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Paper 23
Entered: August 21, 2017

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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AVX CORPORATION,
Petitioner,

v.

PRESIDIO COMPONENTS, INC.,
Patent Owner.

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Case IPR2016-00636
Patent 6,661,639 B1

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Before JUSTIN T. ARBES, BEVERLY M. BUNTING, and KIMBERLY McGRAW, *Administrative Patent Judges*.

McGRAW, *Administrative Patent Judge*.

# FINAL WRITTEN DECISION
*35 U.S.C § 318 and 37 C.F.R. § 42.73*

# I. INTRODUCTION

Petitioner, AVX Corporation, filed a Petition (Paper 1, "Pet."), supported by a declaration by Deborah Chung, Ph.D. (Ex. 1003), requesting an *inter partes* review of claims 1–21 of U.S. Patent No. 6,661,639 B1 (Ex. 1001, "the '639 patent"). *See* 35 U.S.C. § 311. Patent Owner, Presidio Components, Inc. did not file a Preliminary Response. On August 22, 2016, we instituted an *inter partes* of claims 1–21 of the '639 patent. Paper 5 ("Dec. on Inst.").

After institution, Patent Owner filed a Patent Owner Response (Paper 8, "PO Resp."), supported by a declaration by Michael Randall, Ph.D. (Ex. 2001). Petitioner filed a Reply (Paper 12, "Reply"), supported by a second declaration by Dr. Chung (Ex. 1016) and a declaration by John Galvagni (Ex. 1017). Patent Owner contends that Petitioner's Reply and accompanying declarations (Exs. 1016, 1017) contain argument and evidence that exceeds the scope of a proper reply, and requested authorization to file a motion to strike certain portions of the Reply and accompanying declarations or guidance on how to respond to the alleged new bases of unpatentability. Paper 15, 2. Following Board authorization, Patent Owner submitted Paper 16, which identifies material in Petitioner's Reply that Patent Owner contends constitutes new evidence and argument raised for the first time in Petitioner's Reply, to which Petitioner filed a response (Paper 17). An oral hearing was held on May 2, 2017, and a transcript of the hearing has been entered into the record of the proceeding as Paper 22 ("Tr.").

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73 as

to the patentability of the challenged claims of the ’639 patent. As explained below, Petitioner has not shown by a preponderance of the evidence that claims 1–12, 17, and 19–21 of the ’639 patent are unpatentable, but Petitioner has shown by a preponderance of the evidence that claims 13–16 and 18 of the ’639 patent are unpatentable.

## II. BACKGROUND

### *A. Related Proceedings*

The parties state that there are no known related matters. Pet. 1; Paper 4, 2.

### *B. The ’639 Patent (Ex. 1001)*

The ’639 patent, entitled “Single Layer Capacitor,” relates generally to single layer capacitors formed by laminating thin ceramic dielectric material to ceramic/metal composite material (e.g., end blocks) that provide structural strength to the traditionally fragile thin dielectric. Ex. 1001, [54] 1:5–7, 1:51–56, 3:2–8, 4:38–40. The ’639 patent explains that traditional single layer capacitors were made by metalizing two faces of a thin sheet of sintered ceramic material, typically in the range of 4 mils to 10 mils thick. *Id.* at 1:26–28. “The design of single layer capacitors is a compromise between the use of thicker ceramic layers for greater strength and thinner ceramic layers for greater capacitance.” *Id.* at 1:53–56. The ’639 patent states that “[t]he capacitors of the present invention may utilize thin dielectric layers to provide high capacitance without sacrificing structural strength.” *Id.* at 4:36–38. The structural strength is provided by composite end blocks that are either conductive themselves, or plated with a conductive metal. *Id.* at 4:38–40. The conductive end blocks can serve as the electrodes, or to electrically connect internal electrodes (or “metallizations”)

of the capacitor to the metal surface traces on the printed circuit (pc) board. *Id.* at 4:40–43. The '639 patent states that by "assembling the portions of the capacitor in the green-state, and co-firing the assembly, a monolithic or essentially monolithic structure is formed having no preformed parts and containing no epoxy, glue, solder, or attachment means within the capacitor body thus further providing high structural integrity for the capacitor and simplifying the manufacturing process." *Id.* at 3:30–37.

Figure 3A, reproduced below, illustrates an embodiment of the invention described in the '639 patent.

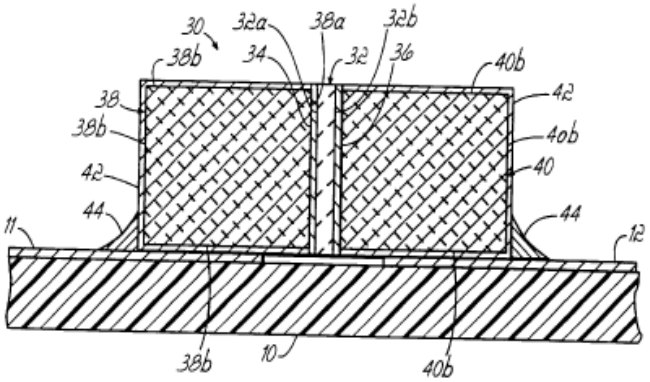


FIG. 3A

Figure 3A illustrates a standing, single layer capacitor having vertically oriented ceramic dielectric layer 32 and non-conductive composite end blocks 38, 40 with metallizations 34, 36 on each of the opposing planar surfaces 32a, 32b of dielectric layer 32. *Id.* at 3:51–54, 5:44–54. Internal metallizations 34, 36 do not cover the entire area of planar surfaces 32a, 32b. *Id.* at 5:50–53. "Metal/ceramic composite end blocks 38, 40 are adjacent respective metallizations 34, 36. Thereby, an internal face 38a, 40a of each end block 38, 40 is in contacting relation with a respective metallization 34, 36." *Id.* at 5:53–56. "The ceramic dielectric layer and the ceramic portion of the composite end blocks sinter together at the edges where the

metallization falls short, providing increased structural support to the capacitor by virtue of being an essentially monolithic structure." *Id.* at 4:54–59.

The composite material of the end blocks does not contain enough metal to render the composite conductive, but does contain sufficient metal to act as "seed points" for an electroplating process to coat the composite with conductive metal 42. *Id.* at 3:13–17, 5:51–54, 5:58–63. The coated composite is mounted to the pc board, and the coating provides an electrical connection to the internal electrode. *Id.* at 3:13–19; *see also id.* at 6:3–4 ("end blocks 38, 40 can be soldered . . . directly to printed metal traces 11, 12 on . . . pc board 10").

In another embodiment, shown in Figure 4A, end blocks 38′, 40′ are made of a ceramic/metal composite material that contains sufficient metal to render the end blocks conductive. *Id.* at 3:56–58, 6:39–42. Figure 4A is reproduced below.

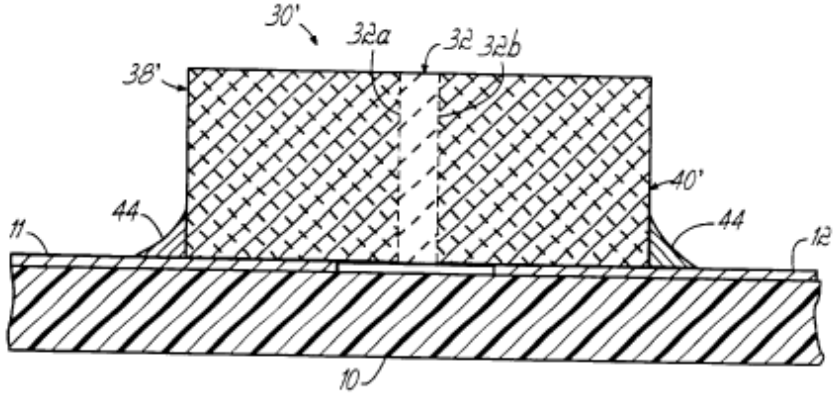



FIG. 4A

Figure 4A illustrates standing, single layer capacitor 30′, having vertically oriented ceramic dielectric layer 32 with opposing surfaces 32a and 32b, and conductive end blocks 38′, 40′ that are adjacent to respective

opposing surfaces 32a, 32b. *Id.* at 6:5–11. Because end blocks 38′, 40′ are already conductive, electroplating is optional. *Id.* at 6:53–54. "Internal metallizations 34, 36 are also optional because the conductive end blocks 38′, 40′ are capable of serving as the electrodes for the capacitor." *Id.* at 6:54–57.

The '639 patent also discloses additional embodiments having internal buried electrodes and vias. *See, e.g.*, *id.* at 4:1–3, Figs. 7A, 7B. Figure 7A, reproduced below, illustrates an alternative embodiment of the capacitor shown in Figure 3A having a pair of internal buried electrodes. *Id.* at 4:1–3, 7:46–53.

