NOTE: This disposition is nonprecedential.

United States Court of Appeals for the Federal Circuit

HOME SEMICONDUCTOR CORPORATION,
Appellant

v.

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

2016-2215

Appeal from the United States Patent and Trademark Office, Patent Trial and Appeal Board in No. IPR2015-00460.

Decided: July 25, 2017

CRAIG R. KAUFMAN, TechKnowledge Law Group LLP, Redwood City, CA, argued for appellant. Also represented by JERRY CHEN.

MICHAEL J. MCKEON, Fish & Richardson, PC, Washington, DC, argued for appellees. Also represented by CRAIG E. COUNTRYMAN, San Diego, CA.

Before LOURIE, MOORE, and O'MALLEY, *Circuit Judges.*

LOURIE, *Circuit Judge.*

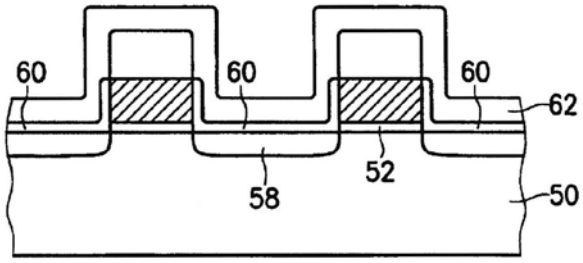
Home Semiconductor Corp. ("Home") appeals from the final written decision of the United States Patent and Trademark Office Patent Trial and Appeal Board ("the Board") in an *inter partes* review ("IPR") proceeding finding that, *inter alia*, claims 2 and 9–14 of U.S. Patent 6,146,997 ("the '997 patent") are unpatentable as anticipated by U.S. Patent 6,277,720 ("Doshi"). *Home Semiconductor Corp. v. Samsung Elecs. Co.*, No. IPR2015-00460, 2016 Pat. App. LEXIS 7424 (P.T.A.B. Apr. 20, 2016) ("*Final Decision*"). For the reasons that follow, we *reverse*.

BACKGROUND

This appeal primarily involves the meaning of the word "over" in the context of the claims, written description, and figures. Home owns the '997 patent, which is directed to "a simplified method for forming a self-aligned contact hole," in which a conductive plug can be formed to electrically connect the semiconductor device to other circuit elements. '997 patent col. 2 ll. 3–4, col. 3 ll. 25–31. The '997 patent first describes the conventional technique of forming a self-aligned contact hole, which involves the separate steps of (1) forming "nitride spacers 22a" by depositing and anisotropically etching "a conformal layer of silicon nitride 22"; and (2) forming the "contact hole 29" after depositing another "conformal layer of etch barrier material 24," which "serv[es] as an etch stop" and is later partially removed to "expose the diffusion region 18." *Id.* col. 1 ll. 33–57, figs. 1B–E. The '997 patent then describes a simplified process that "reduces one etch step and one deposition step as compared to the conventional method." *Id.* col. 3 ll. 10–42. Instead of two separate steps of forming the nitride spacers and forming the

contact hole, each performed after a deposition of respective conformal layers 22, 24, the '997 patent describes a process involving one "conformal layer of silicon nitride 62," which is anisotropically etched to "[s]imultaneously" form "nitride spacers 62a" and a "contact hole 67." *Id.* col. 2 l. 60–col. 3 l. 25.

In both of the known and simplified processes described in the '997 patent, "a thin oxide layer" 20, 60 is "formed *over* the substrate surface and on the sidewalls of the gate electrode" before the conformal layer 22, 62 is deposited, *id.* col. 1 ll. 29–31, col. 2 ll. 55–57 (emphasis added); *id.* figs. 1A, 2A, and once the thin oxide layer 60 is formed and the conformal layer 62 is deposited, the semiconductor structure at this intermediate stage of the described process appears as below:



id. fig. 2B; *see also id.* fig. 1B. Later, a portion of the thin oxide layer is removed "to expose the diffusion region." *Id.* col. 1 ll. 38–40, col. 3 ll. 22–24.

