

THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

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(2) is not binding precedent of the Board.

Paper No. 27

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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Ex parte MEHRDAD M. MOSLEHI

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Appeal No. 95-2503  
Application 08/024,883<sup>1</sup>

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ON BRIEF

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Before HAIRSTON, KRASS, and BARRETT, Administrative Patent Judges.

KRASS, Administrative Patent Judge.

DECISION ON APPEAL

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<sup>1</sup>Application for patent filed March 1, 1993. According to appellant, this application is a continuation of Application 07/721,739, filed June 26, 1991, now abandoned.

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This is a decision on appeal from the final rejection of claims 1 through 8 and 30 through 43, all the claims pending in the application.

The invention pertains to an insulated gate field effect transistor (IGFET) structure. More particularly, the junction depth and doping concentrations of non-overlapped (lightly doped portions of source and drain not beneath the transistor gate) and overlapped (lightly doped portions of source and drain beneath the transistor gate) portions of the source and drain junctions may be controlled independently which is said to result in optimal transistor performance and reliability characteristics tailored to the desired use.

Independent claim 1 is reproduced as follows:

1. An insulated-gate field-effect transistor comprising:  
a semiconductor substrate;

a drain region formed in said semiconductor substrate, said drain region comprising a heavily doped region, a first lightly doped region with a first selected doping concentration and junction depth and a second lightly doped region with a second selected doping concentration and junction depth, wherein said first selected doping concentration and junction depth is independent of said second selected doping concentration and junction depth and wherein said second selected doping concentration and junction depth

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is independent of said first selected doping concentration and junction depth;

a source region formed in said semiconductor substrate;

a channel region separating said source and drain regions;

an insulating layer formed over said channel region and over said second lightly doped drain region; and

a conductive gate formed over said insulating layer.

The examiner relies on the following references:

Lehrer et al. (Lehrer)	4,442,449	Apr. 10, 1984
Nishizawa (Nishizawa)	et al. 4,660,062	Apr. 21, 1987
Liou et al. (Liou)	4,771,014	Sep. 13, 1988
Toyoshima	4,935,379	Jun. 19, 1990
Mori	4,943,836	Jul. 24, 1990
Jain	4,949,136	Aug. 14, 1990
Furuhata (JP)	62-155682 <sup>2</sup>	Jan. 5, 1989

Claims 1 through 8 and 30 through 43 stand rejected under the first and second paragraphs of 35 U.S.C. § 112 as, respectively, relying on an interpretation of the term

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<sup>2</sup>Our understanding of the Furuhata reference is derived from an English translation thereof prepared by the United States Patent and Trademark Office. A copy of that translation is attached hereto.

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"independent" which is not supported by the specification as originally filed and failing to particularly point out and distinctly claim the subject matter applicant regards as the invention.

Claims 1 through 8 and 30 through 43 stand further rejected under 35 U.S.C. § 103. As evidence of obviousness, the examiner cites Jain and Toyoshima with regard to claims 1 through 4, 6, 30 through 35, 42 and 43, adding Mori, Furuhata, Lehrer, Nishizawa and Liou to this combination with regard to claims 5, 7, 8 and 36 through 41.<sup>3</sup>

Reference is made to the briefs and answers for the respective positions of appellant and the examiner.

#### OPINION

Turning first to the rejections under 35 U.S.C. § 112, first and second paragraphs, while we sympathize with the

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<sup>3</sup>It appears that the examiner does not employ the teachings of all these references for each of the claims. For example, it appears that only Mori is employed, together with Jain and Toyoshima, to reject claim 5 but the examiner has improperly lumped all seven references together in order to reject claim 5. When reciting a statement of rejection, the examiner should include only those references necessary for the rejection. In accordance with the examiner's reasoning in support of the rejections, it would appear that each, or some, of claims 5, 7, 8 and 36 through 41 are, in fact, rejected under grounds of rejection that differ from claim to claim.

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examiner regarding the meaning of "independent" in claim 1 and support for the "insulating region" in claim 5, we will, nevertheless, not sustain these rejections.

