

Publication in the Official Journal Yes / ~~No~~

File Number: T 669/90 - 3.4.1

Application No.: 84 306 756.2

Publication No.: 0 138 517

Title of invention: Semiconductor integrated circuits containing
complementary metal oxide semiconductor devices

Classification: H01L 27/08

D E C I S I O N
of 14 August 1991

Proprietor of the patent: American Telephone and Telegraph Company

Opponent: Telefunken electronic GmbH

Headword: Inviting observations/ATT

EPC Art. 56; 101(2), 113(1), 125 Rule 67

Keyword: "Misleading EPO communication" - "no invitation to file
observations" - "decision based on new facts and evidence without
inviting observations" - "substantial procedural violation" -
"inventive step (no)" - "appeal not allowable" - "no refund of
appeal fee possible"

Headnote

Headnote follows



Case Number : T 669/90 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal - 3.4.1
of 14 August 1991

Appellant :
(Proprietor of the patent)

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Decision under appeal :

Decision of the Opposition Division of the
European Patent Office dated 21 June 1990
revoking European patent No. 0 138 517 pursuant
to Article 102(1) EPC.

Composition of the Board :

Chairman : G.D. Paterson
Members : H.J. Reich
U.G. Himmler

Summary of Facts and Submissions

I. The Appellant is owner of European patent No. 0 138 517.

Claim 1 reads as follows:

"1. A semiconductor integrated device comprising:

a semiconductor substrate (20) which includes first (30) and second (40) regions extending from a surface (50) of said substrate, the conductivity type of the second region being opposite to that of the first region; said first and second regions including, respectively, first (130) and second (90) field effect transistors, the channel conductivity type of said first transistor and of said second transistor being opposite, respectively, to the conductivity type of said first region and of said second region, and a trench (140) containing a filler material (160) extending from said surface into said substrate between said first and second regions to provide isolation between the said transistors, the coefficients of thermal expansion of the filler material and the substrate matching to within a factor of three, the side walls of said trench diverging in a direction upwards from the trench bottom the angle of said walls from the vertical being between 5 degrees and 10 degrees for substantially the whole of their vertical extent, and said filler material completely filling said trench and being essentially free of voids."

Claims 2 and 3 are dependent on Claim 1.

II. The patent was opposed by the Respondent on the grounds mentioned in Article 100(a) EPC, referring inter alia to the prior art which can be derived from documents:

D1: "International Electron Devices Meeting",
San Francisco, 13 to 15 December 1982, Technical
Digest, IEEE, New York, pages 237 to 240;

D3-1: "Proceedings of the First International Symposium of
VLSI Science and Technology", Vol. 82-7, pages 339
to 346;

D3-2: "Extended Abstracts", Vol. 82-2 Abstract No. 174,
page 276, and

D4: US-A-4 104 086.

III. Documents D3-1, D3-2 and D4 had been cited in a letter dated 30 October 1989 filed subsequently to the notice of opposition, which letter was enclosed with a communication on Form 2937.1 to the Appellant dated 23 November 1989 with the box "Take note" crossed. No observations in reply to the letter dated 30 October 1989 were filed by the Appellant. On 21 June 1990 the Opposition Division revoked the patent on the ground that the subject-matter of Claim 1 did not involve an inventive step. The late filed-documents D3-1 and D4 were admitted into the opposition in view of their relevance, but document D-2 was not considered sufficiently relevant to be admitted. The claimed invention was held to be obvious because the use of a trench filled with SiO₂ for the isolation of CMOS (complementary metal oxide semiconductor) transistors was known from document D1, a filler material for an isolation trench with a coefficient of thermal expansion which matches that of the substrate within a factor of three (polysilicon) was stated in document D3-1 to give improved

results over SiO₂, and the claimed angle range of 5 to 10 degrees between the trench side walls and the vertical would be the result of routine testing, having regard to the variation of the trench wall taper for optimising device density and completeness of groove filling, as known from document D4.

- IV. An appeal against this decision was lodged by the Appellant, requesting that the decision under appeal be set aside, the patent maintained (unamended) and the appeal fee refunded.
- V. In support of his requests and contrary to the findings in the decision under appeal as derived from the Respondent's late-filed submissions, the Appellant argued essentially as follows:
- (a) Despite the long-time existing problem of a thermally mismatched dielectric in an isolation trench, no reference cited in the decision under appeal would teach or suggest the combination of a thermally matched filler and trench walls diverging at 5-10°. Only the present inventors have found and disclosed for the first time that in order to avoid device failures due to cracking caused by voids, a slope of at least 5 degrees is necessary, i.e. that more than thermal compatibility is required to solve the problem of excessive cracking.
 - (b) A silicon dioxide filled trench diverging upwards at an angle between 0° to 20° as known from document D4, fails to teach the claimed specific range of 5° to 10° for thermally matched polysilicon.