Claim 2 of the '997 patent reads as follows:

> 2. The method as claimed in claim 1, further comprising a step of *forming an oxide layer over the diffusion region* and on the sidewalls of the gate electrode by thermal oxidation prior to forming the barrier layer.

Id. col. 4 ll. 5–8 (emphasis added). Claim 9 is an independent claim involving multiple steps and includes a

similar step of "*forming an oxide layer over the diffusion region* and on the sidewalls of the gate electrode by thermal oxidation." *Id.* col. 4 ll. 32–34 (emphasis added). Claims 10–14 depend from claim 9 and add additional limitations not at issue on appeal.

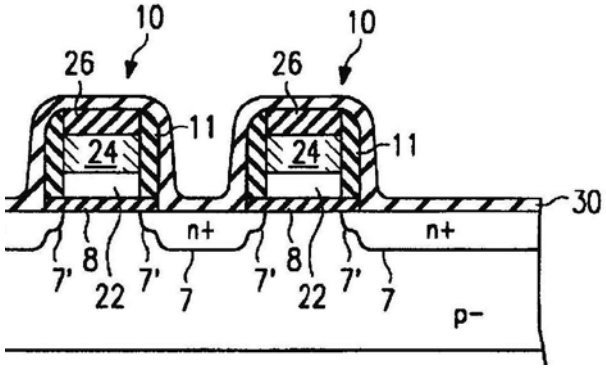
Samsung Electronics Co., Ltd., Samsung Electronics America, Inc., Samsung Semiconductor, Inc., and Samsung Austin Semiconductor LLC (together, "Samsung") filed a petition for IPR of the '997 patent, alleging that claims 1–14 were anticipated by Doshi, that claims 1 and 3–8 were anticipated by U.S. Patent 5,770,498 ("Becker"), and that claims 2 and 9–14 would have been obvious over Becker and Wong, et al., *Process Induced Degradation of Thin Oxides*, ULSI SCI. & TECH. (1987). The Board instituted review only on the anticipation ground based on Doshi. *Home Semiconductor Corp. v. Samsung Elecs. Co.*, No. IPR2015-00460, 2015 WL 3430191, at *8 (P.T.A.B. May 27, 2015).

In its patent owner response, Home argued that "forming an oxide layer over the diffusion region" in claims 2 and 9 should mean "forming an oxide layer *covering* the diffusion region" in light of the specification. J.A. 499 (emphasis added). Based on its proposed construction, Home argued that Doshi did not anticipate the challenged claims.

In reply, as it had done in its IPR petition, Samsung argued that the broadest reasonable interpretation of "forming an oxide layer over the diffusion region" should be "forming an oxide layer *above* the diffusion region." J.A. 695–96 (emphasis added). Samsung argued that construing "over" as "covering" was too narrow a reading for a person of ordinary skill in the art and that its argument was supported by Becker, which describes gate electrode structures that do not cover the substrate as being "over" the substrate.

In its final written decision, the Board construed, *inter alia*, "forming an oxide layer over the diffusion region" in claims 2 and 9 as "forming an oxide layer above the diffusion region," as proposed by Samsung. *Final Decision*, 2016 Pat. App. LEXIS 7424, at *15. In rejecting Home's proposed claim construction, the Board reasoned that Home essentially argued for "over" to be construed as "completely covering" and that the plain meaning of "over" and the specification, which does not use the word "covering," are consistent with understanding "over" to mean "above." *Id.* at *12–14. According to its claim construction, the Board found that all the challenged claims were anticipated by Doshi.

Doshi, entitled "Silicon Nitride Dopant Diffusion Barrier in Integrated Circuits," is generally directed to "a silicon nitride diffusion barrier layer underlying a planarizing doped oxide layer" so that "dopant in planarizing insulating films is prevented from diffusing into the active regions of the integrated circuit." Doshi col. 4 ll. 12–14, 21–23. In particular, Doshi describes that "sidewall filaments 11 are formed by first oxidizing the sides of polysilicon layer 22" and that "[a] layer of silicon nitride is then deposited overall, and then etched anisotropically to remove the nitride from flat surfaces, leaving sidewall filaments 11 behind." Doshi col. 7 ll. 58–62. Subsequently, a silicon nitride layer 30 is formed; the resulting semiconductor structure at this intermediate stage is shown below:



Doshi fig. 3a (in part); *see also id.* fig. 3b (in part).

