

The opinion in support of the decision being entered today was not written for publication in a law journal and is not binding precedent of the Board.

Paper No. 12

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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Ex parte KIRK D. PRALL and GURTEJ S. SANDHU

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Appeal No. 1998-1850  
Application No. 08/596,613

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ON BRIEF

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Before KRASS, FLEMING, and BLANKENSHIP, Administrative Patent Judges.

BLANKENSHIP, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal under 35 U.S.C. § 134 from the examiner's final rejection of claims 1-6, 8-18, 22-24, 40-42, 44, and 45, which are all the claims remaining in the application.

We affirm-in-part, and enter a new ground of rejection in accordance with 37 CFR § 1.196(b).

### BACKGROUND

The invention is directed to a method of forming an electrical contact on a silicon substrate, which includes etching a contact opening over an active region in the wafer and implanting metal ions into the contact opening. Representative claim 1 is reproduced below.

1. A method of forming an electrical contact on a silicon substrate, the method comprising the steps of:

providing a silicon substrate;

forming a dual gate structure on the silicon substrate with an aperture in the dual gate structure;

forming a layer of silicon nitride over the dual gate structure, the silicon nitride layer entering into the aperture and substantially insulating the dual gate structure from the aperture;

forming an insulating layer over the silicon nitride layer and the aperture;

planarizing the insulating layer;

forming a contact opening through the insulating layer to the silicon substrate, the contact opening including at least a portion of the aperture, the contact opening having a bottom and an aspect ratio greater than about 4 to 1;

implanting metal ions into the contact opening; and

annealing the silicon substrate at a temperature and for a time sufficient to result in the formation of a metal silicide layer of substantially uniform thickness in the bottom of the contact opening, the metal silicide layer including the implanted metal ions.

The examiner relies on the following evidence:

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Doan et al. (Doan)	4,936,950	Jun. 26, 1990
Davis et al. (Davis)	5,164,330	Nov. 17, 1992
Yu et al. (Yu)	5,244,534	Sep. 14, 1993
Havemann	5,482,894	Jan. 9, 1996
Tsunohara <sup>1</sup> (published Japanese Patent Application) <sup>2</sup>	6-140358	May 20, 1994

Appellants' admitted prior art (the APA)

Claims 1, 2, 5, 6, 8, 10, 11, 13, 14, 22-24, 40, 44, and 45 stand rejected under 35 U.S.C. § 103 as being unpatentable over Havemann and Tsunohara.

Claim 12 stands rejected under 35 U.S.C. § 103 as being unpatentable over Havemann, Tsunohara, and Sheng.

Claims 3, 4, 9, 41, and 42 stand rejected under 35 U.S.C. § 103 as being unpatentable over Havemann, Tsunohara, and the APA.

Claims 15 and 16 stand rejected under 35 U.S.C. § 103 as being unpatentable over Havemann, Tsunohara, and Doan.

Claims 15 and 18 stand rejected under 35 U.S.C. § 103 as being unpatentable over Havemann, Tsunohara, and Davis.

Claims 15 and 17 stand rejected under 35 U.S.C. § 103 as being unpatentable over Havemann, Tsunohara, and Yu.

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<sup>1</sup> The examiner and appellants refer to the document as "Japan '358."

<sup>2</sup> With English translation provided by the USPTO translation branch, dated Jan. 1997.

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We refer to the Final Rejection (Paper No. 5) and the Examiner's Answer (Paper No. 8) for a statement of the examiner's position and to the Brief (Paper No. 7) and the Reply Brief (Paper No. 9) for appellants' position with respect to the claims which stand rejected.

### OPINION

#### The section 103 rejections

The examiner's first ground of rejection, directed to claims 1, 2, 5, 6, 8, 10, 11, 13, 14, 22-24, 40, 44, and 45 as being unpatentable over Havemann and Tsunohara, is set forth on pages 2 through 4 of the Final Rejection. Appellants assert that these claims stand or fall together (Brief, page 4), and, with one noted exception which we will address later in this decision, appellants argue the limitations of claim 1 as distinguishing over the applied prior art. Accordingly, we select claim 1 as representative of the subject matter with respect to the first ground of rejection. See 37 CFR § 1.192(c)(7).

