

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VOLVO CARS OF NORTH AMERICA and
VOLVO CAR CORPORATION A/K/A VOLVO PERSONVAGNAR AB,
Petitioner,

v.

WATLOW ELECTRIC MANUFACTURING COMPANY,
Patent Owner.

IPR2019-01100
Patent 7,361,869 B2

Before LINDA E. HORNER, JON B. TORNQUIST,
and ARTHUR M. PESLAK, *Administrative Patent Judges*.

PESLAK, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

Volvo Cars of North America and Volvo Car Corporation a/k/a Volvo Personvagnar AB (collectively “Petitioner”), filed a Petition (Paper 2, “Pet.”) requesting an *inter partes* review of claims 1–4 and 8–11 (the “challenged claims”) of U.S. Patent No. 7,361,869 B2 (Ex. 1001, “the ’869 patent”). Petitioner submitted the Declaration of Dr. Michael Randall in support of the Petition. Ex. 1003. Taking into account the arguments presented in Patent Owner’s Preliminary Response, we determined that there was a reasonable likelihood that Petitioner would prevail in its contention that the challenged claims of the ’869 patent are unpatentable under 35 U.S.C. § 103. On November 14, 2019, we instituted this *inter partes* review as to the challenged claims and all grounds presented in the Petition. Paper 7. (“Dec.”).

During the course of trial, Patent Owner filed a Patent Owner Response. Paper 13 (“PO Resp.”). Patent Owner filed a Declaration of Andrew Selvy and a Declaration of Dr. André McDonald in support of the Patent Owner Response. Exs. 2007, 2009. Petitioner filed a Reply to Patent Owner’s Response. Paper 19 (“Pet. Reply”). Petitioner also filed a second Declaration of Dr. Michael Randall in support of Petitioner’s Reply. (Ex. 1077). Patent Owner filed a Sur-reply. Paper 28 (“Sur-reply”). An oral hearing was held on August 14, 2020, and a transcript of the hearing has been entered into the record. Paper 36 (“Tr.”).¹

¹ With our permission, Patent Owner filed a Paper titled “Patent Owner’s Identification of Evidence Exceeding the Proper Scope of Petitioner’s Reply.” Paper 30. Petitioner filed a response thereto. Paper 31. To the extent that we rely on any of the evidence objected to by Patent Owner, we address Patent Owner’s objections in the context of discussing any such evidence.

We have jurisdiction under 35 U.S.C. § 6. This is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of the challenged claims of the '869 patent. For the reasons discussed below, we determine that Petitioner has established by a preponderance of the evidence that claims 1–4 and 8–11 of the '869 patent are unpatentable.

A. Related Matters

The parties state that the '869 patent is asserted in *Watlow Electric Manufacturing Company v. Volvo Cars of North America, LLC and Volvo Car Corporation (a/k/a Volvo Personvagnar AB)*, No. 2:18-cv-10673 (D.N.J.). Pet. 2; Paper 4, 1.

B. Real Parties in Interest

Petitioner names itself and Webasto Thermo & Comfort SE and Webasto SE as real parties in interest. Pet. 2. Patent Owner identifies only itself as a real party in interest. Paper 4, 1.

C. The '869 Patent (Ex. 1001)

The '869 patent issued on April 22, 2008, and is titled “Method for the Production of an Electrically Conductive Resistive Layer and Heating and/or Cooling Device.” Ex. 1001, codes (45), (54). The '869 patent relates generally to a heater with an electrically conductive resistive layer formed on a surface of the heater. *See id.* at 1:18–21, 4:40–41, 5:28. Figures 1 and 2 of the '869 patent are reproduced below:

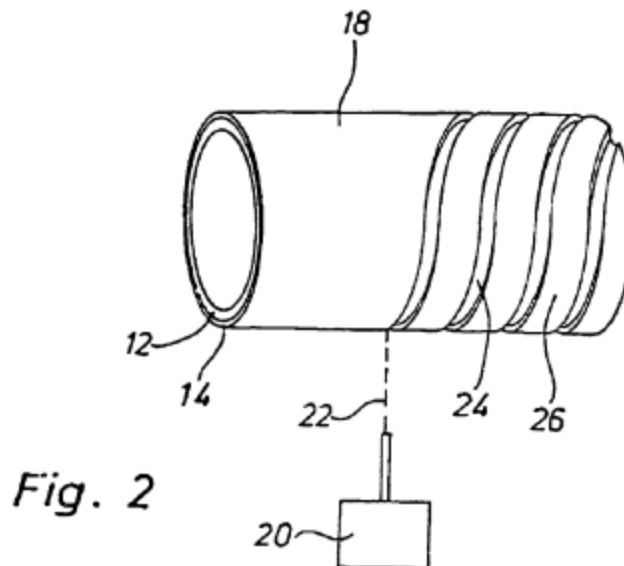
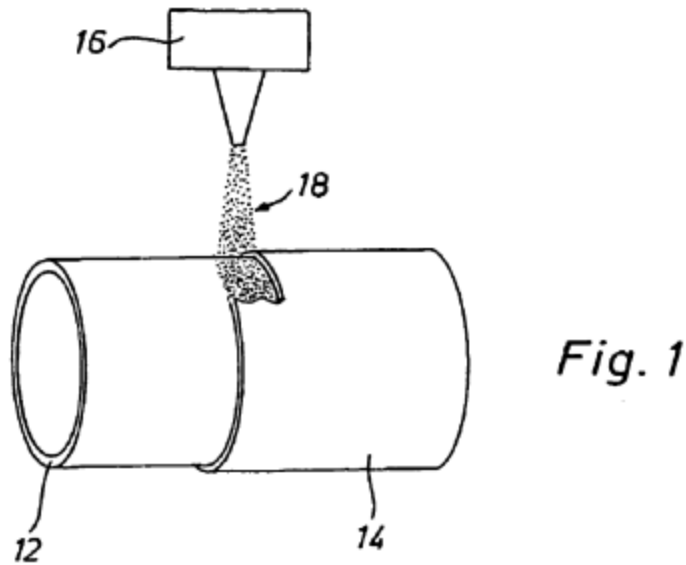


Figure 1 is a “layout of a tube on which an electrically conductive material is sprayed-on” and Figure 2 illustrates a laser beam working on the electrically conductive layer of the tube of Figure 1. *Id.* at 4:20–23.

As shown in Figure 1, an electrically conductive layer is applied to tube 12 by spraying germanium particles 18 onto tube 12 using a cold-gas-spray method to form layer 14. *Id.* at 4:40–47; 5:4–6. The ’869 patent

discloses that other methods “such as plasma-spraying, high-speed-flame-spraying, arc-spraying, autogenous-spraying [sic, autogenous spraying], or laser-spraying” may also be used to deposit particles on the substrate surface. *Id.* at 4:64–66. Germanium particles 18 impact the surface at speeds between 300–1200 m/sec causing the break-up of surface oxides of the surface of tube 12. *Id.* at 4:48–53. In addition, due to “micro-friction because of the impact the temperature of the contact area increases and leads to micro-welding.” *Id.* at 4:53–55. After the electrically conductive layer is sprayed onto tube 12, laser 20 is used to remove part of layer 14 by heating and evaporating selected portions of the material forming layer 14 as shown in Figure 2. *Id.* at 5:12–18. In this case, “an electrically conductive layer (26) is created, that stretches spirally from one axial end of the tube (12) to the other” creating flow heater 28. *Id.* at 5:22–26, Fig. 3. The ’869 patent describes a similar process to create an electrically conductive layer on a flat heat plate. *See id.* at 5:27–36, Fig. 4. The ’869 patent also discloses that “a specially precise and fine tuning of the electrical resistance [of layer 14 is] possible” because “[t]hrough heating local oxides can be brought into the layer, which affects the local electrical conductivity of the material.” *Id.* at 3:53–56.

D. The Challenged Claims

Claims 1 and 8 are independent. Ex. 1001, 6:53–8:33. Claim 1 is reproduced below:

1. A heater adapted for fixed placement proximate a separate and external part or medium to be heated and defining a shape commensurate with the part or medium to be heated, the heater comprising:
 - a complex shaped substrate;
 - a nonconductive layer formed over the substrate; and

an electrically conductive resistive layer formed on the nonconductive layer by a process of forming a material in the form of particles onto the nonconductive layer and subsequently and selectively removing areas of the material using a laser to form a complex contour pattern, wherein removing areas of the material creates a desired resistance of the electrically conductive resistive layer such that at least a portion of the particles are micro-welded along a length of the pattern and local oxides are brought into the pattern to fine tune an electrical resistance along the length of the pattern.

Id. at 6:53–7:2.

E. Prior Art and Asserted Grounds

Petitioner asserts that claims 1–4 and 8–11 of the '869 patent would have been unpatentable on the following grounds² (Pet. 15–69):

Claims Challenged	35 U.S.C. §	Reference(s)
1, 8	103	Toyota ³
1, 8	103	Toyota, Imaoka ⁴
2, 9	103	Toyota, Macher ⁵
2, 9	103	Toyota, Imaoka, Macher
3, 4, 10, 11	103	Toyota, Juliano ⁶
3, 4, 10, 11	103	Toyota, Imaoka, Juliano
1, 8	103	Brook-Levinson ⁷
1, 8	103	Brook-Levinson, Imaoka
2, 9	103	Brook-Levinson, Macher
2, 9	103	Brook-Levinson, Imaoka, Macher

² The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. § 103. Because the '869 patent was filed before the effective date of the relevant amendment, the pre-AIA version of § 103 applies.

³ Toyota, US 6,096,995, issued Aug. 1, 2000 (Ex. 1008, “Toyota”).