In finding that Doshi anticipated "forming an oxide layer over the diffusion region," the Board found that "Doshi discloses forming an oxide layer on the sidewalls of the gate electrode." *Final Decision*, 2016 Pat. App. LEXIS 7424, at *35–36. The Board found that "Doshi describes that the sidewall filaments 11 are formed by first oxidizing the sides of the polysilicon layer 22" and that "the oxide layer (filaments 11) is above the diffusion region," "which includes source/drain extensions 7'." *Id.* at *32–33. The Board disagreed with Home, who argued that the oxide layer in Doshi is "higher but off to the side," and found that "Doshi discloses [that] the oxide layer (sidewall filaments 11) is above the diffusion region, and not merely 'off to the side' as argued by [Home]." *Id.* at *33–36.

Home timely appealed. We have jurisdiction pursuant to 28 U.S.C. § 1295(a)(4)(A).

DISCUSSION

In IPR proceedings, the Board gives claim terms their broadest reasonable interpretation in light of the claim language and the specification. *See Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2142–46 (2016). We review the Board's ultimate claim constructions *de novo* and underlying factual determinations involving extrinsic evidence for substantial evidence. *Microsoft Corp. v. Proxyconn, Inc.*, 789 F.3d 1292, 1297 (Fed. Cir. 2015) (citing *Teva Pharm. U.S.A., Inc. v. Sandoz, Inc.*, 135 S. Ct. 831, 841–42 (2015)).

A patent claim is anticipated "only if each and every element is found within a single prior art reference, arranged as claimed." *Summit 6, LLC v. Samsung Elecs. Co.*, 802 F.3d 1283, 1294 (Fed. Cir. 2015) (citing *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1369 (Fed. Cir. 2008)). Anticipation is a question of fact that we

review for substantial evidence. *REG Synthetic Fuels, LLC v. Neste Oil Oyj*, 841 F.3d 954, 958 (Fed. Cir. 2016). Substantial evidence is "such relevant evidence as a reasonable mind might accept as adequate to support a conclusion." *In re Gartside*, 203 F.3d 1305, 1312 (Fed. Cir. 2000) (quoting *Consol. Edison Co. v. NLRB*, 305 U.S. 197, 229 (1938)). Thus, we reverse the Board's anticipation findings when substantial evidence does not support the Board's decision. *See, e.g.*, *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 851 F.3d 1270, 1275 (Fed. Cir. 2017); *In re Man Machine Interface Techs. LLC*, 822 F.3d 1282, 1287 (Fed. Cir. 2016); *In re Skvorecz*, 580 F.3d 1262, 1267–68 (Fed. Cir. 2009).

On appeal, Home challenges the Board's construction of "forming an oxide layer over the diffusion region" and its findings that claims 2 and 9–14 are anticipated by Doshi. We address each issue in turn.

I. Construction of "Forming an Oxide Layer over the Diffusion Region"

Home argues that the Board's construction of "over" as "above" is unreasonably broad and inconsistent with the specification, citing figures and various uses of the term "over" in the specification. Appellant's Br. 16–19. Home maintains that "over" should be construed as "covering," *id.* at 16, and argues that its proposed construction of "over" means only "covering," *not* "completely covering," and it faults Samsung for "recast[ing]" its construction, Appellant's Reply 1–2. Yet, Home contends that "'covering' means 'covering' the entire relevant region." Appellant's Br. 19. During oral argument, Home was repeatedly asked to clarify its claim construction position, and Home presented its claim construction as "effectively cover[ing] the entire surface" but admitted that it had not argued in its briefings for any alternative construction other than "covering," such as "substantially covering." Oral Argument at 3:20–24, 5:00–09, 7:36–50,

30:48–31:30, *Home Semiconductor Corp. v. Samsung Elecs. Co.*, No. 16-2215 (Fed. Cir. June 9, 2017), http://oralarguments.cafc.uscourts.gov/default.aspx?fl=2016-2215.mp3.