With regard to claim 1, the examiner questions the meaning of "independent," indicating that the specification suggests that "independent" refers to a process of formation. The examiner refers to page 14, lines 8-11 of the specification for the statement:

It is important to notice that the overlapped  
lightly doped source 18 and drain 26 regions have been  
formed independently of non-overlapped portions 16 and 24  
with respect to doping concentration and junction depth.

The examiner further cites page 4, lines 14-15 of the specification, wherein it is stated that "the overlapped and the non-overlapped portions of the source and drain junctions are formed independently from each other..."

Thus, the specification would appear to indicate that the term "independent," when used in conjunction with the first and second selected doping concentration and junction depth being "independent" of each other, does indeed, refer to the

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process of forming the first and second lightly doped regions. Yet, appellant argues that the instant claims, e.g., independent claim 1, are not product-by-process claims. This, of course, is very confusing to the examiner as well as to us.

Appellant notes, on the bottom of page 10 of the principal brief, that "the claims do not require independent formation, only that the concentrations and depths of the regions are 'independent'." Again, this is confusing because as described in the specification and shown in Figures 9 to 10, overlapping portions 18 and 26 appear to have been formed independently of non-overlapping portions 16 and 24 and it is this "formation" which makes the selected doping concentrations and junction depths "independent." Therefore, the independence of the first selected concentration and junction depth from the second concentration and junction depth and vice-versa is clearly dependent on the formation of the overlapping and non-overlapping portions.

Accordingly, we find that the term "independent" in independent claim 1 clearly refers to a process limitation within a product-by-process claim. There is clear support for such a finding within the original specification and there is

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nothing indefinite about the term "independent" when viewed as such. Therefore, while we understand the examiner's confusion and frustration with the term "independent" in view of appellant's arguments and refusal to admit that the term referred to a process limitation, our finding that this term does, indeed, refer to a process limitation obviates the rejections under the first and second paragraphs of 35 U.S.C. § 112.

With regard to claim 5, again, we understand the examiner's frustration but will, nonetheless, not sustain the rejection of this claim under 35 U.S.C. § 112, first and second paragraphs. While the "insulating region" called for by claim 5 does not appear to be shown in the finished product in Figure 1, insulating region 48 is clearly within conductive gate 42 as shown, for example, in Figures 8, 10 and 11. Appellant also refers us to page 10, line 14 and page 13, line 10, as well as Figure 12, for support for the insulating region. Reference to the cited pages in the specification discloses only "thin oxide 48" at page 10 and nothing about element 48 on line 10 of page 13. Also, while appellant refers us to Figure 12, there is no element therein labeled

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"48." The elements referred to by appellant are in Figure 12; they just are not labeled. Appellant should have indicated that the thin oxide 48 is what was meant by the claimed "insulating region" rather than have us resort to making a finding that this, in fact, was what was intended. In any event, we do find that "thin oxide 48" is sufficient support for the now claimed "insulating region" in claim 5. Moreover, since the "insulating region" was also part of original claim 5, there was clear support for such a recitation.

We now turn to the prior art rejections. We will sustain the rejection of claims 1 through 4, 6, 30 through 35, 42 and 43 under 35 U.S.C. § 103 over Jain and Toyoshima as well as the rejection of claims 5, 7, 8, 36 and 38 through 41 under 35 U.S.C.

§ 103 over Jain, Toyoshima, Mori, Furuhata, Lehrer, Nishizawa and Liou. We will, however, not sustain the rejection of claim 37 under 35 U.S.C. § 103.

Appellant argues that the dopant concentration and depth of regions 20 and 21 in Jain are not "independent" from one another. Appellant also argues that Toyoshima appears to use a double diffused drain that has disadvantages which the

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instant invention was designed to avoid and that Toyoshima does not show overlapped and non-overlapped portions of the source and drain junctions "formed independently."

These arguments are unpersuasive since we have found the "independent" limitation to be a process limitation within a product-by-process claim. Determination of patentability in such a claim is based on the product itself, even though the claim is limited and defined by a process, e.g., that certain portions are formed independently, and, therefore, the product in such a claim is unpatentable if it is the same as, or obvious from, a product of the prior art, even if the prior art product was made by a different process. In re Thorpe, 777 F.2d 695, 697; 227 USPQ 964, 966 (Fed. Cir, 1985).