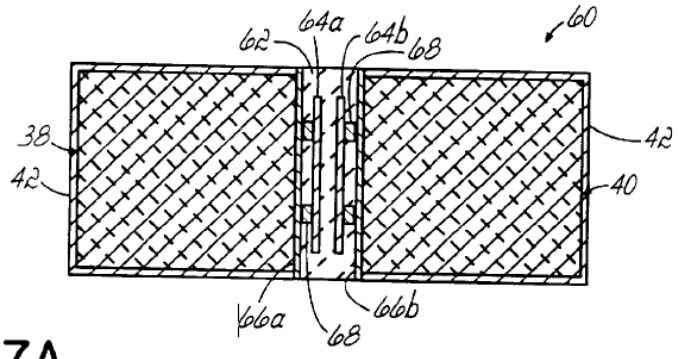
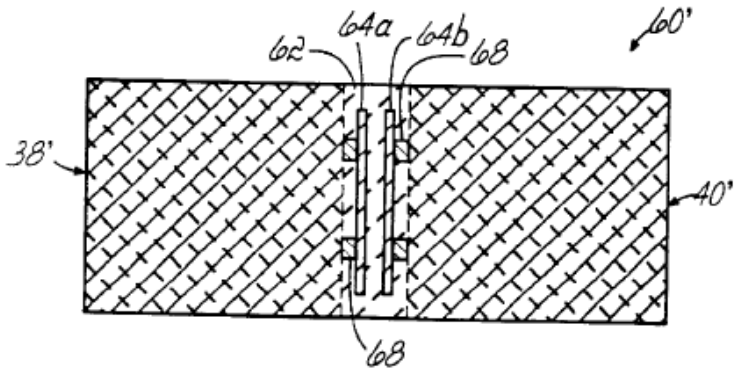



FIG. 7A

Figure 7A illustrates capacitor 60 having buried internal electrodes 64a, 64b and vias 68. *Id.* at 7:46–53. The "pair of internal buried electrodes 64a, 64b, are provided within the dielectric layer 62, and connected to metallization areas 66a, 66b, by a plurality of vias 68." *Id.* at 7:49–53. The vias connect "each buried electrode 64a, 64b to a respective metallization 66a, 66b." *Id.* at 7:53–55. "Use of the buried electrodes and vias enables variation of the capacitance of" capacitor 60. *Id.* at 7:60–61.

Figure 7B, reproduced below, illustrates an alternative embodiment of the capacitor shown in Figure 4A having a pair of internal buried electrodes 64a, 64b. *Id.* at 4:1–3, 7:46–61.




As shown in Figure 7B of the '639 patent above, vias 68 connect buried electrodes 64a, 64b to conductive end blocks 38′, 40′. *Id.* at 7:55–58.

*C. Claims*

Petitioner challenges independent claims 1, 8, 13, and 19 and dependent claims 2–7, 9–12, 14–18, 20, and 21.[1] Claims 1 and 13 are illustrative and are reproduced below.

1. A capacitor comprising:

> an essentially monolithic structure comprising at least one composite portion sintered with a ceramic dielectric portion,
>
> a buried metallization in the dielectric portion and at least one conductive metal-filled via extending from the buried metallization to the composite portion,
>
> wherein the composite portion includes a ceramic and a conductive metal, the capacitor further characterized by a feature selected from the group consisting of:
>
> > (a) the composite portion comprises the conductive metal in an amount sufficient to render the composite portion conductive, wherein the composite portion provides an electrical lead for attaching the capacitor to a metallic surface trace on a printed circuit board; and

[1] Claims 3 and 4 were corrected in a Certificate of Correction issued on June 22, 2004.

(b) a metallization area partially between the composite portion and the ceramic dielectric portion, and a conductive metal coating on faces of the composite portion not sintered to the ceramic dielectric portion, whereby the conductive metal coating provides an electrical lead for attaching the capacitor to a metallic surface trace on a printed circuit board.

13. A capacitor comprising:

a ceramic dielectric layer having first and second opposed substantially coplanar surfaces;

at least one first metallization area on a first portion of the first surface of the ceramic dielectric layer and at least one second metallization area on a first portion of the second surface of the ceramic dielectric layer;

a first composite end block having an internal face and a plurality of external faces, the internal face in contacting relation with the at least one first metallization area and sintered to a second portion of the first surface of the ceramic dielectric layer, wherein the composite comprises a ceramic and a conductive metal in an amount less than about 40% of the composite; and

a first conductive metal coating on the external faces of the first composite end block, whereby the coated first composite end block is adapted to be mounted directly on a printed circuit board to provide an electrical connection between the first metallization area and a metallic surface trace on said printed circuit board.

*D. Grounds of Unpatentability at Issue*

We instituted *inter partes* review of claims 1–21 based on the following asserted grounds of unpatentability:

| References | Basis | Challenged Claim(s) |
|---|---|---|
| Liebowitz,[2] Devoe,[3] and Veater[4] | § 103 | 1, 3, 4, 6, 8, 10, 11, and 17 |
| Liebowitz, Devoe, Veater, and SinghDeo[5] | § 103 | 2 and 9 |
| Liebowitz, Devoe, Veater, and Insetta[6] | § 103 | 5 and 12 |
| Liebowitz, Devoe, Veater, and AAPA[7] | § 103 | 7 |
| Liebowitz and Veater | § 103 | 13, 15, and 18 |
| Liebowitz, Veater, and Insetta | § 103 | 14 |
| Liebowitz, Veater, and Yih[8] | § 103 | 16 |
| Liebowitz and Devoe | § 103 | 19 and 21 |
| Liebowitz, Devoe, and SinghDeo | § 103 | 20 |

Dec. on Inst. 25.

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[2] U.S. Patent No. 6,690,572 B2, filed Mar. 6, 2002, issued Feb. 10, 2004 (Ex. 1004, "Liebowitz").
[3] U.S. Patent No. 6,366,443 B1, filed Dec. 9, 1997, issued Apr. 2, 2002 (Ex. 1005, "Devoe").
[4] U.S. Patent No. 3,581,167, filed Feb. 19, 1970, issued May 25, 1971 (Ex. 1006, "Veater").
[5] U.S. Patent No. 4,882,212, filed Oct. 30, 1986, issued Nov. 21, 1989 (Ex. 1007, "SinghDeo").
[6] U.S. Patent No. 4,953,273, filed May 25, 1989, issued Sept. 4, 1990 (Ex. 1008, "Insetta").
[7] Applicant Admitted Prior Art (Ex. 1001, 1:22–25, "AAPA").
[8] P. Yih & D.D.L. Chung, *Titanium Diboride Copper-Matrix Composites*, 32 J. MATERIALS SCI. 1703 (1997) (Ex. 1012, "Yih").

## III. ANALYSIS

### *A. Principles of Law*

To prevail in challenging Patent Owner's claims, Petitioner must demonstrate by a preponderance of the evidence that the claims are unpatentable. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d). A claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time of the invention to a person having ordinary skill in the art. *KSR Int'l Co. v. Teleflex, Inc*., 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) objective evidence of nonobviousness, i.e., secondary considerations. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). The level of ordinary skill in the art may be reflected by the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001); *In re GPAC Inc*., 57 F.3d 1573, 1579 (Fed. Cir. 1995).

### *B. Level of Ordinary Skill in the Art*

Dr. Chung, Petitioner's declarant, testified that a person of ordinary skill in the art ("POSITA" or "skilled artisan") at the time of the invention of the '639 patent "is generally one who has a Bachelor's degree in material science along with several years of relevant applied research or industry work experience in the field of capacitors." Ex. 1003 ¶ 15. Patent Owner's declarant, Dr. Randall, testified that a skilled artisan during the relevant

period "would have had a Master's Degree in Materials Science and Engineering or [an] analogous degree, and at least two years of industry experience with ceramic capacitor manufacturing." Ex. 2001 ¶ 20.

During oral argument, when questioned, counsel for Patent Owner confirmed that the main difference between the parties' definitions is the type of work experience, specifically whether the skilled artisan must have "just experience with capacitors in general" or whether he or she must have industry "experience with capacitor manufacturing." Tr. 40:3–9; *see also id.* at 57:19–58:22 (Petitioner not disputing Patent Owner's position).

Significantly, neither party describes the impact, if any, of the asserted differences between the parties' definitions of the level of ordinary skill in the art upon the obviousness analysis. Rather, Patent Owner contends that even under Petitioner's definition, Petitioner's declarant, Dr. Chung, lacks the requisite industry experience and therefore Petitioner's arguments must "fail legally" because Dr. Chung is not a person of ordinary skill in the art.[9] PO Resp. 20–21.