⁴ Imaoka, JP S57-172702, published Oct. 23, 1982 (Ex. 1010, “Imaoka”).

⁵ Macher, US 6,717,109 B1, issued Apr. 6, 2004 (Ex. 1012, “Macher”).

⁶ Juliano, US 5,973,296, issued Oct. 26, 1999 (Ex. 1016, “Juliano”).

⁷ Brook-Levinson, WO 00/70915, published Nov. 23, 2000 (Ex. 1009, “Brook-Levinson”).

Claims Challenged	35 U.S.C. §	Reference(s)
3, 4, 10, 11	103	Brook-Levinson, Juliano
3, 4, 10, 11	103	Brook-Levinson, Imaoka, Juliano

II. ANALYSIS

A. Overview

Petitioner bears the burden of establishing the unpatentability of any claim by a preponderance of the evidence. 35 U.S.C. § 316 (e); 37 C.F.R. § 42.1(d). This burden of persuasion never shifts to the patent owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

A claim is unpatentable under § 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 the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *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 skill in the art; and (4) when in evidence, objective indicia of non-obviousness (i.e., secondary considerations).⁸ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

We analyze the asserted grounds based on obviousness with these principles in mind.

⁸ No evidence of objective indicia of non-obviousness has been presented for our consideration.

B. Level of Ordinary Skill in the Art

Petitioner contends that a person of ordinary skill in the art concerning the '869 patent “would have had a Bachelor’s degree in mechanical engineering, materials science, electrical engineering, or a similar discipline, as well as two or more years of relevant industry or research experience.” Pet. 7 (citing Ex. 1003 ¶¶ 13–15). Alternatively, according to Petitioner, a person of ordinary skill in the art would have had “a Master’s degree in mechanical engineering, materials science, electrical engineering, or a similar discipline, as well as one year of industry experience.” *Id.* Petitioner further contends that a person of ordinary skill in the art “would have been familiar with layered heating systems and/or the components and underlying technology used therein.” *Id.* at 8. Patent Owner does not address the level of skill in the art. *See generally* PO Resp.

We adopt Petitioner’s proposed level of ordinary skill in the art because it appears consistent with the problems addressed in the prior art of record and the '869 patent.

C. Claim Construction

For *inter partes* reviews filed on or after November 13, 2018, we apply the same claim construction standard used by Article III federal courts and the ITC, both of which follow *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc), and its progeny. *See* Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board, 83 Fed. Reg. 51,340, 51,340, 51,358 (Oct. 11, 2018) (amending 37 C.F.R. § 42.100(b) effective November 13, 2018) (now codified at 37 C.F.R. § 42.100(b) (2019)). Because the Petition was filed on May, 17, 2019, we apply that standard here. Accordingly, we construe each challenged claim of the '869 patent to generally be “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.”
Id.

Petitioner requests that we construe the claim terms “a complex shaped substrate,” “a complex contour pattern,” “micro-welded,” and “local oxides are brought into the pattern to fine tune an electrical resistance along the length of the pattern.” Pet. 8–13. Patent Owner requests that we construe the claim terms “a process of forming a material in the form of particles onto the nonconductive layer,” “subsequently and selectively removing areas of the material using a laser,” “to form a complex contour pattern,” and “wherein removing areas of the material creates a desired resistance of the electrically conductive resistive layer such that at least a portion of the particles are micro-welded along a length of the pattern and local oxides are brought into the pattern.” PO Resp. 9–18.

With respect to Patent Owner’s proposed constructions, Patent Owner contends and Petitioner agrees that these limitations are written in product-by-process format. *See* PO Resp. 8–18; Sur-reply 4–5; Pet. Reply 2–7. We do not need to construe these limitations to resolve this dispute but, due to the nature of the product-by-process limitations, we address Patent Owner’s claim construction arguments below in the context of analyzing the patentability of these claims. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (noting that “we need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy’”) (citing *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

In our Decision on Institution, we did not definitively construe “complex contour pattern” as recited in claim 1. Dec. 12. We noted “that

patterns formed on a cylindrical substrate may fall within the meaning” of this term and requested that the parties brief the proper construction of this term. *Id.*

Petitioner submits the term “at least encompasses a pattern formed around a cylindrical substrate.” Pet. 9. In support of this position, Petitioner notes that the ’869 patent discloses that “randomly complex contours can be evaporated from the electrically conductive material so that correspondingly complex electrical resistance layers can be manufactured.” *Id.* (quoting Ex. 1001, 2:23–28). Petitioner also directs us to Figures 2 and 3 of the ’869 patent as examples of a contour pattern formed around a cylindrical substrate. *Id.* at 10 (citing Ex. 1003 ¶¶ 147–49).

Patent Owner, in turn, argues that a complex contour pattern “requires a structure having an outer shape that combines parts of multiple simple shapes such that it is complex.” PO Resp. 14 (citing Ex. 2011, 371; Ex. 2012, 465; Ex. 2013). Patent Owner agrees “that Figs. 2 and 3 of the ’869 Patent each illustrate an example of a ‘complex contour pattern.’” *Id.* at 17 n.4. We note that Figures 2 and 3 illustrate a spiral pattern on a cylindrical substrate. Ex. 1001, Figs. 2, 3. Patent Owner also contends that Figure 4 of the ’869 Patent discloses a “complex contour pattern . . . in the form[] of a meandering electrically conductive resistive material layer.” PO Resp. 5. Although Patent Owner contends its proposed construction is supported by the Specification of the ’869 patent (*id.* at 15), Patent Owner does not persuasively explain how either a spiral pattern or meandering pattern as shown in Figures 2–4 of the ’869 patent have outer shapes that “combine parts of multiple simple shapes,” as would be required by its proposed construction. *See generally* PO Resp. Consequently, we do not adopt Patent Owner’s construction.

For the purposes of resolving the dispute between the parties, we determine that a “complex contour pattern” encompasses at least a spiral pattern on a cylinder and a meandering pattern.

D. Grounds 1 & 2: Obviousness over Toyota Alone or in view of Imaoka

Petitioner contends that independent claims 1 and 8 are unpatentable in light of Toyota alone or in combination with Imaoka. Pet. 15–37. In support thereof, Petitioner identifies the disclosures in Toyota and Imaoka alleged to describe the subject matter in the challenged claims. *Id.* Additionally, Petitioner offers declaration testimony from Dr. Michael Randall in support of its position. Ex. 1003 ¶¶ 48–136, 168–72, 174–75, 194–267.

Patent Owner contends Toyota alone or in combination with Imaoka does not disclose a layer formed “by a process of forming a material in the form of particles” (PO Resp. 19–32), “subsequently and selectively removing areas of the material . . . to form a complex contour pattern,” (*id.* at 32–37), or that “at least a portion of the particles are micro-welded along a length of the pattern and local oxides are brought into the pattern.” (*id.* at 37–43).

We begin our analysis with brief overviews of Toyota and Imaoka. We then address the parties’ respective contentions with respect to the challenged claims.

Overview of Toyota – Ex. 1008

Toyota is a United States Patent issued on August 1, 2000, and is entitled “Heating Roller for Fixing.” Ex. 1008, codes (45), (54). Toyota discloses “a cylindrical heater which is used as a heater for hot water.” *Id.* at 2:12–13. Further, Toyota’s cylindrical heater includes “a heating resistor on

a surface of the cylinder with an insulating layer lying therebetween” and “is characterized in that the heating resistor is divided into plural zones along an axial direction of the cylinder,” and includes “slots for adjusting the resistance [that] are respectively shaped in each zone.” *Id.* at 3:1–6.

Figures 6, 7A, and 7B of Toyota are reproduced below:

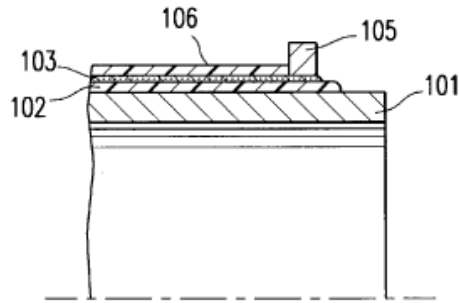


FIG. 6

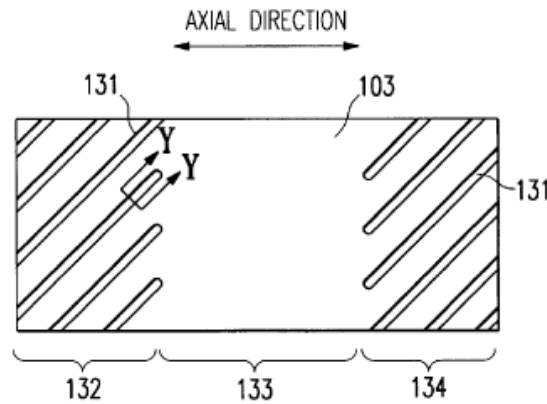


FIG. 7A

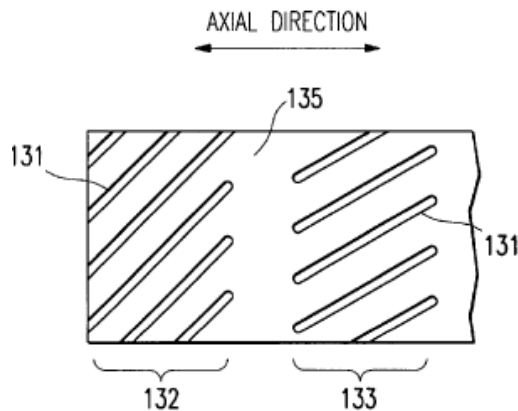


FIG. 7B

Figure 6 is an enlarged sectional view of an embodiment of Toyota's cylindrical heater and Figures 7A and 7B illustrate "a heating resistor in the cylindrical heater" of Toyota. *Id.* at 4:46–49.

