

NOTE: This disposition is nonprecedential.

**United States Court of Appeals
for the Federal Circuit**

LONE STAR SILICON INNOVATIONS LLC,
Appellant

v.

**ANDREI IANCU, UNDER SECRETARY OF
COMMERCE FOR INTELLECTUAL PROPERTY
AND DIRECTOR OF THE UNITED STATES
PATENT AND TRADEMARK OFFICE,**
Intervenor

2019-1669

Appeal from the United States Patent and Trademark
Office, Patent Trial and Appeal Board in No. IPR2017-
01566.

Decided: March 25, 2020

TIMOTHY P. MALONEY, Fitch, Even, Tabin & Flannery,
Chicago, IL, argued for appellant. Also represented by
NICHOLAS T. PETERS, DAVID ALLEN GOSSE.

DANIEL KAZHDAN, Office of the Solicitor, United States
Patent and Trademark Office, Alexandria, VA, argued for
intervenor. Also represented by MAI-TRANG DUC DANG,

THOMAS W. KRAUSE, BRIAN RACILLA, FARHEENA YASMEEN RASHEED, MEREDITH HOPE SCHOENFELD.

Before LOURIE, SCHALL, and CHEN, *Circuit Judges*.

LOURIE, *Circuit Judge*

Lone Star Silicon Innovations LLC (“Lone Star”) appeals from the final written decision of the Patent Trial and Appeal Board (“Board”) holding claims 2 and 7 of U.S. Patent 6,388,330 (the “’330 patent”) unpatentable as obvious. For the reasons described below, we *affirm*.

BACKGROUND

Lone Star is the owner of the ’330 patent, which is directed to semiconductor etch stop layers with low dielectric constants. An etch stop layer is made of material that is resistant to the process used to etch other layers of a semiconductor device and is deposited between two other layers to allow those layers to be etched separately. The invention of the ’330 patent reduces capacitive coupling between layers of metal interconnects by reducing the dielectric constant of the etch stop layers to below 5.5, in contrast to the prior art dielectric constants of 7.5 or higher.

Independent claims 1 and 6, which are not at issue in this appeal, are directed to integrated circuits comprising an “etch stop layer of silicon nitride . . . having a dielectric constant below 5.5.” ’330 patent col. 6 ll. 62–64, col. 7 ll. 22–24, col. 8 ll. 4–6. Dependent claims 2 and 7, which are at issue in this appeal, are directed to the integrated circuits of claims 1 and 6 respectively, wherein the silicon nitride etch stop layer is a “multilayer structure.” *Id.* col. 7 ll. 3–4, col. 8 ll. 12–13.

Micron Technology, Inc. (“Micron”) petitioned for *inter partes* review of claims 1, 2, 5, 6, 7, and 10. Micron asserted a single ground in its petition, namely, that the challenged

claims were obvious over Watatani¹ in view of Tanaka.² The petition stated: “The Ground is explained below and is supported by the Declaration of Dr. Richard B. Fair.” J.A. 70.

Within that single ground, Micron asserted two separate theories regarding the prior art’s teaching of the “multilayer structure” limitation in claims 2 and 7. In its first theory, Micron contended that “Watatani expressly describes an etch stop layer that includes ‘three or more layers’ of silicon nitride.” J.A. 105 (citing Watatani col. 7 ll. 54–55). In its second theory, Micron contended that “[s]uch multilayer silicon nitride layers were well known in the prior art,” and Micron supported this second theory with declaration testimony from its expert as well as prior art references Watatani, SST 1987,³ and Wang.⁴ See J.A. 105–07; see also J.A. 81–82 (“It Was Well Known In The Prior Art To Form Multilayer Silicon Nitride Etch Stop Films”).

The Board instituted review of the challenged claims. J.A. 209. For the “multilayer structure” of claims 2 and 7, the Board rejected Micron’s first theory, *i.e.*, the theory based on the description in Watatani. J.A. 224 (“On this record, we agree with Patent Owner that Watatani does not describe an etch stop layer that includes three or more layers of silicon nitride.”). But the Board expressly

¹ U.S. Patent 6,153,511.