The examiner points to Havemann as disclosing the basis of the method set forth in claim 1. (See Final Rejection, page 2.) However, the examiner finds that "Havemann doesn't teach implanting Ti [metal ions] into the contact hole prior to W [tungsten, which is required by certain of the other claims] plug formation or the details of the refractory metal underlayer or any silicide annealing of an underlying refractory metal, or an aspect ratio greater than 4.0." (Id.)

The examiner turns to Tsunohara as suggesting refinements to the basic method taught by Havemann -- including the disclosure of an aspect ratio equal to 5 -- as showing prima facie obviousness of the subject matter as a whole of claim 1. (See id. at 2-3.) Appellants argue, on pages 5 through 8 of the Brief, that the combination is not well-founded because Havemann “teaches away” from their combination. In particular, although Havemann is recognized as making reference to high aspect ratios (“2:1 and greater aspect ratios,” as disclosed at column 2, lines 9-14), appellants argue that the only aspect ratio disclosed in any embodiment is 2:1 (found at column 4, lines 1-6). In addition, appellants point to information in the “second embodiment” of Havemann, in the first full paragraph of column 5, which is alleged to discourage the artisan from the relatively high aspect ratio openings disclosed by Tsunohara.

“A reference may be said to teach away when a person of ordinary skill, upon [examining] the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant.” Para-Ordnance Mfg. v. SGS Importers Int’l, 73 F.3d 1085, 1090, 37 USPQ2d 1237, 1241 (Fed. Cir. 1995) (quoting In re Gurley, 27 F.3d 551, 553, 31 USPQ2d 1130, 1131 (Fed. Cir. 1994)). We agree with the examiner, for substantially the same reasons advanced in the Final Rejection and Answer, that Havemann does not “teach away” from the proposed combination.

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As shown in the above-identified section of column 2 of the reference, Havemann recognizes the desirability of “high-aspect ratio gaps.” While his disclosed method is suitable for the disclosed “2:1” embodiment, Havemann does not use the technique of implanting metal (titanium) ions into the contact opening, and thereby creating a titanium silicide layer between the contact opening and the active region beneath the contact opening. According to appellants, as disclosed, for example, on page 6 and the paragraph bridging pages 17 and 18 of the instant specification, the metal silicide layer allows construction of devices having greater aspect ratios.

That recognition, however, was in the prior art. Tsunohara discloses, principally on page 8 and the final paragraph of page 10 of the English translation, that greater aspect ratios than the one disclosed by Havemann can be obtained by implanting metal ions into the contact opening, and forming a metal silicide layer, in the manner as set forth by instant claim 1. Havemann does not warn the artisan that his method for constructing the dual gate structures is incompatible with any refinements for yielding higher aspect ratios. Cf. Para-Ordnance, 73 F.3d at 1090, 37 USPQ2d at 1241: “That the Browning Hi-Power does not have a converging frame does not require a finding that it ‘teaches away.’ While it does not teach convergence, there is nothing about the Browning Hi-Power to warn a person of ordinary skill against using convergence.”

Even if, as appellants allege, the second embodiment disclosed by Havemann places constraints on the remainder of Havemann’s disclosure, we do not find the first

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paragraph of column 5 of the reference to be inconsistent with the conclusion of obviousness of the claimed subject matter. Even if, as appellants further allege, the column 5 section refers to non-disclosed ion implantation such as that taught by Tsunohara, Havemann strongest statement is simply that “layer **30** may require thinning after implantation to reduce the aspect ratio of insulated gap **29**.” See Havemann, column 5, lines 2-15. Havemann does not teach to what degree the aspect ratio may need to be reduced. Presumably very little, as there would only be stray ions embedded in the surface of layer 30, assuming that the “implantation” refers to ion implantation as disclosed by appellants or by Tsunohara. The ions would be directed parallel to layer 30, which is “on the sidewalls of conductors 26.”

In any event, Tsunohara discloses an aspect ratio of 5, and the prior art as represented by each of Havemann and Tsunohara recognized that higher aspect ratios were desirable. The claim 1 recitation of “an aspect ratio greater than about 4 to 1” does not take the subject matter out of the realm of prima facie obviousness. The artisan would have been expected to at least experiment with finding the upper limits of practical aspect ratios. “We start from the self-evident proposition that mankind, in particular, inventors, strive to improve that which already exists.” Pro-Mold & Tool Co. v. Great Lakes Plastics, Inc., 75 F.3d 1568, 1573, 37 USPQ2d 1626, 1630-31 (Fed. Cir. 1996). Appellants have provided no evidence to establish that a practical limit exists that is something less than

“an aspect ratio greater than about 4 to 1,” when following the combined teachings of the references.