Figure 6 shows insulating layer 102 on the outer circumferential surface of cylinder 101 and heating resistor 103 formed on insulating layer 102. *Id.* at 11:24–27. Toyota discloses forming a resistance layer by applying a heating resistance component to the insulating layer by screen printing, dipping, spray coating or the like and calcining at 400 to 500°C. *Id.* at 7:44–48. After forming a resistance layer, the resistor "is subject to laser trimming as the need arises so that a resistance value is adjusted." *Id.* at 7:49–51. Figure 7A and Figure 7B illustrate patterns in heating resistor 103 formed by the laser trimming process. *See id.* at 11:40–47.

Figure 11 of Toyota is reproduced below:

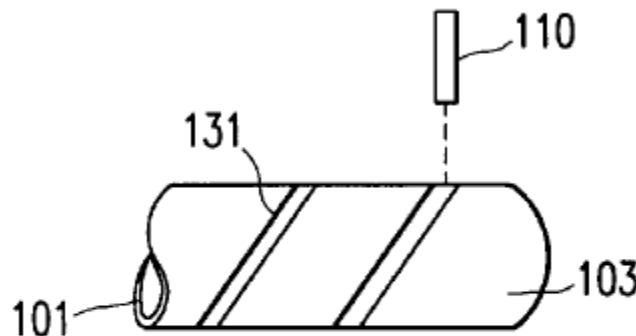


FIG. 11

Figure 11 "is a side elevation view illustrating a conventional heating roller." *Id.* at 4:56–57. Figure 11 "suggests a heating roller which is constituted such that spiral slots 131 are formed on the full length of the

heating resistor 103 which is formed on the whole surface of the cylinder 101.” *Id.* at 2:34–37.

Overview of Imaoka – Ex. 1010

Imaoka is a Japanese Unexamined Patent Application published on October 23, 1982, and is entitled “Thin-Film Resistance Manufacturing Method.” Ex. 1010, 6 (codes (12), (43), (54)). Imaoka is directed to “forming a thin film resistance on an insulating substrate and tuning, to a prescribed value, the resistance value through laser trimming.” *Id.* at 1:6–8. Imaoka further discloses forming “an oxide passivation film on the heat-affected zone on the periphery of the trimmed portion” after laser trimming. *Id.* at 2:24–28.

Analysis of Claim 1

a. Preamble: A heater adapted for fixed placement proximate a separate and external part or medium to be heated and defining a shape commensurate with the part or medium to be heated, the heater comprising:

Petitioner contends that the “preamble of claim 1 is limiting because [Patent Owner] added the language recited in the preamble during prosecution to distinguish the prior art.” Pet. 18 (citing Ex. 1002, 220–30). Petitioner further contends that Toyota discloses the subject matter of the preamble because it teaches “a heater adapted for fixed placement proximate to, and defining a shape commensurate with, a medium to be heated — namely ‘a cylindrical heater’ that can be fixed on a pipe.” *Id.* (citing Ex. 1008, 2:10–13, 2:49–52, 3:20–23, 3:54–59, 14:51–54; Ex. 1003 ¶¶ 48–59, 194–96). Patent Owner does not dispute that Toyota discloses the subject matter set forth in the preamble of claim 1. *See* PO Resp. 19–43.

We need not determine whether the preamble is limiting because, based on the evidence presented by Petitioner, Petitioner establishes that Toyota discloses the subject matter of the preamble of claim 1.

b. a complex shaped substrate

Petitioner contends that Toyota discloses this limitation because it teaches “a heater that could be applied to a cylindrical or tubular (*i.e.*, ‘complex shaped’) substrate, e.g., a pipe, which is the same complex shaped substrate disclosed in Figures 1-3 of the ’869 patent.” Pet. 19 (citing Ex. 1008, Abst., 3:1–2, 7:60–67, 11:23–30, 13:51–52, 14:49–54, Figs. 4–6, 11; Ex. 1003 ¶¶ 60–64, 197–99). Patent Owner does not dispute that Toyota discloses this limitation. *See* PO Resp. 19–43.

Based on the evidence presented by Petitioner, Petitioner establishes that Toyota discloses this limitation.

c. a nonconductive layer formed over the substrate

Petitioner contends that Toyota discloses this limitation because it teaches “a heater comprising an insulating (*i.e.*, ‘nonconductive’) layer between an electrically conductive resistive layer and a substrate.” Pet. 19 (citing Ex. 1008, 7:1–7, 7:37–52, 7:61–65, 11:25–26, 13:55–59, Fig. 6); Ex. 1003 ¶¶ 65–74, 200–02). Patent Owner does not dispute that Toyota discloses this limitation. *See* PO Resp. 19–43.

Based on the evidence presented by Petitioner, Petitioner establishes that Toyota discloses this limitation.

d. an electrically conductive resistive layer formed on the nonconductive layer by a process of forming a material in the form of particles onto the nonconductive layer

Petitioner contends that, for product-by-process limitations, “the focus for invalidity is on claimed structures, and process-specific elements

are disregarded because they are not entitled to patentable weight.” Pet. 13 (citing *Purdue Pharma v. Epic Pharma*, 811 F.3d 1345, 1354 (Fed. Cir. 2016)). Petitioner further contends this limitation “require[s] only that the recited *product* comprise particles.” Pet. Reply. 3.

Petitioner contends that Toyota discloses this limitation because its resistive layer is formed from “metallic materials and metallic compounds . . . in particulate form before being mixed into a ‘paste’ (the “paste embodiment”) with a ‘solvent, binder, dispersant’ and ‘applied to the insulating layer 2 by screen printing, dipping, spray coating or the like.’” Pet. 20 (citing Ex. 1008, 7:8–13, 7:44–48; Ex. 1003 ¶¶ 205–08). Petitioner further contends that Toyota’s metallic materials and metallic compounds “would be in particulate form before being mixed into a ‘paste’” in order to “effectively create a paste from such materials suitable for handling and deposition.” *Id.* (citing Ex. 1003, ¶¶ 205–208).

Petitioner alternately contends that Toyota suggests this limitation because of the disclosure that its heating resistor can be formed by metallizing (the “metalizing embodiment”). *Id.* at 21. According to Petitioner, one of ordinary skill in the art would recognize that metallizing processes “include various thermal spray processes, including flame spraying, plasma-arc spraying, and electric-arc spraying”, and that “[s]uch processes deposit materials ‘in the form of particles.’” *Id.* (citing Ex. 1008, 7:9–26; Ex. 1003 ¶¶ 210–11; Ex. 1011, 1:66–67, 3:40–41, 3:53, 6:6; Ex. 1022, Abst.; Ex. 1025, 5:35–39; Ex. 1026, Title, 1:29–40; Ex. 1029, 1:35–39).

Patent Owner contends that because this limitation is a product-by-process limitation, “the structural aspects of the product covered by the limitation must be considered when assessing the patentability of the claim”

and the question “is whether the Petition established that Toyota discloses an electrically conductive resistive layer having the same structural and functional characteristics as a resistive layer formed by the recited process of forming material in the form of particles.” PO Resp. 19–20 (citing *In re Nordt Dev. Co., LLC*, 881 F.3d 1371, 1374 (Fed. Cir. 2018); Sur-reply 5. Patent Owner contends that neither Toyota’s paste embodiment nor the metalizing embodiment disclose this limitation. PO Resp. 20–32. We analyze the paste embodiment and the metallizing embodiment separately.

i. Paste Embodiment

Patent Owner contends that the Petition fails to demonstrate that the structure resulting from Toyota’s paste embodiment is “the same as the structure that would result from forming a material in the form of particles,” as required by claim 1. PO Resp. 21. According to Patent Owner, Petitioner’s contention “that a paste structure includes particles” is insufficient to satisfy the limitations of claim 1 that the “material is formed onto a [substrate] in the [form] of particles.” *Id.*

Patent Owner contends that “a layer [of] material formed onto a surface from particles will have certain unique characteristics.” *Id.* at 22 (citing Ex. 2009 ¶¶ 12–16). Patent Owner relying on the testimony of its declarant, Dr. McDonald, contends that a layer formed by particles as recited in claim 1 “results in the forming of a material consisting of interconnected particles which could take the form of deformed splats.” Ex. 2009 ¶ 13. Dr. McDonald also testifies that the particles will be “joined together” with “a spatial separation (e.g., voids) between the particles. The material will be relatively porous and have open interstitial spaces between the particles forming the material.” *Id.* at ¶ 20.

Again relying on Dr. McDonald's testimony, Patent Owner further contends that Toyota's paste embodiment "would take a different form." PO Resp. 23 (citing Ex. 2009 ¶ 21). According to Patent Owner, Toyota's paste embodiment "would have a density substantially greater than the material formed from particles on a substrate, would not be very porous and would not have significant spatial separation between the particles to the same degree as the structure formed from particles onto a substrate." *Id.* Patent Owner also contends that there would be additional differences including "differences in the presence of a lamellar microstructure, interstitial spaces between the particle splats and single-phase material structure." *Id.* (citing Ex. 2009 ¶ 22).

Petitioner, in turn, contends that Toyota's paste embodiment satisfies this claim limitation "because particles are formed on the surface." Pet. Reply 8. Petitioner further contends that the claims do not "exclude[s] forming 'a material in the form of particles' by applying particles with 'a synthetic resin or glass containing matrix.'" *Id.* Petitioner further contends that "Patent Owner effectively seeks to require that particles be sprayed . . . [b]ut the claims recite 'forming a material in the form of particles' — not spraying." *Id.* at 8–9.