Taking Toyoshima, for example, and applying it to instant claim 1, this reference shows, in Figure 9, a transistor comprising a substrate and a drain region 31 formed in the substrate. The drain region has a heavily doped region 29, a first lightly doped region 27 and a second lightly doped region 25. Clearly, these first and second lightly doped regions have some selected doping concentration and junction depth values. The fact that the claim requires these doping

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concentration and junction depth values to be "independent" is irrelevant to this product-by-process claim because no difference can be discerned from the structure shown in Figure 9 of Toyoshima and the structure (Figure 1 of the instant application) obtained by the instant claimed invention, the "independence" relating to the way the first and second lightly doped regions are formed.

At page 13 of the principal brief, appellant contends that:

Certainly, the depth of a junction represents a structure. Similarly, the concentration of dopants in a region is a structure. Therefore, the claimed relationship of the doping concentrations and junction depths is a structural limitation.

We simply do not understand how appellant can contend that a selected doping concentration and a selected junction depth represent structural limitations. The claim does not require a specific physical junction depth; only that a junction depth exists. Clearly, any lightly doped region, such as the ones shown by Toyoshima, has some junction depth, as claimed. With regard to the claimed "doping concentration," one cannot ascertain, by a physical observation of regions, what the doping concentration is for

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those regions. Clearly, there is no physically observable difference between structures with differing doping concentrations. Accordingly, contrary to appellant's contention, the concentration of dopants in a region is *not* a structure. Therefore, we do not understand how a claimed relationship of the doping concentrations and junction depths is a structural limitation.

Although appellant argues that "the resultant structure is what is important in the structure claim, not the method of forming that structure" (page 13 of the principal brief), and we agree, the burden is upon appellant to come forward with evidence establishing an unobvious difference between the claimed structure and the prior art structure. See In re Marosi, 710 F.2d 799, 803, 218 USPQ 289, 293 (Fed. Cir. 1983).

Thus, the "independent" limitations of claim 1 do not distinguish the instant claimed invention from the structure shown by the applied references. We continue in our analysis.

Toyoshima clearly shows a source region 30 formed in the substrate and a channel region separates the source and drain regions. An insulating layer, gate oxide film 23, is formed over the channel region and over the second lightly doped

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region 25. Further, a conductive gate (aluminum wire 36) is formed over the insulating layer 23. Accordingly, the subject matter of claim 1 is met by Toyoshima, alone. Therefore, we will sustain the rejection of claim 1 under 35 U.S.C. § 103 as unpatentable over Jain and Toyoshima.

While we have shown how Toyoshima, alone, would make the subject matter of instant claim 1 unpatentable, this is not a new ground of rejection as Jain is merely cumulative to the teachings of Toyoshima and anticipation is merely the epitome of obviousness. In re Fracalossi, 681 F.2d 792, 794, 215 USPQ 569, 571 (CCPA 1982).

With regard to claim 5, appellant argues (page 20- principal brief) that the claim calls for a gate including "an insulating region formed therein" and that the examiner has cited Mori for an EPROM device which includes an insulator to isolate the floating gate from the control gate. Appellant then states, "[a]ppellant agrees that claim 5 is broad enough to encompass EPROM and EEPROM devices." Thus, appellant appears to admit that the examiner's rejection of claim 5 is proper. To the extent, appellant is merely saying that while Mori does, indeed, disclose the limitations added by claim 5,

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claim 5 actually also includes the limitations of independent claim 1 which are unobvious for previously argued reasons, we have shown, supra, how the limitations of claim 1 are met by the prior art. Since appellant is not arguing that the teachings of Mori are not combinable with the other references' teachings, we will sustain the rejection of claim 5 under 35 U.S.C. § 103.