² Masayuki Tanaka et al., *Low-k SiN Film for Cu Interconnects Integration Fabricated by Ultra Low Temperature Thermal CVD*, in 1999 SYMPOSIUM ON VLSI TECHNOLOGY, DIGEST OF TECHNICAL PAPERS, 47–48 (Bus. Center for Acad. Societies Japan, 1999).

³ Novellus Sys., *Continuous Process CVD System*, 30 SOLID STATE TECH., no. 10, Oct. 1987, at 49–50.

⁴ U.S. Patent 6,017,791.

acknowledged that Micron had asserted a second independent theory for the “multilayer structure” limitation:

Petitioner’s contentions regarding claims 2 and 7 are not, however, based solely on Watatani’s disclosure of multilayer etch stops. Petitioner also contends that “multilayer silicon nitride layers were well known in the prior art.”

J.A. 225. The Board found that Micron’s evidence—including the teachings of SST 1987 and Wang—was “sufficient to support its contention that multilayer silicon nitride layers were known in the art.” J.A. 226.

Lone Star filed a request for rehearing, arguing that the Board exceeded its authority by instituting review of claims 2 and 7 “based on a new ground not asserted in the Petition.” J.A. 241. The Board denied Lone Star’s request, finding that the institution decision relied on additional prior art references “in the same way” that Micron’s petition did, namely, “as evidence of the knowledge of a person of ordinary skill in the art.” J.A. 258. The Board noted that Lone Star “cites no authority for the proposition that a reference relied upon to show that a claim limitation is within the knowledge of a [person of ordinary skill in the art] must be expressly included in the list of references that denominate the ground.” J.A. 259; *see* J.A. 258 (“Our reliance on SST 1987, however, does not transform the instituted ground into a ‘new ground,’ as argued by Patent Owner.”).

In its patent owner response, Lone Star again raised its contention that the Board had exceeded its authority and also addressed the merits of the obviousness challenge. Micron argued in reply that the instituted ground based on Watatani, Tanaka, and the knowledge of a person of ordinary skill had been asserted in the petition. J.A. 378–80. Micron also submitted a second declaration from its expert

declarant, Dr. Fair, who cited yet another reference, Yota,⁵ to support his opinion that that multilayer silicon nitride films were well-known in the art. *See* J.A. 890–94.

Lone Star believed that portions of Micron’s reply improperly relied on new evidence, particularly those portions that relied on Dr. Fair’s citations to additional exhibits, such as Yota, that were not previously submitted with Micron’s petition. *See* J.A. 1483–85. The parties jointly requested permission from the Board to submit additional briefing, which the Board allowed. *Id.* Lone Star thus had the opportunity to submit a sur-reply in which it addressed Dr. Fair’s second declaration, including his reliance on Yota. *See* J.A. 397–99.

In its final written decision, the Board held all of the challenged claims, including claims 2 and 7, obvious over Watatani in view of Tanaka. J.A. 2. The Board again rejected Lone Star’s argument that the Board had exceeded its authority and again emphasized that its institution decision and final written decision properly relied on additional references like SST 1987 “in the *same way* as it was relied upon in the Petition: as evidence that multilayer silicon nitride layers were known in the prior art.” J.A. 42. On the merits, the Board held that Micron proved by a preponderance of the evidence that a person of ordinary skill in the art would have been motivated to use a multilayer silicon nitride structure when forming an etch stop layer and would have had a reasonable expectation of success in achieving the subject matter of claims 2 and 7. J.A. 38–39.

⁵ Jiro Yota et al., *Comparison between HDP CVD and PECVD Silicon Nitride for Advanced Interconnect Applications*, in PROC. OF THE IEEE 2000 INT’L INTERCONNECT TECH. CONFERENCE, 76–78 (IEEE Electron Devices Soc’y, 2000).

