

The opinion in support of the decision being entered today was not written for publication in a law journal and is not binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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***Ex parte*** JEFFREY P. ERHARDT, KASHMIR S. SAHOTA,  
and EMMANUIL LINGUNIS

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Appeal No. 2005-2173  
Application No. 10/151,595

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ON BRIEF

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Before KRASS, GROSS, and SAADAT, ***Administrative Patent Judges.***  
GROSS, ***Administrative Patent Judge.***

***DECISION ON APPEAL***

This is a decision on appeal from the examiner's final rejection of claims 1 through 16.

Appellants' invention relates to a method of manufacturing an integrated circuit including the steps of forming an opening in a semiconductor substrate and entirely filling the opening with a doped material.

Claim 1 is illustrative of the claimed invention, and it reads as follows:

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1. A method of manufacturing an integrated circuit comprising:

forming an opening in a semiconductor substrate;

entirely filling the opening with a doped material;

forming a first doped high conductivity region from the doped material; and

forming a semiconductor structure over the doped high conductivity region.

The prior art references of record relied upon by the examiner in rejecting the appealed claims are:

Lee	6,060,357	May 09, 2000
Park et al. (Park)	6,261,902	Jul. 17, 2001
Chen et al. (Chen)	US 2001/0028075	Oct. 11, 2001

The amendment of claims 1 and 9, filed September 4, 2003, stands objected to under 35 U.S.C. § 132 as introducing new matter.

Claims 1 through 16 stand rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement.

Claims 4 through 7 and 12 through 15 stand rejected under 35 U.S.C. § 112, second paragraph, for failing to particularly point out and distinctly claim the subject matter which appellants regard as the invention.

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Claims 1, 3, 9, and 11 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Lee.

Claims 4 through 6 and 12 through 14 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Lee.

Claims 1, 3, 4, 8, 9, 11, 12, and 16 stand rejected under 35 U.S.C. § 102(e) as being anticipated by, or in the alternative, under 35 U.S.C. § 103(a) as obvious over Chen.

Claims 1 through 3, 7, 9 through 11, and 15 stand rejected under 35 U.S.C. § 102(e) as being anticipated by, or in the alternative, under 35 U.S.C. § 103(a) as obvious over Park.

Reference is made to the Examiner's Answer (mailed November 26, 2004) for the examiner's complete reasoning in support of the rejections, and to appellants' Brief (filed September 10, 2004) and Reply Brief (filed January 26, 2005) for appellants' arguments thereagainst.

#### **OPINION**

As a preliminary matter, we note that the issue regarding whether an amendment was properly objected to under 35 U.S.C. § 132 as introducing new matter is petitionable, not appealable. Thus, there will be no further discussion on this issue.

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We have carefully considered the claims, the applied prior art references, and the respective positions articulated by appellants and the examiner. As a result of our review, we will reverse the lack of written description rejection of claims 1 through 16, the indefiniteness rejection of claims 4 through 7 and 12 through 15, the anticipation rejection of claims 1, 3, 9, and 11 over Lee, the obviousness rejection of claims 4 through 6 and 12 through 14 in view of Lee, and the anticipation and alternative obviousness rejection of claims 4 and 12 over Chen. We will, however, affirm the anticipation and alternative obviousness rejection of claims 1, 3, 8, 9, 11, and 16 over Chen and the anticipation and alternative obviousness rejection of claims 1 through 3, 7, 9 through 11, and 15 over Park.

Regarding the 35 U.S.C. § 112, first paragraph rejection, the examiner asserts (Answer, page 5) that the addition to claims 1 and 9 that the doped material entirely fills the opening in the substrate is not described in the specification as originally filed. Appellants argue (Brief, page 7) that support for the amendment is in Figures 8 and 9, which show an opening (516-518) entirely filled with a doped material (520). Appellants further state (Reply Brief, page 2) that "an oxide liner is not present in the claimed invention because such a liner would prevent the

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diffusing of dopant in the high conductivity material into the semiconductor substrate." Thus, appellants conclude that since the doped material (520) is the only element within the opening (516-518), the opening is "entirely filled." In response, the examiner argues (Answer, page 14) that although Figures 8 and 9 show filling an opening up to and above the top of the opening, they lack sufficient detail to determine exactly what is present in or near the opening that is to be filled and whether that opening includes an oxide liner. The examiner further states (Answer, page 15) that since the prior art generally teaches the usage of a liner in the opening, and such a liner would generally be expected for a buried bit line, the specification and figures do not support an interpretation of "entirely filling the opening" with a doped material.

We find appellants' argument persuasive as Figures 8 and 9 show only a doped material (520) in the opening (516-518). Further, appellants do not claim an oxide liner nor do they discuss any need for such a liner within the specification. Thus, the disclosure as originally filed provides support for the amendment. Although the examiner (Answer, pages 14-15) supplies

three examples<sup>1</sup> of an oxide liner as evidence that the skilled artisan would expect an oxide liner in appellants' opening, nothing in appellants' disclosure nor in the examples would have suggested to the skilled artisan that appellants' invention must include such a liner. Thus, we cannot sustain the written description rejection of claims 1 through 16.