In this regard, we note that appellants mention (Brief, page 8) claiming aspect ratios of 4:1 to 5:1. Although appellants have ostensibly chosen to rely on the limitations of independent claim 1, we note that instant claim 8 recites that the aspect ratio is “in a range of between about 4 to 1 and about 5 to 1.” For substantially the same reasons for our conclusion that an aspect ratio of “about 4 to 1” does not distinguish over the prior art, we also conclude that an aspect ratio of 5 to 1, or “about” 5 to 1, also fails to distinguish. That is, the combined teachings of Havemann and Tsunohara, based on the evidence before us, would have led the artisan to aspect ratios of 5 to 1 or about 5 to 1.

We have also considered appellants’ additional argument on page 6 of the Reply Brief, disagreeing with the examiner’s finding of what structures define the “aspect ratio” in the Havemann device. Even accepting appellants’ arguments as accurately reflecting the facts of Havemann, we do not see, and appellants have not persuasively explained, how claim 1 might set forth a distinction over the structures disclosed by Havemann, as improved by the teachings of Tsunohara.

Appellants rely on the arguments in regard to the combination of Havemann and Tsunohara, as applied against claim 1, in answer to the section 103 rejection of claim 12 over Havemann, Tsunohara, and Sheng, and in answer to the section 103 rejection of claims 3, 4, 9, 41, and 42 over Havemann, Tsunohara, and the APA. (See Brief, pages 8-

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9.) Since we are unconvinced of error in the examiner's rejection of claim 1, appellants have not shown any of the rejections of these additional claims to be in error. We sustain the section 103 rejection of claims 1, 2, 5, 6, 8, 10, 11, 13, 14, 44, and 45 as being unpatentable over Havemann and Tsunohara. Further, we sustain the section 103 rejection of claim 12 over Havemann, Tsunohara, and Sheng. Finally, we sustain the section 103 rejection of claims 3, 4, 9, and 42 over Havemann, Tsunohara, and the APA.

However, because we consider the scope of claims 15-18, 22-24, 40 and 41 to be indefinite, we reverse, pro forma, the section 103 rejections of those claims. We reverse for the reason that rejections of claims over prior art should not be based on speculation as to the meaning of terms employed and assumptions as to the scope of the claims. In re Steele, 305 F.2d 859, 862, 134 USPQ 292, 295 (CCPA 1962). We enter a new ground of rejection against the claims under 37 CFR § 1.196(b), infra.

We also note, however, that the rejection of claims 22-24 and 40 over Havemann and Tsunohara, and the rejection of claim 41 over Havemann, Tsunohara, and the APA, appear defective on their face. Each of the claims depends, directly or indirectly, from claim 16. The examiner relies on the disclosure of Doan, in addition to Havemann and Tsunohara, to allege unpatentability of the subject matter of claims 15 and 16. Thus, it is apparent that Doan must be added to the combination of Havemann and Tsunohara for a proper showing of unpatentability of claims depending from claim 16.

We also observe, in view of the arguments and counter-arguments with respect to the rejections of claims 15 through 18, that appellants may have misapprehended the basis of the examiner's rejection of these claims. Appellants argue that limitations of claim 15 distinguish over the applied art. (See Brief, pages 10-15.) The examiner's position appears to be that the references of Doan, Davis, and Yu suggest ways of improving a tungsten plug in a contact hole, and each of the methods of improving the plug would ultimately result in the removal of at least a portion of the metal ions implanted into the surface of the insulating layer around the contact opening, the ions being in place in accordance with the teachings of Tsunohara. (Consistent with the examiner's finding, appellants admit at page 3 of the Reply Brief that ions would become embedded in an insulating layer, when following the teachings of Tsunohara.)

