs during prosecution of the original application, without forming a basis of any rejections by the Examiner. *See Becton, Dickinson & Co. v. B. Braun Melsungen AG*, IPR2017-01586, Paper 8 at 17-18 (precedential); *see also Hum Industrial Technology, Inc. v. Amsted Rail Company, Inc.*, IPR2023-00539, Paper 10 at 51 (“We do not consider the Examiner’s initials on an IDS citing almost 100 references with the Examiner’s failure to use [two references] to reject [the] claims ... as indicating that the Examiner sufficiently evaluated or appreciated the relevance of either reference.”).

Specifically, Applicant’s assertion during prosecution that he was entitled to a priority date of at least November 16, 2006 would have led the Examiner to also erroneously conclude that Sung’026 or Sung’146 were not prior art. However, the Office did not have the benefit of Sung’s subsequent representation in district court that the claimed subject matter “is not disclosed in any of the patents or patent applications to which the ’802 Patent claims priority.” EX1011, ¶¶17-21. Hence, even though the ’802 Patent initially claimed priority to Sung’026 and Sung’146, Sung’026 and Sung’146 qualify as prior art and the Office erred by failing to issue a rejection based on Sung’026/Sung’146.

Accordingly, the Office erred by failing to apply Sung'026/Sung'146 under the second prong of *Advanced Bionics*.

1. Sung'026 Is Not The Same Art As Sung'869

To the extent Sung argues that Sung'026 is substantially the same art as Sung'869 (which was applied by the Examiner in an Office Action), institution is again favored.

First, under the first part of *Advanced Bionics*, Sung'026 and Sung'869 are not substantially the same art. There is no claim of priority to each other to indicate any relationship between the two references. *See* EX1004, Cover; EX1009, Cover. Furthermore, the figures of Sung'026 and Sung'869 are different with respect to each other. EX1005, Figs. 1-8; EX1009, Figs. 1-5. Moreover, this Petition relies on Sung'026's paragraph [0073] for [2], [3], [13], and [14], which is not present in Sung'869. Accordingly, Sung'026 and Sung'869 cannot be considered to be the same.

Second, to the extent the Patent Owner nevertheless argues that Sung'026 and Sung'869 are substantially the same art, institution is still favored under the second part of *Advanced Bionics* because the Examiner erred in accepting Applicant's arguments as to Sung'869. As explained in Section VII.B [Prosecution History], Sung argued that the 802 Patent "pre-dates ... Sung['869]." EX1003, 194. The Examiner disqualified Sung'869 as prior art because the Office did not have the

benefit of Sung’s subsequent representation in district court that the claimed subject matter “is not disclosed in any of the patents or patent applications to which the ’802 Patent claims priority.” EX1011, ¶¶17-21. Moreover, the Examiner failed to appreciate the teachings in paragraph [0060] of Sung’869,¹² which taught that “the plurality of superabrasive particles is arranged such that their tips vary from the designated profile by less than about 1 micron.” See EX1009, [0060]. As explained in greater detail in Sections X.B.2.i [2, 3] and X.B.5.i [13, 14], Sung’026’s paragraph [0056] contains the commensurate teaching, which this Petition relies on for claims [2], [3], [13], and [14]. Hence, even if Sung’869 and Sung’026 are substantially the same art, the Examiner erred and institution is again favored under the second part of *Advanced Bionics*.

B. *Fintiv* Factors Favor Institution

The six *Fintiv* factors considered favor institution. See *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (precedential).

1. No Evidence Regarding A Stay

No motion to stay has been filed, so this factor is neutral.

¹² The Examiner only relied on paragraphs [0010] and [0057]-[0059] of Sung’869. See EX1003, 129-131.

2. Parallel Proceeding Trial Date

The median time from filing to trial in the Eastern District of Texas is currently approximately 21 months, which means that trial is expected just shortly before or around the expected time of the Board's Final Written Decision.¹³ EX1030. However, no trial date is currently scheduled and the Final Pretrial Conference is scheduled for September 3, 2025, which means that actual trial is expected to occur *after* the time of the Board's Final Written Decision. *See* EX1019, 5. This factor favors institution, or at a minimum is neutral.

3. Investment in Parallel Proceeding

The co-pending litigation is in its early stages, and the investment in it has been minimal. *See* EX1019. The parties have not served infringement or invalidity contentions or exchanged preliminary positions on claim construction, and discovery has just begun. *See PEAG LLC v. Varta Microbattery GmbH*, IPR2020-01214, Paper 8, 17. Further, the Markman hearing is not scheduled until September 4, 2024, which is after the expected institution decision date by the Board. *See* EX1019, 2. This factor favors institution.

¹³ Petitioner expects a notice of accorded filing date for this petition to be in March 2025, which means a Final Written Decision is expected sometime around September 2025.

4. Overlapping Issues With The Parallel Proceeding

Petitioner stipulates that if the IPR is instituted, Petitioner will not pursue the same grounds in the district court litigation. *Sand Revolution II LLC v. Continental Intermodal Group – Trucking LLC*, IPR2019-01393, Paper 24 at 7 (informative).

This factor favors institution.

5. Identity Of Parties

Petitioner is the defendant in the litigation. This factor should not be a basis for denying institution.

6. Other Circumstances, Including The Merits

“[T]he PTAB will not deny institution ... under *Fintiv* (i) when a petition presents compelling evidence of unpatentability.” Memorandum, “Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation,” 9 (June 21, 2022). Here, the evidence of unpatentability is compelling, and thus the PTAB should not deny institution under *Fintiv*. This factor favors institution.

Accordingly, *Fintiv* factors favor institution.

C. General Plastic Factors Favor Institution

The only prior IPR Petition challenging the '802 Patent (IPR2021-00638), filed by an unrelated party—Kinik Co.—was withdrawn prior to an institution

decision. Hence, none of the *General Plastic* factors apply to this Petition and favor institution.

XII. Conclusion

Petitioner respectfully requests that the Board institute *inter partes* review, hold the challenged claims unpatentable, and cancel the challenged claims.

Dated: February 29, 2024

Respectfully submitted,

/Yung-Hoon Ha/

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CERTIFICATION UNDER 37 C.F.R. § 42.24(d)

I hereby certify that this Petition for *Inter Partes* Review of U.S. Patent No. 9,724,802 has, excluding the portions exempted under 37 C.F.R. § 42.24(a), 13,804 words as counted by the word-processing system used to prepare this document, in compliance with 37 C.F.R. § 42.24(d).

Dated: February 29, 2024

Respectfully submitted,

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CERTIFICATE OF SERVICE

Under 37 C.F.R. §§ 42.6(e) and 42.126, the undersigned certifies that on February 29, 2024, complete copies of the foregoing and any accompanying exhibits were caused to be served by sending them via Federal Express Priority Overnight shipping, which is at least as fast and reliable as U.S. Priority Mail Express, to the correspondence address of record for U.S. Patent No. 9,724,802 as indicated in Patent Center:

Devlin Law Firm
1526 Gilpin Ave.
Wilmington, DE 19806

Dated: February 29, 2024

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