Lone Star appealed the Board's final written decision only with respect to claims 2 and 7. Micron declined to participate in the appeal because it had already reached a settlement with Lone Star. The Director of the United States Patent and Trademark Office ("Director") intervened pursuant to 35 U.S.C. § 143. We have jurisdiction under 28 U.S.C. § 1295(a)(4)(A).

DISCUSSION

Our review of a Board decision is limited. *In re Baxter Int'l, Inc.*, 678 F.3d 1357, 1361 (Fed. Cir. 2012). We review the Board's legal determinations *de novo*, *In re Elsner*, 381 F.3d 1125, 1127 (Fed. Cir. 2004), but we review the Board's factual findings underlying those determinations for substantial evidence, *In re Gartside*, 203 F.3d 1305, 1316 (Fed. Cir. 2000). A finding is supported by substantial evidence if a reasonable mind might accept the evidence as adequate to support the finding. *Consol. Edison Co. v. NLRB*, 305 U.S. 197, 229 (1938). "Where there is adequate and substantial evidence to support either of two contrary findings of fact, the one chosen by the board is binding on the court regardless of how we might have decided the issue if it had been raised *de novo*." *Mishara Constr. Co. v. United States*, 230 Ct. Cl. 1008, 1009 (1982) (citing *Koppers Co. v. United States*, 186 Ct. Cl. 142, 151 (1968), and *Nat'l Concrete & Found. Co. v. United States*, 170 Ct. Cl. 470, 478 (1965)).

Lone Star raises two challenges on appeal. First, Lone Star contends that the Board exceeded its authority when it reviewed claims 2 and 7 and held them unpatentable based on a ground of obviousness that was not asserted in Micron's petition for inter partes review. Second, Lone Star contends that the Board's obviousness conclusion for claims 2 and 7 is not supported by substantial evidence. We address Lone Star's challenges in turn.

I

Lone Star argues that the petition set forth a single ground of obviousness based solely on the combination of Watatani and Tanaka, but the Board held the claims unpatentable based on an unasserted ground that included a combination of those two references with at least three additional references—SST 1987, Wang, and Yota. According to Lone Star, the Board exceeded its authority, as set forth in 37 C.F.R. § 42.108(a), to authorize review to proceed on “all or some of the *grounds* of unpatentability asserted for each claim.” Appellant Br. 37 (quoting and adding emphasis to the regulation).

The Director responds that Lone Star is attempting to challenge the Board’s institution decision, which is a non-appealable issue pursuant to 35 U.S.C. § 314(d). The Director further argues that, even to the extent that Lone Star’s challenge is appealable, the Board did not abuse its discretion or exceed its authority in this case.

We agree with the Director that Lone Star’s challenge is directed to the Board’s institution decision, which is not appealable. The relevant statutory language is the “No Appeal” clause in Section 314(d):

(d) No Appeal.—The determination by the Director whether to institute an inter partes review under this section shall be final and nonappealable.

In *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2141 (2016) (“*Cuozzo III*”), the Supreme Court held that “[t]he text of the ‘No Appeal’ provision, along with its place in the overall statutory scheme, its role alongside the Administrative Procedure Act, the prior interpretation of similar patent statutes, and Congress’ purpose in crafting inter partes review, all point in favor of precluding review of the Patent Office’s institution decisions.”

We recently addressed a challenge similar to the one presented here. See *Koninklijke Philips N.V. v. Google*

LLC, 948 F.3d 1330 (Fed. Cir. 2020). In that case, the petition presented a single obviousness ground based on the SMIL reference but also relied on the Hua reference as evidence of what was known in the art. *Id.* at 1333–34. Although the petition asserted only one obviousness ground, the Board instituted review on two obviousness grounds—(1) SMIL in view of Hua and (2) SMIL “in light of the *general* knowledge of the skilled artisan.” *Id.* at 1334. Regarding the first instituted ground, we concluded that it was error for the Board to institute review based on a ground of obviousness over SMIL and Hua because that ground was not presented in the petition. *Id.* at 1337. But regarding the second instituted ground, we found no error in the Board’s decision to institute review based on obviousness over SMIL in view of the knowledge of a person of ordinary skill. *Id.* at 1338. Notably, the evidence presented to support the knowledge of a person of skill relied in part on other references, including Hua.

