United States District Court,
D. Delaware.

THORN EMI NORTH AMERICA, INCORPORATED,
Plaintiff.
v.
INTEL CORPORATION,
Defendant.

Civil Action No. 95-199-RRM

Aug. 29, 1996.

Patentee brought infringement action against competitor, claiming infringement of its patent for an improved method of fabricating metal oxide semiconductor field effect transistors in a large scale integrated circuit. On competitor's motion for summary judgment, the District Court, McKelvie, J., held that: (1) patent was not literally infringed, but (2) fact issue as to whether patent was infringed under doctrine of equivalents precluded summary judgment.

Motion denied.

4,486,943. Cited.

Josy W. Ingersoll, Martin S. Lessner, and Lisa B. Goodman, Young, Conaway, Stargatt & Taylor; Donald F. Parsons, Jr., and Lisa B. Baeurle, Morris, Nichols, Arsht & Tunnell, Wilmington, Delaware; James P. Bradley, Dale B. Nixon, Michael Rocco Cannatti, D. Scott Hemingway, and Michael Chibib, Richards, Medlock & Andrews, Dallas, Texas; Ivan S. Kavrukov, and Peter J. Philips, Cooper & Dunham, L.L.P., New York City, for plaintiff Thorn EMI North America, Inc.

William J. Marsden, Jr., and Joanne Ceballos, Potter, Anderson & Corroon, Wilmington, Delaware; James J. Elacqua, Timothy N. Trop, Christopher R. Benson, Stephen D. Dellett, and Henry A. Petri, Jr., Arnold, White & Durkee, Houston, Texas, for defendant Intel Corporation.

OPINION

McKELVIE**, District Judge.**

This is a patent case. Plaintiff Thorn EMI North America, Inc. ("TENA") is the owner of U.S. Patent No. 4,486,943 ("the "3 patent"). The "3 patent claims an improved method for fabricating metal oxide semiconductor field effect transistors ("MOS" or "MOSFET" transistors) in a large scale integrated circuit. On March 29, 1995, TENA filed a complaint against defendant Intel Corporation ("Intel") alleging that many of Intel's processes for manufacturing MOS transistors infringe the "3 patent. On June 19, 1995, Intel

filed an answer denying infringement and asserting the invalidity of the "3 patent and certain equitable defenses.

On May 28, 1996, the court issued an opinion construing a portion of the claims of the "3 patent in accordance with Markman v. Westview Instruments, Inc., 52 F.3d 967 (Fed.Cir.1995), *aff'd,* 517 U.S. 370, 116 S.Ct. 1384, 134 L.Ed.2d 577 (1996). *See* Thorn EMI North America, Inc. v. Intel Corp., 928 F.Supp. 449 (D.Del.1996). Based on that construction, the court also granted Intel's motion for partial summary judgment of noninfringement with respect to three of its accused processes: P652, P852 (revisions 9 & 10), and P864.3. *Id.*

On June 10 and 11, 1996, immediately prior to trial, the court held a hearing to construe any remaining disputed claims. At the end of the hearing, the court orally announced its construction of the disputed claims. Upon hearing the court's claim construction, Intel orally moved for summary judgment of noninfringement with respect to all of its remaining accused processes. The parties agreed to dismiss the jury pending resolution of Intel's motion. On June 19, 1996, TENA filed an answering brief in opposition to Intel's oral motion for summary judgment and a declaration by its expert Dr. Richard Fair in support of its opposition. On June 27, 1996, Intel filed a reply brief in support of its motion for summary judgment and a motion to strike portions of TENA's answering brief and all of Fair's June 19, 1996 declaration.

This is the court's explanation of its claim construction and its decision on Intel's motion to strike and motion for summary judgment.

I. *FACTUAL BACKGROUND*

In its May 28, 1996 Opinion, the court set out a description of the parties' contentions, the technology underlying this lawsuit, a brief description of the specification and the preferred embodiment of the "3 patent, and certain relevant aspects of the prosecution history. After the court issued its Opinion, TENA apparently withdrew its assertions of infringement with respect to independent claims 6 and 15-17. TENA now asserts only independent claim 1 and dependent claims 2 and 3 against Intel's three remaining accused processes: P650, P651, and P852 (revisions 1-8).

Claim 1 states:

1. A method of fabricating on a substrate an MOS transistor having a gate electrode and a self-aligned source/drain region with zero overlap comprising:

(a) forming a doped polysilicon gate electrode upon but insulated from the substrate; then

(b) differentially thermally growing an oxide to serve as an implant mask having controlled thickness on both the top and sides of the gate electrode whereby a relatively thicker layer of oxide is developed on the top and sides of the gate electrode and a relatively thinner layer of oxide is developed on the intended source and drain regions of the substrate; then

(c) anisotropically etching said oxide;

(d) implanting a source/drain region in the substrate such that said implant mask shields an underlying portion of the substrate from implantation to result in a gap between a side edge of the gate electrode and a

side edge of the implanted region; and then

(e) heat driving the implanted source/drain region until its side edge is substantially aligned with the previously separated side edge of the gate electrode, whereby the source/drain edge is aligned with the gate electrode edge and there is substantially zero overlap.

The parties do not dispute any additional language in dependent claims 2 and 3.

During this litigation, the parties have presented the following issues of claim construction with respect to claim 1 of the "3 patent:

1) Must the gate electrode be doped prior to differentially thermally growing an oxide layer over the gate electrode?

2) How much oxide must be grown on the top and sides of the gate electrode versus on the substrate for the oxide to be "differentially" grown as required by step (b)?

3) What is the meaning of the word "gap" in step (d)?

4) What are the meanings of the phrases "substantially aligned" and "substantially zero overlap" in step (e)?

