NOTE: This disposition is nonprecedential.

United States Court of Appeals for the Federal Circuit

BASF CORPORATION,
Appellant

v.

ENTHONE, INC.,
Appellee

2018-1095

Appeal from the United States Patent and Trademark Office, Patent Trial and Appeal Board in No. IPR2016-00696.

Decided: October 26, 2018

RUSSELL BLYTHE, King & Spalding LLP, Atlanta, GA, argued for appellant. Also represented by HOLMES J. HAWKINS, III.

ROBERT M. EVANS, JR., Stinson Leonard Street LLP, St. Louis, MO, argued for appellee. Also represented by JOHN R. SCHROEDER, KYLE G. GOTTUSO.

Before DYK, WALLACH, and TARANTO, *Circuit Judges.*

WALLACH, *Circuit Judge.*

Appellant BASF Corporation ("BASF") petitioned for inter partes review of Enthone, Inc.'s ("Enthone") U.S. Patent No. 7,303,992 ("the '992 patent"). The U.S. Patent and Trademark Office's ("USPTO") Patent Trial and Appeal Board ("PTAB") issued a final written decision "determin[ing] that BASF has not shown by a preponderance of the evidence that claims 1–15, 17–22, and 26–28 [('the Challenged Claims')] of the '992 [p]atent are unpatentable" as obvious over two asserted combinations of prior art. *BASF Corp. v. Enthone, Inc.* (*BASF I*), IPR2016-00696, 2017 WL 4014997, at *10 (P.T.A.B. Sept. 11, 2017).

BASF appeals. We have jurisdiction pursuant to 28 U.S.C. § 1295(a)(4)(A) (2012). We vacate and remand.

BACKGROUND

Entitled "Copper Electrodeposition in Microelectronics," the '992 patent generally relates to the field of "microelectronics manufacture to provide electrical interconnection in a wide variety of applications, such as . . . in the manufacture of semiconductor integrated circuit . . . devices." '992 patent col. 1 ll. 13–16. Specifically, it teaches a "method . . . for electrolytically plating [copper] onto a semiconductor integrated circuit substrate having submicron-sized interconnect features." *Id.*, Abstract. "An interconnect feature is a feature such as a via or trench formed in a dielectric substrate which is then filled with metal to yield an electrically conductive interconnect." *Id.* col. 1 ll. 23–25. The '992 patent's "method involves superfilling by rapid *bottom-up deposition* at a superfill speed by which [copper] deposition [occurs] in a vertical direction from the bottoms of the features to the top openings of the features [and] is substantially greater than [copper] deposition on the side walls." *Id.*, Abstract (emphasis added). Superfilling differs from conventional copper deposition methods, such

as conformal plating that involves filling "at an equal rate on all . . . surfaces," and therefore "avoid[s] seams and pinching off that can result in voiding." *Id.* col. 2 ll. 9–11.

Independent claims 1 and 17 are illustrative. Claim 1 recites:

> A method for electroplating a copper deposit onto a semiconductor integrated circuit device substrate with electrical interconnect features including submicron-sized features having bottoms, sidewalls, and top openings, the method comprising:
>
> > immersing the semiconductor integrated circuit device substrate including submicron-sized features having bottoms, sidewalls, and top openings wherein said submicron-sized features include high aspect ratio[1] features having dimensions such that the high aspect ratio features have aspect ratios of at least about 3:1 into an electrolytic plating composition comprising a source of [copper] ions in an amount sufficient to electrolytically deposit [copper] onto the substrate and into the electrical interconnect features and a polyether suppressor compound comprising a combination of propylene oxide (PO) repeat units and ethylene oxide (EO) repeat units present in a PO:EO ratio between about 1:9 and about 9:1 and bonded to a nitrogen-containing species, wherein the molecular weight of the suppressor com-

---

1 An aspect ratio is a ratio comparing depth to width. '992 patent col. 2 l. 39.

> pound is between about 1000 and about 30,000; and
>
> supplying electrical current to the electrolytic composition to deposit [copper] on the substrate and superfill the submicron-sized features of rapid bottom-up deposition at rate of growth in the vertical direction which is greater than a rate of growth in the horizontal direction.

Id. col. 18 ll. 19–46. Similarly, claim 17 teaches a superfilling method that involves, inter alia:

> supplying electrical current to the electrolytic composition to deposit [copper] onto the substrate and superfill the submicron-sized features by rapid bottom-up deposition at a vertical [copper] deposition growth rate in features from the bottoms of the features to the top openings of the features which is greater than 15 times faster than a field deposition growth rate on substrate surfaces outside the features.

Id. col. 20 ll. 51–58.