Here, like the second instituted ground in *Koninklijke Philips*, the Board instituted inter partes review based on the ground of obviousness that was presented in Micron’s petition—Watatani in view of Tanaka. The petition undisputedly asserted only one obviousness ground. The Board was not, however, obligated to “ignore the skilled artisan’s knowledge when determining whether it would have been obvious to modify the prior art.” *Id.* at 1337. Indeed, the statutory definition of obviousness expressly depends on what would have been known to a person having ordinary skill in the art. 35 U.S.C. § 103.

Lone Star focuses entirely on the listed references. Lone Star insists that the instituted ground was not actually presented in the petition because it relies on additional references beyond Watatani and Tanaka that were not presented in the petition and the Board lacked authority to *sua sponte* add its own ground of unpatentability. Lone Star argues that the mere fact that the Board failed to explicitly acknowledge this as a “new ground” is insufficient

to distinguish this case from the first instituted ground in *Koninklijke Philips*, which we found to be instituted in error. 948 F.3d at 1337. But here, the Board repeatedly made clear that the instituted ground was based on Watatani and Tanaka, and that the additional references were being relied on exclusively for their teachings about what was well-known in the art. J.A. 225; *see also* J.A. 42, 258. And the Board only did so after it expressly interpreted the petition to have presented that argument. *E.g.* J.A. 225 (quoting “[p]etitioner’s contention[] . . . that ‘multilayer silicon nitride layers were well known in the prior art.’” (emphasis added)); J.A. 226 (“*Petitioner’s* evidence is sufficient to support *its* contention . . .”). Under Section 314(d), the Board’s decision to institute review based on its interpretation of the petition is not appealable. *See Cuozzo III*, 136 S. Ct. at 2139 (holding that the Board’s interpretation of the petition to have implicitly presented a challenge was unreviewable).

Lone Star attempts to avoid the “No Appeal” clause by arguing that its challenge in this case is not to the Board’s institution decision, but rather to the scope of the Board’s statutory and regulatory authority throughout the proceeding, which is reviewable. Lone Star relies heavily on the Supreme Court’s acknowledgment that the petition is “the centerpiece of the proceeding both before and after institution.” *SAS Inst., Inc. v. Iancu*, 138 S. Ct. 1348, 1358 (2018). Lone Star argues that the “No Appeal” clause in Section 314(d) pertains only to the “preliminary patentability [decision]” based on the “patentability merits of particular claims,” and is thus inapplicable in this case. *See* Reply Br. 6 (quoting *Wi-Fi One, LLC v. Broadcom Corp.*, 878 F.3d 1364, 1372 (Fed. Cir. 2018) (en banc)). According to Lone Star, the controlling authority in this case is 37 C.F.R. § 42.108, which allows the Board to institute review “on all or some of the grounds of unpatentability asserted.” Lone Star also argues that 35 U.S.C. § 311(b) limits the

scope of the Board's authority to a ground on which a petitioner asks for review.

We disagree with Lone Star's characterization of both its challenge and the Board's institution decision. In *Cuozzo III*, the Supreme Court held that the "No Appeal" clause applies to attacks that are "closely tied" to the Board's "decision to initiate inter partes review." 136 S. Ct. at 2141. We find that this is such a case. In order to grant the relief that Lone Star requests, we would have to unwind the Board's institution decision and compare it to the particular language used in Micron's petition regarding the "multilayer structure" limitation, which is precisely the kind of analysis the Supreme Court cautioned against. *Id.* at 2139. In essence, Lone Star's argument that a specific theory was not within "the grounds of unpatentability asserted" under 37 C.F.R. § 42.108 "is little more than a challenge to the Patent Office's conclusion, under § 314(a), that the 'information presented in the petition' warranted review." *Id.* at 2142.