Petitioner next contends that, contrary to Patent Owner's contention, material deposited by a spray process will "not necessarily (or even generally) [be] 'relatively porous' with 'interstitial spaces.'" *Id.* at 9. According to Petitioner, "[a] spray process can deposit dense material." *Id.* (citing Ex. 1077 ¶¶ 36–50). Petitioner further contends that Patent Owner fails to cite support for "its expert's assertions that there are structural differences between 'Toyota's paste process' and 'forming a material in the form of particles.'" *Id.* (citing Ex. 1002 ¶¶ 12–22; Ex. 1077 ¶¶ 36–50). For

the following reasons, we agree with Petitioner that Toyota's paste embodiment discloses this limitation.

The parties agree that this limitation is a product-by-process limitation. We note that "when considering the patentability of product claims that contain process limitations, claim scope is generally based on the product itself, not the process." *In re Nordt*, 881 F.3d at 1374 (citing *In re Thorpe*, 777 F.2d 695, 697 (Fed. Cir. 1985)). The Federal Circuit, however, instructs us that we should engage in two distinct inquiries. *Id.* at 1375. First, we determine if the limitation is "a process or structural limitation" and second, if the limitation is structural, we determine "the precise meaning of the limitation." *Id.* In addition, "words of limitation that can connote with equal force a structural characteristic of the product or a process of manufacture are commonly and by default interpreted in their structural sense, unless the patentee has demonstrated otherwise." *Id.* (citations omitted). In determining that the claim limitation at issue in *Nordt*, "injection molded," connoted structure, the Federal Circuit relied on disclosure in the applicant's specification that "injection molding" results in an "integral component." *Id.* We analyze the limitations of claim 1 with these principles in mind.

Patent Owner asserts that this limitation is written in product-by-process format. PO Resp. 9–10. Based on the rule set forth in *In re Thorpe*, this means that the process limitation is entitled to no patentable weight. PO Resp. 9–10. Patent Owner goes on to argue, however, that we should consider the structural aspects of the product formed by the process recited in the claims. *Id.* at 19–20. This appears to be a request that we engage in the two-part inquiry from *In re Nordt* to determine if the limitation is structural and, if so, what is the precise meaning of the limitation. For the

following reasons, we come to the same conclusion regardless of whether we treat the limitation as a product-by-process limitation or a structural limitation.

As the Federal Circuit did in *In re Nordt*, we determine if the limitation “formed . . . by a process of forming a material in the form of particles onto the nonconductive layer” is a product-by-process limitation or a structural limitation. We look to the language of claim 1 and the Specification of the ’869 patent in making this determination. *See In re Nordt*, 881 F.3d at 1375 (Reviewing the applicant’s specification to determine if injection molded limitation was a process limitation or a structural limitation.).

We start with the claim language. Claim 1 requires that the “electrically conductive resistive layer” is “formed on the nonconductive layer by a process of forming a material in the form of particles onto the nonconductive layer” Ex. 1001, 6:59–61. This claim language, requires, as a matter of structure, that the particles forming the layer are electrically conductive. We are directed to no persuasive evidence, however, that the claimed “process of forming a material in the form of particles onto the nonconductive layer” connotes a specific structure. *Nordt*, 881 F.3d at 1374–1375.

The ’869 patent describes numerous ways in which an electrically conductive resistive layer may be formed on the nonconductive layer. For example, the ’869 patent Specification describes one embodiment wherein Germanium particles are sprayed onto tube 12 using a cold-gas spray method. *Id.* at 4:40–47. This method results in deformed Germanium particles, surface-oxides of tube 12 are “broken up” and “[t]hrough micro-friction because of the impact [of the particles] the temperature of the

contact area increases and leads to micro-welding.” *Id.* at 4:51–55. The Specification also discloses applying the electrically conductive material to the substrate by “plasma-spraying, high-speed-flame-spraying, arc-spraying, autogenous-spraying [sic, autogenous], or laser-spraying.” *Id.* at 4:63–67.

Patent Owner contends that the product-by-process “format of this claim element . . . requires that the resistive ‘material’ is created on the surface . . . by forming particles on the surface.” PO Resp. 10. The Specification appears to support Dr. McDonald’s testimony that the particles applied with the disclosed cold gas spray method are “interconnected” by micro-welding and are also “deformed.” *See* Ex. 2009 ¶ 13. But, Dr. McDonald does not direct us to any intrinsic evidence that particles applied by the other methods referenced in the Specification would have these properties as well. Further, we find no support in the Specification for Dr. McDonald’s testimony that the particles in the layer will have “spatial separation (e.g., voids) between the particles” nor for his testimony that “[t]he material will be relatively porous and have open interstitial spaces between the particles forming the material.” *See id.* at ¶ 20. At best, Patent Owner’s arguments amount to a request that we improperly import structural limitations from the disclosed cold gas spray method into claim 1, as well as other limitations based on unsupported expert testimony. We decline to do so. To the extent that this limitation is a structural limitation, we determine that the claim only requires what the plain language recites, *i.e.*, the electrically conductive layer is formed from electrically conductive particles.

Patent Owner does not dispute that Toyota’s paste embodiment forms an electrically conductive layer that includes electrically conductive particles. *See* PO Resp. 20–21. If we treat the “process of forming a material in the form of particles” limitation as a process of manufacture, it is

entitled to no patentable weight. Consequently, Toyota's paste embodiment meets the limitation because it forms an electrically conductive layer from electrically conductive particles. *See* Ex. 1018, 7:8–13; Fig. 3.

If we treat the limitation as structural, we find that the preponderance of the evidence indicates that there are no material structural differences, as argued by Patent Owner, between the product formed by the process of claim 1 and the paste embodiment of Toyota. *See* PO Resp. 23. The alleged structural differences argued by Patent Owner are that particles fixed and disbursed within a resin or glass matrix in the paste embodiment “would not be very porous”, “would not have significant spatial separation between the particles”, “differences in the presence of a lamellar microstructure”, and “single phased material structure.” *Id.* (citing Ex. 2009 ¶¶ 20–22). However, none of these alleged structural differences are relevant to the claim requirements. Consequently, treating this limitation as a structural limitation, Toyota's paste embodiment meets the limitation because it forms an electrically conductive layer containing electrically conductive particles. *See* Ex. 1018, 7:8–13, Fig. 3.

For all the foregoing reasons, Petitioner establishes that Toyota's paste embodiment discloses this limitation because it forms an electrically conductive layer from electrically conductive particles as required by claim 1.

ii. Metallizing Embodiment

Patent Owner contends that one of ordinary skill in the art “would not have a clear understanding of what Toyota intended by its reference to ‘metallizing’” because “[m]etallizing” is a generally vague and highly generic term that describes a broad class of operations for forming a metal coating on a base.” PO Resp. 24–25 (citing Ex. 2007 ¶¶ 10–11; Ex. 2009 ¶¶

24–25). According to Patent Owner’s declarants, Dr. McDonald and Mr. Selvy, the term metallizing encompasses a number of different operations including “dipping, plating, plasma vapor deposition, chemical vapor deposition, laminating, cladding, spinning, electroplating, printing, thermal spraying, cold-gas dynamic spraying, and directed energy deposition.” *Id.* at 25 (citing Ex. 2005 ¶ 11; Ex. 2009 ¶ 25). Patent Owner contends that many of these processes “do not result in structures formed by the process of forming a material in the form of particles.” *Id.* (citing Ex. 2005 ¶ 12; Ex. 2009 ¶ 26). Patent Owner further contends that these processes “will result in different macro and/or microstructures, varied layer thicknesses and densities as well as different material properties which are critical to the design of a resistive heater.” *Id.* at 26 (citing Ex. 2005 ¶ 12). Patent Owner further contends that the Petition “fails to establish that a skilled artisan would necessarily understand the reference to ‘metallizing’ in Toyota to mean a thermal spray process or would otherwise find the use of a thermal spray process obvious in light of Toyota’s single-sentence passing reference to ‘metallizing.’” *Id.*

Petitioner in turn contends that it is not required to “show ‘metallizing’ ‘mean[s] thermal spraying’” as Patent Owner asserts but it must “show only that Toyota’s disclosure of ‘metallizing’ renders such processes obvious.” Pet. Reply 12 (citing *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 419 (2007)). Petitioner further contends that “Toyota cites prior art disclosing thermal spray processes in describing how ‘a conventional heating roller’ was made, confirming that a [skilled artisan] would have applied thermal spraying as an obvious metallizing technique.” *Id.* at 13 (citing Ex. 1008, 2:34–48, 4:55–56; Ex. 1052, 3 (replaced by Ex.

1078)(“Nagasaka”); Ex. 1053, 2 (replaced by Ex. 1079)(“Saito”)); Ex. 1077 ¶¶ 54–58).

Patent Owner objects to Exhibits 1078 and 1079, submitted with Petitioner’s Reply, as beyond the proper scope of a Reply. Paper 30, 2. According to Patent Owner, “[h]ad the Petitioner intended to argue in the Petition that a [skilled artisan] would have found it obvious to modify Toyota to include the process allegedly described in new Exhibits . . . (1078 and/or 1079) it could have done so. But it did not.” *Id.* Petitioner responds that Exhibits 1078 and 1079 are cited in Toyota and were submitted in response to Patent Owner’s argument that one of ordinary skill in the art would not have considered Toyota’s reference to metallizing to include thermal spraying. Paper 31, 2–3 (citing Ex. 1008, 2:34–48, 4:55–56; PO Resp. 31–32).