DISCUSSION

I. Standard of Review and Legal Standard

"We review the PTAB's factual findings for substantial evidence and its legal conclusions de novo." *Redline Detection, LLC v. Star Envirotech, Inc.*, 811 F.3d 435, 449 (Fed. Cir. 2015) (citation omitted). "Substantial evidence is something less than the weight of the evidence but more than a mere scintilla of evidence," meaning that "[i]t is such relevant evidence as a reasonable mind might accept as adequate to support a conclusion." *In re NuVasive, Inc.*, 842 F.3d 1376, 1379–80 (Fed. Cir. 2016) (internal quotation marks and citations omitted). "If two inconsistent conclusions may reasonably be drawn from

the evidence in record, the PTAB's decision to favor one conclusion over the other is the epitome of a decision that must be sustained upon review for substantial evidence." *Elbit Sys. of Am., LLC v. Thales Visionix, Inc.*, 881 F.3d 1354, 1356 (Fed. Cir. 2018) (internal quotation marks, brackets, and citation omitted). We also review the PTAB's decision to ensure that the decision did not constitute arbitrary and capricious agency action. *See Vicor Corp. v. SynQor, Inc.*, 869 F.3d 1309, 1323 (Fed. Cir. 2017).

A patent claim is invalid "if the differences between the subject matter sought to be patented 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 [relevant] art ['PHOSITA']." 35 U.S.C. § 103(a) (2006).[2] Obviousness "is a question of law based on underlying findings of fact." *In re Gartside*, 203 F.3d 1305, 1316 (Fed. Cir. 2000). Those underlying findings of fact include (1) "the scope and content of the prior art," (2) "differences between the prior art and the claims at issue," (3) "the level of ordinary skill in the pertinent art," and (4) the presence of objective indicia of nonobviousness such "as commercial success, long felt but unsolved needs, failure of others," and unexpected results. *Graham v. John Deere Co. of Kan. City*, 383 U.S. 1, 17–18 (1966); *see United States v.*

---

[2] Congress amended § 103 when it enacted the Leahy-Smith America Invents Act ("AIA"). Pub. L. No. 112-29, § 3(b)(1), 125 Stat. 284, 285–87 (2011). However, because the application that led to the '992 patent has never contained (1) a claim having an effective filing date on or after March 16, 2013, or (2) a reference under 35 U.S.C. §§ 120–121 or 365(c) to any patent or application that ever contained such a claim, the pre-AIA § 103 applies. *See id.* § 3(n)(1), 125 Stat. at 293.

Adams, 383 U.S. 49, 50–52 (1966). In assessing the prior art, the PTAB also "consider[s] whether a PHOSITA would have been motivated to combine the prior art to achieve the claimed invention and whether there would have been a reasonable expectation of success in doing so." *In re Warsaw Orthopedic, Inc.*, 832 F.3d 1327, 1333 (Fed. Cir. 2016) (internal quotation marks, brackets, and citation omitted).

II. Obviousness

Before the PTAB, BASF asserted that two combinations of prior art rendered the Challenged Claims obvious: (1) U.S. Patent No. 6,444,110 ("Barstad") in view of U.S. Patent Application No. 2002/0127847 ("Alling") (J.A. 468–74) and BASF, Pluronic & Tetronic Block Copolymer Surfactants (1989) ("BASF Catalog") (J.A. 436–67), and (2) U.S. Patent Application No. 2002/0043467 ("Morrissey") (J.A. 429–35) in view of Alling and the BASF Catalog. *See BASF I*, 2017 WL 4014997, at *1. On appeal, the parties do not dispute the PTAB's finding that both combinations teach each limitation of the Challenged Claims. *See id.* at *5–7. *See generally* Appellant's Br.; Appellee's Br. Instead, the central issue is whether, in view of Alling, a PHOSITA would have been motivated to replace either Barstad's or Morrissey's suppressor with the BASF Catalog's Tetronic® surfactant copolymer.[3] *See* Appellant's Br. 27; Appellee's Br. 1–2.

BASF raises two primary arguments. First, BASF argues the PTAB erred by applying an overly "stringent version" of the motivation to combine test. Appellant's Br. 29; *see id.* at 29–33. Second, BASF contends that certain of the PTAB's findings are inadequately supported

---

[3] "Tetronic" is the tradename of a "tetra-functional block copolymer[]" produced by BASF. J.A. 441.

or explained. *See id.* at 33–40. We address each argument in turn.