- (c) Despite the existence of document D4 since 1977, the authors of document D1 have used vertical side walls for their thermally matched filler.
- (d) Figures 1(a) and 1(b) of document D3-1 teaching that a mere lack of overhang - i.e. a non-negative side wall slope - is sufficient to deposit a thermally matched filler without voids, it could not be obvious that the divergence of the wall slope from vertical has to be increased up to at least 5 degrees in order to eliminate voids which cause cracking. Due to the fact that the side walls in Figure 1(b) apparently diverge from the vertical only near the bottom of the trench and not "for substantially the whole of their vertical extent" and were produced by reactive ion etching processes which at the relevant date (1982) allowed a sidewall divergence of only 0 to 2.5 degrees, any anticipation of the invention as claimed by Figure 1(b) itself has to be considered as accidental.
- (e) The crossing of the "Take note" box instead of the box "File observations within a period of ... months" in the communication (EPO Form 2937.1) dated 23 November 1989 - informing the Appellant about the Respondent's new arguments based on new references D3-1 and D4 -constituted a representation from the Opposition Division that no observations from the Appellant were required. The information in the communication - contrary to Decision T 22/89 dated 26 June 1990 - constituted a discouragement to the Appellant to file observations, an "ample time" for filing observations being of no use if no time limit has been set and beyond that, if there has been a discouragement to file observations, since there is no point in filing observations if it has been

represented that they are not necessary. The Opposition Division, however, subsequently based its decision mainly on documents D3-1 and D4; in this circumstance it was "necessary" to invite observations prior to issuing the decision having regard to Article 101(2) EPC, and failure to do so also breached Article 113(1) EPC. Furthermore, failure to invite observations in this circumstance constituted a breach of the principle of good faith which governs relations between the EPO and the parties coming before it. In any case, there was a substantial procedural violation which justifies the refund of the appeal fee.

VI. The Respondent requested the appeal to be dismissed, and submitted the following arguments:

- (a) Document D3-1 teaches a skilled person not only to use a thermally matched filler material for isolation trenches but also - on page 342, paragraph 4 - to provide trenches with a depth of 5-6 μm and a width of 1-1.5 μm by RIE (reactive ion etching). These values result in angles of the trench walls from the vertical being between 4.8 and 8.5 degrees and are thus almost identical with the claimed region. There is no passage in document D3-1 stating that the trench walls are vertical. Furthermore, document D3-1 indicates on page 340, last but one paragraph, that the improved RIE profile of Figure 1(b) is completely filled with polysilicon leaving no void.
- (b) Document D3-1 made it obvious to use tapered trench walls in order to exclude voids in a thermally matched trench filler. A hint to vary the angle of slope for finding its optimal value is derivable from document D4, column 3, lines 21-27. Thus, a skilled

person would be able to arrive at the subject-matter of Claim 1 without exercising an inventive step.

Reasons for the Decision

1. Inventive step

1.1 In view of the technical starting point of the present patent the Board considers document D1 as the nearest prior art, being the only cited document from which a typical CMOS structure with a polysilicon filled and thus thermally matched isolation trench is known. In the wording of Claim 1 from document D1 there is known:

"A semiconductor integrated device comprising: a semiconductor substrate which includes first and second regions extending from a surface of said substrate, the conductivity type of the second region being opposite to that of the first region (see D1, the subtitle of Figure 1 on page 239 in combination with Figure 7a on page 240); said first and second regions including, respectively, first and second field effect transistors, the channel conductivity type of said first transistor and of said second transistor being opposite, respectively, to the conductivity type of said first region and of said second region (see the subtitles of Figures 5 and 6 on page 240); and a trench containing a filler material extending from said surface into said substrate between said first and second regions to provide isolation between the said transistors (Figures 1 and 7a), the coefficients of thermal expansion of the filler material and the substrate matching to within a factor of three (see "polysilicon" on page 237, right column, line 8) and said filler material completely filling said trench (Figure 1d)".

Hence, the subject-matter of Claim 1 diverges from this known device as follows:

- (a) "the side walls of said trench diverging in a direction upwards from the vertical";
- (b) "the angle of said walls from the vertical being between 5 degrees and 10 degrees for substantially the whole of their vertical extent"; and
- (c) "said filler material being essentially free of voids."

None of the other documents on file comes near to the subject-matter of Claim 1, most of them describing MOS devices without complementary transistors.