We disagree with Patent Owner's contention that a declarant must actually be a person of ordinary skill in the art in order to present testimony as to what a person of ordinary skill in the art would have understood at the time of the invention. *See, e.g.*, *SEB S.A. v. Montgomery Ward & Co. Inc.*, 594 F.3d 1360, 1373 (Fed. Cir. 2010) (stating there is no requirement of a

[9] Patent Owner further contends Petitioner admitted that it was "required to present the opinions of a person of ordinary skill in the art . . . at the time of the invention of the '639 patent." PO Resp. 20 (citing Ex. 1003 ¶ 15). We have reviewed the cited material and find Petitioner did not make any such admission.

perfect match between an expert's experience and the field of the art in question, provided the expert has "sufficient relevant technical experience" to testify). The Federal Circuit has explained that a person of ordinary skill in the art is a "hypothetical person postulated by § 103" that is "presumed to have . . . knowledge of all material prior art." *Kimberly-Clark Corp. v. Johnson & Johnson*, 745 F.2d 1437, 1452–53 (Fed. Cir. 1984); *see also id.* at 1454 ("It should be clear that that hypothetical person [of ordinary skill in the art] is not the inventor, but an imaginary being possessing 'ordinary skill in the art' created by Congress to provide a *standard of patentability* . . . ."). Thus, the proper question to ask is not whether the testifying witness is in fact such a "hypothetical person," but rather whether the testifying witness possesses sufficient qualifications to be able to testify as to what the hypothetical person of ordinary skill in the art postulated by § 103 would have known and understood at the time of the invention.

Although Dr. Chung may not have "industry" experience (Ex. 1016 ¶ 65), we find that Dr. Chung possesses sufficient education, training, and experience to provide testimony as to what a POSITA would have understood at the time of the invention, under either party's proffered definition. *See, e.g.*, Ex. 1011, 1–34; Ex. 1003 ¶¶ 2–5; Ex. 1016 ¶¶ 63–65 (describing Dr. Chung's experience). For example, Dr. Chung has both a master's degree and a doctorate in Materials Science from the Massachusetts Institute of Technology. Ex. 1003 ¶ 3. Dr. Chung has been active in capacitor research for at least 16 years, including experience in the design of single-layer capacitors, as evidenced by numerous publications. Ex. 1011; Ex. 1016 ¶¶ 64, 65. Additionally, Dr. Chung is the Founding Director of the Composite Materials Research Laboratory at the University of Buffalo, is a

professor, and has taught classes in Materials Science, including teaching concepts in the design of single layer capacitors to her students. *See, e.g.*, Ex. 1003 ¶¶ 4–5; Ex. 1016 ¶ 64. We further note that Dr. Chung is the author of Yih (Ex. 1012), which is one of the prior art references that is asserted in this proceeding. Certainly, the prior art of record in this proceeding—namely, Liebowitz, Devoe, Veater, SinghDeo, Insetta, and Yih—is indicative of the level of ordinary skill in the art. *See Okajima*, 261 F.3d at 1355; *GPAC Inc*., 57 F.3d at 1579.

Moreover, to the extent Dr. Chung is less familiar with aspects relating to the manufacture of semiconductor devices, we weigh Dr. Chung's testimony accordingly, taking into account the extent of her expertise in these areas, as discussed in further detail below. *See, e.g.*, *Yorkey v. Diab*, 601 F.3d 1279, 1284 (Fed. Cir. 2010) ("It is within the discretion of the trier of fact to give each item of evidence such weight as it feels appropriate." (citation omitted)); *In re Am. Acad. of Sci. Tech Ctr.*, 367 F.3d 1359, 1368 (Fed. Cir. 2004) ("[T]he Board is entitled to weigh the declarations and conclude that the lack of factual corroboration warrants discounting the opinions expressed in the declarations.").

Further, Patent Owner did not file a motion to exclude Dr. Chung's testimony under 37 C.F.R. § 42.64(c) on the theory that she is not qualified as an expert under Federal Rule of Evidence 702. Rather, Patent Owner cites *Tyco Healthcare Group LP v. Ethicon Endo-Surgery, Inc.*, 774 F.3d 968, 976 (Fed. Cir. 2014), for the proposition that a petitioner must present testimony from a POSITA in order to establish unpatentability. PO Resp. 20–21. However, *Tyco* merely states that an obviousness determination requires an analysis of what a POSITA would have known at the time of the

invention, not that testifying witnesses must themselves be POSITAs. *See* 774 F.3d at 976 ("The obviousness determination requires an objective analysis, which focuses on what a person of ordinary skill would have known at the time of invention."). Under Patent Owner's reasoning, a petition that fails to include an expert declaration must fail as a matter of law. We decline to adopt such a rule.

Based on the record before us, including our review of the '639 patent and the types of problems and solutions described in the '639 patent and the cited prior art, we agree with Patent Owner's assessment of the level of ordinary skill in the art and apply it for purposes of this Decision, but note that our analysis would be the same under either parties' definition.

### *C. Claim Construction*

In an *inter partes* review, claim terms in an unexpired patent are given their broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b); *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2142 (2016). Consistent with the broadest reasonable construction, absent any special definitions, claim terms are presumed to have their ordinary and customary meaning, as understood by a person of ordinary skill in the art, in the context of the entire patent disclosure. *See In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Any special definitions for claim terms must be set forth with reasonable clarity, deliberateness, and precision. *See In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). The Board, however, may not "construe claims during IPR so broadly that its constructions are *unreasonable* under general claim construction principles. . . . [T]he protocol of giving claims their broadest reasonable interpretation . . . does not include giving claims a

legally incorrect interpretation." *Microsoft Corp. v. Proxyconn, Inc.*, 789 F.3d 1292, 1298 (Fed. Cir. 2015) (citation omitted). Rather, "claims should always be read in light of the specification and teachings in the underlying patent," and "[t]he PTO should also consult the patent's prosecution history in proceedings in which the patent has been brought back to the agency for a second review." *Id.* at 1298.

In our Decision on Institution, we construed "essentially monolithic structure" in claims 1 and 8 to mean "an essentially solid structure of materials that are sintered together" and that has "internal metallizations that create a partial boundary or seam within the structure, but because the metallizations do not cover the entire area of the dielectric layer, the ceramic materials sinter together around the edges of the metallization." Dec. on Inst. 8–12. We disagreed with Petitioner's argument that "essentially monolithic structure" should be interpreted broadly "to incorporate the elimination of any or all 'boundaries/joints' within a structure." *Id.* (citing Pet. 6). Rather, we determined that the '639 patent distinguished between a "monolithic structure," which lacks any boundary or seam, and an "essentially monolithic structure" that possesses a partial boundary or seam. *Id.* at 10 (citing Ex. 1001, 5:3–19).

The parties do not dispute our interpretation in their Patent Owner Response and Reply. Moreover, in consideration of the arguments and evidence developed during trial, we do not perceive any reason or evidence that compels any deviation from this interpretation. Accordingly, we adopt our previous analysis and claim interpretation of "essentially monolithic structure" for purposes of this Decision. *Id.* at 8–12. We further determine that for the purposes of this Decision, no other claim terms require

construction. *See Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (stating "only those terms need be construed that in controversy and only to the extent necessary to resolve the controversy").

### *D. Asserted Obviousness of Claims 1, 3, 4, 6, 8, 10, 11, and 17 over Liebowitz, Devoe, and Veater*

Petitioner contends claims 1, 3, 4, 6, 8, 10, 11, and 17 of the '639 patent are unpatentable under 35 U.S.C. § 103 over Liebowitz, Devoe, and Veater. Pet. 13–41, 56–57. Patent Owner opposes. For the reasons set forth below, we conclude that Petitioner has not shown by a preponderance of the evidence that claims 1, 3, 4, 6, 8, 10, 11, or 17 are unpatentable under 35 U.S.C. § 103 over Liebowitz, Devoe, and Veater.

#### *1. Liebowitz (Ex. 1004)*

Liebowitz is directed to single layer capacitors having a "thin," "fragile" ceramic dielectric layer sandwiched between two "thick, strong" ceramic/metal composite electrodes, which give the structure required physical strength for manufacture, handling, and usage. Ex. 1004, [57], 2:18–23, 2:30–34. Liebowitz explains that traditional true "single layer capacitors" (SLCs) are limited to about 0.004 inches (4 mils) in minimum thickness because of the fragility of dielectric material at lesser thicknesses. *Id.* at 1:64–67. Because ceramic dielectric layers are fragile, ceramics traditionally are used in multi-layer form, "which incorporate additional alternating layers of dielectric and electrode, electrically connected in parallel." *Id.* at 1:9–11, 1:40–43. Liebowitz states that multi-layer structures "yield[] high capacitance per unit board area but also cause[] high inductance, an undesirable property, relative to single layer devices." *Id.* at 1:40–45. Liebowitz further states this "high inductance drawback also

applies to devices with a single dielectric layer and one or more electrodes buried within a multi-layer structure in which electrical contact(s) to said buried layer(s) are brought to the surface through vias, edge connections, etc." *Id.* at 1:45–49. Liebowitz states that the "present invention avoids any of these inductance-increasing methods and in fact makes practical a classic single layer ceramic capacitor with dielectric thickness of 0.001 inch or less." *Id.* at 1:49–53; *see also id.* at 2:3–6 (stating that the disclosed method of manufacturing provides for true SLCs with a "ceramic dielectric having thickness as low as 0.0005 inch").

Figure 2 of Liebowitz, reproduced below, illustrates a single layer capacitor before firing. *Id.* at 2:46–47.