With regard to claim 3, appellant specifically argues that the claim recites "an elevated semiconductor source region formed above said heavily doped portion of said source." Appellant argues (page 21-principal brief) that the silicide regions 24 and 26 of Jain are not "semiconductor" regions and therefore do not meet this claim limitation. The examiner counters that silicide "has a band gap, and would thus appear to be a semiconductor" (bottom of page 12 of the principal answer). Thus, while we have no evidence one way or the other, the examiner contends that the silicide regions of Jain are semiconductors while appellant contends that they are not. A semiconductor is an electronic conductor with resistivity in the range between metals and insulators. The silicide regions of Jain clearly conduct somewhat and,

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therefore, are not insulators. At the same time, the silicide regions of Jain are not metal. Therefore, we find that these regions must be semiconductors and appellant has not shown us any evidence establishing that they are not semiconductors. Further, it would have been obvious to use the silicide contacts of Jain as caps over the source and drain regions of Toyoshima rather than the aluminum elements 34 and 35 in Toyoshima since they are all conductive contacts to the source and drain regions. Accordingly, we will sustain the rejection of claim 3 under 35 U.S.C. § 103.

With regard to claims 40 and 41, appellant argues that the elevated source and drain regions comprise "germanium" and a "silicon/germanium alloy," respectively. The examiner cites Lehrer for a teaching of a binary germanium-silicon interconnect and electrode structure. The examiner relies on Furuhashi for the teaching of elevated source and drain regions to provide for interconnects to other devices. Therefore, concludes the examiner, it would have been obvious to use germanium-silicon for interconnects, as taught by Lehrer, "interconnecting source and drain regions as taught by

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Furuhata, to connect to other devices as taught by Furuhata" (page 12 of the principal answer).

While the examiner appears to have made a prima facie of obviousness, appellant argues only (principal brief-page 22) that Lehrer "does not teach or suggest elevated source/drain regions." This argument is unpersuasive since it is not Lehrer, but, rather Furuhata which the examiner relies on for the teaching of elevated source/drain regions. Accordingly, we will sustain the rejection of claims 40 and 41 under 35 U.S.C. § 103. We also will sustain the rejections of claims 2, 4, 6 through 8, 30 through 36, 38 and 39 under 35 U.S.C. § 103 since, not being separately argued as to their merits, these claims fall with the claims from which they depend.

We will, however, not sustain the rejection of claim 37 under 35 U.S.C. § 103. This claim requires that the elevated source/drain regions "comprise a single crystal semiconductor." The examiner contends that Nishizawa teaches that source and drain regions 14 and 15 comprise a "single crystal semiconductor" and that it would have been obvious to use a heavily doped single crystal semiconductor to elevate source and drain regions instead of the silicide of Jain "in

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order to allow the elevated source and drain to be formed by etching the substrate material, as taught by Nishizawa" (pages 11-12 of the principal answer).

We disagree. First, it is not clear to us that Nishizawa even discloses a "single crystal semiconductor." We do not find such recitation in the disclosure of Nishizawa and, yet, appellant never specifically denies that Nishizawa discloses a single crystal semiconductor. Appellant simply says, at page 21 of the principal brief, that Nishizawa "simply does not teach or suggest a single crystal semiconductor elevated source or drain region formed over a heavily doped source or drain region." But, even assuming, arguendo, that a single crystal semiconductor is taught, we find no convincing rationale by the examiner as to why the skilled artisan would have sought to replace the silicide of Jain with a single crystal semiconductor. What advantage is to be gained? We find no suggestion of this in the applied references and the examiner has not convinced us otherwise.

We have not sustained the rejection of claims 1 through 8 and 30 through 43 under either the first or second paragraph of 35 U.S.C. § 112 nor have we sustained the rejection of

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claim 37 under 35 U.S.C. § 103. We have, however, sustained the rejection of claims 1 through 8, 30 through 36 and 38 through 43 under 35 U.S.C. § 103.

Accordingly, the examiner's decision is affirmed-in-part.

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

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	Kenneth W. Hairston	)	
	Administrative Patent Judge	)	
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	Errol A. Krass	)	BOARD OF
PATENT		)	
	Administrative Patent Judge	)	APPEALS AND
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