A. The PTAB Did Not Commit Legal Error in Analyzing the Motivation to Combine the Prior Art References

The PTAB found Alling did not provide the requisite motivation to combine the BASF Catalog's Tetronic copolymer with either Barstad's or Morrissey's superfilling method. *See BASF I*, 2017 WL 4014997, at *10. The PTAB determined that a PHOSITA "would not have had any basis for predicting the effectiveness for superfilling of any suppressor whose structure or properties varied *in any material respect* from the suppressors that had already been demonstrated" to be effective for superfilling, and that "there must be some specific motivation to employ specific plating bath components, given the general unpredictability in the field and the art." *Id.* at *8 (emphasis added). BASF argues it was error for the PTAB to "require[] an explicit and specific disclosure in the prior art references" of a Tetronic copolymer used in superfilling. Appellant's Br. 30 (citation omitted). According to BASF, "limited unpredictability does not require the prior art to state explicitly that the combination would be successful, without allowing for any reasonable inferences by a [PHOSITA]." *Id.* at 31 (citations omitted). By not allowing such inferences, BASF contends the PTAB improperly "treated a [PHOSITA] as an automaton, able only to understand what is set forth explicitly in a prior art reference." *Id.* at 32. We disagree with BASF.

The PTAB adhered to our precedent when it considered whether the level of unpredictability in the art demanded BASF demonstrate a more definite motivation to combine the prior art in the manner alleged within BASF's petition. *See BASF I*, 2017 WL 4014997, at *8. In *KSR International Co. v. Teleflex Inc.*, the Supreme Court explained "[t]he combination of familiar elements according to known methods is likely to be obvious when it does

no more than *yield predictable results*." 550 U.S. 398, 416 (2007) (emphasis added). It rejected "rigid and mandatory formulas" in a motivation to combine analysis, *id.* at 419, and instead employed an "expansive and flexible approach," *id.* at 415. *KSR* teaches that "the analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim . . . [but instead] can take account of the inferences and creative steps that a [PHOSITA] would employ." *Id.* at 418. We have explained that, under *KSR*, "predictability is a vital consideration in the obviousness analysis." *Otsuka Pharm. Co. v. Sandoz, Inc.*, 678 F.3d 1280, 1298 (Fed. Cir. 2012) (citing *KSR*, 550 U.S. at 421). "To the extent an art is *unpredictable*, . . . *KSR*'s focus on these identified, predictable solutions *may present a difficult hurdle* because potential solutions are less likely to be genuinely predictable." *Eisai Co. v. Dr. Reddy's Labs., Ltd.*, 533 F.3d 1353, 1359 (Fed. Cir. 2008) (emphases added) (internal quotation marks omitted). While it is true that "[o]bviousness does not require absolute predictability of success," *In re O'Farrell*, 853 F.2d 894, 903 (Fed. Cir. 1998), the PTAB did not require *absolute predictability*. Despite some confusing language in the PTAB's decision, we read its opinion as not departing from *KSR*'s holding that there need not be "precise teachings" of a motivation to combine in the prior art. 550 U.S. at 418. Instead, we read the PTAB's decision as simply requiring BASF to demonstrate a sufficiently "apparent reason to combine the known elements in the fashion claimed by the patent at issue," *id.* at 418, in light of the record evidence of "general unpredictability in the field and the art," *BASF I*, 2017 WL 4014997, at *8. The PTAB was entitled to consider BASF's asserted combinations of references in light of this unpredictability. *See Eisai*, 533 F.3d at 1359.

BASF's citation to *In re Kubin* does not alter our conclusion. Appellant's Br. 31 (citing 561 F.3d 1351, 1360–61 (Fed. Cir. 2009)). In *In re Kubin*, we affirmed the PTAB's

finding of obviousness and "decline[d] to cabin *KSR* to the 'predictable arts' (as opposed to the 'unpredictable art' of biotechnology)." 561 F.3d at 1360; *see id.* at 1361. However, *In re Kubin* does not stand for the proposition that unpredictability is not relevant to the motivation to combine analysis. Instead, we explained that, "in the face of *KSR*, [we cannot] cling to formalistic rules for obviousness, customize its legal tests for specific scientific fields in ways that deem entire classes of prior art teachings irrelevant, or discount the significant abilities of [PHOSITAs] in an advanced area of art." *Id.* at 1360. Therefore, we looked to *the record* to determine whether a PHOSITA would find the "claimed results profoundly predictable." *Id.* (internal quotation marks omitted). Contrary to BASF's argument that the PTAB's approach of requiring a more definitive motivation to combine is overly "stringent," Appellant's Br. 29, this approach fits within the Supreme Court's directive to "account [for] the inferences and creative steps that a [PHOSITA] would employ," *KSR*, 550 U.S. at 418, by considering whether, based on the record, the level of unpredictability in the art would affect such inferences and creative steps, such that a PHOSITA might require a more explicit directive, *see BASF I*, 2017 WL 4014997, at *8. We conclude that the PTAB did not apply an incorrect legal standard in its motivation to combine analysis, and we therefore turn to whether the PTAB's findings are supported by substantial evidence.