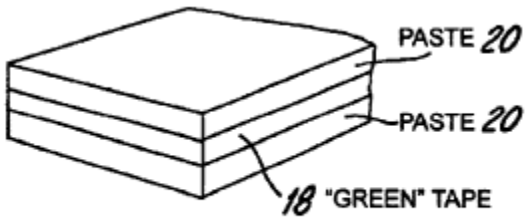


FIG.2

As shown in the illustration of a single layer capacitor before firing in Figure 2 above, conductive paste 20 is applied to both sides of thin green ceramic tape 18, which is the precursor for the dielectric layer of the finished capacitor. *Id.* at 2:65–3:12. "[C]onductive paste 20 contains metal and ceramic powders to provide a suitable conductive electrode after firing." *Id.* at 3:3–4. "[P]aste 20 is applied to . . . thin green ceramic tape 18 (the dielectric) by stencil, screen printing or other suitable method at a thickness that will assure the physical integrity of the finished product." *Id.* at 3:9–12. "The green tape and paste [are] subjected to thermal processing (firing) that results in a thin dielectric layer adhering to a conductive electrode (or two

electrodes)." *Id.* at 3:15–18. "The metal powder in the paste is chosen so that it does not melt nor react with the dielectric at its sintering temperature, but forms a strong electrically conductive bond with it." *Id.* at 3:43–45. Liebowitz explains that "devices are formed with capacitance values up to about 10 times (or more) the value of a conventional single layer device of their size, by virtue of the actual dielectric after firing being a fraction as thick as the conventional device." *Id.* at 4:6–10**.**

*2. Devoe (Ex. 1005)*

Devoe, entitled "Ceramic Chip Capacitor of Conventional Volume and External Form Having Increased Capacitance from Use of Closely-Spaced Interior Conductive Planes Reliably Connecting to Positionally-Tolerant Exterior Pads through Multiple Redundant Vias," is directed to, *inter alia*, a capacitor having internal conductive planes (interior metallizations) and vias. Ex. 1005, [54], [57]. Devoe explains that adding interior metallization planes increases the capacitance of the capacitor by decreasing the distance between the electrodes. *Id.* at 7:9–18, 10:49–55. Specifically, Devoe states that the capacitance between the interior metallization planes is greater than the capacitance that would have been "seen between opposed exterior pads (which have heretofore served as the electrodes) should no electrically-connected interior metallization plane(s) be present." *Id.* at 7:11–19; *see also id.* at 7:9–11 (explaining that capacitance between two conducting planes is inversely proportional to the distance between the planes).

Figure 11 of Devoe, reproduced below, illustrates a capacitor having a ceramic body, exterior metallization pads 11a, 11b, and interior

metallization planes 14a, 14b. *See id.* at 17:37–43; *see also id.* at 10:30–41, 15:9–13, 15:25–29, 15:39–50.

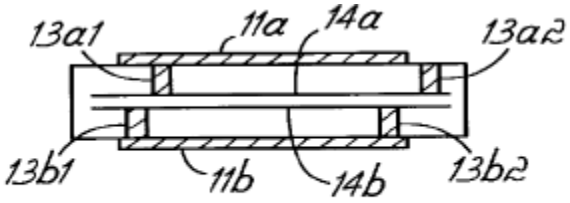


Fig. 11

As shown in Figure 11, interior metallization planes 14a, 14b are electrically connected to exterior metallization pads 11a, 11b by metal filled vias 13a1 and 13b1. *Id.* at 17:37–43; *see also id.* at 10:29–49, 15:39–51, Fig. 5. Devoe explains that the interior metallization planes are "interior to the [ceramic] body and substantially co-planar to the exterior metallizations." *Id.* at 10:40–42. "Each of these [interior] planes is thus more closely situated to each exterior metallization than the exterior metallizations are to each other." *Id.* at 10:42–44.

*3. Veater (Ex. 1006)*

Veater, titled "Reinforced Ceramic Capacitor and Method of Making the Same," is directed to a disc type ceramic capacitor. Ex. 1006, [54]; *see* Ex. 2001 ¶ 159 (describing Veater as relating to "disc type" ceramic capacitors). Figure 5 of Veater is reproduced below.

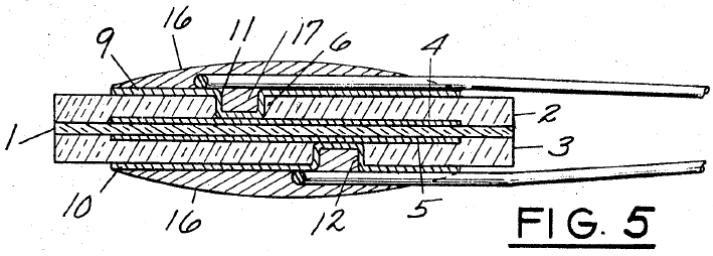


FIG. 5

Figure 5 of Veater illustrates a section view of a ceramic capacitor having thin central ceramic layer 1 sandwiched between two outer ceramic

layers 2, 3. *Id.* at 1:5–8, 1:20–24. "The outer layers 2, 3 are of the same ceramic as the central layer 1 or at least of a ceramic compatible with the central layer." *Id.* at 1:30–32. Metallic electrodes 4, 5 are painted onto opposite faces of central layer 1, "so as to leave a margin . . . surrounding the electrodes." *Id.* at 1:24–26, 1:36–39. The "outer [ceramic] layers [2, 3] have perforations providing access to the electrodes [4, 5] and have terminal coatings which extend into the perforations to make contact with the electrodes." *Id.* at [57]. The assembly is fired at ceramic firing temperatures to sinter electrodes 4, 5 to central layer 1 and to sinter layers 2, 3 to the margin of central layer 1. *Id.* at 1:46–49. Capacitor leads are soldered to terminals 9, 10. *Id.* at 2:36–38. The ends of the leads lie flat on the terminal surfaces and are held in place by solder. *Id.* at 2:40–42. After soldering, the arch of the lead is cut, "leaving ends 19, 20, which extend edgewise beyond the capacitor for making electrical connections into a circuit." *Id.* at 2:44–47.

*4. Discussion*

*a. Claim 1*

Claim 1 is directed to, *inter alia*, a capacitor having "an essentially monolithic structure comprising at least one composite portion sintered with a ceramic dielectric portion," and "a buried metallization in the dielectric portion and at least one conductive metal-filled via extending from the buried metallization to the composite portion" (hereinafter the "buried metallization claim element"). Ex. 1001, 11:14–20.

Based on its proposed construction of "essentially monolithic structure," which we declined to adopt, Petitioner asserts that because Liebowitz teaches a capacitor having a "composite portion" (paste 20)

sintered with a "ceramic dielectric portion" (thin green ceramic tape 18), Liebowitz teaches an "essentially monolithic structure." Pet. 14–17 (citing Ex. 1004, 3:15–18, Fig. 2; Ex. 1003, 29–32). Petitioner does not argue that the structure of Liebowitz has a partial boundary. Therefore, we disagree with Petitioner that Liebowitz alone teaches an essentially monolithic structure.

Petitioner argues alternatively that the combination of Veater and Liebowitz teaches an "essentially monolithic structure," as Veater teaches a metallization area partially between its outer layers and its dielectric portion, and that the combination of Liebowitz and Veater would result in Veater's metallization area creating a partial boundary between the dielectric portion and Liebowitz's composite portion. *See id.* at 16–17 (citing Ex. 1003, 38–40). Patent Owner does not dispute that the combination of Veater and Liebowitz teaches an essentially monolithic structure.[10]

Petitioner contends that Devoe's interior metallization planes 14a, 14b within dielectric ceramic capacitor 1 and conductive metal filled vias 13a1, 13b1 that connect each interior metallization plane 14a, 14b to a respective associated exterior pad 11a, 11b teach the buried metallization claim element. *Id.* at 17–19 (citing Ex. 1005, Fig. 11, 10:30–44, 15:40–42, 17:37–43; Ex. 1003, 33, ¶ 46). Petitioner further contends that a skilled artisan would have incorporated the buried metallizations and vias of Devoe into the dielectric portion of the capacitors of Liebowitz to decrease the distance between the capacitor's electrodes, thereby increasing its overall

[10] *See* Paper 6, 3 ("[A]ny arguments for patentability not raised in the response will be deemed waived.").

capacitance. *Id.* at 19–21 (citing Ex. 1003, 33–35, ¶¶ 47–49). Petitioner also asserts that a skilled artisan would have had a reasonable expectation of success in combining the interior metallization planes and vias of Devoe with the capacitor of Liebowitz. *Id.* at 23 (citing Ex. 1003, 35–36).

Patent Owner responds that Petitioner has not provided a sufficient reason to combine the metallizations (or vias) of Devoe into the capacitor of Liebowitz having composite end portions. PO Resp. 22–23, 29–36. Patent Owner points out that Liebowitz expressly states that it avoids buried metallizations and vias due to the undesirable high inductance that would result, and consequently, a skilled artisan would not have had a reason for, and in fact would be motivated away from, incorporating the buried metallizations, vias, and the resulting multilayer structure disclosed in Devoe, with Liebowitz. *See id.* at 22–23.

