

The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte JEFFREY B. JOHNSON, ALVIN J. JOSEPH and
VIDHYA RAMACHANDRAN

Appeal No. 2006-1797
Application No. 09/866,319

ON BRIEF

Before TIMM, BLANKENSHIP and HOMERE, Administrative Patent Judges.

HOMERE, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal under 35 U.S.C. § 134 from the final rejection of claims 2 through 45, all of which are pending in this application. Claim 1 has been cancelled by Appellants.

We affirm.

Invention

Appellants' invention relates generally to a high voltage silicon germanium (SiGe) heterojunction bipolar transistor having improved AC performance. The SiGe bipolar transistor includes an emitter (28), a base (22), a collector (14), isolation regions (20) and a base collector junction. The collector includes a subcollector region (12) a deep collector region (16) and an n-type dopant region (18) between the subcollector (12) and the base collector junction. The n-type dopant region (18) is located atop and in contact with the deep collector (16). Further, the n-type dopant region has a vertical width sufficiently narrow to avoid lowering the collector-base breakdown voltage and a dopant concentration sufficiently high to restrict the base widening when the base-emitter junction is forward biased.

Claim 45 is representative of the claimed invention and is reproduced as follows:

45. A method of fabricating a bipolar device comprising the steps of:

- (a) providing a structure comprising at least a sub-collector region, a collector region and isolation regions, said collector region including a deep collector region located therein;
- (b) forming a n-type dopant region within said collector region so as to be in contact with said deep collector, said n-type dopant region having a vertical width

Appeal No. 2006-1797
Application No. 09/866,319

sufficiently narrow to avoid lowering collector-base breakdown voltage and a dopant concentration sufficiently high to restrict base widening when a base-emitter junction is forwarded(sic)biased;

- (c) forming a base; and
- (d) forming an emitter.

References

The Examiner relies on the following references:

Rodgers	3,924,265	Dec. 02, 1975
Wen et al. (Wen)	5,252,841	Oct. 12, 1993
Ohmi et al. (Ohmi)	5,541,444	Jul. 30, 1996
Sato	6,020,245	Feb. 01, 2000 (filed Nov. 10, 1997)
Marty et al. (Marty)	6,316,818	Nov. 13, 2001 (filed Jun. 01, 1999)
Akatsu et al. (Akatsu)	6,329,704	Dec. 11, 2001 (filed Dec. 09, 1999)
Trivedi et al. (Trivedi)	6,410,984	Jun. 25, 2002 (filed Nov. 08, 1999)
Botula et al. (Botula)	6,429,489	Aug. 06, 2002 (filed May 18, 2001)
Ju	6,476,446	Nov. 05, 2002 (filed Jan. 03, 2000)

Rejections At Issue

A. Claims 4, 6, 8, 12, 13, 15, 16, 19, 23-25, 28, 30, 32, 34-36, 39-41, 43 and 45 stand rejected under 35 U.S.C. § 102 as being anticipated by Marty.

Appeal No. 2006-1797
Application No. 09/866,319

B. Claims 2, 3, 14, 22, 26, 27 and 33 stand rejected under 35 U.S.C. § 103 as being unpatentable over Marty.

C. Claims 5 and 29 stand rejected under 35 U.S.C. § 103 as being unpatentable over the combination of Marty and Wen.

D. Claims 7 and 31 stand rejected under 35 U.S.C. § 103 as being unpatentable over the combination of Marty and Ohmi.

E. Claims 9, 10, 37 and 38 stand rejected under 35 U.S.C. § 103 as being unpatentable over the combination of Marty and Rodgers.

F. Claim 11 stands rejected under 35 U.S.C. § 103 as being unpatentable over the combination of Marty and Akatsu.

G. Claims 17 and 42 stand rejected under 35 U.S.C. § 103 as being unpatentable over the combination of Marty and Sato.

H. Claim 18 stands rejected under 35 U.S.C. § 103 as being unpatentable over the combination of Marty, Sato and Ju.

I. Claims 20 and 44 stand rejected under 35 U.S.C. § 103 as

Appeal No. 2006-1797
Application No. 09/866,319

being unpatentable over the combination of Marty and Botula.