B. Important PTAB Findings Regarding Its Holding of Nonobviousness Either Lack Support in the Cited Evidence or Are Inadequately Explained

The PTAB found that a PHOSITA would understand "the differences between [conventional,] conformal plating and superfilling electrolytic plating," and "would have appreciated that it was unpredictable whether a given molecule would have served as a suppressor effective for superfilling." *Id.* at *5. According to the PTAB, a

PHOSITA would not know, without any additional direction, "that Alling would have had specific utility to superfilling." *Id.* at *8. BASF argues the PTAB erred by, inter alia, (1) failing to support its finding that Alling has no application to superfilling, Appellant's Br. 42–45; and (2) reaching inconsistent conclusions, in two separate inter partes reviews, regarding whether Barstad discloses Tetronic copolymers as suppressors in superfilling, *id.* at 48–50. We agree with BASF.

1. Alling's Application to Superfilling

The PTAB failed to support its finding that a PHOSITA would not have found Alling applicable to superfilling. Barstad and Morrissey each teach a method of superfilling that utilizes a suppressor. *See* Barstad col. 6 ll. 5–8 (stating "use of a suppressor agent . . . provides surprisingly enhanced plating performance, particularly in bottom-fill plating"); J.A. 430 (providing, in Morrissey, that additives such as "suppressor compounds" are used "particularly . . . in copper electroplating baths designed to provide superfill of small apertures"). Both references teach superfilling that may be used to plate high aspect ratio vias or trenches, with diameters of about 200 nanometers. *See* Barstad col. 7 l. 66–col. 8 l. 1 (explaining that "aspect ratios of at least 4:1, having diameters of about 200 [nanometers] or smaller have been effectively copper plated with no defects," such as "voids"); J.A. 433 (stating, in Morrissey, that "aspect ratios of at least 4:1, having diameters of about 200 [nanometers] or smaller have been effectively copper plated with no defects," including "voids"). Alling teaches that "chip interconnects are required at critical dimensions of 200 [nanometers] or less," J.A. 469, and that copolymers, such as those "sold by BASF under [the] Tetronic . . . tradename[]," may be used as "suppressor agents for plating compositions," J.A. 472.

The PTAB determined that a PHOSITA would not understand Alling as relating to superfilling because "the mentioning of chip interconnects at dimensions of 200 [nanometers] and less in Alling would not have informed [a PHOSITA] that Alling would have had specific utility to superfilling because those specific dimensions could effectively receive electrodeposition without superfilling." *BASF I*, 2017 WL 4014997, at *8 (citing J.A. 1029–30). The PTAB cited no support except one passage in Enthone's expert declaration. *See id.* But nothing in the cited portion of that declaration supports the proposition that chip interconnects at dimensions of 200 nanometers or less *could be effectively plated without superfilling*. *See* J.A. 1029–30 (acknowledgment, by Enthone's expert, that Alling references chip interconnects at dimensions of 200 nanometers or less, but stating "beyond that the reference offers no description of or allusion to filling submicron features," nor does it explicitly mention superfilling). At oral argument, Enthone admitted that the PTAB failed to support its finding. Oral Arg. at 16:41–19:22, http://oralarguments.cafc.uscourts.gov/default.aspx?fl=2018-1095.mp3 (Q: "I'm struck by what appears to be, first of all, a mis-citation on [J.A.] 21–22, where [the PTAB] reject[s] this argument that the dimensions disclosed in Alling necessarily require superfilling, and they say no that's not true 'because those specific dimensions could effectively receive electrodeposition without superfilling,' and they cite [J.A.] 2031 and paragraph 69 for that proposition. . . . [T]hat paragraph . . . does not support what the [PTAB] says about it." A: "That statement is not in [paragraph] 69.").

The PTAB's failure to provide "an adequate evidentiary basis for its findings" renders its motivation to combine analysis insufficient. *In re NuVasive*, 842 F.3d at 1382 (internal quotation marks and citation omitted). Indeed, this determination served as the PTAB's basis to disregard other, conflicting deposition testimony from

Enthone's expert that appears to support BASF's position. *See* J.A. 946 (Q: "[S]uccessfully plating copper and chip interconnects of 200 nanometers [or] less is going to involve superfilling, correct?" A: "For those interconnects of that dimension, 200 nanometers or less, yes. For larger interconnects perhaps not."); *see also BASF I*, 2017 WL 4014997, at *8 (accepting this testimony as "correct," but ultimately crediting Enthone's expert declaration). Accordingly, we vacate and remand to the PTAB to reconsider whether either of the asserted combinations of prior art provide the requisite motivation to combine, in light of the discussion of Alling above.