A patent claim "composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." *KSR*, 550 U.S. at 418. To prove obviousness, there must have been, at the time of invention, "an apparent reason to combine the known elements in the fashion claimed by the patent at issue." *Id*. Such a reason cannot be provided by the very patent whose claims are being challenged as obvious. *Id*. at 421 ("A factfinder should be aware, of course, of the distortion caused by hindsight bias and must be cautious of arguments reliant upon *ex post* reasoning."); *Cheese Sys., Inc. v. Tetra Pak Cheese & Powder Sys., Inc.*, 725 F.3d 1341, 1352 (Fed. Cir. 2013) ("Obviousness cannot be based on the hindsight combination of components selectively culled from the prior art to fit the parameters of the patented invention." (citation and quotation marks omitted)). The Federal Circuit has held that

> [o]bviousness may be defeated if the prior art indicates that the invention would not have worked for its intended purpose or otherwise teaches away from the invention. A reference teaches away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken in the claim. A reference that merely expresses a general preference for an alternative invention but does not criticize, discredit, or otherwise discourage investigation into the claimed invention does not teach away.

*Meiresonne v. Google, Inc.*, 849 F.3d 1379, 1382 (Fed. Cir. 2017) (citations and quotation marks omitted). Further, "[t]he fact that [a] motivating benefit comes at the expense of another benefit, however, should not nullify its use as a basis to modify the disclosure of one reference with the teachings of another." *Winner Int'l Royalty Corp. v. Wang*, 202 F.3d 1340, 1349 n.8 (Fed. Cir. 2000). "Instead, the benefits, both lost and gained, should be weighed against one another." *Id.*

Now, with the record fully developed, we agree with Patent Owner that Petitioner has not articulated sufficient reasoning with rational underpinning explaining why a POSITA would have combined the buried metallizations of Devoe with the particular capacitor of Liebowitz. As the Federal Circuit has made clear, when a reason to combine or modify references is in dispute, we must make a finding of a motivation to combine and must have an adequate evidentiary basis for that finding. *See In re Nuvasive, Inc.*, 842 F.3d 1376, 1382 (Fed. Cir. 2016). "'[C]onclusory statements' alone are insufficient and, instead, the finding must be supported by a 'reasoned explanation.'" *Id.* at 1383 (quoting *In re Lee*, 277 F.3d 1338, 1342, 1345 (Fed. Cir. 2002)); *accord id.* at 1384 (not permitting the Board to effectively adopt a petitioner's argument, which "amount[ed] to nothing

more than conclusory statements that a [POSITA] would have been motivated to combine the prior art references to obtain additional information"). Moreover, the Board "cannot rely solely on common knowledge or common sense to support [its] findings." *Id.*

Liebowitz discloses a "high inductance drawback" to buried metallizations and vias, and expressly states that its invention is designed to "avoid[] any of these inductance-increasing methods." Ex. 1004, 1:40–53; *see also* Ex. 2009, 113 (prosecution history of the '639 patent, where the applicants distinguished Devoe by arguing that "the present invention recognizes that buried multi-layered structures can be used to make capacitors using vias and edge connections" and "it is this very construction that the present inventor seeks to avoid" (emphases omitted)). Indeed, Dr. Chung in her declaration filed in support of the Petition expressly recognized the high inductance drawback mentioned in Liebowitz. Ex. 1003 ¶ 49. Yet Petitioner's proposed combination is based on a POSITA looking to Devoe to incorporate *the very feature that Liebowitz states should be avoided*.

Petitioner and Dr. Chung do not account sufficiently for this express disclosure in Liebowitz. Instead, Dr. Chung testifies that a skilled artisan would have understood that the benefits of increased capacitance "*may* outweigh any negative impacts of an increase in inductance" because "the inductance concerns raised in Liebowitz are not always applicable." Ex. 1003 ¶ 49 (emphasis added). Dr. Chung concludes that a skilled artisan would have combined the buried metallizations and vias of Devoe with the capacitor of Liebowitz "when increasing capacitance is of greater concern than lowering inductance." *Id.*

However, Petitioner does not provide sufficient explanation or credible evidence to explain when or under what circumstances increasing capacitance would have been of greater concern than lowering capacitance, or sufficient evidence to show that a skilled artisan would have understood that the benefits of increased capacitance would have outweighed the negative effects of high inductance. In particular, Dr. Chung's unsupported and equivocal testimony that increased capacitance "may" outweigh increased inductance is insufficient for Petitioner to meet its burden.[11] *See id.*

Patent Owner, on the other hand, has provided persuasive arguments and evidence demonstrating that adding metallization layers and vias to the capacitor of Liebowitz would have been unattractive to a skilled artisan for fear of raising the inductance. PO Resp. 30 (citing Ex. 1004, 1:39–51; Ex. 2001 ¶¶ 64–68). Dr. Randall testifies that "Liebowitz teaches that incorporating multiple layers of ceramic in a single layer capacitor results in high inductance, which in this case is an undesirable property of capacitors." Ex. 2001 ¶ 64 (citing Ex. 1004, 1:39–45). Dr. Randall further states that "undesirable high inductance results when vias are incorporated in order to achieve electrical contact to buried electrodes, otherwise referred to as buried metallizations." *Id.* ¶ 65 (citing Ex. 1004, 1:45–49). According to

[11] Petitioner's arguments in its Reply are equally equivocal. *See, e.g.*, Reply 5 (asserting that "a POSITA would understand that the benefit of increased capacitance that can be achieved using buried metallizations *may* outweigh the negative impacts of an increase in inductance," and that "a POSITA would have further recognized that multiple parallel vias *could* have been used to the extent that a designer wished to minimize the inductance of the buried metallizations even further" (emphases added)).

Dr. Randall, a "POSITA would understand . . . that incorporating buried metallizations and vias with Liebowitz would result in poorer device performance, as it would result in increased inductance." *Id.* ¶ 66. Dr. Randall explains that "Liebowitz expressly rejects incorporating buried metallizations and vias despite the fact that, according to [Dr. Chung], incorporating those features would increase overall capacitance." *Id.* Dr. Randall's testimony is consistent with the disclosure of Liebowitz and is persuasive. Further, as Patent Owner points out, Dr. Chung admitted during cross-examination that incorporating buried metallizations would not produce the stated objectives of Liebowitz. *See* PO Resp. 31; Ex. 2020, 129:16–130:1 (Dr. Chung agreeing that "the internal metallizations of Devoe and the vias of Devoe, those are both the things mentioned in column one of Liebowitz, in other words, buried electrodes and vias that Liebowitz's invention avoids the use of," and "Liebowitz avoids using buried electrodes and vias per his statement at lines 50 to 52").

We also note that Petitioner's asserted reason in the Petition for combining Liebowitz with Devoe—increased capacitance—is undermined by the teachings of Liebowitz. *See* Pet. 19–21. Liebowitz specifically notes that "ceramics are usually used in multi-layer form, which yields *high capacitance* per unit board area but also causes *high inductance, an undesirable property*," and the disclosed invention is meant to "avoid[]" such high inductance. Ex. 1004, 1:40–52. Thus, we are not persuaded that a person of ordinary skill in the art would have looked to a reference like Devoe to incorporate buried metallizations, which would have imported the increased inductance problem that Liebowitz sought to avoid. *See DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 567 F.3d 1314, 1326 (Fed.

Cir. 2009) ("An inference of nonobviousness is especially strong where the prior art's teachings undermine the very reason being proffered as to why a person of ordinary skill would have combined the known elements.").

Petitioner argues in its Reply that Liebowitz merely states a "preference" for capacitor structures having thin dielectrics to minimize inductance, not that buried metallizations "should *always* be avoided in capacitor design." Reply 3. However, Patent Owner is not arguing that Liebowitz teaches against use of buried metallizations in *all* capacitor designs, rather just in connection with the particular capacitor structure of Liebowitz. Liebowitz recognizes that some prior art single layer capacitors use buried metallizations and vias and reduce the thickness of the dielectric layer, thereby increasing overall capacitance, yet expressly rejects incorporating buried metallizations and vias. *See*, *e.g.*, Ex. 1004, 1:49–53 (stating that its invention "avoids any of these inductance-increasing methods and in fact makes practical a classic single layer ceramic capacitor with dielectric thickness of 0.001 inch or less"). As such, we find that Liebowitz expressly teaches that buried metallizations are to be avoided in connection with the capacitor of Liebowitz, and that such disclosure would have discouraged a POSITA from incorporating buried metallizations of the type taught by Devoe.

In its Reply, Petitioner also argues that a skilled artisan would have combined the teachings of Devoe and Liebowitz to allow for "increased strength and reliability," to reduce the size of SLCs, to improve "manufacturability," to use "better performing ceramic materials," and to achieve "better high frequency performance." Reply 4. Patent Owner states that these arguments exceed the proper scope of a reply. Paper 16, 2–3.