J. Claim 21 stands rejected under 35 U.S.C. § 103 as being unpatentable over the combination of Marty and Trivedi.

Rather than reiterating the arguments of Appellants and the Examiner, the opinion refers to respective details in the Briefs¹ and the Examiner's Answer². Only those arguments actually made by Appellants have been considered in this decision. Arguments that Appellants could have made but choose not to make in the Briefs have not been taken into consideration. See 37 CFR 41.37(c)(1)(vii)(eff. Sept. 13, 2004).

OPINION

In reaching our decision in this appeal, we have carefully considered the subject matter on appeal, the Examiner's rejections, the arguments in support of the rejections and the evidence of anticipation and obviousness relied upon by the Examiner as support for the rejections. We have, likewise, reviewed and taken into consideration Appellants' arguments set forth in the Briefs along with the Examiner's rationale in support of the rejections and arguments in the rebuttal set forth

1 Appellants filed an Appeal Brief on April 23, 2004. Appellants filed a Reply Brief on September 16, 2004.

2 The Examiner mailed an Examiner's Answer on July 14, 2004. The Examiner mailed an office communication December 10, 2004, stating that the Reply Brief has been entered and considered.

Appeal No. 2006-1797
Application No. 09/866,319

in the Examiner's Answer.

After full consideration of the record before us, we agree with the Examiner that claims 4, 6, 8, 12, 13, 15, 16, 19, 23-25, 28, 30, 32, 34-36, 39-41, 43 and 45 are properly rejected under 35 U.S.C. § 102 as being anticipated by Marty. We also agree with the Examiner that claims 2, 3, 14, 22, 26, 27 and 33 are properly rejected under 35 U.S.C. § 103 as being unpatentable over Marty. Additionally, we agree with the Examiner that claims 5, 7, 9, 10, 11, 17, 18, 20, 21, 29, 31, 37, 38, 42 and 44 under 35 U.S.C. § 103 as being unpatentable over Marty in combination with Wen, Ohmi, Rodgers, Akatsu, Sato, Ju, Botula or Trivedi. Accordingly, we affirm the Examiner's rejections of claims 2 through 45 for the reasons set forth **infra**.

Appellants have indicated that for purposes of this appeal the claims stand or fall together in nine (9) groups. See pages 6-7 of the Appeal Brief. However, the reasons set forth **infra** are applicable to all the claims. Therefore, we will consider Appellants' claims as standing or falling together, and we will consider claim 45 as being representative of the claimed invention.

I. Under 35 U.S.C. § 102(e), is the Rejection of Claims 4, 6, 8, 12, 13, 15, 16, 19, 23-25, 28, 30, 32, 34-36, 39-41, 43 and 45 as Being Anticipated By Marty Proper?

It is axiomatic that anticipation of a claim under § 102 can be

Appeal No. 2006-1797
Application No. 09/866,319

found only if the prior art reference discloses every element of the claim. **See In re King**, 801 F.2d 1324, 1326, 231 USPQ 136, 138 (Fed. Cir. 1986) and **Lindemann Maschinenfabrik GMBH v. American Hoist & Derrick Co.**, 730 F.2d 1452, 1458, 221 USPQ 481, 485 (Fed. Cir. 1984).