2. Inconsistent Findings Regarding Barstad

"[T]he PTAB must examine the relevant data and articulate a satisfactory explanation for its action including a rational connection between the facts found and the choice made." *In re NuVasive*, 842 F.3d at 1382 (internal quotation marks and citation omitted). "This explanation enables the court to exercise its duty to review the PTAB's decisions to assess whether those decisions are arbitrary, capricious, an abuse of discretion, or unsupported by substantial evidence." *Id.* (internal quotation marks, ellipses, and citation omitted).

The PTAB acted arbitrarily and capriciously by failing to provide a reasoned explanation for reaching an inconsistent finding regarding Barstad. Barstad states that, in general, electroplating solutions may contain additives "such as surfactants, brighteners, levelers[,] and suppressants." Barstad col. 1 ll. 24–25. Barstad teaches that "preferably the plating bath [of the invention] . . . contains a surfactant-type suppressor agent," and that "such a suppressor agent in combination with elevated brightener concentrations can result in effective 'bottom-fill' copper plating of a microvia or other aperture without defects such as inclusions or voids." *Id.* col. 3 ll. 20–25. In an inter partes review of U.S. Patent No. 7,815,786 ("the '786

patent")[4] involving the same parties and asserted combinations of prior art, the PTAB found the challenged claims obvious, determining that "Barstad discloses polyethylene glycol copolymers as preferable *surfactant-type suppressor agents*, and expressly discloses the polyethylene glycol copolymers that were commercially available from BASF under the Tetronic tradename." *BASF Corp. v. Enthone, Inc.* (*BASF II*), IPR2016-00697, 2017 WL 4015000, at *7 (P.T.A.B. Sept. 11, 2017) (emphasis added) (internal quotation marks and citation omitted). Here, the PTAB determined that Barstad discloses Tetronic copolymers as surfactants, and therefore they cannot be suppressors, because Barstad "describes suppressors and surfactants as separate components of the electrodeposition bath." *BASF I*, 2017 WL 4014997, at *8 (internal quotation marks and citation omitted); *see id.* (disagreeing with BASF that "Barstad implies that Tetronic[] copolymers may be used as suppressors").

The PTAB's finding that Barstad teaches that suppressors and surfactants are separate is, therefore, plainly inconsistent with the PTAB's finding in the inter partes review of the '786 patent that Barstad teaches a Tetronic copolymer acting as a *surfactant-type* suppressor agent. *Compare BASF II*, 2017 WL 4015000, at *7, *with BASF I*, 2017 WL 4014997, at *8. This inconsistency is critical

---

[4] The application that led to the '786 patent was filed as a divisional of the application that led to the '992 patent. "[A] divisional application contains an identical disclosure to its parent application" and "is defined as a later application for an independent or distinct invention, carved out of a pending application and disclosing and claiming only subject matter in the earlier or parent application." *Pfizer, Inc. v. Teva Pharm. USA, Inc.*, 518 F.3d 1353, 1359, 1360 (Fed. Cir. 2008) (internal quotation marks, brackets, and citation omitted).

because, if the PTAB finds Barstad teaches a Tetronic copolymer may be used as a suppressor in superfilling, such a finding would be highly relevant to obviousness. *See BASF I*, 2017 WL 4014997, at *8 (requiring "*some* specific motivation to employ specific plating bath components, given the general unpredictability in the field and the art" (emphasis added)). Rather than providing a satisfactory explanation for its divergent findings, the PTAB simply rejected BASF's argument "that Barstad does not contain the clear delineation between suppressors and surfactants," by stating it was "not persuaded that Barstad does not disclose each distinctly." *Id.* (internal quotation marks and citation omitted). Absent "any reasoned explanation for th[is] inconsistent result" between the two inter partes reviews, we find it appropriate to vacate and remand so the PTAB may reevaluate whether Barstad discloses Tetronic copolymers as suppressors for use in superfilling. *Vicor*, 869 F.3d at 1323; *see id.* (vacating and remanding where the PTAB failed to provide any reasoned explanation for reaching directly conflicting obviousness conclusions in two reexaminations involving closely-related subject matter).

CONCLUSION

We have considered the parties' remaining arguments and find them unpersuasive. Accordingly, the Final Written Decision of the U.S. Patent and Trademark Office's Patent Trial and Appeal Board is

VACATED AND REMANDED

COSTS

No costs.