Since we consider the scope of claims 15 through 18 to be indefinite, we reach no conclusion as to whether or not the examiner has met his initial burden in establishing a prima facie case of obviousness with respect to those claims. However, we agree with the general proposition that the prior art need not explicitly teach removal of implanted metal ions to show obviousness. If the prior art taught methods which resulted in the implantation of metal ions in an insulating layer, and elsewhere the prior art taught removal of a portion of the insulating layer, subsequent to placement of a tungsten plug in the contact opening, for the purpose of improving properties of the device, then we agree that the combined teachings would result in suggesting the action of removing implanted metal ions in the

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insulating layer. That is, with motivation in the prior art for actions resulting in the placement of implanted metal ions in an insulating layer, and with motivation in the prior art for subsequently removing a portion of the insulating layer, then as a consequence the action of removing “at least a portion” of the ions would have been suggested by the prior art, even if the artisan’s purpose was not directed to removing “at least a portion” of the ions. Even in an anticipation context, the prior art need only show the steps of the claimed process to establish unpatentability. It is not required that the artisan recognize what may be inherent in the process. See *Verdegaal Bros., Inc. v. Union Oil Co.*, 814 F.2d 628, 633, 2 USPQ2d 1051, 1054 (Fed. Cir. 1987) (disclosed process held to anticipate claimed invention, even if inventor of disclosed process did not recognize inherent property).

Again, we emphasize that we are not ruling on the facts supporting the rejections of claims 15 through 18. However, we agree with the general proposition, apparently rejected by appellants, that in order to show obviousness there is no requirement that the prior art disclose the patent applicant’s precise reason for endeavor. For the purposes of an obviousness enquiry, there is no requirement that an artisan’s reasons for making modifications of the prior art be the same as that of the patent applicant. See *In re Kemps*, 97 F.3d 1427, 1430, 40 USPQ2d 1309, 1311 (Fed. Cir. 1996) (citing *In re Dillon*, 919 F.2d 688, 693, 16 USPQ2d 1897, 1901 (Fed. Cir. 1990) (in banc) (“Although the motivation to combine here differs from that of the applicant, the motivation in the prior art

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to combine the references does not have to be identical to that of the applicant to establish obviousness.”)).

Appellants’ position is succinctly stated on pages 3 and 4 of the Reply Brief. Appellants assert patentability because “the prior art did not teach removal of such implanted metal ions and did not understand the benefits of doing so.” (See Reply Brief, page 3.) Appellants go on to state that the references fail to make any suggestion that ion removal would be beneficial. “Accordingly, this failure to understand the benefits of removing implanted ions represents a complete lack of motivation for combining the references.” (Id. at 4.) However, “failure to understand the benefits” might merely mean that the reason for combining the references is not for the same purpose as that of appellants. The “failure to understand” does not necessarily show a lack of motivation for combining the references.

New ground of rejection -- 37 CFR § 1.196(b)

We enter the following new ground of rejection against the claims in accordance with 37 CFR § 1.196(b): Claims 15-18, 22-24, 40, and 41 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regard as the invention.

Claim 15 recites a “method as recited in Claim 1, further comprising the step, prior to the step of implanting metal ions, of forming a patterned insulating layer having a surface

around the contact opening....” Claim 1 recites “forming an insulating layer over the silicon nitride layer and the aperture....” Claim 15 further recites the additional step of “removing at least a portion of the metal ions that are implanted into the surface of the insulating layer....”

The last-noted reference to “the insulating layer” thus lacks proper antecedent in the claims. On one hand, being within claim 15 and in closer proximity to the “patterned insulating layer,” the reference appears to be to the “patterned” insulating layer. On the other hand, the reference does not specify “the patterned insulating layer,” and therefore may refer to the “insulating layer” set forth in claim 1.

Moreover, it is unclear what a “patterned” insulating layer may be. The instant specification relates, at page 9, lines 8-9, that the “insulating layer is...patterned with photoresist and etched to form the contact opening.” The remaining portion of the “insulating layer” is not formed “around the contact opening,” as recited in claim 15. Rather, the contact opening is formed within the insulating layer, as shown in instant Figure 6 and further described on page 13, lines 1-11 of the specification.

In addition, the claim 15 requirement of two separate “insulating layers” is, at the least, inconsistent with the disclosed invention. Claim 1 requires, *inter alia*, “forming a dual gate structure on the silicon substrate with an aperture in the dual gate structure....” This step is disclosed in appellants’ “alternate embodiment,” shown in Figure 11 (dual gate

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structure 58) and described at page 17, lines 1-21 of the written description. Disclosed is an insulating layer 54 (Fig. 11), having contact opening 56.