Prior to the hearing on June 10 and 11, 1996, both parties submitted briefs, expert reports, and documentary evidence outlining their positions with respect to these disputed issues. In its May 28, 1996 Opinion, the court decided the first issue in the affirmative. In other words, the court construed claim 1 to require doping the gate electrode prior to differentially thermally growing an oxide layer over the gate electrode.

At the conclusion of the hearing on June 10 and 11, the court announced its resolution of the remaining claim construction issues. The court construed the phrases "differentially thermally growing," "relatively thicker," and "relatively thinner" to require three elements:

1) the grown oxide must be thick enough on top of the gate electrode to serve as a mask for the implant of step (d);

2) the grown oxide must be thick enough on the side of the gate electrode to block the implant of step (d), thereby making a "gap;" and

3) the top oxide thickness must be in a proportion of at least 1.77 to 1 to the substrate oxide thickness.

The court construed the term "gap" to mean the following:

The area of the substrate under the oxide mask grown during step (b) that is protected by the mask from the implantation of ions that reverse the polarity of the substrate and thereby create the source and drain regions.

The court construed the phrases "substantially aligned" and "substantially zero overlap" to mean "the same as or very close to perfect alignment" and "the same as or very close to zero overlap."

On June 12, 1996, TENA read the following stipulated fact into the record ostensibly in order to place the

case into a posture for the court to grant Intel's motion for summary judgment based on the court's claim construction:

TENA and Intel stipulate that the thermally grown oxide layer on the top of the gate electrode in the P650, P651, and P852 (revs. 1-8) processes used by Intel to fabricate MOSFET transistors does not by itself mask the top of the gate electrode from the N+ and P+ implants at the energy levels used in said process for said implants.

The designations "N+" and "P+" refer to the polarity of the ions implanted into the gate electrode and the substrate during the fabrication of MOS transistors.

II. *DISCUSSION*

Intel's motion to strike seeks to eliminate all of Dr. Fair's June 19, 1996 declaration and portions of TENA's answering brief in opposition to Intel's motion for summary judgment, both of which are relevant to the court's construction of the claims of the "3 patent and its decision on Intel's motion for summary judgment. Thus, the court must first determine whether to grant Intel's motion to strike. The court will then discuss its construction of the claims. Finally, the court will determine whether to grant Intel's motion for summary judgment.

A. *Should the Court Strike Dr. Fair's June 19, 1996 Declaration and Part of TENA's Answering Brief In Opposition to Intel's Motion for Summary Judgment?*

Intel makes three arguments in support of its motion to strike. First, Intel argues that TENA has introduced disputed facts by way of its answering brief after TENA's counsel represented that TENA would not do so. Second, Intel argues that TENA has introduced new contentions that were not disclosed during pre-trial discovery or in the Joint Pre-Trial Order. Third, Intel argues that Dr. Fair offers an opinion with respect to infringement under the doctrine of equivalents that was not in his expert report or identified during his deposition. TENA responds that its answering brief is a proper response to Intel's motion for summary judgment. In addition, TENA argues that the Joint Pre-trial Order and discovery gave Intel sufficient notice of TENA's allegedly new arguments and Dr. Fair's allegedly new opinion.

1. *Should the court allow TENA to introduce disputed facts?*

[1] Even if TENA's counsel did in fact make a representation that TENA would not introduce disputed facts, the court will not hold TENA to that representation because to do so would be unfair in this instance. The Federal Circuit's recent decision in *Markman,* which requires the court to construe patent claims, poses new and unusual procedural dilemmas, particularly with respect to when the court should construe the claims. In this case, the court construed the claims after a hearing immediately prior to the trial. Consequently, TENA's counsel had less than 24 hours in which to decide how to proceed with the case as a result of a claim construction largely adverse to TENA. TENA should not be penalized for this unusual procedural problem or its good faith attempt to spare the expense of a trial while protecting its rights.

Denying TENA the opportunity to present disputed facts in response to Intel's motion for summary judgment would also be inconsistent with the Federal Rules of Civil Procedure and the case law of the Court of Appeals for the Third Circuit. A party opposing a motion for summary judgment has the right and obligation to "set forth specific facts showing that there is a genuine issue for trial." Fed.R.Civ.P. 56(d); *see* Brooks v. Hussman Corp., 878 F.2d 115 (3d Cir.1989) (reversing the trial court's decision to grant an oral

motion for summary judgment without allowing the nonmoving party a reasonable opportunity to respond). Thus, the court will not grant Intel's motion to strike based on TENA's alleged representation that it would not present disputed facts

2. ***Should the court allow TENA to present its "new" contentions?***

[2] [3] The court requires parties to identify their factual and legal contentions in the Joint Pre-Trial Order. *See* Fed.R.Civ.Pro. 16(e); D.Del. LR 16.4(d). In addition, the court encourages parties to use "contention" interrogatories to seek the legal contentions made by opposing parties and the factual bases for those legal contentions. The purpose of contention interrogatories and the Joint Pre-Trial Order is to give each party sufficient notice of the opposing party's contentions at trial and an opportunity to respond to those contentions. The court will prevent a party from raising a claim or defense at trial that was not adequately described in a response to a contention interrogatory or in the Joint Pre-Trial Order. *See, e.g.,* CPC Int'l Inc. v. Archer Daniels Midland Co., 831 F.Supp. 1091, 1102-03 (D.Del.1993), *aff'd,* 31 F.3d 1176 (Fed.Cir.1994), *cert. denied,* 513 U.S. 1184, 115 S.Ct. 1176, 130 L.Ed.2d 1129 (1995); Mars, Inc. v. Conlux USA Corp., 818 F.Supp. 707, 718 (D.Del.1993).