The ’869 patent discloses that the electrically conductive layer can be formed by “thermal spraying.” Ex. 1001, 1:60–65. Petitioner’s declarant, Dr. Randall, testifies that a skilled artisan would understand that “metallizing processes, e.g., thermal spray processes . . . deposit metallic particles.” Ex. 1003 ¶ 211. Both of Patent Owner’s declarants, Mr. Selvy and Dr. McDonald, agree with Dr. Randall that metallizing includes, *inter alia*, thermal spraying. Ex. 2007 ¶ 11; Ex. 2009 ¶ 25. Although Mr. Selvy and Dr. McDonald both testify that many of the other processes that fall under the umbrella of metallizing do not form structures by depositing particles, neither disputes Dr. Randall’s testimony that thermal spray processes deposit metal particles. Ex. 2007 ¶ 12; Ex. 2009 ¶ 26. Based on the testimony of Petitioner’s and Patent Owner’s declarants we find that one of ordinary skill in the art would have understood that thermal spraying is a “metallizing” process and that thermal spraying is a process by which metal

particles are deposited on a substrate. Therefore, we determine that Toyota's reference to "metallizing" would have rendered a thermal spray process obvious to one of ordinary skill in the art.

We now address Patent Owner's contention that Nagasaka and Saito exceed the proper scope of a Reply. Our Trial Practice Guide provides that "Petitioner may not submit new evidence or argument in reply that it could have presented earlier, e.g., to make out a *prima facie* case of unpatentability. A party also may submit rebuttal evidence in support of its reply." Consol. TPG,⁹ 73 (Nov. 2019) (citing *Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1077–78 (Fed. Cir. 2015)). The Federal Circuit has explained that "[a]s we have regularly held, 'the petitioner in an inter partes review proceeding may introduce new evidence after the petition stage if the evidence is a legitimate reply to evidence introduced by the patent owner.'" *Apple, Inc. v. Andrea Elec. Corp.*, 949 F.3d 697, 706–707 (Fed. Cir. 2020) (citation omitted). In the Patent Owner Response, Patent Owner refers to the testimony of Dr. McDonald and Mr. Selvy to support its argument that a skilled artisan "would not have been led by Toyota's reference to 'metallizing' to use a thermal spray process to create the resistive layer of Toyota's heater." PO Resp. 31. Patent Owner further argues a skilled artisan "would not have considered Toyota's reference to 'metallizing' to suggest the use of a thermal spray process to create an active resistive heating element, because such processes were understood at that time to be primarily, and nearly exclusively, used for passive protection against surface degradation." *Id.* at 31–32. In the Reply, Petitioner contends that "Toyota cites prior art disclosing thermal spray processes in describing how 'a

⁹ Available at www.uspto.gov/trialpracticeguideconsolidated.

conventional heating roller’ was made.” Pet. Reply 13 (citing Ex. 1008, 2:34–48; Ex. 1078, 3). Petitioner does not rely on this evidence to establish its prima facie case but rather to rebut Patent Owner’s argument that Toyota’s reference to metallizing does not suggest thermal spraying as contended in the Petition. Consequently, Exhibit 1078 and 1079 constitute legitimate reply evidence in response to evidence introduced by Patent Owner.

Figure 11 of Toyota “suggests a heating roller which is constituted such that spiral slots 131 are formed on the full length of the heating resistor 103 which is formed on the whole surface of cylinder 101.” Ex. 1008, 2:34–37. Nagasaka, Japanese Examined Patent Application No. H6-36121, is cited in Toyota’s description of Figure 11. *Id.* at 2:37–38. Nagasaka discloses forming a heating resistor on a hollow pipe by “thermal spraying.” Ex. 1078, 11. Nagasaka, thus, supports Petitioner’s contention that Toyota’s reference to “metallizing” renders using a thermal spray process to form the electrically conductive layer obvious.

For all the reasons discussed above, Petitioner establishes that Toyota’s metallizing embodiment renders this claim limitation obvious regardless of whether this limitation is deemed a product-by-process limitation or a structural limitation because it suggests using a thermal spray process to form an electrically conductive layer from electrically conductive particles.

*e. subsequently and selectively removing areas of the material
using a laser to form a complex contour pattern*

Petitioner contends that Toyota discloses removing material from the resistive layer “to shape ‘slots for adjusting the resistance . . . in each zone’” and the slots can be accurately formed “by using a laser beam.” Pet. 22–23

(citing Ex. 1008, 3:5–6, 13:19–21; Ex. 1003 ¶¶ 212–14). Petitioner further contends that Figure 11 of Toyota discloses a spiral pattern on a cylinder similar to Figure 3 of the '869 patent. *Id.* at 23–24 (citing Ex. 1001, Fig. 3; Ex. 1003 ¶¶ 215–216; Ex. 1008, Fig. 11). Petitioner further contends that Toyota discloses that conventional spiral patterns such as shown in Figure 11 of Toyota can be improved by “‘delicately chang[ing] the resistance value’ of a resistive heating layer through patterning ‘plural zones’ of that layer” such as shown in Toyota’s Figure 7A. *Id.* at 24 (citing Ex. 1008, 2:53-3:6, 11:48–50, Fig. 7A). Petitioner also directs us to Figures 10, 19, 20a, and 20b of Toyota as examples of “patterns that are much more complex than those described and depicted in the ‘869 patent.” *Id.* at 25–26 (quoting Ex. 1003 ¶ 220).

Patent Owner¹⁰ contends that there is a distinction between “laser ablation” and “laser trimming.” *See* PO Resp. 32–33. According to Patent Owner, laser ablation is the removal of material by a laser to form “a specific, desired shape or pattern . . . and define the basic path of current flow through the heater.” *Id.* at 33 (citing Ex. 2007 ¶14; Ex. 2009 ¶ 29). Further, according to Patent Owner, Imaoka (Ex. 1010) discloses “laser trimming” that is “used to finely tune the resistance of a resistor that is already in its desired shape” and this process “may not be necessary if the

¹⁰ Patent Owner contends that the limitation “subsequently and selectively removing areas of the material using a laser” should be construed as “require[ing] removal of resistive material occur only *after* the particulate matter has been formed.” PO Resp. 10–11; Sur-reply 10 (“Petitioner’s Reply is correct . . . that the prior art need not disclose the recited . . . sequence of processes to impact the validity of the challenged claims.”). We need not address this claim construction issue because Patent Owner does not dispute that Toyota teaches this sequence of operations. *See id.* at 32–37.

resistor as originally patterned is within desired tolerances.” *Id.* (citing Ex. 2007 ¶ 15). Based on this distinction, Patent Owner contends that Petitioner fails to establish “that Toyota uses a laser to form the outer boundaries of a resistive layer or discloses the structure that would result from such a process.” *Id.* at 34. According to Patent Owner, Toyota “discloses the use of laser-ablated slots to adjust the resistance of portions of its resistive heater.” *Id.* (citing Pet. 22; Ex. 1003 ¶¶ 212–214; Ex. 1008, 3:5–6, 13:19–21). Patent Owner further contends that “[t]he slots in Toyota do not result in the creation of a contour pattern or shape” because “they are not used to define or form the contour (or outer boundaries) of a resistive layer as required by the claims” but “are internal to the resistive pattern and are used solely to adjust the resistance values of portions of Toyota’s resistor.” *Id.* (citing Ex. 1008, 7:49–52, 11:46–13:21; Ex. 2005, 99:7–12; Ex. 2007 ¶ 16). Patent Owner further contends that Petitioner’s reliance on Figure 11 of Toyota is misplaced because it “does not disclose FIG. 11 as an example of a pattern contemplated by its disclosure” but rather describes Figure 11 “as an example of a conventional heating roller for fixing.” *Id.* at 36 (citing Ex. 1008, 4:55–57; Ex. 2009 ¶¶ 33–34). According to Patent Owner, Toyota “does not describe how the spiral slots 131 of the [Figure 11 roller] were formed or indicate that they were formed through laser ablation, or laser ablation of a material formed from particles.” *Id.* n.5 (citing Ex. 1008, 2:34–68). Patent Owner further contends that Toyota explicitly teaches away from forming slots “on the full length of a heating resistor” because it teaches “that if the formation of spiral slots extending the full length of the resistor were attempted, ‘it is very difficult to accurately form the slots 131 by deliberately changing intervals since the resistance value can be adjusted

only by the intervals of the slots.” *Id.* at 36–37 (citing Ex. 1008, 2:63–67; Ex. 2009 ¶ 36).

Petitioner, in turn, contends that Patent Owner’s declarants cite no evidence to support a distinction between laser ablation and laser trimming and that skilled artisans “draw no such distinction; rather [skilled artisans] would have understood that laser trimming is an approach to forming a complex contour pattern, as claimed.” Pet. Reply 17–18 (citing Ex. 1077 ¶¶ 82–86). Petitioner also contends that Dr. McDonald and Mr. Selvy admit that “laser trimming” removes material. *Id.* at 18 (citing Ex. 1075, 105:11–13; Ex. 1076, 122:2–4). Petitioner further contends that Patent Owner attempts to “improperly add[] a requirement that the pattern continuously ‘extend[] the full length of the resistor,’ contending that [Toyota’s] ‘disjoint’ slots extending axially along the heater do not meet the claim limitation.” *Id.* at 16 n.9 (citing PO Resp. 36–37). According to Petitioner, Patent Owner’s proposed construction of complex contour pattern “does not require the pattern to extend continuously along the heater’s entire length.” *Id.* (citing PO Resp. 14). Petitioner further contends that “Toyota discloses using a laser to form contour ‘patterns that are much more complex than those described and depicted in the ’869 patent,’ including *both* outer and interior boundaries of a resistive layer.” *Id.* at 15 (citing Ex. 1003 ¶ 220; Ex. 1077 ¶¶ 66–81, 84). According to Petitioner, Dr. McDonald admits that “Toyota’s Figure 10 depicts a resistive layer that ‘meanders’ over and under branch slots, between axial slots.” *Id.* (citing Ex. 1075, 110:8–20). Dr. Randall testifies that “[t]his is the same type of ‘meander-shaped’ patterning depicted in the ’869 patent’s Figure 4.” *Id.* (citing Ex. 1077 ¶¶ 78–80). Petitioner further contends that Toyota’s Figure 11 discloses “a heating resistor in a spiral pattern on a cylindrical substrate” formed by

using a laser. *Id.* (citing Ex. 1008, 2:34–43, 4:55–56; Ex. 1003 ¶¶ 215–217; Ex. 1077 ¶¶ 68–71; Ex. 1079). Petitioner further contends that Patent Owner’s teaching away argument “ignores that Toyota teaches how its invention overcomes this difficulty” with the Figure 11 embodiment. *Id.* at 17 (citing Ex. 1008, 2:53–3:6). According to Petitioner, Toyota discloses improving the “Figure 11 design by forming spiral slots along the length of the cylinder and adjusting their resistance by shaping them ‘in each zone,’ as Dr. McDonald conceded.” *Id.* (citing Ex. 1075, 112:1–5; Ex. 1077 ¶¶ 74–76).