Samsung contends that the Board correctly construed the term "over" as "above," giving the term "the full breadth of its ordinary meaning." Appellee's Br. 14–15. Samsung argues that construing "over" as "covering" is not supported by the use of the term "over" in the specification and would result in improperly importing limitations into the claims. Samsung also maintains that the specification and another prior art reference, Becker, support that "over" cannot mean completely covering.

We conclude that the Board's construction of "over" as meaning "above" is unreasonable in light of the claim language and the specification.

The Board construed "forming an oxide layer over the diffusion region" to mean "forming an oxide layer above the diffusion region," adopting the broad construction of the term "over" that Samsung proposed. The Board discussed how its construction of "over" as "above" is consistent with the specification; however, it adopted its construction without regard to the context in which it is used in the claims and the specification. In adopting the "full breadth" of the term as advocated by Samsung, the Board focused on the word "above," rather than the claim term "over." That was error.

Even when giving the claim term the broadest reasonable interpretation, the Board cannot construe the claims "so broadly that its constructions are *unreasonable* under general claim construction principles." *Microsoft*, 789 F.3d at 1298 (emphasis in original). "[T]he protocol of giving claims their broadest reasonable interpretation . . . does not include giving claims a legally incorrect interpretation" "divorced from the specification and the

record evidence." *Id.* (citations and internal quotation marks omitted).

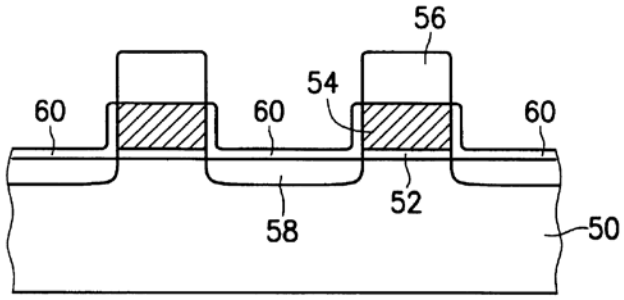
As in any claim construction, we start with the claim language itself. *See PPC Broadband, Inc. v. Corning Optical Commc'ns RF, LLC*, 815 F.3d 747, 752 (Fed. Cir. 2016). The language at issue is not simply "over," but is "forming an oxide layer *over the diffusion region*," and the use of the term "over" in "forming an oxide layer over the diffusion region" connotes more than an insignificant or incidental vertical overlap between the oxide layer and the diffusion region. Although "over" and "above" can be interchangeable in certain contexts, they are not coextensive here, and the full scope of "above," which is not a claim term, cannot be adopted to give meaning to the actual claim term "over" if that adoption would result in an *unreasonable* interpretation of the claim term in context. This understanding of the claim term "over" is also supported by the specification, which repeatedly describes two *significantly overlapping* layers or structures as one being "over" another. '997 patent col. 1 ll. 29–31, 41–47, col. 2 ll. 55–58, 60–62, col. 3 ll. 1–3, 17–20.

The Board, in its claim construction, brought into the claim the concept of the oxide layer being merely higher in position relative to the diffusion region regardless of the minor extent of the vertical overlap between the oxide layer and the diffusion region, which is contrary to the claim language itself and to the specification. In so doing, the Board injected ambiguity into its claim construction by replacing the claim term "over" with "above" and then resolved that ambiguity by erring on the side of a broader understanding of the word "above" to reach its anticipation finding.

The Board's reading of "forming an oxide layer over the diffusion region" is also inconsistent with the remaining language of claims 2 and 9. The common limitations of claims 2 and 9 read: "forming an oxide layer over the

diffusion region *and on the sidewalls of the gate electrode* by thermal oxidation." '997 patent col. 4 ll. 6–8, 32–34 (emphasis added). Generally, claim construction that gives "meaning to all of a claim's terms," *Apple, Inc. v. Ameranth, Inc.*, 842 F.3d 1229, 1237 (Fed. Cir. 2016), and does not "render[] other parts of the claim superfluous," *Merck & Co., Inc. v. Teva Pharm. USA, Inc*, 395 F.3d 1364, 1372 (Fed. Cir. 2005), is favored. *See Wasica Fin. GmbH v. Cont'l Auto. Sys., Inc.*, 853 F.3d 1272, 1288 n.10 (Fed. Cir. 2017).