Intel identifies four allegedly new contentions made by TENA. TENA's first "new" contention is that even if claim 1 requires the side oxide thickness to be in a proportion of at least 1.77 to 1 to the substrate oxide thickness, claim 1 does not require the top oxide layer to be that thick. Intel is correct that TENA has never specifically stated an argument with respect to the top oxide layer in exactly this manner. TENA has maintained throughout this litigation, however, that neither the top nor the side oxide must be in any specific proportion to the substrate oxide. Moreover, it appears that Intel did not raise its contention that the top oxide ratio must be 1.77 to 1 until after the close of discovery. Therefore, TENA should be allowed to respond to Intel's contention in a manner that is consistent with its previous arguments.

TENA's second and related "new" contention is that Intel's processes do in fact result in a 1.77 to 1 ratio of top oxide thickness to substrate oxide thickness. Intel argues that TENA previously set a cap of 1.3 to 1 in its previous arguments and in Dr. Fair's previous opinions. As the court understands TENA's previous arguments, however, TENA merely cited 1.3 to 1 as a minimum ratio of growth as between an undoped polysilicon gate and a monosilicon substrate. Furthermore, TENA has identified additional factors that enhance oxide growth during Intel's processes, such as doping the gate electrode. Thus, TENA's "new" contention is merely a factual application of its contention that Intel's processes contain sufficient differential growth to infringe claim 1 of the "3 patent.

TENA's third "new" contention is that the Federal Circuit's decision in Amhil Enterprises Ltd. v. Wawa, Inc., 81 F.3d 1554 (Fed.Cir.1996), is inapposite to the construction of the phrases "substantially zero overlap" and "substantial alignment." Intel first raised this case in its claim construction brief. At the claim construction hearing, TENA indicated its contention that this case should not apply to the facts presented here. The court specifically gave TENA permission to elaborate its legal arguments in its answering brief in opposition to Intel's motion for summary judgment. Therefore, the court will not preclude TENA's arguments with respect to that case.

TENA's fourth "new" contention is that although Intel's grown oxide layer is not "thick enough on top of the gate electrode to serve as a mask for the implant of step (d)" as required by claim 1, the combination of the oxide layer and a deposited nitride layer used by Intel in its processes is thick enough to serve this function. Thus, TENA argues that there is a genuine issue of material fact with respect to infringement under the

doctrine of equivalents that precludes the entry of summary judgment against TENA despite the stipulated fact. Intel argues that TENA did not make this doctrine of equivalents contention until after the court's claim construction. TENA argues that Intel had sufficient notice of this contention.

The court observes that TENA cannot satisfy its disclosure obligation merely by pointing to discovery responses in which it contended generically that Intel's processes infringe under the doctrine of equivalents. TENA's responses to Intel's interrogatories and the Joint Pre-Trial Order, however, specifically identify TENA's doctrine of equivalents contention. For example, TENA's response to Intel's Interrogatory No. 35 states that the term "implant mask" refers to a "growing an oxide so that the resulting thickness ... subsequently serves in total or in combination with an additional masking layer as an ion implantation shield." In addition, the Joint Pre-Trial Order identifies the following issue of fact to be litigated:

Whether ... a thermally grown oxide layer over a gate electrode may be formed beneath a deposited shielding layer to cooperate with the shielding layer in protecting the gate edges and the underlying substrate from ion implantation.

Therefore, the court will not preclude TENA from asserting its doctrine of equivalents contention.

3. ***Should the court strike Dr. Fair's June 19, 1996 declaration?***

Intel claims that Dr. Fair never previously asserted an opinion with respect to the doctrine of equivalents arguments now advanced by TENA, that the combination of a grown oxide layer and a deposited nitride layer can serve as an implant mask or can satisfy the limitation requiring a certain amount of differential oxide growth. Dr. Fair's February 27, 1996 declaration, however, specifically refers to the use of a "composite mask" in Intel's processes consisting of nitride and oxide. Moreover, Intel's expert Dr. James Chung specifically denied that a composite nitride/oxide mask would satisfy the doctrine of equivalents, suggesting that Intel was on notice of TENA's contention.

Intel also claims that Dr. Fair previously stated that Intel's processes do not result in a ratio of greater than 1.3 to 1 of top oxide growth to substrate oxide growth. For the reasons set out above, the court finds that Intel is misreading Dr. Fair's previous statements. Dr. Fair was merely setting a lower limit of differential growth; he never set a cap on such growth. Therefore, the court will not strike any part of Dr. Fair's June 19, 1996 declaration.

B. ***What is the Proper Construction of the Claims of*** the "3 Patent***?***

[4] [5] [6] [7] The construction of patent claims is a matter for the court. Markman, 52 F.3d at 979-81. In construing the words and phrases in a claim, the court should give those words and phrases their ordinary meaning, unless the specification clearly indicates that the inventor intended a different meaning. Intellicall, Inc. v. Phonometrics, Inc., 952 F.2d 1384, 1388 (Fed.Cir.1992). The court may also consider other words in the claim, other claims in the patent, the specification, and the prosecution history. Markman, 52 F.3d at 979-81; Elf Atochem North America v. Libbey-Owens-Ford Co., 894 F.Supp. 844, 859 (D.Del.1995). The court may also consider relevant extrinsic evidence, such as expert testimony, when the patent, the specification, and the prosecution history are ambiguous. Vitronics Corp. v. Conceptronic, Inc., 90 F.3d 1576, 1583 (Fed.Cir.1996).