With respect to representative claim 45, Appellants argue in the Appeal and Reply Briefs that the Marty reference does not disclose an n-type dopant region having a vertical width (W) that is sufficiently narrow to avoid lowering the collector base breakdown voltage and a dopant concentration sufficiently high to restrict base widening when the base junction is forward biased. Appellants further contend that because Marty teaches overdoping the SIC region by implanting phosphorous into the collector through the base, a tail of n-type dopant is necessarily present, and it is extended from the base to the collector, thereby preventing the vertical width of the SIC region from being sufficiently narrow. Particularly, at pages 8 and 9 of the Appeal Brief, Appellants state the following:

Marty, et al. disclose a bipolar transistor including an overdoped selectively implanted collector (SIC) region, where the SIC region is formed by a process requiring a high-energy implant and a light (high-diffusivity) ion, such as phosphorus. See Col. 3, line 66. The high implant energy and light ion are required in the prior art to produce the SIC region, since the SIC region is formed by implanting the light (high-diffusivity) ion into the

Appeal No. 2006-1797
Application No. 09/866,319

collector 4 through the base region 80, 81, 82 of the transistor.

Appellants submit that a broad shallow profile of the SIC region results from the combination of the light (high-diffusivity) dopant ion and high-energy implant necessary to implant SIC dopants through the base region 80, 81, 82, as disclosed in Marty, et al. Subsequent spreading of the highly mobile light ion during high temperature processing forms a broad shallow implant profile, as opposed to Appellants' n-type region having a narrow vertical width (W). Appellants further submit that a tail of n-type dopants is necessarily present in the prior art transistor extending from the SIC region into the base 80, 81, 82. Although not depicted in the drawings provided in Marty et al., the tail of n-type dopants is present, since the SIC region is formed by implanting the high-diffusivity n-type dopants through the base 80, 81, 82 into the collector 4. Therefore, since the SIC region disclosed in Marty, et al. has a broad shallow dopant profile that necessarily includes a tail of n-type dopants contacting the base 80, 81, 82, Marty, et al. fail to disclose an n-type dopant region having a vertical width sufficiently narrow to avoid lowering collector-base breakdown voltage when the device is forward biased.

To determine whether claim 45 is anticipated, we must first determine the scope of the claim. We note that claim 45 reads in part as follows:

"[F]orming a n-type dopant region within said collector region so as to be in contact with said deep collector, said n-type dopant region having a vertical width sufficiently narrow to avoid lowering collector-base breakdown voltage and a dopant concentration sufficiently high to restrict base widening when a base-emitter junction is forwarded (sic) biased."

At page 8, lines 3-19, Appellants' specification states:

In accordance with the present invention, the n-type dopant region has a vertical width, W, that is less than about 2000 Å and a peak concentration that is greater than a peak concentration of said collector region. Thus, n-type dopant

Appeal No. 2006-1797
Application No. 09/866,319

region 18 is a narrow, medium doped spike in the doped collector region of a high-voltage heterojunction bipolar transistor. The inventive n-type dopant region is heavy enough however to significantly delay the onset of the Kirk effect, yet narrow enough to avoid creating a high-electric field region of sufficient duration to degrade the breakdown characteristics of the device.

Further, at page 11, lines 8-13, Appellants' specification states:

In accordance with the present invention, n-type dopant region 18 has a width (measured vertically) that is less than about 2000 Å, and a peak concentration that is greater than a peak concentration of said collector region. More preferably, n-type dopant region 18 has a vertical width of from about 800 to about 1200 Å. Another characteristic of the inventive dopant region is that it has a doping level, i.e., concentration, that is lower than that of the base region.

Thus, the claim does require an n-type dopant region having a vertical width (W) that is sufficiently narrow to avoid lowering the collector base breakdown voltage and a dopant concentration sufficiently high to restrict base widening when the base junction is forward biased.

Our reviewing court states that: "[W]hile features of an apparatus may be recited either structurally or functionally, claims directed to an apparatus must be distinguished from the prior art in terms of structure rather than function." **In re Schreiber**, 128 F.3d 1473, 1477-78, 44 USPQ2d 1429, 1431-32 (Fed.