Petitioner contends that these arguments are responsive to Patent Owner's argument that Liebowitz teaches the avoidance of buried metallizations and vias due to the undesirable high inductance that results. Paper 17, 1–2.

We agree with Patent Owner, as we find that Petitioner's arguments do not relate to inductance but rather present entirely new rationales to explain why a person of ordinary skill in the art allegedly would have combined the teachings of Liebowitz and Devoe. *See Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1370 (Fed. Cir. 2016) (finding the Board did not err in refusing to consider evidence in a reply brief presenting a new reason to combine the asserted references). As such, we do not consider these belatedly presented arguments. *See* 37 C.F.R. §§ 42.22(a)(2), 42.23(b); Office Patent Trial Practice Guide, 77 Fed. Reg. 48,756, 48,767 (Aug. 14, 2012) ("While replies can help crystalize issues for decision, a reply that raises a new issue or belatedly presents evidence will not be considered and may be returned. . . . Examples of indications that a new issue has been raised in a reply include new evidence necessary to make out a *prima facie* case for the patentability or unpatentability of an original or proposed substitute claim, and new evidence that could have been presented in a prior filing.").

We have considered the evidence of record and have weighed the alleged advantages (e.g., increased capacitance) and disadvantages (e.g., increased inductance) of adding buried metallizations to the capacitor of Liebowitz. We find that, on balance, the evidence does not support a finding that one of ordinary skill in the art would have combined the teachings of Liebowitz and Devoe in the manner asserted. To the contrary, the disclosure of Liebowitz discussed above would have discouraged a person of ordinary

skill in the art from making the asserted combination. We are, therefore, not persuaded by Petitioner's arguments and evidence that it would have been obvious to one of ordinary skill in the art to combine the buried metallizations of Devoe with the particular capacitor of Liebowitz to achieve increased capacitance, given that Liebowitz expressly teaches that increased inductance from doing so is to be avoided.

In view of the foregoing and based on our review of the full trial record, we conclude that Petitioner has not shown by a preponderance of the evidence that claim 1 would have been obvious over the combined teachings of Liebowitz, Devoe, and Veater.

*b. Claim 8*

Independent claim 8 is also directed to a capacitor comprising, *inter alia*, an essentially monolithic structure having composite end blocks, a ceramic dielectric portion at least partially sintered to the composite end blocks, and a pair of buried metallizations in the ceramic dielectric portion and a conductive metal-filled via that extends from each buried metallization to an end block. Ex. 1001, 11:65–12:11. Petitioner contends claim 8 is unpatentable over Liebowitz, Devoe, and Veater and relies on the same arguments presented with respect to claim 1 to explain why it allegedly would have been obvious to combine the teachings of Liebowitz and Devoe. Pet. 32–33. Having found Petitioner's arguments concerning the unpatentability of claim 1 unpersuasive, for the same reasons we determine Petitioner has not demonstrated by a preponderance of the evidence that claim 8 is unpatentable over Liebowitz, Devoe, and Veater.

*c. Dependent Claims 3, 4, 6, 10, 11, and 17*

Petitioner argues claims 3, 4, 6, 10, 11, and 17[12] are unpatentable over the combined teachings of Liebowitz, Devoe, and Veater. Pet. 37–41, 56–57. Petitioner does not provide any additional argument as to why a skilled artisan would have combined the teachings of Liebowitz and Devoe, beyond that set forth with respect to independent claims 1 and 8. *See id.* Claim 17, which depends from claim 13, recites "at least one buried metallization in the ceramic dielectric layer intermediate the opposed coplanar surfaces, and having at least one metal-filled via extending from the buried metallization to one of the first and second metallization areas." Petitioner relies on its previous arguments regarding claims 1 and 8. *Id.* at 56–57. Accordingly, for the same reasons discussed above with respect to independent claim 1, Petitioner has not demonstrated by a preponderance of the evidence that claims 3, 4, 6, 10, 11, and 17 are unpatentable over Liebowitz, Devoe, and Veater.

*E. Asserted Obviousness of Claims 2, 5, 7, 9, 12, and 19–21 over,* inter alia, *Liebowitz and Devoe*

Petitioner contends that claims 2 and 9 are unpatentable over Liebowitz, Devoe, Veater, and SinghDeo; that claims 5 and 12 are unpatentable over Liebowitz, Devoe, Veater, and Insetta; that claim 7 is unpatentable over Liebowitz, Devoe, Veater, and AAPA; that claims 19 and

[12] Claims 3, 4, and 6 depend from claim 1; claims 10 and 11 depend from claim 8; and claim 17 depends from claim 13.

21 are unpatentable over Liebowitz and Devoe; and that claim 20 is unpatentable over Liebowitz, Devoe, and SinghDeo.

Petitioner's unpatentability arguments regarding dependent claims 2, 5, 7, 9, 12, and 19–21 each rely, *inter alia*, upon the combined teachings of Liebowitz and Devoe. For each of these claims, Petitioner relies upon the same arguments presented for claim 1 as to why a skilled artisan allegedly would have combined the teachings of Liebowitz and Devoe. *See, e.g.*, Pet. 41, 44, 45, 48, 59, 60. For the same reasons discussed above with respect to independent claim 1, Petitioner has not demonstrated by a preponderance of the evidence that claims 2, 5, 7, 9, 12, and 19–21 are unpatentable over the asserted prior art including Liebowitz and Devoe.

### *F. Asserted Obviousness of Claims 13, 15, and 18 over Liebowitz and Veater*

#### *1. Claim 13*

Independent claim 13 of the '639 patent is directed generally to a capacitor having metallization areas on the opposing sides of a ceramic dielectric layer and composite end blocks comprising ceramic and conductive metal that are in contacting relation with the metallization areas and that are sintered to the ceramic dielectric layer. Ex. 1001, 12:47–67. Petitioner provides a detailed analysis, with supporting testimony from Dr. Chung, showing where the combination of Liebowitz and Veater teaches each limitation of the claim, referring to its analysis of claims 1 and 8 for certain limitations.[13] Pet. 49–52. Specifically, Petitioner contends that

[13] Unlike claims 1 and 8, claim 13 does not recite a buried metallization in the dielectric portion of the capacitor.

Liebowitz teaches a capacitor comprising a ceramic dielectric layer (thin green ceramic tape 18) that has first and second opposed substantially coplanar surfaces, sandwiched between composite end blocks (conductive paste 20) containing metal and ceramic powders. *Id.* at 14–15, 49; *see* Ex. 1004, 2:65–66, 3:3–4, 3:9–12, Fig. 2. Paste 20 (the composite end block) has an internal face that is adjacent to green tape 18 and a plurality of external faces that are not adjacent to green tape 18. Ex. 1004, Fig. 2; Ex. 1003, 42. When fired, the green tape becomes the dielectric and paste 20 becomes the electrode. Ex. 1004, 3:3–4.

Liebowitz states that "[t]he ratio of metal to powder in the paste can range from about 0.4 grams to 9 grams of metal per gram of powder." *Id.* at 3:30–32. A composite that contains 0.4 grams of metal per gram of powder comprises 28.6% metal (i.e., less than 40% metal, as recited in claim 13). Pet. 51; Ex. 1003, 64; Ex. 1004, 3:30–32. The composite electrode (i.e., end block) in Liebowitz can be coated with a thin conductive metal layer. Ex. 1004, 3:59–61. The coated electrodes can be mounted directly onto a printed circuit board to provide an electrical connection. *See, e.g.*, *id.* at 6:5–10 (stating the capacitor can be "flush-mounted with one electrode bonded directly to a conductive substrate"); *see also* Ex. 1003, 64–65.

For the first and second metallization area limitations of claim 13, Petitioner relies on Veater's description of metal electrodes 4, 5 that are painted on opposite sides of green ceramic central layer 1 (the dielectric layer). Pet. 26–27, 49. Veater teaches that the internal face of outer layer 2 is in contacting relation with metallization 4, that after firing, electrodes 4, 5 are sintered to central layer 1, and that outer layers 2, 3 (ceramic end blocks) are sintered to the margins of layer 1. Ex. 1006, Fig. 5, 1:47–52. Petitioner

asserts that although Veater does not explicitly disclose that ceramic outer layers 2, 3 are composite, Liebowitz's composite ceramic outer layers make up for this deficiency. Pet. 50.

Petitioner argues that it would have been obvious to modify the capacitor of Liebowitz to include the metallization areas of Veater to "create a capacitor with a more uniform electric potential, thereby resulting in more predictable results from the capacitor." *Id.* at 51–52 (citing Ex. 1003, 39–40, ¶¶ 51–52). Specifically, Petitioner explains that "the metallization areas of Veater would help make a voltage input to the capacitor even more uniform across the area of the capacitor, by correcting for any possible lack of uniformity of metal in the composite." *Id.*

Having reviewed all of the arguments and evidence of record, we find that Petitioner has shown that the combination of Liebowitz and Veater teaches all of the limitations of claim 13 and has articulated sufficient reasoning for why a POSITA would have combined the teachings of the references.

