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opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.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. 24

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte MUHAMMED A. SHIBIB

Appeal No. 95-5041
Application 08/163,967[1]

ON BRIEF

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

HAIRSTON, Administrative Patent Judge.

DECISION ON APPEAL

This is an appeal from the final rejection of claims 1, 4 and 5.

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[1] Application for patent filed December 8, 1993.

The disclosed invention relates to a high voltage semiconductor device having an improved junction termination extension for increasing the surface breakdown junction voltage.

Claim 1 is the only independent claim on appeal, and it reads as follows:

1. A high voltage semiconductor device having an improved junction termination extension for increasing the surface breakdown junction voltage, comprising:

a semiconductor substrate of a first electrical conductivity type, said substrate defining a major surface having an edge;

a first impurity region of a second electrical conductivity type formed in said substrate and having a first doping concentration;

a second impurity region formed in said substrate between said first impurity region and said edge and in contact with said first impurity region and extending on said major surface from said first impurity region to a junction extension remote from said first impurity region, said second impurity region being of said second electrical conductivity type and having a second doping concentration less than said first doping concentration;

a first field shield plate disposed on said major surface directly above and in electrical contact with said first impurity region, said first field shield plate having an outer edge terminating directly above said second impurity region before said junction extension;

a first layer of insulating material disposed on said major surface of said substrate and separating said first

field shield plate from said second impurity region;

a second layer of insulating material disposed directly above said first field shield plate; and

a second field shield plate disposed on said second layer of insulating material, directly above and in electrical contact with said first impurity region, and having an outer edge terminating directly above said substrate beyond said junction extension so that said junction extension is positioned on said major surface between the outer edge of said first field shield plate and the outer edge of said second field shield plate.

The reference relied on by the examiner is:

Terashima 5,204,545 Apr. 20, 1993

Claims 1, 4 and 5 stand rejected under 35 U.S.C. § 103 as being unpatentable over the admitted prior art in Figures 2A and 3A in view of Terashima. According to the examiner (Answer, page 4):

> Appellant's prior art figures 2A and 3A disclose all the claimed subject matter except for the first field shield plate having an outer edge terminating before the PN junction. However, Terashima teaches from line 38 of column 2 that it is "possible to prevent concentration of electric fields caused in the end region 7a of the island 7" by applying electric fields from interconnection 15 (equivalent to layer 34 in figure[s] 2A to 3B of Appellant's drawings) with a fixed potential[s] (note line 31 of column 2) at plates 16b, 16c, and 16d (equivalent to layer 30 in figure[s] 2A to 3B of Appellant's drawings) so that "the equipotential lines in the depletion layers are not concentrated toward the p-type isolating diffusion region 13" (note line 43 of column 2) to increase "breakdown voltage" (note line 49 of column 2). Therefore, it would have been obvious to one of ordinary skill in the art to form the first field shield plate 30 in Appellant'[s]

> prior art figure[s] 2A and 3A before the PN junction to form the depletion layer in region 28 to increase the surface breakdown voltage as taught by Terashima.

Appellant argues that the claimed invention, like Terashima, reduces "the concentration of electric field that occurs at the major surface between the high voltage and low voltage terminals of semiconductor devices, thereby increasing the effective breakdown voltage of such devices" (Brief, page 5). Despite the functional similarities between the claimed invention and Terashima, appellant argues that "the present invention attains such functionality in an entirely different manner than does Terashima" (Brief, pages 5 and 6). Appellant also argues (Brief, pages 8 and 9) that the teaching or suggestion to combine the admitted prior art with Terashima is only apparent from appellant's disclosure.

Reference is made to the brief and the answer for further detailed positions of the appellant and the examiner.

OPINION

We have carefully considered the entire record before us, and we will reverse the obviousness rejection of claims 1, 4 and 5.