Appeal No. 2006-1797
Application No. 09/866,319

Cir. 1997). Further, it has been held that: "[W]here the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes, a prima facie case of either anticipation or obviousness has been established." **In re Best**, 562 F.2d 1252, 1255, 195 USPQ 430, 433 (CCPA 1977). "When the PTO shows a sound basis for believing that the products of the applicant and the prior art are the same, the applicant has the burden of showing that they are not." **In re Spada**, 911 F.2d 705, 709, 15 USPQ2d 1655, 1658 (Fed. Cir. 1990). Therefore, the prima facie case can be rebutted by evidence showing that the prior art products do not necessarily possess the characteristics of the claimed product. **In re Best**, 562 F.2d at 1255, 195 USPQ at 433. See also **Titanium Metals Corp. v. Banner**, 778 F.2d 775, 227 USPQ 773 (Fed. Cir. 1985).

Now, the question before us is what Marty would have taught to one of ordinary skill in the art? To answer this question, we find the following facts:

At column 3, lines 25-39, Marty states the following:

[A] stack 8 of three layers 80, 81 and 82, within which the future base of the transistor will be produced, is then epitaxially grown. More precisely, a first layer of undoped silicon 80 is epitaxially grown over a

thickness of a few tens of nanometers. The second layer 81, formed by silicon/germanium, is then grown epitaxially. It is formed by a first sublayer of $\text{Si}_{1-x}\text{Ge}_x$, with x for example a constant lying between 0.1 and 0.2, on top of which there is a second sublayer, also formed by an $\text{Si}_{1-x}\text{Ge}_x$ alloy (with x decreasing to 0) and P doped with boron. The total thickness of the layer 81 is moderate, typically from 20 to 100 nm. An epitaxial layer 82, having a thickness of a few tens of nanometers and made of silicon P doped using boron, is then placed on top of the second sublayer of the layer 81.

At column 3, line 44 to column 4, line 5, Marty states the following:

This stack of layers will make it possible to form a silicon/germanium heterojunction base. It should be noted here that the epitaxy for producing the heterojunction base is nonselective epitaxy. This silicon nitride layer also makes it possible to obtain good thickness uniformity of the epitaxial deposition of the base. It also makes it possible to obtain a peak/trough level difference on the surface of the stack on the order of 500 to 600 Å (whereas this level difference is on the order of 1000 Å. with an initial layer of amorphous silicon).

Next, a first layer 9 of silicon dioxide having a thickness on the order of 200 Å is deposited on the layer 81. A second layer 10 of silicon nitride (Si_3N_4) having a thickness of 300 Å is also deposited on the first silicon dioxide layer 9. Next (FIG. 3), a zone 100 in the nitride layer 10 corresponding to an emitter window lying above the intrinsic collector 4 is defined with the aid of a mask. Plasma etching of the nitride layer 10 with termination on the silicon dioxide layer 9 is then carried out in the conventional way, with the aid of a resin layer corresponding to the mask, so as to expose the zone 100. Next, keeping the resin which is present on the layer 10 and has been used in etching the layer 10, implantation of phosphorus is carried out through the stack. Selective overdoping of the collector (selective implantation collector) under the window of the emitter can be carried out in one or more implantation steps, thus contributing to an increase in the speed of the transistor by reducing the resistance

Appeal No. 2006-1797
Application No. 09/866,319

of the collector. An overdoped SIC zone is therefore obtained under the emitter window.

With the above discussion in mind, we find that Marty teaches a vertical bipolar transistor having an SiGe heterojunction base of layers into which phosphorous is implanted in order to overdope the SIC region of the transistor. One of ordinary skill in the art would have construed this teaching to mean that the SIC region disclosed in Marty has a narrow vertical width and a high dopant concentration. Therefore, the ordinarily skilled artisan would have found such teaching to be equivalent to the claimed limitation of an n-type dopant region having a narrow vertical width and a high dopant concentration. We further find that the qualifying limitation, whereby the vertical width of the n-type dopant is sufficiently narrow to avoid lowering the breakdown voltage, and the dopant concentration is sufficiently high to restrict the base widening when the base emitter junction is forward biased cannot be relied upon to distinguish the claim over Marty. The claimed transistor and the one disclosed in Marty are structurally similar, and they are produced by similar processes. Additionally, we find that Appellants have merely provided gratuitous allegations not supported by evidence to establish a difference between the claimed transistor and Marty's. Therefore, Appellants have not effectively rebutted the Examiner's prima facie case of anticipation. Consequently, we do not find error in the Examiner's stated position, which concludes

Appeal No. 2006-1797
Application No. 09/866,319

that Marty teaches an n-type dopant region having a vertical width (W) that is sufficiently narrow to avoid lowering the collector base breakdown voltage and a dopant concentration sufficiently high to restrict base widening when the base junction is forward biased.