In an attempt to distinguish *Cuozzo III*, Lone Star points to a number of cases in which this court has reviewed institution-stage issues. But in each such case the reviewable issue was not closely tied to substantive patentability requirements. See *Arista Networks, Inc. v. Cisco Sys., Inc.*, 908 F.3d 792, 799 (Fed. Cir. 2018) (reviewing assignor estoppel); *Wi-Fi One*, 878 F.3d 1364, 1374 (reviewing time bar); see generally *Applications in Internet Time, LLC v. RPX Corp.*, 897 F.3d 1336 (Fed. Cir. 2018) (reviewing the real party in interest requirement). And while the Supreme Court itself acknowledged that the "No Appeal" clause does not extend to appealable constitutional or statutory violations, *Cuozzo III*, 136 S. Ct. at 2141–42, that acknowledgement is not applicable here, where Lone Star's challenge is to the evidentiary basis underpinning the Board's interpretation of the petition in its institution decision.

We also note that that this court has entertained challenges to the Board for exceeding its authority in violation of the Administrative Procedure Act (“APA”) by, for example, failing to give “notice of and a fair opportunity to meet the grounds of rejection.” *In re NuVasive, Inc.*, 841 F.3d 966, 971 (Fed. Cir. 2016) (quoting *Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1080 (Fed. Cir. 2015)). But, importantly, Lone Star has not raised such a challenge under the APA in this case. Indeed, the crux of Lone Star’s argument is that the Board exceeded its authority notwithstanding the undisputed fact that Lone Star *did* have notice of the full scope of the inter partes review and an adequate opportunity to respond in its patent owner response and its sur-reply. In the context of challenges under the APA, we have found that the Board is within its authority to institute review and consider even arguments that were *not* asserted in the petition “after giving [the patent owner] a full opportunity to submit additional evidence and arguments on that point.” *NuVasive*, 841 F.3d at 975 (citing *In re Kumar*, 418 F.3d 1361, 1367–69 (Fed. Cir. 2005)). All the more so here, where the Board put Lone Star on notice of its finding that the “multilayer structure” theory *was* presented in the petition, there is nothing in the patent statute or the regulations that limits the Board’s authority to include that theory within the scope of its review.⁶

⁶ Although not cited in the petition, Yota was not needed for the petition to establish, on the basis of SST 1987 and Wang, that multilayer silicon nitride structures were well known. To the extent that the Board relied on Yota to rebut specific arguments made by Lone Star against reasonable expectation of success, the Board was within its authority to do so where Lone Star was given ample opportunity to respond.

At bottom, the Board interpreted the petition to have presented a specific theory for the “multilayer structure” limitation. The Board instituted an inter partes review that includes that theory. Lone Star asks us to review that institution decision. Under the “No Appeal” clause, as interpreted by the Supreme Court in *Cuozzo III*, that decision is not reviewable.

II

We turn now to Lone Star’s challenge on the merits of the Board’s obviousness conclusion for claims 2 and 7. Obviousness is a question of law based on underlying facts, including the scope and content of the prior art, differences between the prior art and the claims at issue, the level of ordinary skill, and relevant evidence of secondary considerations. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). Whether a skilled artisan would have been motivated to combine prior art references is also a question of fact. *Wyers v. Master Lock Co.*, 616 F.3d 1231, 1238–39 (Fed. Cir. 2010).