During the oral hearing, Patent Owner argued that, although not asserted in its Response, its arguments regarding claim 5 as to why a skilled artisan would not have considered combining Veater with Liebowitz and Devoe should be read to apply to claim 13 as well. Tr. 47:1–12; *see* PO Resp. 40–49 (challenging Petitioner's asserted ground of "unpatentability of Claim 5" because a skilled artisan would not consider combining Veater with Liebowitz and Devoe). However, Patent Owner does not provide any arguments directed specifically to independent claim 13 in its Response, and thus waived any arguments as to claim 13. *See* Paper 6, 3 ("The patent

owner is cautioned that any arguments for patentability not raised in the response will be deemed waived.").

Even if Patent Owner's arguments regarding claim 5 are considered with respect to claim 13, for the reasons below, we do not find them persuasive. Specifically, Patent Owner contends that Veater's disc capacitors are not used for the same applications as single layer capacitors, the technologies and devices are very different from each other, and the method of painting electrodes in Veater's "much larger" disc capacitors could not produce the smaller margins required in single layer capacitors of Liebowitz. PO Resp. 40–42. Patent Owner, however, does not explain how the differences between disc capacitors and single layer capacitors are relevant to whether a skilled artisan would have found it obvious to use metal layers at a dielectric-composite electrode interface of a capacitor, particularly given that the claims include no limitations on the shape or size of the recited capacitors. Petitioner, on the other hand, explains persuasively in rebuttal that the differences between single layer capacitors and disc capacitors do not impact Veater's teachings to provide a metal layer at a dielectric-composite electrode interface. *See, e.g.*, Reply 18–19; Ex. 1016 ¶¶ 40–43.

Patent Owner contends that the much smaller margins of the buried electrodes of Liebowitz could not be achieved by the painting method used to paint the electrodes in the larger sized Veater capacitors. PO Resp. 41–42. This argument is not persuasive because it is not necessary that the devices of the references be physically combinable. Rather, the question is what the combined teachings of the references would have suggested to those of ordinary skill in the art. The record shows that a POSITA would

have been able to provide a metal layer at a dielectric-composite electrode interface using technology appropriate for the smaller-sized single layer capacitor. *See, e.g.*, Ex. 2001 ¶ 161 (Patent Owner's own declarant testifying that at the time of the invention of the '639 patent, a skilled artisan would have understood that metal deposition techniques, such as "screen printing" appropriate for manufacturing single layer capacitors, were to be used, instead of painting metal electrodes, as taught by Veater); *see also* Reply 18–19; Ex. 1016 ¶¶ 40–43. Thus, the evidence of record shows that a skilled artisan would have had reason to use the improved techniques for depositing the required metal layers, rather than the old painting techniques of Veater. Ex. 1016 ¶ 42; Ex. 2001 ¶ 161.

Next, Patent Owner argues a skilled artisan "would be dissuaded from using" Veater's metal electrodes as opposed to electrodes containing ceramic additives. PO Resp. 42–43. Patent Owner asserts that electrodes with ceramic additives, similar to the composite materials used in Liebowitz, offer better conductance than the pure metal electrode metallizations of Veater and that ceramic-metal composite electrode materials were preferred over metallizations at the time of the '639 patent. *Id.* at 42–48; *see also* Ex. 2001 ¶ 167–177 (stating that ceramic filled composite metals are superior to pure metals when used as internal electrodes in co-fired ceramic capacitor applications). However, Patent Owner has not provided evidence that a POSITA would not have considered using metal electrodes. Indeed, Dr. Randall characterizes metal electrodes without ceramic additives as "standard electrodes." Ex. 2001 ¶ 173 (referring to "ceramic additives or fillers . . . used in conjunction with metals" as an "Advanced Electrode" and "standard electrodes without ceramic additives (i.e., Std. Electrode)").

Patent Owner's evidence that certain ceramic-metal electrodes may be superior to "standard" metal electrodes does not support an argument that a POSITA would not have considering using metal electrodes. "A known or obvious composition does not become patentable simply because it has been described as somewhat inferior to some other product for the same use." *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994).

Finally, Patent Owner contends the age of the Veater reference, which issued more than 30 years before the filing date of the application that issued as the '639 patent, supports a finding of non-obviousness. PO Resp. 48–49. This argument is not persuasive, as the "mere age of the references is not persuasive of the unobviousness of the combination of their teachings, absent evidence that, notwithstanding knowledge of the references, the art tried and failed to solve the problem." *In re Wright*, 569 F.2d 1124, 1127 (CCPA 1977). Further, as explained above, Petitioner is not relying on an "obvious to try" analysis, but rather provides specific reasons as to why a POSITA would have been motivated to combine the teachings of the references, which we find sufficient based on the record presented. *See* PO Resp. 48–49. Having considered all of the evidence and arguments during trial, Petitioner presents sufficient evidence to support a finding that a skilled artisan would have combined Veater's teachings regarding metal electrodes with the capacitor teachings of Liebowitz to create a capacitor with a more uniform electric potential, thereby resulting in more predictable results from the capacitor.

Based on the evidence and arguments presented, Petitioner has shown that Liebowitz and Veater disclose each of the limitations of claim 13 and has articulated sufficient reasoning for combining the references.

Accordingly, on the record before us, Petitioner has demonstrated, by a preponderance of the evidence, that claim 13 would have been obvious based on Liebowitz and Veater.

*2. Claims 15 and 18*

Claim 15 depends from claim 13 and further requires that the "composite comprises a matrix of the ceramic, and particles of the conductive metal are disbursed in the matrix." Petitioner contends Liebowitz teaches a matrix of ceramic and conductive metals as required by claim 15. Pet. 37–40, 52 (citing Ex. 1004, 3:3–4, 4:20–23, 4:46–52; Ex. 1003, 65). Claim 18 also depends from 13 and further requires:

> a second composite end block having an internal face and a plurality of external faces, the internal face in contacting relation with the at least one second metallization area and sintered to a second portion of the second surface of the ceramic dielectric layer, and
>
> a second conductive metal coating on the external faces of the second composite end block, whereby the coated second composite end block is adapted to be mounted directly on a printed circuit board to provide an electrical connection between the second metallization area and a metallic surface trace on said printed circuit board.

Petitioner argues that Liebowitz teaches first and second composite end blocks having an internal face and a plurality of external faces (Pet. 53 (citing *id.* at 30–32 for analysis of similar limitation in claim 8)) as well as applying or coating a thin conductive layer to the outer surface of the composite electrode end block (*id.* at 53–54 (citing Ex. 1004, 3:59–61)). Petitioner also contends that the limitations of the "whereby" clause regarding mounting the end block on a circuit board are taught by Liebowitz for the same reason argued with respect to claim 1. *Id.* at 54 (citing

Ex. 1004, 6:5–10, 6:17–21, Ex. 1003, 65–66); *see also id.* at 29–30, 51.

Petitioner contends that Veater's Figure 5 teaches claim 18's "second metallization area" (metallization areas 3, 4) sintered "to a second portion of the second surface of the ceramic dielectric layer" (dielectric 1) and "the internal face" of the "end block" (ceramic layers 2, 3) "in contacting relation with the at least one second metallization area" (metallization areas 3, 4). Pet. 35, 53; *see* Ex. 1006, Fig. 5. Petitioner contends that "it would have been obvious to modify the capacitor of Liebowitz with the techniques taught in Veater to create a capacitor with a more uniform electric potential, thereby resulting in more predictable results from the finished capacitor." *Id.* at 53; *see* Ex. 1003, 65–66 (supporting testimony from Dr. Chung).

Patent Owner does not challenge Petitioner's contentions regarding claims 15 and 18. *See* Paper 6, 3 ("The patent owner is cautioned that any arguments for patentability not raised in the response will be deemed waived."). Based on the arguments and evidence cited in the Petition, Petitioner has shown that Liebowitz and Veater disclose each of the limitations of claims 15 and 18 and has articulated sufficient reasoning for combining the references. Accordingly, on the record before us, Petitioner has demonstrated, by a preponderance of the evidence, that claims 15 and 18 would have been obvious based on Liebowitz and Veater.

*G. Asserted Obviousness of Claim 14 over Liebowitz, Veater, and Insetta*

Claim 14, which depends from claim 13, requires that "the composite comprises a plurality of ceramic sheets in alternating relation with a plurality of conductive metal sheets." Ex. 1001, 13:1–3. Petitioner contends that these limitations are taught by Insetta's disclosure of alternating layers of ceramic and conductive metal sheets as shown in Figures 2, 5, and 6.

Pet. 54–55 (citing Ex. 1003 ¶ 67; Ex. 1008, 3:38–42); *see also id.* at 44–46; Ex. 1003, 56–57. Petitioner argues that it would have been obvious to substitute Liebowitz's composite, which includes metallic particles dispersed in a ceramic, with the alternating metal/ceramic sheets of Insetta, to create a more uniform electric potential across the area of the capacitor. Pet. 45–46 (citing Ex. 1003, 57–58).