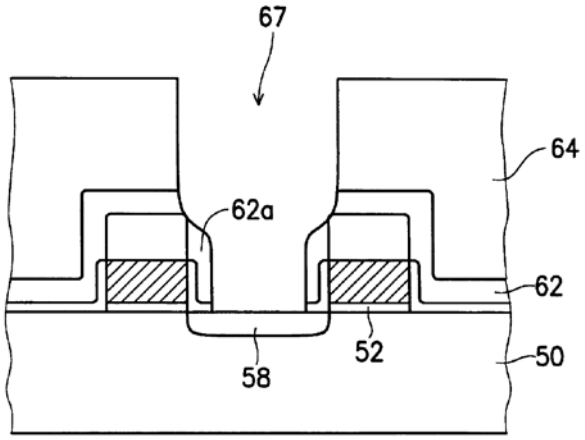
The '997 patent describes that "a thin oxide layer 60 having a thickness of about 150 Å is formed over the substrate surface and on the sidewalls of the gate electrode 54 by rapid thermal oxidation at about 800 to 1100 °C," col. 2 ll. 55–59, and shows the semiconductor structure at this stage as below:



id. fig. 2A. The full claim limitation read in light of the specification indicates that the oxide is formed *both* "over the diffusion region," that is, "over the substrate surface," *and* "on the sidewalls of the gate electrode," which is separate from the oxide formed "over the diffusion region." If "forming an oxide layer over the diffusion region" is so broadly interpreted that forming an oxide *on the sidewalls* of the gate electrode that is merely higher than the diffusion region can correspond to "forming an oxide layer over the diffusion region," then the remainder of the claim limitation, namely "and on the sidewalls of the gate electrode," would be rendered superfluous.

We therefore conclude that the Board erred in construing "over" to mean "above."

However, we decline to adopt Home's proposed construction of "over" to mean an unqualified "covering." In support of its proposed claim construction, Home in part refers to Figure 2D, which is reproduced below, and shows the semiconductor structure after "the conformal nitride layer 62 underneath the opening is anisotropically etched to remove *the portion over the diffusion region 58*." '997 patent, col. 3 ll. 17–20 (emphasis added).



Id. fig. 2D. Home argues that "the portion over the diffusion region 58" that is being removed according to this description is the portion that "covers" the diffusion region 58 and suggests that the term "over" should be construed as "covering" accordingly. Appellant's Br. 17–18. However, as Home acknowledged during oral argument, this construction of "over" as "covering" requires a previously unarticulated qualifier, such as "effectively" or "substantially," which Home has not argued and hence we do not consider.

Thus, even though we conclude that the Board erred in its claim construction of "over" as "above," we find that neither Home's inconsistent proposed constructions of "over," nor Samsung's, which the Board adopted, is per-

suasive. In light of the full claim limitation and the specification, we conclude that regardless of the arguments of the parties and the reasoning of the Board, "forming an oxide layer over the diffusion region" should be understood in the context of "forming an oxide layer over the diffusion region and on the sidewalls of the gate electrode by thermal oxidation," which means forming an oxide layer over the diffusion region in addition to on the sidewalls of the gate electrode.

Accordingly, we conclude that the claims in which "forming an oxide layer over the diffusion region" appear are not anticipated by Doshi, for reasons stated below.

II. Anticipation by Doshi

In discussing Doshi's teachings, the Board determined that "sidewall filaments 11 are formed by first oxidizing the sides of polysilicon layer 22," and appears to have proceeded on the assumption that the sidewall filaments 11 are oxide layers. *Final Decision*, 2016 Pat. App. LEXIS 7424, at *32–36. To the extent that the Board equated the sidewall filament 11 to an oxide layer, that was an error that is not supported by Doshi's own teachings. In Doshi, oxidizing the sides of the polysilicon layer 22 is only the "first" step of forming the sidewall filaments 11. Doshi col. 7 ll. 58–59. The remaining steps of forming the sidewall filaments 11 entail "deposit[ing]" "[a] layer of silicon nitride . . . overall" and "anisotropically" "etch[ing]" that layer of silicon nitride "to remove the nitride from flat surfaces," which "leav[es] sidewall filaments 11 behind," *i.e.*, completes the "formation of the sidewall filaments 11." Doshi col. 7 ll. 59–62, 66.