1. ***To what extent must the oxide growth of step (b) be "differential"?***

At the conclusion of the claim construction hearing on June 10 and 11, 1996, the court set out three requirements that are implied by the following phrases in step (b) of claim 1: "differentially thermally growing," "relatively thicker," and "relatively thinner." In its answering brief in opposition to Intel's motion for summary judgment, TENA raises arguments against each of these requirements. The court will first explain its basis for a particular construction of the claim language. It will then address TENA's arguments in opposition to that construction.

a. "*The grown oxide must be thick enough on top of the gate electrode to serve as a mask for the implant of step (d)*"

[8] The plain language of claim 1 and the prosecution history support the requirement that the grown oxide must be thick enough on top of the gate electrode to serve as a mask for the implant of step (d). Step (b) of claim 1 specifically recites "growing an oxide to serve as an implant mask having controlled thickness on both the top and sides of the gate electrode." Step (d) of claim 1 defines the term "implant mask" as a device that "shields an underlying portion of the substrate from implantation" of the source and drain regions. Thus, the claim language states that a *grown oxide* mask *alone* must be sufficient to block implantation. Furthermore, the prosecuting attorney, Edward Manzo, added in his First Proposed Amendment after Final Rejection the limitation that the mask must consist of a grown oxide, rather than a deposited oxide or other deposited material.

TENA merely seeks to clarify this part of the court's construction in light of an alleged ambiguity. TENA believes that this construction might imply that the oxide layer must remain on top of the gate during the implant of step (d). Intel has never asserted this contention. In fact, Dr. Chung specifically testified at the claim construction hearing that the oxide layer may be removed after it is grown. Moreover, requiring the oxide layer to remain on top of the gate would be inconsistent with the anisotropic etching step in claim 1, which suggests that the oxide layer may be removed, and dependent claim 4, which explicitly requires the oxide layer to remain on top of the gate. Thus, to the extent the court's construction has caused any ambiguity, the construction is not meant to imply that the oxide layer must remain on top of the gate during implantation.

b. "*The grown oxide must be thick enough on the side of the gate electrode to block the implant of step (d), thereby making a 'gap'* "

[9] The requirement that the grown oxide must be thick enough on the side of the gate electrode to block the implant of step (d), thereby making a "gap" is also straightforward. According to step (d) of claim 1, the oxide mask "shields an underlying portion of the substrate from implantation to result in a gap between a side edge of the gate electrode and a side edge of the implanted region." Likewise, the specification, at column 3, lines 42-44, states that the oxide on the sides of the gate electrode must be thick enough to act as the implant mask of step (d) "to shield underlying portions of the substrate from implantation." Thus, the oxide mask on the sides of the gate electrode must be thick enough *by itself* to block implantation of the source and drain regions.

TENA argues that "[i]f this construction means that the grown oxide alone must be thick enough to block the implant of step (d) thereby making a gap, it is erroneous for the reasons earlier discussed." TENA does not explicitly state the "earlier reasons" to which it is referring. It appears that TENA is arguing the following. The three requirements set out in the court's construction of the phrases "differentially thermally growing," "relatively thicker," and "relatively thinner" are interdependent. If the first requirement is that the oxide on the top of the gate electrode must remain on the top during the implant of step (d), that requirement

is erroneous. Therefore, the requirement that the oxide mask on the sides of the gate electrode must be thick enough alone to block the implant of step (d) is erroneous.

TENA's argument is inapposite for two reasons. First, as set out above, the court has never construed claim 1 to require that the oxide mask remain on the top of the gate electrode during the implant of step (d). Second, the three requirements set out by the court are not interdependent in the way that TENA seeks to imply. Separate evidence from the claims, specification, and prosecution history supports each requirement independently. In finding each requirement, the court does not rely on a separate finding with respect to claim construction. For example, in finding that the oxide alone must be thick enough on the sides to block the implant of step (d), the court does not rely on its finding that the oxide on the top of the gate electrode must be thick enough to serve as an implant mask, or even its finding that doping the gate electrode must precede differential growth. These separate findings are consistent, but they do not interlock such that all fail if one is incorrect.

c. "*The top oxide thickness must be in a proportion of at least 1.77 to 1 to the substrate oxide thickness*"

[10] The limitation that the top oxide thickness must be in a proportion of at least 1.77 to 1 to the substrate oxide thickness derives entirely from the prosecution history. As initially filed, claim 1 did not contain any reference to differential thermal growth. In subsequent amendments, however, Manzo added a differential growth limitation to dependent claims 2 and 3. The examiner nevertheless issued a final rejection of all of the claims as obvious in light of the combination of the Cohen and Steinmaier patents. Referring to the process of the Steinmaier patent, the examiner stated, among other things, that "[t]he thermally grown oxide is inherently thicker on the top and sides of the polysilicon gate than on the silicon substrate."

In his First Proposed Amendment After Final Rejection, Manzo amended claim 1 to state in relevant part:

....

(b) *differentially thermally growing* an implant mask of oxide of a controlled thickness on both the sides and on the top of the gate electrode *including controlling ambient conditions to promote a high rate of oxidation on the top and sides of the doped polysilicon gate compared to the silicon substrate, whereby a relatively thicker layer of oxide is developed on the top and sides of the gate and a relatively thinner layer of oxide is developed on the intended source and drain regions of the substrate;* then.... (emphasis added to show amendments to claim)

Manzo observed, citing the Kamins article, that the inherent differential growth observable in Steinmaier would result in only a 7% to 9% differential. Manzo emphasized that the differential growth of the "3 patent contemplated, in its preferred embodiment, a differential of 300%. *See also* First Proposed Amendment at 14 ("Clearly the application inherently supports the use in the claims of 'a high differential' because a ratio of 3 to 1 is certainly high compared to 1.07 to 1.").

In his subsequent File Wrapper Continuing Application, Manzo continued to distinguish the differential growth of the Steinmaier patent. Manzo stated:

Further, the oxidation in a dry atmosphere at 950 (deg.)C for a mere 50 minutes would not lead to an appreciably different thickness because, as Table I of Kamins establishes, the differential will be a factor of only 1.77, and that is when 375 minutes of dry oxidation occurs.... Thus, the offset which would result from

the process specified in Steinmaier, even if the ordinarily skilled artisan inadvertently practiced the method with doped poly, would be quite small.