1.2 Starting from the prior art according to document D1, the technical aim of the present invention is to avoid excessive cracking of a trench-containing substrate (see the patent under appeal, column 1, lines 45 to 49, and column 2, lines 6 and 7), the trench of which already contains a filler material with an optimally matched coefficient of thermal expansion (polysilicon).

A skilled person arrives at this technical difficulty automatically in practice and will start to analyse the cracked final product after its high-temperature production steps. Due to the fact that there is identity of the chemical substance used for the substrate and for the filler material, it is regarded as logical and conclusive to expect the cause of a remaining thermal mismatch to lie in structural lattice and grain differences. Thus, the Board regards it to be normal laboratory skill to reduce the reason for cracking to the existence of voids in the filler material and to verify

this experimentally; see for instance Figures 2(a), (b) and (c) in document D1. There is no evidence that void-sizes below the resolving limit of SEM (secondary electron microscope) views are the problem solved in the present invention. Hence, in the Board's view, the objective technical problem underlying the present invention is to realize a void-free filling of isolation trenches with a thermally matched material (see also the patent under appeal, column 2, line 4), and, for the above reasons, no contribution to inventive step is to be found in the recognition of the technical problem.

- 1.3 Distinguishing feature (c) in paragraph 1.1. above being thus the structural aim to be achieved, the above problem is solved by distinguishing features (a) and (b).
- 1.4 The Board follows the Respondent's view in paragraph VI that document D3-1, in particular Figures 1(a) and (b), makes it obvious to "provide side walls of said trench diverging in a direction upwards from the vertical" (i.e. distinguishing feature (a)) in order to enable a void-free filling with a thermally matched material (polysilicon).
- 1.5 The Appellant is followed in his statement according to paragraph V-(d) that in Figure 1(b) of document D3-1 the side walls of the trench deviate from the vertical only in its bottom region. However, nothing inventive can be seen in keeping the divergation angle constant and thus maintaining its value "for substantially the whole of their (the walls') vertical extent"; see the second part of distinguishing feature (b) in paragraph 1.1 above. At the priority date of the patent under appeal it was generally known in the art that a trench with a constant taper and up to 20 degrees can be etched into a substrate by keeping the process parameters of RIE (reactive ion etching) process constant; see as expert opinion document

D4, Figure 2, curve 20, with the corresponding description. Hence, said second part of distinguishing feature (b), in the Board's view, represents no process measure with a surprising effect but a mere manufacturing simplification with a foreseeable result, i.e. a loss of integration density due to the larger surface opening of the trench at constant angle.

- 1.6 The use of vertical side walls for the thermally matched filler in the trenches of document D1 - see the Appellant's arguments in paragraph V-(a) and (c) - in the Board's view, does not represent a prejudice against the use of tapered side walls for polysilicon but an acceptance of a lower yield of uncracked final products. Such an acceptance cannot be regarded as blocking the expert's mind in making an analogous use of the teaching of document D3-1 in the device of document D1.

- 1.7 The range between 5 degrees to 10 degrees for the deviation from the vertical - i.e. the first part of distinguishing feature (b) in paragraph 1.1 - does not define a purposively selected region wherein an unforeseeable effect is produced. In the Board's view, the claimed angle range has to be regarded as an arbitrary optimisation between two conflicting aims, i.e. yield and integration density, and constitutes the result of routine trial and error experiments which falls within the normal capacities of a skilled person.

- 1.8 As stated in detail above, a skilled person arrives at the subject-matter of Claim 1 by an analogous use of the known effects of the teaching of document D3-1 in the device of document D1 followed by an obvious arbitrary selection of

an optimal region. Therefore, Claim 1 is considered to lack an inventive step within the meaning of Article 56 EPC. Claims 2 and 3 fall because of their dependency on Claim 1.

2. Request for refund of the appeal fee

2.1 As set out in paragraph V(e) above, the Appellant has requested refund of the appeal fee on the basis that there was a breach of the principle of good faith and a substantial procedural violation by the Opposition Division, in that the further observations of the Respondent dated 3 October 1989 based upon new prior documents were sent to the Appellant, without any invitation to file observations in reply prior to the issue of the decision adverse to the Appellant and based upon such new references.

Rule 67 EPC only allows an appeal fee to be refunded in opposition proceedings if the appeal is allowed. Since in the present case the appeal is to be dismissed, the Appellant's request for refund must be rejected. Nevertheless, in view of the nature and importance of the submissions made by the Appellant, the Board makes the following observations.

2.2 The conduct of the examination of an opposition is governed by Article 101(2) EPC, which requires that "the Opposition Division shall invite the parties, as often as necessary, to file observations, within a period to be fixed by the Opposition Division, as communications from another party or issued by itself". This wording makes it clear that such an invitation by the Opposition Division to file observations is distinct from a communication issued by the Opposition Division.