Appellants' main, or preferred, embodiment is shown in Figures 6 through 10, having insulating layer 34 with contact opening 36. The specification, at page 16, lines 14-26 describes the final step of claim 15 in "removing at least a portion of the metal ions that are implanted into the surface of the insulating layer." Thus, there are no embodiments having both an "insulating layer over the silicon nitride layer" (claim 1) and a "patterned insulating layer having a surface around the contact opening" (claim 15). Absent a description in the specification with regard to how a device with the two insulating layers is to be formed, the subject matter set forth by claim 15 cannot be understood to any reasonable degree of certainty.

The function of claims is (1) to point out what the invention is in such a way as to distinguish it from the prior art; and (2) to define the scope of protection afforded by the patent. In re Vamco Mach., Inc., 752 F.2d 1564, 1577 n.5, 224 USPQ 617, 635 n.5 (Fed. Cir. 1985). The legal standard for definiteness is whether a claim reasonably apprises those of skill in the art of its scope. In re Warmerdam, 33 F.3d 1354, 1361, 31 USPQ2d 1754, 1759 (Fed. Cir. 1994). The inquiry is merely to determine whether the claims do, in fact, set out and circumscribe a particular area with a reasonable degree of precision and particularity. In re Moore, 439 F.2d 1232, 1235, 169 USPQ 236, 238 (CCPA 1971). The definiteness of the language employed must be analyzed -- not in a vacuum, but in light of

the teachings of the prior art and of the particular application disclosure as it would be interpreted by one possessing the ordinary level of skill in the pertinent art. Id.

For the reasons previously stated, we conclude that instant claim 15 fails to reasonably apprise those of skill in the art of its scope, and thus fails to pass muster under 35 U.S.C. § 112, second paragraph. Claims 16-18, 22-24, 40, and 41, incorporating the limitations of claim 15, also fail to meet the requirements of the statute.

Considering instant claim 18 in isolation, we also point out a discrepancy between the claim and the disclosed invention. Claim 18 recites that the bottom of the contact opening has a “layer of native oxide thereon,” and the etch which removes metal ions implanted in the insulating layer “etches into the layer of native oxide.” However, the specification at page 15, lines 9-13 discloses that “native oxide insulating layer 39” (Fig. 6) may form on the surface of contact opening 36, but it is “volatized and removed” as a consequence of “the metal ion implantation and annealing step.” The “layer of native oxide,” if present, is thus removed prior to the etch which removes the metal ions that are implanted into the surface of the insulating layer, contrary to the language of claim 18. Compare instant Figures 6 and 8, and also see the description of the “plasma etchback” to remove implanted metal ions at page 16, lines 14-26 of the specification.

#### CONCLUSION

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The section 103 rejections of claims 1-6, 8-14, 42, 44, and 45 are affirmed, but the rejections of claims 15-18, 22-24, 40, and 41 under the same statute are reversed. The examiner's decision in rejecting claims 1-6, 8-18, 22-24, 40-42, 44, and 45 is thus affirmed-in-part.

Claims 15-18, 22-24, 40, and 41 are newly rejected by us under 35 U.S.C. § 112, second paragraph.

This decision contains a new ground of rejection pursuant to 37 CFR § 1.196(b)(amended effective Dec. 1, 1997, by final rule notice, 62 Fed. Reg. 53,131, 53,197 (Oct. 10, 1997), 1203 Off. Gaz. Pat. & Trademark Office 63, 122 (Oct. 21, 1997)). 37 CFR § 1.196(b) provides that, "A new ground of rejection shall not be considered final for purposes of judicial review."

37 CFR § 1.196(b) also provides that the appellant, WITHIN TWO MONTHS FROM THE DATE OF THE DECISION, must exercise one of the following two options with respect to the new ground of rejection to avoid termination of proceedings (§ 1.197(c)) as to the rejected claim:

(1) Submit an appropriate amendment of the claim so rejected or a showing of facts relating to the claim so rejected, or both, and have the matter reconsidered by the examiner, in which event the application will be remanded to the examiner

.....

(2) Request that the application be reheard under § 1.197(b) by the Board of Patent Appeals and Interferences upon the same record. . . .

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No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED-IN-PART -- 37 CFR § 1.196(b)

ERROL A. KRASS	)	
Administrative Patent Judge	)	
	)	
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	)	BOARD OF PATENT
MICHAEL R. FLEMING	)	APPEALS
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	)	INTERFERENCES
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