Regarding the rejection under 35 U.S.C. § 112, second paragraph, for claims 4 through 6 and 12 through 14, the examiner contends (Answer, page 6) that the terms "lateral spread of dopant", "lateral straggle shorting distance", and "transient enhanced diffusion shorting distance" (hereinafter distances) are purely artifacts of ion implantation and that they do not provide a measure against which the claimed invention is to be compared. Thus, the examiner concludes (Answer, page 6) that the claim language reciting the distances in relation to the implant-less method is indefinite.

Appellants argue (Brief, page 11) that "lateral spread of dopant", "lateral straggle shorting distance", and "transient enhanced diffusion shorting distance" are measured, physical dimensions of a desired implant. Appellants further state (Reply Brief, page 6) that the distances are defined with reference to

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<sup>1</sup> Chen, Park, and US Patent 5,529,943 to Hong issued June 25, 1996.

implanted bitlines and serve as a comparison to show the benefits of the implant-less bitline of the claimed invention.

We find appellants' position persuasive. As indicated by appellants (Brief, page 11), the distances are measured, physical dimensions of a desired implant that can be calculated or measured without undue experimentation. The claim language compares the distances of appellants' implant-less method to that of an implanted method, thus showing the improved features of appellants' implant-less method. Accordingly, we cannot sustain the indefiniteness rejection of claims 4 through 6 and 12 through 14.

Regarding the indefiniteness rejection for claims 7 and 15, the examiner states (Answer, page 6) that "it is unclear as to how high conductivity regions can be formed from the doped polysilicon material without changing the doping or conductivity of the high conductivity regions, as is required by the claims."<sup>2</sup> Appellants argue (Brief, page 13) that "the doped material changes conductivity because the dopants diffuse into the high conductivity region while the doping of the doped high conductivity region does not change because no additional dopant

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<sup>2</sup> We note that the claims merely require changing the conductivity without changing the doping, not without changing the conductivity.

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is added to the region, such as by implantation." Appellants further state (Reply Brief, pages 7-8) that "[s]ince the high conductivity region . . . includes the doped polysilicon, the diffusing of dopant from the doped polysilicon into the doped silicon will not change the amount of dopant (doping) in the high conductivity region." As a result, the conductivity in doped polysilicon can be controlled, while the doping stays the same. The examiner maintains (Answer, page 16) that having dopants diffuse into the high conductivity region will change the doping of the high conductivity region.

We find appellants' position persuasive. The high conductivity region is defined by the combination of the doped polysilicon and the doped silicon (Reply Brief, page 7). Through changing the distribution of the dopants, the conductivity may be altered without changing the amount of dopants (i.e., adding more dopants). Although the concentration of the dopants may be altered within the high conductivity region, this does not mean that the amount of doping is changed. Accordingly, we cannot sustain the indefiniteness rejection of claims 7 and 15.

Regarding the anticipation rejection over Lee, appellants argue (Reply Brief, page 9) that Lee teaches (column 4, lines 9-12) an implantation (doping) step to form the doped region (118), and thus does not teach "filling an opening with a doped material." Appellants further argue (Brief, page 15) that Lee teaches away from a doped material in the trench because it would render the device inoperative by short-circuiting adjacent components. Lastly, appellants argue (Brief, page 15) that since undoped polysilicon is already conductive, there is no need to dope the material. In response, the examiner argues (Answer, pages 17-18) that undoped polysilicon has resistivity of around  $10^6$  ohm-cm, and thus would not be considered to be a conductive material. The examiner further argues (Answer, page 17) that since Lee teaches that the material in the trench forms a portion of a bit line, and hence must be conductive, the polysilicon must then be doped. Lastly, the examiner argues (Answer, page 17) that using a doped material would not render Lee inoperative because the buried bit region (120) is disposed in an insulating layer of the substrate (112).

We find appellants' position persuasive for two reasons. First, the examiner has provided no evidence on the record to support her position that the polysilicon material must be doped,

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but maintains that it would have been known to one of ordinary skill in the art that the material is doped. This position, absent any additional supporting evidence, is not sufficient. Second, as stated by appellants, Lee teaches (column 4, lines 9-12) an implantation step to create the doped region (118), which indicates that the polysilicon is not a doped material. Accordingly, absent any additional evidence to support the examiner's position, we cannot sustain the anticipation rejection of claim 1 in view of Lee.

Regarding independent claim 9, and dependent claims 3 and 11, since appellants (Brief, page 3) have grouped these claims with claim 1 and do not separately argue them, we will not sustain the anticipation rejection of these claims over Lee for the same reasons as for claim 1.