We begin our analysis by noting that claim 1 does not recite either “laser ablation” or “laser trimming” but rather “selectively *removing areas of material* using a laser to form a complex contour pattern.” Both Mr. Selvy and Dr. McDonald testify that using a laser to create a pattern or for “trimming” both entail using the laser to remove material. Ex. 2007 ¶¶ 14–15; Ex. 2009 ¶¶ 28–30. Both processes, thus, satisfy the limitation of claim 1 requiring removing areas of material. Consequently, any distinction between “laser ablation” and “laser trimming” is immaterial to our analysis of claim 1.

Toyota discloses that “the present invention provides a cylindrical heater having a heating resistor on a surface of the cylinder . . . and slots for adjusting resistance are respectively shaped in each zone.” Ex. 1008, 3:1–6. Toyota further discloses that “after the heating resistor 103 is formed previously on the whole surface, its surface is processed so that the slots 131 are formed . . . by using a laser beam particularly, the slots 131 can be formed accurately.” *Id.* at 13:16–21. Patent Owner admits that Toyota’s slots are “laser ablated” but argues that this is insufficient because Toyota uses the “slots to adjust the resistance of portions of its resistive heater.” PO

Resp. 34. Patent Owner argues that, to satisfy claim 1, laser ablation must be used to “determine or define a desired path for current flow, which is what occurs when a laser removal process is used to create a contour pattern.” *Id.* at 35. We are not persuaded by Patent Owner’s arguments because Patent Owner admits that Toyota’s slots are created by using a laser to remove material, which is all that claim 1 requires. Further, Patent Owner’s argument that Toyota’s laser ablated slots are insufficient to satisfy this claim limitation because it uses the slots to adjust the resistance of the heater is contrary to the requirement of claim 1 that “removing areas of the material creates a desired resistance.” Additionally, Patent Owner’s argument would require us to improperly import a limitation into claim 1 that the complex contour pattern “determine[s] or define[s] a desired path for current flow.”

We now analyze whether Toyota’s disclosure of removing material with a laser to create slots in an electrically conductive layer teaches the creation of a complex contour pattern. As discussed above in Section II.C, we determine that a spiral pattern on a cylindrical substrate is encompassed within the term “complex contour pattern.” Petitioner relies on Figure 11 of Toyota for such a pattern. Pet. 23. Toyota discloses “spiral slots 131 . . . formed on the full length of the heating resistor 103 which is formed on the whole surface of the cylinder 101.” Ex. 1008, 2:34–37, Fig. 11. Patent Owner contends that Petitioner fails to show that slots 131 in Figure 11 are formed by laser ablation of a material formed by particles. *See* PO Resp. 36 n.5. As discussed above in our analysis of the metallizing embodiment, Nagasaka discloses that the electrically conductive layer in Figure 11 was formed by thermal spraying of particles. Toyota discloses that “slots 131 can be formed accurately” with a laser beam. Ex. 1008, 13:19–21; *see also*

Ex. 1075, 155:18 (Dr. McDonald testifying that item 110 shown in Toyota's Figure 11 is a laser head). Thus, Toyota in light of Nagasaka's disclosure, which is specifically referenced in Toyota, satisfies this claim limitation. In its Reply, Petitioner directs us to Ex. 1079 ("Saito") which is also referenced in Toyota's description of Figure 11. Pet. Reply 17 n. 10 (citing Ex. 1008, 2:37–39).¹¹ Saito discloses forming a resistor layer 13 by, *inter alia*, thermal spraying and that "part of the resistor layer that is exposed [to laser beam 10] will evaporate." Ex. 1079, 2–3. Thus, Petitioner has established that Toyota's Figure 11 discloses a complex contour pattern formed by laser removal of material from an electrically conductive layer formed by depositing particles on a cylindrical substrate. Although not required by claim 1, Toyota discloses that "spiral slots 131 [in Figure 11] are formed on the full length of the heating resistor." Ex. 1008, 2:35–36.

We are also not persuaded by Patent Owner's contention that Toyota teaches away from the claimed invention by forming slots on the full length of a heating resistor. PO Resp. 36–37. "A reference may be said to teach 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 by the applicant."

DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc., 567 F.3d 1314, 1327 (Fed. Cir. 2009) (citation omitted). A reference does not teach away "if it merely expresses a general preference for an alternative invention but does

¹¹ Patent Owner objects to Exhibit 1079 as exceeding the proper scope of a Reply for the same reasons as Exhibit 1078. Paper 30, 2. For the reasons discussed above with respect to Exhibit 1078, we determine that Exhibit 1079 is legitimate reply evidence in response to arguments introduced by Patent Owner.

not ‘criticize, discredit, or otherwise discourage’ investigation into the invention claimed.” *Id.* at 1327 (citation omitted). First, claim 1 does not require “forming slots on the full length of a heating resistor” so this argument is not commensurate in scope with claim 1. Second, Toyota describes slots 131 as being formed on the full length of the cylinder. Ex. 1008, 2:35–36. Third, Toyota discloses that the electrical resistance can be adjusted by “changing the intervals between the slots 131.” *Id.* at 2:40–43. Based on our review of the entirety of Toyota’s disclosure, even if claim 1 requires forming slots on the full length of a heating resistor, we find that Toyota does not criticize, discredit, or otherwise discourage a skilled artisan from doing so.

For all the foregoing reasons, Petitioner establishes that Toyota discloses this claim limitation.

f. wherein removing areas of the material creates a desired resistance of the electrically conductive resistive layer

Petitioner contends that Toyota discloses that “its slots for adjusting resistance ‘can be formed accurately’” by using a laser beam. Pet. 26 (citing Ex. 1003 ¶¶ 93–115, 227–29; Ex. 1008, 3:5–6, 11:40–13:50). Patent Owner does not specifically address this claim limitation. *See* PO Resp. 19–44.

Based on the evidence cited by Petitioner, Petitioner demonstrates that Toyota discloses this limitation.

g. such that at least a portion of the particles are micro-welded along a length of the pattern

Petitioner contends that Toyota discloses “the recited laser trimming process” and that one of ordinary skill in the art “would have understood that such laser trimming causes particles to join (‘micro-weld’) along a length of the trimmed pattern.” Pet. 26 (citing Ex. 1003 ¶¶ 230–32; Ex. 1008, 3:5–6,

11:40–13:50). Petitioner further contends that one of ordinary skill in the art “would have understood that Toyota’s laser heats resistive material to a high enough temperature to vaporize it, and that particles remaining along the length of the pattern, on the edge of the cut, would melt and re-solidify and join (i.e., ‘micro-weld’).” *Id.* at 27 (citing Ex. 1003 ¶¶ 116–23, 232–35; Ex. 1007, 233–34, 241–42; Ex. 1019, 1:17–19, 5:41–44; Ex. 1030).

Petitioner further contends that Toyota’s process of forming the resistive layer and “then calcining at 400–500° C” would produce “micro-welded particles of the resistive materials, as adjacent particles of the resistive materials will deform and ‘neck’ into, and therefore join, each other.” *Id.* at 28 (citing Ex. 1003 ¶¶ 236, 238–41). Petitioner next contends that Toyota’s metallizing processes for forming the resistive layer “result in particles being micro-welded on the surface onto which they are applied and to each other.” *Id.* at 28–29 (citing Ex. 1003 ¶¶ 116–17, 124–31, 236–37; Ex. 1009, 24, Fig. 3; Ex. 1012, 1:66–67, 3:40–41, 3:53, 6:6; Ex. 1022, 2:55–58; Ex. 1025, 1:56–59, 5:42–47). Petitioner further contends that this limitation is disclosed by Toyota in connection with the micro-welding that occurs through the calcining and deposition processes “and after slots are laser trimmed . . . will be micro-welded ‘along a length of the pattern’ trimmed, as claimed.” *Id.* at 29 (citing Ex. 1003 ¶ 241).