Thus, Manzo thought that a differential of "only 1.77" would result in an offset that is "quite small" compared the offset obtained by the differential growth required to practice the inventions of the "3 patent.

After the submission of the First Proposed Amendment and the File Wrapper Continuing Application, the examiner interviewed Manzo to discuss claim 1 in light of the Cohen and Steinmaier patents. The examiner stated the following in his "Examiner Interview Summary Record" ("EISR"): "Mr. Manzo to submit preliminary amendment to place case in condition for allowance. Anisotropic etching limitation to be added to claim[ ] 1...."

Manzo subsequently submitted a Voluntary Amendment in which he added an anisotropic etching step to claim 1 and removed the following language from that claim: "controlling ambient conditions to promote a high rate of oxidation on the top and sides of the doped polysilicon gate compared to the silicon substrate." Manzo left in the requirement that the oxide be "differentially thermally grown," however. In addition, he left in the requirement that the oxide on the top and sides of the gate electrode be "relatively thicker" than the oxide on the substrate, which is to be "relatively thinner." Therefore, it appears that differential growth is still important to claim 1 of the "3 patent and that a minimum differential of 77% is still required.

TENA makes three arguments in opposition to this limitation. First, TENA asserts that by removing the "ambient conditions" language, Manzo removed the limitation in claim 1 requiring a "high rate" of oxidation. Thus, TENA argues that the court's construction impermissibly resurrects that removed limitation. TENA is correct that Manzo removed the "high rate" limitation from claim 1. The court's construction requiring a 1.77 differential does not resurrect this limitation, however.

TENA fails to acknowledge that the "high differential" of claims 6, 10, and 15 is most likely the 300% differential identified in the specification, at column 3, lines 26-33, and in the First Proposed Amendment. Thus, while claim 1 may no longer require a 3 to 1 ratio, the removal of the "ambient conditions" language does not suggest what ratio is required. Moreover, Manzo did not remove *all* of the limitations directed to differential growth added in the First Proposed Amendment. Thus, TENA's argument only establishes that the differential required by claim 1 is less than 300%. A 77% differential is substantially smaller than the "high differential" of 300%. Therefore, the court is not resurrecting a limitation that was specifically removed from the claims. Rather, it is construing the claims consistently with Manzo's representations to the examiner.

TENA's second argument is that Manzo was not speaking about the oxide on the top of the gate electrode when he referred to the 1.77 differential. Instead, he was arguing that the 1.77 differential was an advantage for the side oxide in order to create a sufficient gap between the edges of the source and drain regions and the edges of the gate electrode. TENA's argument appears correct but irrelevant. The patent does not teach, and none of the experts have explained, how one skilled in the art of making MOS transistors could achieve differential growth as between the top and sides of the gate electrode, which are made of the same material. Testimony at the hearing established that during the heating stage the oxide on the top of the gate electrode should grow at approximately the same rate as the oxide on the sides of the gate electrode. Therefore, a limitation that the oxide on the sides of the gate electrode must be 77% bigger than the oxide over the substrate as a practical matter is a limitation that the oxide on the top of the gate electrode must be 77% bigger as well.

TENA's third argument is that Manzo made a mistake in interpreting the Steinmaier patent in light of the Kamins article. Citing In re Eskild, 387 F.2d 987, 989 (C.C.P.A.1968), TENA argues that the true content of Steinmaier and Kamins "must necessarily result from an inquiry made from the objective standpoint of ... one of ordinary skill in the art." Manzo's statement does not appear to be properly characterized as a mistake, however. Rather, it appears that Manzo was defining the differential growth required to practice the patent by speaking in hypothetical terms about Steinmaier in light of Kamins. For example, the Steinmaier process involves oxidation of an undoped gate electrode in a dry atmosphere at 950 (deg.)C for 50 minutes. Manzo's hypothetical, based on the Kamins article, involved dry oxidation of a doped gate electrode for 375 minutes. Manzo obviously was aware that the Kamins article did not accurately reflect the process taught by Steinmaier ("Thus, the offset which would result from the process specified in Steinmaier, even if the ordinarily skilled artisan *inadvertently* practiced the method with doped poly, would be quite small." (emphasis added)). Manzo clearly had in mind that even if Steinmaier resulted in 77% differential growth, such differential growth would not create a sufficient "gap" in order to practice the inventions of the "3 patent.

2. *What is the meaning of the word "gap"?*

[11] At the close of the claim construction hearing, the court construed "gap" in the following manner:

The area of the substrate under the oxide mask grown during step (b) that is protected by the mask from the implantation of ions that reverse the polarity of the substrate and thereby create the source and drain regions.

This construction resulted from a combination of the claim language and the expert testimony offered at the claim construction hearing. Step (d) of claim 1 states that the "gap" must exist "between a side edge of the gate electrode and a side edge of the implanted region." The "implanted region" of step (d) is the "source/drain region" of step (d) that is implanted after the oxide mask of step (b) is grown. Therefore, at a minimum, the claim language requires the oxide mask to protect the "gap" from implants that will constitute the source and drain regions. According to the testimony of both parties' experts, the source and drain regions are created by implanting ions that reverse the polarity of a portion of the substrate. Thus, the "gap" must be the area under the oxide mask that is protected by the mask from the implantation of ions that reverse the polarity of the substrate, thereby creating the source and drain regions.

The specification and the prosecution history both support this construction. The specification states:

Because of the masking effect provided by the oxide on the sides of the gate electrode 16, the source/drain regions 20 and 22 are not implanted adjacent the vertical edges of the gate electrode. Rather, a gap is provided between the gate electrode 16 and the source/drain regions to allow for subsequent diffusion of the source/drain regions.