Lone Star challenges a number of the facts underlying the Board’s obviousness conclusion. Lone Star contends that, even accepting that a multilayer structure of silicon nitride was well-known in the art, the record is devoid of evidence that such a multilayer structure was known to be used *as an etch stop layer*, which is what claims 2 and 7 actually require. Lone Star also challenges the Board’s conclusions regarding motivation to combine and reasonable expectation of success. Lone Star argues that the two alleged motivations to use a multilayer structure—layer uniformity and avoiding pinholes—are divorced from the overall context of the claims, which require that the etch stop layer have a dielectric constant below 5.5. And Lone Star argues that the evidence in the record demonstrates that a person of skill would have expected a multilayer structure to increase the dielectric constant of the etch stop

layer, which is the opposite of the claimed invention directed to lower dielectric constants.

The Director responds that the multilayer structure limitation of claims 2 and 7 adds no patentable significance to the obvious integrated circuit of claims 1 and 6. Said differently, the Director argues that claims 2 and 7 are directed to nothing more than starting with an obvious integrated circuit and adding a well-known multilayer structure that has well-established benefits for integrated circuits. The Director further argues that Lone Star's motivation to combine argument is contrary to law, and that substantial evidence from both parties' experts and multiple prior art references supports the Board's findings regarding reasonable expectation of success.

We agree with the Director. The Supreme Court has made clear that "if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007). For purposes of this appeal, it is not disputed that multilayer structures were known to improve integrated circuits by improving layer uniformity and decreasing pinholes. And the record contains substantial evidence that using the multilayer structure of silicon nitride recited in claims 2 and 7 would improve the etch stop layers in the integrated circuits of claims 1 and 6 in the same way. Thus, the multilayer structure does not render nonobvious the otherwise obvious integrated circuits of claims 1 and 6.

Furthermore, regarding a motivation to combine, we reject Lone Star's contention that the known advantages that would have motivated a person of skill to use multilayer structures must be shown to directly impact the claimed lower dielectric constant. On the contrary, the law is clear that "the motivation to modify a prior art reference

to arrive at the claimed invention *need not* be the same motivation that the patentee had.” *Monsanto Tech. LLC v. E.I. DuPont de Nemours & Co.*, 878 F.3d 1336, 1347 (Fed. Cir. 2018) (citation omitted, emphasis added). Here, there is substantial evidence that a person of skill would have been motivated to use a multilayer structure of silicon nitride as an etch stop layer to improve layer uniformity and avoid pinholes. And, having been motivated to use a multilayer structure, the person of skill would have thus arrived at the claimed invention of claims 2 and 7.

Finally, regarding the reasonable expectation of successfully achieving a low dielectric constant with a multilayer structure, the Board relied on the testimony of both parties’ expert witnesses regarding the relationship between density and dielectric constants when stacking multiple thin layers to achieve thickness. J.A. 41–42 (citing both Dr. Fair and Dr. Bottoms). And simply put, the Tanaka prior art reference teaches a silicon nitride layer with a dielectric constant that is below 5.5 as required by the claims, *see* J.A. 41, and Micron’s expert, Dr. Fair, pointed to multiple references to support his opinion that the low dielectric constant could be maintained using a multilayer structure. J.A. 893–94. Lone Star challenged Dr. Fair’s opinions below with the same factual arguments it now raises on appeal, but the Board rejected Lone Star’s challenges based on the teachings of the prior art references, the background of the ’330 patent itself, and inconsistencies within Lone Star’s positions. J.A. 47–48. We are not in a position to second-guess the Board’s evaluation of expert witnesses’ credibility or its reconciliation of perceived inconsistencies in their testimony. *Yorkey v. Diab*, 601 F.3d 1279, 1284 (Fed. Cir. 2010) (“We defer to the Board’s findings concerning the credibility of expert witnesses.” (citing *Velandar v. Garner*, 348 F.3d 1359, 1371 (Fed. Cir. 2003))). On this record, the Board’s finding that a person of skill would have had a reasonable expectation

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of successfully achieving the invention of claims 2 and 7 is supported by substantial evidence.

CONCLUSION

We have considered Lone Star's remaining arguments, but we find them to be unpersuasive. Accordingly, the decision of the Board holding unpatentable claims 2 and 7 of the '330 patent is affirmed.

AFFIRMED