As indicated supra, Terashima is concerned with preventing field concentration in an end portion of a semiconductor region caused by p-n junction isolation on a semiconductor substrate (column 1, lines 11 through 14). Terashima discloses (Figure 3) a semiconductor substrate 12 of a first electrical conductivity type, a first impurity region 11 of a second electrical conductivity type formed in the substrate and having a first doping concentration, a second impurity region 7a formed in the substrate between the first impurity region 11 and the edge of the substrate and in contact with the first impurity region and extending on a major surface from the first impurity region to form a junction extension remote from the first impurity region. The second impurity region 7a is of the second electrical conductivity type, and the doping concentration thereof is less than the doping concentration of the first impurity region 11. A first field shield plate 16e is disposed on the major surface directly above and in electrical contact with the first impurity region 11 (column 2, lines 5 through 12). A layer of insulating material 14 is disposed on the major surface of the substrate, and it separates the first field

shield plate 16e from the second impurity region 7a, and it also separates the first field shield plate 7a from a second field shield plate 15 (column 1, line 67 through column 2, line 8). The second field shield plate 15 is located directly above and in electrical contact with the first impurity region 11, and has an outer edge terminating directly

above the substrate but beyond the junction extension 7a (column 2, lines 1 through 5).

The first field shield plate 16e is linked to conductive plates 16a through 16d (column 2, lines 5 through 15).

According to Terashima (column 2, lines 27 through 50):

> The conductive plate 16a is fixed at the low potential of the p-type separation diffusion region 13, and the conductive plate 16e is fixed at the high potential of the n-type diffusion region 11. The floating conductive plates 16b, 16c and 16d are fixed at certain potentials by a first capacitance between the conductive plates 16a to 16e and a second capacitance between the aluminum wiring 15 and the respective conductive plates 16a to 16e . . . . Thus, it is possible to prevent concentration of electric fields caused in the end region 7a of the island 7, particularly on its surface, through influence exerted by an electric field from the high-potential aluminum interconnection 15 . . . . Thus, the island 7 . . . is increased in breakdown voltage.

Appellant argues (Brief, pages 7 and 8) that:

> With respect to the Examiner's rejection of the claims . . . , the Examiner appears to have combined Terashima plates 16b, 16c and 16d, i.e. the "floating plates", with fixed conductive plate (16e) to create a "combination plate", and has treated this "combination plate" as an equivalent to applicant's first field shield plate 30 in an effort to show that the junction extension region of Terashima extends beyond the far edge of the "combination plate", i.e. beyond the left edge of plate 16b in FIG. 3 of the reference. However, there is absolutely no support or teaching for the

> Examiner's proffered combination. If a "combination plate" is to be envisioned in accordance with the Examiner's reasoning, all of the Terashima plates (16a through 16e) should be combined, thereby resulting in a bridging of the entire region from the high voltage diffusion region (11) to the low voltage diffusion region (13). In other words, and with reference to the terminology of the present invention, this "combination plate" would create a first field shield plate having one end in electrical contact with the high voltage region and the other end in electrical contact with the low voltage region and extending above the major surface over the entire junction extension region. Such a result is exactly the configuration shown in applicant's prior art FIGS. 2A and 3A. There is no teaching whatsoever, nor any suggestion in Terashima or in any of the prior art to either shorten the first field shield plate 30 or, in the alternative, to extend the junction extension region 28 "so that the junction extension (29) is positioned on the major surface between the outer edge of the first field shield plate and the outer edge of the second field shield plate" as is expressly recited in applicant's claim 1.
>
> It is respectfully submitted that the Examiner has simply exercised impermissible hindsight in applying the Terashima reference in combination with applicant's prior art FIGS. 2A and 3A to reject applicant's claims.

We agree. In the absence of a teaching or suggestion in the applied prior art or a convincing line of reasoning by the examiner, the examiner cannot pick and choose among the conductive plates 16a through 16e in Terashima to select only those conductive plates (i.e., 16b through 16e) that terminate

before the junction extension 7a (Brief, page 8).

In summary, the obviousness rejection of claims 1, 4 and 5 is reversed.

DECISION

The decision of the examiner rejecting claims 1, 4 and 5 under 35 U.S.C. § 103 is reversed.

REVERSED

KENNETH W. HAIRSTON Administrative Patent Judge	)	
LEE E. BARRETT Administrative Patent Judge	)	BOARD OF PATENT APPEALS AND INTERFERENCES
ANITA PELLMAN GROSS Administrative Patent Judge	)	

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