In other words, the oxide mask prevents the implantation next to the gate electrode of ions that would create the source and drain regions. Thus, the "gap" is the area of the substrate under the mask that is shielded from the implants that create those latter regions. Moreover, during the prosecution Manzo distinguished the Steinmaier patent, U.S. Patent No. 3,472,712, EPO publication 24 125, and EPO publication 34 508 because there was no "gap" between the sides of the gate electrode and the source and drain regions at the time of implantation. These prior art processes did not use a mask to prevent the implantation next to the gate of ions that would create the source and drain regions.

TENA objects to this construction of the word "gap." TENA argues that this construction expands the word "gap" beyond its ordinary usage, which merely implies a distance between two points. Moreover, TENA argues that this construction places limitations in the claims that are not supported by the evidence. Upon reflection, the court finds that TENA is partially correct and partially incorrect. TENA is correct that the word "gap" is not the proper source of these limitations. TENA is incorrect, however, because the claim language, the specification, the prosecution history, and the expert testimony all support these limitations. These limitations derive from reading step (d) of claim 1 as a whole, rather than just attempting to define the word "gap."

Step (d) of claim 1 states that the "gap" is "between a side edge of the gate electrode and a side edge of the implanted region." There is no dispute as to the location of the side edges of the gate electrode. In addition, there appears to be no dispute as to the location of the "side edge of the implanted region." As set out above, the source and drain regions form the "implanted region." Both parties' experts testified that the source and drain regions are regions of opposite polarity as compared to the substrate surrounding them. Thus, the side edge of a source or drain region is that area in the substrate where regions of opposite polarity meet; in other words, the side edge is where the concentration of N+ polarity equals the concentration of P+ polarity.

The logical conclusion is that the "gap" is simply the distance between the side edge of the gate electrode and the area in the substrate where the polarity reverses. Consequently, although the court's construction was correct when examining step (d) as a whole, the construction was slightly misleading in that it focused solely on the word "gap" in step (d) without also recognizing the implicit definition of the phrases "implanted region" and "a side edge of the implanted region."

In summary, the court will construe the word "gap" to have its ordinary meaning-"a distance between a side edge of the gate electrode and a side edge of the implanted region." The court will then construe the phrases "implanted region" and "source/drain region" to mean "regions of opposite polarity as compared to the substrate surrounding them." Finally, the court will construe the phrase "a side edge of the implanted region" to mean "where the concentration of N-type polarity equals the concentration of P-type polarity." This construction accurately captures the limitations of the claim as a whole while attaching each limitation to its corresponding claim language.

3. ***What is the meaning of the phrases "substantially zero overlap" and "substantially aligned"?***

[12] Throughout this litigation, Intel has asserted that "substantially zero overlap" and "substantially aligned" mean that the edges of the source/drain regions cannot overlap the edges of the gate electrode to any degree. By contrast, TENA has contended that "substantially zero overlap" and "substantially aligned" do not require perfect alignment. Rather, TENA asserts that these phrases allows for a tolerance of (plus-or-minus sign)10% of the gate electrode length. Neither argument has much credibility.

a. ***Does the patent require zero overlap and perfect alignment?***

Intel essentially wants the court to read the word "substantially" out of the claims. Intel argues that the claims, the specification, and the prosecution history use the phrases "zero overlap/perfect alignment" and "substantially zero overlap/substantial alignment" interchangeably. For example, the title of the patent, the abstract, the summary of the invention, and the preambles of claims 1, 10, and 15 recite "zero overlap," "perfect alignment," and "non-overlapping," whereas the preferred embodiment and step (e) of each claim recite phrases such as "closely aligned," "substantially aligned," "without substantial overlap," and

"substantially zero overlap." Moreover, in Amendment B and the First Proposed Amendment, Manzo refers to "zero drain overlap devices" and "perfect alignment" in describing the inventions of the "3 patent.

Intel relies heavily on Amhil Enterprises Ltd. v. Wawa, Inc., 81 F.3d 1554 (Fed.Cir.1996). In *Amhil,* the Court of Appeals for the Federal Circuit construed the phrases "substantially vertical sides," "substantially vertical side edges," and "substantially vertical side walls." The court observed that the preferred embodiment was completely vertical but stated that this was not determinative. *Id*. at 1559. Examining the entire specification, the court stated that the patentee used "substantially vertical" and "vertical" interchangeably, even within the claims themselves. *Id*. Examining the prosecution history, the court stated that the patentee narrowed "substantially" to overcome similar prior art and again used "substantially vertical" and "vertical" interchangeably. *Id*. at 1559-62. Finally, the court stated that to avoid prior art in a crowded field, "substantially vertical face" had to be construed "as the same as or very close to 'vertical face.' " *Id*. at 1562.

Although *Amhil* is certainly helpful in construing the claims, it is not precisely on point. The invention in *Amhil,* which is related to plastic coffee mug lids, involves a large physical structure whose dimensions are relatively easy to control and measure. By contrast, the invention of claim 1 of the "3 patent is submicroscopic and has dimensions that are difficult to control and measure. In addition, the "3 patent does not use the terms "substantially aligned" and "aligned" or "substantially vertical" and "vertical" interchangeably within the claims themselves. Furthermore, the Federal Circuit seemed to rely primarily on the fact that the invention in *Amhil* was in a crowded art that compelled a narrow construction. Finally, the court still found that "substantially" had some meaning in the claim, albeit a very narrow meaning. Therefore, *Amhil* does not support Intel's effort to deprive "substantially" of any meaning whatsoever.

b. *Does the patent allow for a tolerance of (plus-or-minus sign)10%?*

TENA wants to give the word "substantially" a broad, specific numerical reading. TENA points to the declaration and testimony of Dr. Fair, who defines "substantially zero overlap" and "substantially aligned" as allowing a tolerance as (plus-or-minus sign)10% of the drawn gate length based on his "knowledge of MOS transistors." TENA also points to the specification, at column 1, lines 21-23, which uses the phrase "substantially aligned" in discussing the prior art: "Conventional fabrication techniques usually cause the edges of the source/drain regions to be initially substantially vertically aligned with the edges of their gate." Dr. Fair asserts that the alignment of these conventional fabrication techniques was within (plus-or-minus sign)10% of the gate electrode length. Finally, TENA observes that one of Intel's experts, Dr. Frey, testified in a previous litigation that the term "substantially aligned" allowed for tolerances of (plus-or-minus sign)10% of the gate electrode length.