Therefore, we will sustain the Examiner's rejection of claims 4, 6, 8, 12, 13, 15, 16, 19, 23-25, 28, 30, 32, 34-36, 39-41, 43 and 45 under 35 USC 102(e).

II. Under 35 U.S.C. § 103, is the Rejection of Claims 2, 3, 14, 22, 26, 27 and 33 as Being Unpatentable over Marty Proper?

In rejecting claims under 35 U.S.C. § 103, the Examiner bears the initial burden of establishing a **prima facie** case of obviousness. **In re Oetiker**, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992). **See also In re Piasecki**, 745 F.2d 1468, 1472, 223 USPQ 785, 788 (Fed. Cir. 1984). The Examiner can satisfy this burden by showing that some objective teaching in the prior art or knowledge generally available to one of ordinary skill in the art suggests the claimed subject matter. **In re Fine**, 837 F.2d 1071, 1074, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). Only if this initial burden is met does the burden of coming forward with evidence or argument shift to the Appellants. **Oetiker**, 977 F.2d at 1445, 24 USPQ2d at 1444. **See also Piasecki**,

Appeal No. 2006-1797
Application No. 09/866,319

745 F.2d at 1472, 223 USPQ at 788.

An obviousness analysis commences with a review and consideration of all the pertinent evidence and arguments. "In reviewing the [E]xaminer's decision on appeal, the Board must necessarily weigh all of the evidence and argument." **Oetiker**, 977 F.2d at 1445, 24 USPQ2d at 1444. "[T]he Board must not only assure that the requisite findings are made, based on evidence of record, but must also explain the reasoning by which the findings are deemed to support the agency's conclusion." **In re Lee**, 277 F.3d 1338, 1344, 61 USPQ2d 1430, 1434 (Fed. Cir. 2002).

With respect to the rejection of dependent claims 3 2, 3, 14, 22, 26, 27 and 33, we select claim 22 as representative of the issues on appeal. To reject this claim the Examiner relies upon the findings discussed in the anticipation rejection for the subject matter of claim 45 (Answer, p. 7). The Examiner acknowledges that Marty does not specifically disclose the additional limitation of claim 22. The Examiner, however, concludes that it would have been obvious to one of ordinary skill in the art at the time of the invention to form the deep

³ We note that Appellants failed to particularly discuss the limitations of these dependent claims in the Briefs. Instead, Appellants rely on their earlier discussion of the limitations of independent claims 45 and 24, which they incorporate by reference in each instance. Consequently, our finding for representative claim 45 applies to these dependent claims as well.

Appeal No. 2006-1797
Application No. 09/866,319

collector as claimed based on the finding that such method is used to form the sub collector region and this method is a widely known and used method for making doped semiconductor regions. We conclude that the Examiner has established a prima facie case of obviousness with regard to the subject matter of this claim.

Appellants argue in the Appeal and Reply Briefs that Marty does not render the subject matter of the independent claims obvious. Particularly, Appellants reiterate the arguments previously submitted in their discussion of independent claims 24 and 45. Appellants resubmit that Marty does not teach an n-type dopant region having a vertical width (W) that is sufficiently narrow to avoid lowering the collector base breakdown voltage and a dopant concentration sufficiently high to restrict base widening when the base junction is forward biased. We have already addressed this argument in the discussion of representative claim 45 above, and we do not agree with Appellants. Consequently, we do not find error in the Examiner's stated position, which concludes that Marty teaches an n-type dopant region having a vertical width (W) that is sufficiently narrow to avoid lowering the collector base breakdown voltage and a dopant concentration sufficiently high to restrict base widening when the base junction is forward biased. With respect to the subject matter of claim 22, Appellants have not sufficiently rebutted the prima facie case of obviousness. It is therefore