Perhaps recognizing this shortcoming of the Board's analysis, Samsung urges that by siding with Samsung, the Board actually adopted its contention that the sidewall filament 11 "*includes* an oxide layer." Appellee's Br. 22 (emphasis added). On appeal, Samsung further refines its previous arguments that were before the Board and

urges that what actually corresponds to an "oxide layer" in Doshi is part of the sidewall filament 11, in particular the portion of the sidewall filament 11 that is near and in contact with the side of the polysilicon layer 22. Samsung argues that the Board found that the oxide layer is part of the sidewall filaments 11 rather than part of the polysilicon layer 22.

Contrary to Samsung's contentions, however, the Board did not make such findings in reaching its anticipation decision. In particular, the Board did not make any explicit finding that an oxide layer is the portion of the sidewall filament 11 that is near and in contact with the polysilicon layer 22 nor did it make a finding of where Doshi's "oxide layer" resides—either in the sidewall filaments 11, polysilicon layer 22, or both—if the oxide layer were to be considered not coextensive with the sidewall filament 11. Regardless, even assuming *arguendo* that the Board had implicitly made a finding that an oxide layer is part of the sidewall filament 11 near the polysilicon layer 22 as urged by Samsung, Doshi's such teachings cannot anticipate "forming an oxide layer over the diffusion region."

It is undisputed that the oxidation in Doshi occurs on the sides of the gate electrode, which itself does not vertically overlap with the diffusion region and is only aligned on an extended edge above the diffusion region. Regardless whether the oxidation of the polysilicon 22 in Doshi results in an oxide being formed within the sidewall filament 11, the polysilicon 22, or both, the "oxide layer" in Doshi, which teeters above on the outermost edge of the diffusion region, cannot be understood as an oxide layer formed "over the diffusion region." The Board rejected Home's similar line of argument that the oxide layer in Doshi is "higher but off to the side." *Final Decision*, 2016 Pat. App. LEXIS 7424, at *33–35. It is difficult to discern the Board's reasoning and analysis in response, but

regardless, we conclude that the Board erred in its anticipation finding because its claim construction was flawed.

Doshi's "oxide layer" is only "above" the diffusion region in the sense that it is higher in position, but is merely insignificantly overlapping with the diffusion region, and therefore is not "over the diffusion region." "[O]xidizing the sides" of the gate electrode in Doshi is not "forming an oxide layer over the diffusion region"; it is the "layer of silicon nitride" that is "deposited overall" in Doshi. Doshi col. 7 ll. 59–60. Substantial evidence thus does not support the Board's finding of anticipation because Doshi fails to teach forming an oxide layer over the diffusion region in addition to on the sidewalls of the gate electrode. Because independent claim 9 is not anticipated by Doshi, dependent claims 10–14 are also not anticipated by Doshi.

Samsung argues in the alternative that a growth of the oxide layer in Doshi occurs over, and covers, the diffusion region. Although argued for by Samsung during the IPR proceeding, the Board did not make a specific finding on whether an oxide layer grows over and covers the diffusion region. Even if factual findings to that effect had been made in favor of Samsung, they would only have been relevant if Samsung had argued that Doshi inherently teaches the limitation because Samsung had admitted that Doshi does not expressly disclose an oxide layer covering the diffusion region. Because such argument was not squarely before the Board, and the Board did not decide on what appears to be an inherency argument, the issue is not properly before us.

We therefore conclude that the Board's finding that Doshi anticipates claims 2 and 9–14 of the '997 patent was not supported by substantial evidence.

CONCLUSION

For the foregoing reasons, the decision of the Board is reversed.

REVERSED