Patent Owner does not dispute that Insetta discloses the limitations recited in claim 14. Rather, Patent Owner argues that the '639 patent requires the conductive metal sheets be formed by electroplating and that Insetta teaches away from electroplating.[14] *See*, *e.g.*, PO Resp. 17–18, 23–25, 49–52. Specifically, Patent Owner contends the '639 patent requires metal sheets to be formed by electroplating because

> the '639 patent states "ceramic film 52 in . . . end blocks 48, 50 is thin enough that electroplating will occur over the ceramic film from metal layer 54 to metal layer 54 to provide the conductive metal coating 56 on . . . end blocks 48, 50." To form the claimed "metal coating," the '639 patent states that "*electroplating* . . . end blocks 48, 50 *is necessary*."

PO Resp. 23–24 (quoting Ex. 1001, 7:28–38). Patent Owner further contends that Insetta teaches away from electroplating by describing how contaminants introduced during the plating process may degrade capacitor performance. *Id.* at 24 (citing Ex. 1008, 1:62–2:7).

Patent Owner's argument is not convincing because claim 14 does not recite electroplating, nor otherwise recite process steps requiring that the alternating conductive metal sheets be applied by electroplating.

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[14] Again, Patent Owner's arguments in its Response apply only to claim 5. *See* PO Resp. 49–52.

Additionally, we disagree with Patent Owner's argument that Insetta teaches away from electroplating because Insetta expressly states that in order to improve electrical connections when glass-containing composites are used, "a metal plating process is sometimes used." Ex. 1008, 1:61–68; *see also* Ex. 1016 ¶¶ 55–57. As such, Insetta recognizes that electroplating is an alternative method for forming metal sheets.

Petitioner presents sufficient arguments and evidence to support a finding that it would have been obvious to substitute Liebowitz's composite, which includes metallic particles dispersed in a ceramic, with the alternating metal/ceramic sheets of Insetta, to create a more uniform electric potential across the area of the capacitor. Pet. 45–46, 54–55 (citing Ex. 1003, 57–58).

Based on our review of the full trial record and for the reasons discussed above, Petitioner has demonstrated, by a preponderance of the evidence, that claim 14 would have been obvious based on Liebowitz, Veater, and Insetta.

### *H. Asserted Obviousness of Claim 16 over Liebowitz, Veater, and Yih*

Claim 16 depends from claim 13 and requires that "the composite comprises ceramic particles coated with conductive metal." Ex. 1001, 13:7–8. Petitioner argues that Yih teaches coating ceramic particles (titanium diboride ($TiB_2$) platelets) with copper powder, a conductive metal, and that the copper-coated titanium diboride ceramic particles exhibited superior characteristics, such as "lower coefficient of thermal expansion [CTE], higher compressive yield strength, greater hardness, greater abrasive wear, greater scratch resistance, and lower porosity," as compared to the corresponding admixture comprising a mixture of copper powder and $TiB_2$

platelets. Pet. 55–56 (quoting Ex. 1012, 1703–1704); *see also* Ex. 1003 ¶ 78. Petitioner argues that a skilled artisan would have used Yih's method of metal coating ceramic particles to create the composite of Liebowitz, in which a paste contains "ceramic and metal particles," to improve structural strength and support. Pet. 55–56; Ex. 1003, 70–71, ¶ 78. Petitioner argues that a skilled artisan "would have had a reasonable expectation of success using the coated particle method of Yih because it would have involved simply substituting the composite of Liebowitz [i.e., mixture containing ceramic and metal powders] with a composite created using Yih's method [i.e., a ceramic coated with metal powder]." Pet. 56; Ex. 1003, 71.

Patent Owner does not dispute that Yih teaches the additional limitations of claim 16 but rather argues that there is no reason to combine Yih with Liebowitz because "$TiB_2$ is not and cannot be used in a ceramic composite [as] claimed in the '639 patent." PO Resp. 52–57.

Patent Owner first argues that $TiB_2$ is not a suitable ceramic dielectric material for ceramic capacitors because ceramic dielectric materials used in a capacitor must be an electrical insulator and $TiB_2$ is not an electrical insulator but rather is electrically conductive. *Id.* at 18–19, 54. Patent Owner contends that "[f]or this reason alone, a POSITA would understand that $TiB_2$ is not an electrical insulator, which is a requirement of a ceramic dielectric material used in a ceramic capacitor." *Id.* at 18–19; *see also id.* at 53 (stating that $TiB_2$ would not be used with ceramic dielectric material in the context of capacitors).

Claim 16, however, requires the metal and ceramic composite end blocks, and *not the non-conductive dielectric layer*, to comprise the metal coated ceramic particles. Ex. 1001, 13:7–8. Patent Owner has not provided

sufficient evidence that the metal and ceramic composite end blocks cannot comprise a conductive material. As such, Patent Owner's argument that *ceramic-metal composite end blocks* cannot comprise electrically conductive $TiB_2$ because the *ceramic dielectric* must be an electrical insulator is not persuasive.

Patent Owner next argues that $TiB_2$ is not compatible with the ceramic dielectric material of a capacitor. PO Resp. 19–20; *see also* Ex. 2001 ¶¶ 213–217. Petitioner, however, is not arguing that Yih's $TiB_2$-metal composite should be combined with Liebowitz; rather, Petitioner is arguing that it would have been obvious to use the method taught in Yih to coat ceramic particles with a metal powder so as to produce the ceramic-metal composite of Liebowitz. *See* Pet. 55–56. As such, Patent Owner's argument is not convincing because it does not address Petitioner's proposed combination of using the *method* taught by Yih to produce the ceramic-metal composite of Liebowitz.

Petitioner presents sufficient arguments and evidence to support a finding that one of ordinary skill in the art would have had reason to produce the ceramic-metal composite of Liebowitz using the method of metal coating ceramic particles taught by Yih to improve structural strength and support of the capacitor.

For the reasons discussed above, Petitioner has demonstrated, by a preponderance of the evidence, that claim 16 would have been obvious based on Liebowitz, Veater, and Yih.

### *I. Patent Owner's Objection to Reply as Containing New Arguments and Evidence*

Patent Owner objects to certain portions of Petitioner's Reply and

associated citations to Exhibits 1016 and 1017 as containing improper new evidence and arguments that should have been provided in the Petition.[15] Paper 16, 1–3; 37 C.F.R. § 42.23(b); 37 C.F.R. § 42.104(b)(5). As explained above, we agree with Patent Owner that certain material found on page 4 of the Reply, and related portions of the reply declarations, contain improper new evidence and argument. *See supra* Section III.D.4.a. As to the remaining objections, we have not relied on any of the identified material in a manner adverse to Patent Owner, and thus need not determine whether such material contains arguments or evidence that exceed the proper scope of a reply.

## IV. CONCLUSION

For the foregoing reasons and based on the evidence and arguments, Petitioner has demonstrated by a preponderance of the evidence that:

(1) claims 13, 15, and 18 are unpatentable under 35 U.S.C. § 103 over Liebowitz and Veater;

(2) claim 14 is unpatentable under 35 U.S.C. § 103 over Liebowitz, Veater, and Insetta; and

(3) claim 16 is unpatentable under 35 U.S.C. § 103 over Liebowitz, Veater, and Yih.

Based on the evidence and arguments, Petitioner has not demonstrated by a preponderance of the evidence that:

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[15] Petitioner contends that material found in the Reply on the first full paragraphs on pages 4, 5, and 7, the second full paragraphs on pages 1, 5, and 12, the paragraphs bridging pages 2 and 3, pages 9 and 10, and pages 22 and 23, as well as the first partial paragraph on page 20 contain improper arguments. Paper 16, 1–3.

(1) claims 1, 3, 4, 6, 8, 10, 11, and 17 are unpatentable under 35 U.S.C. § 103 over Liebowitz, Devoe, and Veater;

(2) claims 2 and 9 are unpatentable under 35 U.S.C. § 103 over Liebowitz, Devoe, Veater, and SinghDeo;

(3) claims 5 and 12 are unpatentable under 35 U.S.C. § 103 over Liebowitz, Devoe, Veater, and Insetta;

(4) claim 7 is unpatentable under 35 U.S.C. § 103 over Liebowitz, Devoe, Veater, and AAPA;

(5) claims 19 and 21 are unpatentable under 35 U.S.C. § 103 over Liebowitz and Devoe; and

(6) claim 20 is unpatentable under 35 U.S.C. § 103 over Liebowitz, Devoe, and SinghDeo.

## V. ORDER

Accordingly, it is

ORDERED that claims 13–16 and 18 of U.S. Patent No. 6,661,639 B1 are held to be unpatentable;

FURTHER ORDERED that claims 1–12, 17, and 19–21 of U.S. Patent No. 6,661,639 B1 have not been shown to be unpatentable on the record presented; and

FURTHER ORDERED that, because this Decision is final, a party to the proceeding seeking judicial review of the Decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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