Patent Owner contends that this is a product-by-process limitation. PO Resp. 38. According to Patent Owner, this limitation requires Petitioner to show that Toyota discloses or suggests “a final resistive layer that both: (1) has particles micro-welded along the length of the pattern as required by the claim and (2) has the same structural and functional characteristics as the layer that results from the process of forming a material in the form of particles onto an insulating layer.” *Id.* at 38–39 (citing *Nordt*, 881 F. 3d. at

1374). According to Patent Owner, Petitioner fails to “show that the laser trimming of Toyota’s calcined paste would result in a layer . . . having the structure that would result from laser ablating a material formed from particles onto a substrate.” *Id.* at 40. Patent Owner contends that claims 1 and 8 require “micro-welding of the type that occurs as the result of the removal of material by a laser” and that “such micro-welding that occurs as a result of laser ablation is micro-welding that occurs along the edges of the ablated material, where particles will melt and re-solidify.” *Id.* at 41 (citing Ex. 1003 ¶¶ 120–123). Patent Owner further contends that claims 1 and 8 do not require “micro-welding in a generalized sense, but rather micro-welding that will be found along the edges of a pattern formed by laser ablation.” *Id.* Relying on the testimony of Dr. McDonald, Patent Owner contends that “any micro-welding that occurs as the result of calcining will occur throughout the material in a highly uniform manner” rather than “localized micro-welding along the edge of a material (as would result from laser removal).” *Id.* at 43 (citing Ex. 2009 ¶ 18). Patent Owner further contends that the proper construction of claim 1 “requires the creation of micro-welds . . . of the type that would not be present before the laser removal step but that, instead, are present in the pattern created by the laser removal step.” *Id.* at 18.

Petitioner, in turn, contends that Patent Owner does not dispute that “applying Toyota’s ‘laser ablation’ . . . satisfies the claims.” Pet. Reply 18–19. According to Petitioner, Patent Owner incorrectly “argues that the claim limitations are not met where Toyota’s material is deposited as a paste, as opposed to by thermal spraying, or where the metallizing process itself results in micro-welding.” *Id.* at 19. Petitioner further contends that Patent Owner’s argument that the paste embodiment is insufficient is based on

Patent Owner’s “erroneous position that *only* particles can be deposited,” but Patent Owner “does not, and cannot, dispute that applying Toyota’s laser ablation to Toyota’s paste results in micro-welding and bringing local oxides into the pattern.” *Id.* According to Petitioner, Patent Owner is arguing that Toyota’s calcination and metallizing processes “provide *more* micro-welding than Patent Owner contends the claims require.” *Id.* at 20.

Petitioner further contends that there is no support in the ’869 patent for excluding micro-welding resulting from a thermal spray process because “the only micro-welding disclosed . . . results from metallizing deposition processes.” *Id.* at 21 (citing Ex. 1001, 4:48–55; Pet. 10; Ex. 1075, 90:18–91:3; Ex. 1077 ¶ 96).

We start our analysis with the language of claim 1, which requires “that at least a portion of the particles are micro-welded along a length of the [complex contour] pattern.” The language of claim 1 does not require that the micro-welding of the particles occur along the edge of the pattern as Patent Owner contends but rather that the micro-welding occur along a length of the pattern. Further, as noted by Petitioner, the only disclosure of particle micro-welding in the Specification of the ’869 patent is in connection with particle deposition not in connection with using a laser to create the complex contour pattern. *See* Ex. 1001, 4:53–55 (“Through micro-friction because of the impact the temperature of the contact area increases and leads to micro-welding.”). Dr. McDonald confirms that the ’869 patent does not discuss micro-welding resulting from laser removal of material. Ex. 1075, 90:18–91:3. The embodiment in the ’869 patent, thus, discloses the “generalized” micro-welding that Patent Owner argues is insufficient to satisfy this claim limitation. Because the particles forming the electrically conductive layer in the ’869 patent extend along the length of

the substrate (Ex. 1001, Figs. 3, 4), it logically follows that micro-welding of particles due to micro-friction would extend along a length of the complex contour pattern after the laser forms the pattern apart from any micro-welding arising from laser removal of material to form the pattern. Likewise, in Toyota, in both the paste embodiment and the metallizing embodiment, the particles extend along a length of the pattern and thus, micro-welding of particles resulting from the calcining process or the metallizing process extend along a length of the pattern. Ex. 1003 ¶ 241.

As noted above, Patent Owner contends that this claim limitation is a product-by-process limitation. Therefore, if we give no patentable weight to using “a laser” to create micro-welded particles along a length of the complex contour pattern, Toyota’s micro-welding of particles resulting from calcination or the deposition of particles by metallizing satisfies this limitation.

Alternatively, if we treat the limitation as a structural limitation, we come to the same conclusion. Patent Owner contends that the structural requirements of claim 1 are “micro-welding that occurs along the edges of the ablated material, where particles will melt and re-solidify” and “that will be found along the edges of a pattern formed by laser ablation.” PO Resp. 41. As discussed above, Toyota discloses using a laser to remove material to create the complex contour pattern regardless of whether the electrically conductive layer is formed from a paste or by metallizing. Petitioner relies on both micro-welding due to either calcination or metallizing *and* micro-welding caused by using a laser to create a complex contour pattern. Pet. 29 (citing Ex. 1003 ¶ 241). As discussed above, Toyota discloses first creating the electrically conductive layer in the paste embodiment followed by calcining which creates micro-welded particles or

through deposition of particles in the metallizing embodiment which also creates micro-welding of particles. Toyota discloses the subsequent step of using a laser to create complex contour patterns by removing material. The result of the second step is the creation of micro-welds along the edge of the pattern “that would not be present before the laser removal step but that, instead, are present in the pattern created by the laser removal step.” PO Resp. 18. The fact that additional “generalized” micro-welding would be present in either of Toyota’s embodiments is of no moment because the claim does not preclude “generalized micro-welding” and “generalized micro-welding” would also be present in the embodiment disclosed in the ’869 patent after laser trimming.

For all the foregoing reasons, Petitioner establishes that Toyota discloses this claim limitation.

h. local oxides are brought into the pattern to fine tune an electrical resistance along the length of the pattern

Petitioner contends that this limitation would have been obvious over Toyota. Pet. 29–30. Petitioner contends that based on Toyota’s disclosure of a laser trimming process that adjusts resistance of its heating resistor, it would have been obvious to one of ordinary skill in the art “to control oxidation to reach a desired resistance in Toyota’s resistive layer.” *Id.* (citing Ex. 1008, 3:5–6, 11:40–13:50; Ex. 1003 ¶¶ 132–36, 242–44). According to Petitioner, it was well known in the art “that resistance could be controlled through local oxidation.” *Id.* (quoting Ex. 1023, 5:13–26; citing Ex. 1003 ¶¶ 133–34; Ex. 1024, 1:62–2:4, 3:3–10).

Petitioner alternately contends that this claim limitation would have been obvious over the combined teachings of Toyota and Imaoka. Pet. 31–33. In particular, Petitioner contends that Imaoka discloses forming a thin

film resistance layer by laser trimming and also “performs an ‘oxidizing treatment . . . to simultaneously tune and stabilize the resistance value of the thin film resistance’ while laser trimming the resistor.” *Id.* at 31 (citing Ex. 1010, 1–2). Petitioner further contends that Imaoka discloses that where the resistive material is laser cut, “the resistive material is heat treated but not vaporized” resulting in the resistance in that area becoming unstable. *Id.* at 31–32. Petitioner further contends that “Imaoka remedies the instability by blowing oxygen gas over the area being cut by the laser . . . and forms an ‘oxide passivation film’ which stabilizes resistance.” *Id.* at 32 (citing Ex. 1003 ¶¶ 245–49; Ex. 1010, 1–2).

Petitioner provides two reasons why one of ordinary skill in the art would have combined Imaoka’s oxidation technique with Toyota’s laser trimming of slots. *Id.* First, one of ordinary skill in the art “would have reasonably expected to succeed in stabilizing the resistor’s resistance over time and reducing manufacturing steps and costs, as explained in Imaoka.” *Id.* (citing Ex. 1003 ¶¶ 249–51; Ex. 1010, 1–2). Second, one of ordinary skill in the art “would have known that Imaoka’s process is applicable to various resistive materials . . . and would have known that absent performance of Imaoka’s process, the issues Imaoka aims to solve – e.g., poor stability with the passage of time, . . . – would be present in Toyota’s heaters.” *Id.* (citing Ex. 1003 ¶¶ 249–51).

Patent Owner does not specifically dispute Petitioner’s contentions with respect to local oxides but groups this limitation with the previously discussed micro-welding limitation. PO Resp. 37–43. Patent Owner’s contention is that “the Petition fails to show that the structure resulting from the teachings of Toyota would include local oxides brought into a pattern as required by the challenged claims.” *Id.* at 43. Patent Owner also contends

that the claim requires “local oxides brought into the pattern beyond those oxides that may exist in such bulk structure.” Sur-reply 11. With respect to the combination of Toyota with Imaoka, Patent Owner does not dispute that Imaoka discloses oxidizing a laser trimmed resistor or the reasons given by Petitioner for combining Toyota and Imaoka. PO Resp. 44.

We have reviewed Petitioner’s evidence cited above concerning why it would have been obvious to control the resistance of Toyota’s electrically conductive layer through a well-known technique, *i.e.*, oxidation. Petitioner supports its contention with reference to Dr. Randall’s testimony which is supported by evidence. *See* Ex. 1003 ¶¶ 132–136; Ex. 1023, 5:13–26; Ex. 1024, 1:62–2:4, 3:3–10. Patent Owner does not dispute that oxidation was a well-known technique for controlling resistance or Petitioner’s reasons why a skilled artisan would have applied this technique to Toyota’s resistor. Patent Owner’s argument that the local oxides must be brought into the pattern beyond those oxides that may exist in the bulk structure is not supported by the claim language or the Specification of the ’869 patent, which provides that “[t]hrough heating local oxides can brought into the layer.” Ex. 1001, 3:53–54. Further, Patent Owner’s argument is contrary to its contention that “the prior art need not disclose the recited . . . sequence of processes.” Sur-reply 10. Therefore, we determine that Petitioner establishes that this claim limitation would have been obvious in view of Toyota.