Regarding the obviousness rejection of claims 4 through 6 and 12 through 14 in view of Lee, these claims are dependent upon claims 1 and 9, respectively, and include all the limitations thereof, including those which we found lacking from Lee. Accordingly, we will not sustain the obviousness rejection of claims 4 through 6 and 12 through 14 over Lee for substantially the same reasons as for claim 1.

As to the anticipation and alternative obviousness rejection of claims 1, 3, 8, 9, 11, and 16 over Chen, appellants argue (Brief, page 21) that Chen discloses (Figures 7-14) an insulating layer (24) that fills a portion of the opening (32), and, therefore, the doped polysilicon fill layer (204) actually partially fills the insulating layer (24) and not the opening (32). Thus, appellants conclude that the doped material does not "entirely fill" the opening because the insulating liner (24) is also in the opening (32). In response, the examiner argues (Answer, page 21) that the claim language does not specify that the opening is completely bounded by substrate material. The examiner reasons (Answer, page 21) that Chen's oxide-lined trench (32) also defines an opening, which is then "entirely filled" with a doped material (204).

We find the examiner's position persuasive primarily because there is no claim language that limits the boundaries of the opening to that of the substrate. Claims 1 and 9 are method claims that comprise a plurality of steps, but the method is not restrained from including additional steps. Thus, the examiner's interpretation of the oxide-lined trench as the opening, which is then entirely filled with a doped material, is reasonable. Accordingly, we will sustain the anticipation rejection (and also

the obviousness rejection, as anticipation is the epitome of obviousness) of claims 1, 3, 8, 9, 11, and 16 over Chen.

Regarding the anticipation and alternative obviousness rejection of claims 4 and 12 over Chen, appellants argue (Reply Brief, page 16) that the closest analogy to the doped high conductivity regions that Chen has are the implanted source/drain regions (38, 40). Appellants further state (Reply Brief, page 16) that due to the oxide liner (24), there are no other high conductivity regions that can have a dopant spread as required by claim 1. Appellants thus conclude (Brief, page 24) that the dopant spread would be that expected of an implanted region, not the implant-less region of appellants' claimed invention. In response, the examiner states (Answer, page 11) that the high conductivity region is formed from the polysilicon material (801) rather than the source/drain region. Thus, the examiner argues (Answer, pages 22-23) that the cited implant parameters are those associated with the doped high conductivity region of the doped material, not those associated with the adjacent source and drain regions.

We find appellants' position persuasive. As discussed previously, the claim language compares the lateral spread of appellants' implant-less method to that of an implanted method.

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Regardless of whether the high conductivity region is that of the doped material (204) or the source/drain regions (38, 40), due to the presence of the insulative oxide liner (24), there is no lateral spread of dopant into the substrate region (22). Thus, forming the high conductivity region, whichever region that may be, has no effect on the lateral spread of dopant. Accordingly, we cannot sustain the anticipation nor the obviousness rejection of claims 4 and 12 over Chen.

Lastly, regarding the anticipation and/or obviousness rejection of claims 1 through 3, 7, 9 through 11, and 15 over Park, appellants' and the examiner's respective arguments are essentially the same as those for Chen. As discussed above regarding Chen, there is no claim language that limits the boundaries of the opening to that of the substrate. Claims 1 and 9 are method claims that comprise a plurality of steps, but the method is not restrained from including additional steps. Thus, the examiner's interpretation of the oxide-lined trench as the opening, which is then entirely filled with a doped material, is reasonable. Accordingly, we will sustain the anticipation rejection (and also the obviousness rejection, as anticipation is the epitome of obviousness) of claims 1 through 3, 7, 9 through 11, and 15 over Park.

**CONCLUSION**

The decision of the examiner rejecting claims 1 through 16 under 35 U.S.C. § 112, first paragraph, and claims 4 through 7 and 12 through 15 under 35 U.S.C. § 112, second paragraph, has been reversed. Likewise, the decision of the examiner rejecting claims 1, 3, 9, and 11 under 35 U.S.C. § 102(b) over Lee and claims 4 through 6 and 12 through 14 under 35 U.S.C. § 103(a) over Lee has been reversed.

The decision of the examiner rejecting claims 1, 3, 4, 8, 9, 11, 12, and 16 under 35 U.S.C. § 102(e) as being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Chen is affirmed as to claims 1, 3, 8, 9, 11, and 16, but reversed as to claims 4 and 12.

The decision of the examiner rejecting claims 1 through 3, 7, 9 through 11, and 15 under 35 U.S.C. § 102(e) as being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Park is affirmed. Since there are some claims for which no rejection has been sustained, the examiner's decision is affirmed-in-part.

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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)(1)(iv).

***AFFIRMED-IN-PART***

ERROL A. KRASS	)	
Administrative Patent Judge	)	
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	)	
	)	BOARD OF PATENT
ANITA PELLMAN GROSS	)	APPEALS
Administrative Patent Judge	)	AND
	)	INTERFERENCES
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	)	
MAHSHID D. SAADAT	)	
Administrative Patent Judge	)	

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