Appeal No. 2006-1797
Application No. 09/866,319

our view, after consideration of the record before us, that the evidence relied upon and the level of skill in the particular art would have suggested to the ordinarily skilled artisan the invention as set forth in claims 2, 3, 14, 22, 26, 27 and 33. Accordingly, we will sustain the Examiner's rejection of claims 2, 3, 14, 22, 26, 27 and 33.

III. Under 35 U.S.C. § 103, is the Rejection of Claims 5, 7, 9, 10, 11, 17, 18, 20, 21, 29, 31, 37, 38, 42 and 44 as Being Unpatentable over the combination of Marty with Wen, Ohmi, Rodgers, Akatsu, Sato, Ju, Botula or Triveda Proper?

With respect to dependent claims 4 5, 7, 9, 10, 11, 17, 18, 20, 21, 29, 31, 37, 38, 42 and 44, Appellants argue at pages 21 through 33 of the Appeal and Reply Briefs that the combination of Marty with Wen, Ohmi, Rodgers, Akatsu, Sato, Ju, Botula or Triveda does not render the cited claims unpatentable under 35 U.S.C. § 103(a). First, Appellants submit that Marty does not teach an n-type dopant region having a vertical width (W) that is sufficiently narrow to avoid lowering the collector base breakdown voltage and a dopant concentration sufficiently high to restrict base widening when the base junction is forward biased.

⁴ We note that Appellants failed to particularly discuss the limitations of these dependent claims in the Briefs. Instead, Appellants rely on their earlier discussion of the limitations of independent claims 45 and 24, which they incorporate by reference in each instance. Consequently, our finding for representative claim 45 applies to these dependent claims as well.

Appeal No. 2006-1797
Application No. 09/866,319

We have already addressed this argument in the discussion of claim 45 above, and we do not agree with Appellants. Further, Appellants argue that none of the cited references cures the deficiencies of Marty. We find no such deficiencies for any of the references to cure. It is therefore our view, after consideration of the record before us, that the evidence relied upon and the level of skill in the particular art would have suggested to the ordinarily skilled artisan the invention as set forth in claims 5, 7, 9, 10, 11, 17, 18, 20, 21, 29, 31, 37, 38, 42 and 44. Accordingly, we will sustain the Examiner's rejection of claims 5, 7, 9, 10, 11, 17, 18, 20, 21, 29, 31, 37, 38, 42 and 44.

CONCLUSION

In view of the foregoing discussion, we have sustained the Examiner's decision rejecting claims 4, 6, 8, 12, 13, 15, 16, 19, 23-25, 28, 30, 32, 34-36, 39-41, 43 and 45 under 35 U.S.C. § 102.

We have also sustained the Examiner's decision rejecting claims 5, 7, 9, 10, 11, 17, 18, 20, 21, 29, 31, 37, 38, 42 and 44 under 35 U.S.C. § 103. Additionally, we have sustained the Examiner's rejection of claims 2, 3, 14, 22, 26, 27 and 33 under 35 U.S.C. § 103. Therefore, we affirm.

Appeal No. 2006-1797
Application No. 09/866,319

AFFIRMED

CATHERINE TIMM)	
Administrative Patent Judge)	
)	
)	
)	BOARD OF PATENT
HOWARD B. BLANKENSHIP)	
Administrative Patent Judge)	APPEALS AND
)	
)	INTERFERENCES
)	
JEAN R. HOMERE)	
Administrative Patent Judge)	

JRH/kis

Appeal No. 2006-1797
Application No. 09/866,319

STEVEN & FISHMAN, ESQ.
SCULLY, SCOTT, MURPHY & PRESSER
400 GARDEN CITY PLAZA
GARDEN CITY, NY 11530