Imaoka discloses oxidizing the area of a resistive layer that has previously been laser trimmed in order to stabilize the resistance of the resistive layer. Ex. 1010, 1–2, Fig. 1. Further, Petitioner presents reasons for combining the teachings of Imaoka and Toyota that are supported by evidence. *See* Ex. 1003 ¶¶ 249–51. Patent Owner does not squarely address

Petitioner's evidence or arguments concerning the combination of Toyota and Imaoka. PO Resp. 43–44. Thus, based on the evidence and arguments presented by Petitioner, Petitioner establishes that this claim limitation would have been obvious to one of ordinary skill in the art over the combined teachings of Toyota and Imaoka.

Conclusion Regarding Claim 1

For the reasons explained above, we determine that Petitioner has established by a preponderance of the evidence that claim 1 would have been unpatentable over Toyota alone or Toyota in combination with Imaoka.

Claim 8

Petitioner contends that “Claim 8 is ‘substantially identical’ to claim 1” and relies on the same evidence and arguments submitted for claim 1, except for one additional limitation in claim 8 that is not present in claim 1. Pet. 34–37. Patent Owner does not provide contentions for claim 8 apart from those for claim 1 discussed above. *See generally* PO Resp. 19–44.

Unlike claim 1, claim 8 recites that the electrically conductive resistive layer is formed on the complex shaped substrate not on an intervening nonconductive layer. Ex. 1001, 7:34–35. In connection with this limitation, Petitioner contends that Patent Owner argued in co-pending district court litigation that this limitation “is met by a resistor layer formed on a substrate with an intervening dielectric layer” and, based on this, argues that if this limitation “covers such a structure, it would have been obvious over Toyota for the same reasons as” the corresponding limitation in claim 1. Pet. 34–35 (citing Ex. 1003 ¶ 259; Ex. 1040, B-2 at 23–24, 33).

Petitioner alternately contends that when the applicant “added the claims that issued as challenged claims 8–11” it “stated that those claims

were ‘substantially identical’ to the claims that issued as challenged claims 1–4 except they ‘do not include the nonconductive layer formed over the substrate and instead recite the electrically conductive resistive layer formed directly on the substrate.’” Pet. 35 (citing Ex. 1002, 146). Petitioner further contends that if this claim limitation is interpreted as requiring direct deposition of the resistive layer on the substrate, the limitation would still have been obvious over Toyota because one of ordinary skill in the art “would have understood that Toyota’s heater could be manufactured without an insulating layer by depositing the resistive layer directly on a substrate” and the direct deposition of material on substrates was well known. *Id.* at 35–36 (citing Ex. 1003 ¶¶ 65–74, 260–62; Ex. 1012, 1:51–53, 1:62–63; Ex. 1018, 2:45–51; Ex. 1025, 1:23–36). We have reviewed the evidence cited by Petitioner and determine that Petitioner establishes that Toyota renders this limitation obvious.

For the reasons explained above in connection with claim 1 and the evidence cited in connection with claim 8, we determine that Petitioner has established by a preponderance of the evidence that claim 8 would have been unpatentable over Toyota alone or Toyota in combination with Imaoka.

E. Grounds 3 & 4: Obviousness over Toyota and Macher and Toyota, Imaoka, and Macher

Petitioner alternatively contends that dependent claims 2 and 9 are unpatentable over Toyota in view of Macher or Toyota and Imaoka in view of Macher. Pet. 38–41 (citing Ex. 1003 ¶¶ 177–80, 268–78). Patent Owner does not provide separate arguments for the patentability of claim 2 or claim 9 but relies on its arguments for claims 1 and 8. PO Resp. 58–59.

Overview of Macher

Macher issued on April 6, 2004, and is titled “Heatable Mirror, Method for Producing a Heat Conductive Layer, and the Use Thereof.” Ex. 1012, codes (45), (54). Macher’s heatable mirror comprises heating element 2 that “is provided with a covering layer 21 of electrically non-conductive material.” *Id.* at 5:62–63. Covering layer 21 is “preferably formed by a self-curing polymer coating, for example of silane-modified polymer.” *Id.* at 5:65–67.

Analysis

Petitioner contends that Macher’s “covering layer ‘functions as a sealing material.’” Pet. 40 (citing Ex. 1012, 3:14–16). Relying on the testimony of Dr. Randall, Petitioner submits that a skilled artisan “would have known and been motivated to use a Macher-type ‘covering layer’ to thermally and electrically insulate a resistive layer in one of Toyota’s water heaters, where safety and protection of the heater would be important.” *Id.* at 40 (citing Ex. 1003 ¶¶ 272–273).

Based on the evidence and arguments presented by Petitioner, we determine that Petitioner establishes by a preponderance of the evidence that claim 2 and claim 9 would have been unpatentable as obvious over Toyota and Macher and Toyota, Imaoka, and Macher.

F. Grounds 5 & 6: Obviousness over Toyota and Juliano and Toyota, Imaoka, and Juliano

Petitioner contends that claims 3, 4, 10, and 11 are unpatentable over Toyota alone or in view of Juliano or alternately Toyota and Imaoka in view of Juliano. Pet. 41–47 (citing Ex. 1003 ¶¶ 182–83, 279–93). Patent Owner does not provide separate arguments for the patentability of claims 3, 4, 10, and 11 but relies on its arguments for claims 1 and 8. PO Resp. 58–59.

Overview of Juliano

Juliano issued on October 26, 1999, and is titled “Thick Film Heater for Injection Mold Runner Nozzle.” Ex. 1016, codes (45), (54). Juliano discloses a resistive element heater with “alternating stacked layers of dielectric 84, thick film resistive element 86, and temperature sensor 88 material.” *Id.* at 7:15–18, Fig. 6a.

Analysis

With respect to claims 3 and 10, Petitioner contends that it was well known “to use more than one insulating layer to separate multiple resistive layers.” Pet. 42 (citing Ex. 1016, 7:14–18, Fig. 6a). Petitioner further contends that Juliano discloses resistive heaters and “explained, ‘multiple layers [we]re often desired to achieve a certain temperature profile, or achieve greater thermal isolation, or to maintain temperature uniformity.’” *Id.* at 42–43 (quoting Ex. 1016, 3:5–8). Petitioner further contends that a skilled artisan “would have been motivated to use stacked dielectric and resistive layers like those disclosed in Juliano in a Toyota water heater” because “a multiple layer system could be more reliable and stable and could possess increased heating capacity and efficiency, which might be required in, for example, colder environments (e.g., to avoid cold spots and freezing).” *Id.* at 44–45 (citing Ex. 1003 ¶¶ 285–286). Petitioner makes substantially the same arguments for claims 4 and 11. *Id.* at 46–47.

Based on the evidence and arguments presented by Petitioner, we determine that Petitioner establishes by a preponderance of the evidence that claims 3, 4, 10 and 11 are unpatentable as obvious over Toyota and Juliano and Toyota, Imaoka, and Juliano.

G. Grounds 7–12

In Grounds 7–12, Petitioner substitutes disclosures from Brook-Levinson for the disclosures of Toyota in Grounds 1–6 and requests we determine that claims 1–4 and 8–11 are unpatentable over Brook-Levinson alone, Brook-Levinson and Imaoka, Brook-Levinson and Macher, Brook-Levinson, Imaoka, and Macher, Brook-Levinson and Juliano, and Brook-Levinson, Imaoka, and Juliano. Pet. 47–69.

For the reasons discussed above in connection with Grounds 1–6, Petitioner demonstrates by a preponderance of the evidence that claims 1–4 and 8–11 would have been unpatentable. We, thus, have addressed all challenged claims. *See SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1359 (2108) (holding that a petitioner “is entitled to a final written decision addressing all of the claims it has challenged”); *see also* 35 U.S.C. § 318(a). Accordingly, we need not and do not decide whether Petitioner has shown by a preponderance of the evidence that claims 1–4 and 8–11 also would have been unpatentable as alleged in Grounds 7–12. *Cf. In re Gleave*, 560 F.3d at 1338 (not reaching other grounds of unpatentability after affirming the anticipation ground); *see also Beloit Corp. v. Valmet Oy*, 742 F.2d 1421, 1423 (Fed. Cir. 1984) (holding that once a dispositive issue is decided, there is no need to decide other issues).

III. CONCLUSION¹²

Based on the all the evidence and arguments presented to us during trial, we determine that Petitioner demonstrates by a preponderance of the evidence that claims 1–4 and 8–11 would have been unpatentable.

In summary:

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1, 8	103	Toyota	1, 8	
1, 8	103	Toyota, Imaoka	1, 8	
2, 9	103	Toyota, Macher	2, 9	
2, 9	103	Toyota, Imaoka, Macher	2, 9	
3, 4, 10, 11	103	Toyota, Juliano	3, 4, 10, 11	
3, 4, 10, 11	103	Toyota, Imaoka, Julian	3, 4, 10, 11	
1, 8	103	Brook-Levinson ¹³		
1, 8	103	Brook Levinson, Imaoka ¹⁴		
2, 9	103	Brook-Levinson, Macher ¹⁵		
2, 9	103	Brook-Levinson,		

¹² Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

¹³ We do not reach this ground.

¹⁴ We do not reach this ground.

¹⁵ We do not reach this ground.

		Imaoka, Macher ¹⁶		
3, 4, 10, 11	103	Brook-Levinson, Juliano ¹⁷		
3, 4, 10, 11	103	Brook-Levinson, Imaoka, Juliano ¹⁸		
Overall Outcome			1–4, 8–11	

IV. ORDER

For the foregoing reasons, it is hereby:

ORDERED that, based on a preponderance of the evidence that claims 1– 4 and 8–11 of the '869 patent are unpatenable as set forth in the summary table above;

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

¹⁶ We do not reach this ground.

¹⁷ We do not reach this ground.

¹⁸ We do not reach this ground.

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