TENA's evidence is less than convincing. It appears from Dr. Frey's previous testimony that he identified a range of (plus-or-minus sign)5% on either side of the edge of the gate electrode, making a total range of 10% instead of (plus-or-minus sign)10% for a total range of 20%. In addition, Dr. Chung testified, and Dr. Fair appeared to confirm, that an underlap of -10% would drastically reduce the performance of an MOS transistor, particularly with respect to the problem of Miller capacitance that the "3 patent seeks to avoid. Finally, Dr. Fair has not cited to anything in the claims or prosecution history in support of his opinion that the (plus-or-minus sign)10% range is appropriate. His attempt to bootstrap his definition of "substantially" in the claims by defining the word "substantially" in the specification to mean the same thing is questionable without some objective basis.

c. *What does "substantially" mean?*

The word "substantially" tends to become somewhat of a chameleon when it appears in patent claims. It sneaks in during the prosecution of a patent application without having much substance or importance. The applicant rarely imposes strict mathematical requirements or guidelines for the word unless forced to do so by the examiner or by the prior art. After the issuance of the patent, however, the word swells up to envelop potentially infringing products or processes. The plaintiff's expert opines that a specific percentage range exists and, coincidentally, that the range encompasses the defendant's accused products or processes. Likewise, the defendant's expert opines that a smaller range exists that, coincidentally, does not encompass the defendant's accused products or processes.

Courts are in a bind when it comes to construing the word "substantially." On the one hand, the court has a duty according to *Markman* to construe the word to provide guidance to the jury as to the proper scope of the claim for determining infringement. This duty is particularly important when the parties' experts have testified to conflicting mathematical ranges required by the claim. Moreover, the ordinary meaning of the word "substantially"-"in a substantial manner" or "so as to be substantial" FN1-is practically useless as a guide to understanding or decision. On the other hand, a court should not impose mathematical certainty on a word when none exists. Often the claims, the specification, the prosecution history, and even all the extrinsic evidence will fail to provide any reasonable basis for selecting a mathematical range.

FN1. *Webster's Third New International Dictionary* 2280 (1986).

In the present case, the specification and the prosecution history present only theoretical limits to the percentage range allowed by the word "substantially." The specification states that the amount of overlap and alignment must be sufficient to prevent the occurrence of Miller capacitances in order to increase the speed of the transistor, but it does not provide a mathematical reference. During the prosecution, Manzo specifically defined "substantially zero overlap" and "zero drain overlap" over the results achieved by Figure 10 of U.S. Patent No. 4,356,623 issued to Hunter, Figure 4D of EPO publication 24 125, and the Steinmaier patent, but he never provided a mathematical explanation of the prior art process. Furthermore, the parties have never offered extrinsic evidence to suggest mathematical ranges based on these theoretical limits, and the court lacks sufficient understanding or skill to ascertain such ranges itself.

The parties instead have offered what appear to be litigation-driven constructions of the term "substantially" that have little support in the claim language, the specification, the prosecution history, or the extrinsic evidence. Intel's construction seeks to write the word out of the patent and to impose a level a mathematical certainty that does not appear physically possible. By contrast, TENA's construction ignores a specific goal sought by the inventions of the "3 patent and argued by Manzo extensively during the prosecution history: manufacturing an MOS transistor with as little overlap as possible to improve operating speed and reduce Miller capacitances. Thus, at the end of the claim construction hearing, the court was compelled to reject both parties' constructions in favor of its own.

The court adopted the following construction of the word "substantially"-"the same as or very close to." In other words, "substantially zero overlap" means "the same as or very close to zero overlap" and "substantially aligned" means "the same as or very close to perfect alignment." The court bases this construction on the many references to zero overlap and perfect alignment in the patent and the prosecution history and the stated importance in the specification of near-perfect alignment for the speed and efficiency

of the inventions of the "3 patent. No further guidance is possible, however, because nearly every attempt to restate the word "substantially" adds little to its inherent meaning.

C. ***Is Intel Entitled to Summary Judgment of Noninfringement With Respect to the Remainder of Its Accused Processes?***

Summary judgment is appropriate when the evidence admissible at trial fails to demonstrate a genuine issue of material fact and when the moving party is entitled to judgment as a matter of law. *See, e.g.,* Brewer v. Quaker State Oil Refining Corporation, 72 F.3d 326, 329 (3d Cir.1995). In this case, Intel must show that TENA has presented insufficient evidence to carry its burden of persuasion at trial that Intel's processes infringe the "3 patent. *Id.* If Intel meets this burden, TENA must create a genuine issue of material fact such that a reasonable jury could return a verdict in its favor. *Id.* at 330 (citing Anderson v. Liberty Lobby, Inc., 477 U.S. 242, 248, 106 S.Ct. 2505, 2510, 91 L.Ed.2d 202 (1986)).

[13] To determine whether Intel is entitled to a judgment as a matter of law that its processes do not infringe the "3 patent, the court must perform a two-step process. The court first must construe the claims of the patent. Texas Instruments, Inc. v. United States International Trade Commission, 988 F.2d 1165, 1171 (Fed.Cir.1993). The court then must compare the properly construed claims of the patent to the accused processes to determine if all of the limitations in the claims are present in these accused processes.Johnston v. IVAC Corporation, 885 F.2d 1574, 1577 (Fed.Cir.1989). As set out above, the court has construed claim 1 of the "3 patent. Thus, the court must compare claim 1 with Intel's accused processes.

[14] Based on the stipulated fact, TENA appears to agree that Intel's accused processes do not literally infringe claim 1 of the "3 patent. Because "the thermally grown oxide layer on the top of the gate electrode in the P650, P651, and P852 (revs. 1-8) processes used by Intel to fabricate MOSFET transistors does not by itself mask the top of the gate electrode from the N+ and P+ implants at the energy levels used in said process for said implants," Intel's accused processes do not meet the limitation that a grown oxide alone must be able to serve as an implant mask to prevent the implantation of the gate electrode.

[15] [16] [17] [18] TENA nevertheless argues that Intel's accused processes infringe claim 1 under the doctrine of equivalents. The doctrine of equivalents prevents an infringer from avoiding liability by making insubstantial changes to a patented product or process. *See* Hilton Davis Chemical Co. v. Warner-Jenkinson Company, Inc., 62 F.3d 1512 (Fed.Cir.1995). A court can determine whether substantial differences exist by looking to whether the claimed and accused methods and products perform substantially the same function in substantially the same way to obtain the same result. *Id.* at 1517. Other evidence relevant to this inquiry may include whether one skilled in the art would have known of the interchangeability of an ingredient, element, or step and would have considered the change insubstantial, whether the alleged infringer copied the claim in a way that may suggest insubstantial changes, whether the infringer attempted to design around the claims, and whether the alleged infringer developed its product or process through independent research. *Id.* at 1518-20.

TENA states that "Intel's accused processes all deposit a thick layer of nitride on top of a differentially thermally grown oxide layer, the combination of which is of sufficient thickness to block the implant of step (d) (if it remained on top of the gate during step (d))." Dr. Fair's June 19, 1996 declaration and other evidence offered by TENA demonstrate that all of Intel's accused processes deposit a nitride layer over a grown oxide layer. It seems that this combination could perform substantially the same function-blocking the implantation of the source and drain regions-in substantially the same way-by being sufficiently thick to

shield the substrate-to achieve substantially the same result-a "gap" between the side edges of the gate electrode and the edges of the source and drain regions.

[19] [20] Intel does not appear to dispute that a nitride/oxide composite layer could serve as an implant mask for step (d) of claim 1 of the "3 patent. Intel nevertheless argues that the prosecution history estops TENA from making this argument. The doctrine of prosecution history estoppel prevents a patent owner from using the doctrine of equivalents to reclaim subject matter surrendered during the prosecution of the patent. Loctite Corp. v. Ultraseal Ltd., 781 F.2d 861, 870 (Fed.Cir.1985). The standard is whether a person skilled in the art would reasonably conclude, upon reviewing the prosecution history, that the patent applicant gave up the equivalent structure to procure issuance of the patent. Modine Mfg. Co. v. United States Int'l Trade Comm'n, 75 F.3d 1545, 1555 (Fed.Cir.1996). Prosecution history estoppel may apply even when the function/way/result test is met by the accused device. *Id*.

[21] As initially filed, claim 1 in the patent application referred simply to "forming an implant mask of a controlled width on the sides of the gate electrode" during step (b) of the process. The patent examiner rejected this claim for reasons unrelated to the method of forming the mask. In his Amendment B, Manzo nevertheless amended many of the claims depending from claim 1 to include differential thermal growth as the specific method of forming the implant mask. Manzo also stated many advantages to using a grown oxide over a deposited oxide as the implant mask. Claim 1, however, still referred generically to "forming" the implant mask rather than "growing" it. The examinersubsequently rejected all of the claims based on the inherent differential oxide growth of the Steinmaier patent, even though claim 1 did not refer to differential growth.

In his First Proposed Amendment After Final Rejection, Manzo decided to focus on the alleged novelty of combining differential thermal oxide growth with anisotropic etching. He amended claim 1 to require differential thermal growth of an oxide implant mask. He also made many arguments distinguishing the inherent differential oxide growth of the Steinmaier patent. Manzo did not amend independent claim 6 to require growth of the implant mask, however. Claim 6 still referred generically to "establishing a dielectric layer" as the implant mask. The examiner eventually indicated that both claim 1 and claim 6 would be acceptable with the addition of an anisotropic etching step.

It was not until his subsequent Voluntary Amendment that Manzo amended claim 6 to require growth of the implant mask. Manzo stated the following in that document:

Independent method claim [6] does not specifically recite oxidation but has been amended to include the feature of growing a dielectric layer to develop a high differential. Obviously, differential thermal oxidation is one method, but there might be other methods of establishing a dielectric with a differential growth process.

The court could read this statement in combination with Manzo's previous amendments as rejecting the use of any method other than growth to form the implant mask. It is not clear, however, that the court should find such an estoppel based on these facts.

It appears that Manzo voluntarily chose to pursue growth rather than deposition as the method of forming the implant mask. Moreover, he never indicated that deposition would not suffice to meet the limitations of the claims. For example, he never stated that deposition could not produce a sufficient differential between the portion of the mask on the gate electrode and the portion on the substrate. Finally, the examiner never

rejected the use of deposition to form the implant mask; in fact, she appeared to accept deposition as an acceptable method by indicating that she would allow claim 6 without a growth limitation.

Based on these facts, the court cannot find that the prosecution history estops TENA from arguing that the combination of a differentially thermally grown layer and a deposited nitride layer infringes claim 1 under the doctrine of equivalents. Therefore, the court cannot grant Intel's motion for summary judgment on the issue of whether its remaining accused processes infringe the "3 patent under the doctrine of equivalents.

The court will issue an Order in accordance with this Opinion.

D.Del.,1996.
Thorn EMI North America, Inc. v. Intel Corp.