In the present case no communication was issued by the Opposition Division prior to the issue of its decision. Furthermore, no invitation to file observations in reply to the Opponents' observations dated 3 October 1989 was issued either. The Appellant has contended that it was in fact "necessary" in the circumstances of the case for the Opposition Division to have invited observations from him, before issuing a decision revoking the patent on the basis of such observations and the new documents referred to therein. This depends in the first place upon the meaning of the word "necessary" in the context of Article 101(2) EPC.

- 2.3 In this connection, as a preliminary matter the relationship of Article 101(2) EPC with Article 113(1) EPC should be considered. The provision in Article 113(1) EPC that "decisions of the EPO may only be based on grounds or evidence on which the parties concerned have had an opportunity to present their comments" was recognised in Decision J 20/85 as being "of fundamental importance for ensuring a fair procedure between the EPO and parties conducting proceedings before it". Nevertheless, the fact that in a particular case Article 113(1) EPC has been complied with does not necessarily mean that the procedure in that case has been "fair". In proceedings before the EPO (as in other judicial or quasi-judicial proceedings) not only is it necessary for the principle expressed in Article 113(1) EPC to be complied with: beyond this, it is always necessary that the procedure in such proceedings is fair to the parties involved.

The right to fair procedure and a fair hearing is one of the principles of procedural law generally recognised in the Contracting States, and has to be taken into account by the EPO under Article 125 EPC. In many circumstances, such as those of the present case, the right to fair

procedure overlaps with the principle of good faith which, in accordance with the established jurisprudence of the Boards of Appeal (see Decisions G 5/88, J 10/89 and J 3/87, for example) governs the relationship between the EPO and its users.

In the Board's view, even if Article 113(1) EPC has been literally complied with in a particular case, it is "necessary" for the EPO to invite a party pursuant to Article 101(2) EPC to file observations on a communication from another party or issued by itself, if the failure so to invite that party would result in unfair procedure or a violation of the principle of good faith. In this connection, it is of fundamental importance that a party to proceedings should not be taken by surprise by the grounds or evidence in which an adverse decision is based.

- 2.4 In the present case, the new documents D3-1, D3-2 and D4 filed by the Respondent with letter dated 30 October 1989 were "not submitted in due time" in the opposition procedure, within the meaning of Article 114(2) EPC, and could therefore be disregarded by the EPO, depending in particular upon their relevance. Whether such documents were to be admitted into the opposition procedure or disregarded was a matter to be decided by the Opposition Division. If all such documents were to be disregarded as not sufficiently relevant, it would have been pointless for the Appellant to file observations upon them.

The Board notes that before receiving the decision under appeal, the Appellant had no way of knowing whether the Opposition Division would regard documents D3-1 and D4 as not sufficiently relevant to be admitted into the opposition, in the same way as document D3-2 was considered insufficiently relevant to be admitted.

In the Board's view, the sending by the Opposition Division of these new documents and the accompanying letter under cover of a form having the "Take note" box crossed in combination with the "File observations ..." box left uncrossed implied that the Opposition Division had decided that such new documents should not be admitted into the proceedings, and misled the Appellant into believing that there was therefore no need for the Appellant to file observations upon such late-filed documents and the accompanying arguments of the Respondent relating to them. The overall effect of the form was to discourage the filing of any observations in response.

Furthermore, having regard to this misleading communication by the Opposition Division, in the Board's view the issue of the decision of the Opposition Division without first informing the Appellant in a further communication that two of the three newly introduced documents were considered to be not only sufficiently relevant to be admitted, but also potentially decisive against the Appellant, and inviting observations thereon, was contrary to Article 113(1) EPC, which requires that parties "should have had an opportunity to present their comments" on grounds or evidence on which a decision is based. In the Board's view, if, as in the present case, the EPO sends a communication which (as a reasonable interpretation) misleads a party into believing that it is not necessary to defend its interest by filing observations in reply to new facts and evidence filed by an adverse party, and if such new facts and evidence then form the basis for a decision adversely affecting the misled party, the latter has not had "an opportunity to present its comments" within the meaning of Article 113(1) EPC.

Following the late filing of evidence by an opponent, if the EPO intends to consider such evidence in view of its relevance to the decision to be taken, then in the absence of observations upon such evidence by the patent proprietor, it is necessary within the meaning of Article 101(2) EPC to invite the proprietor to present his comments by filing observations, before the case can be decided on the basis of such evidence. This necessity follows from both Article 113(1) EPC and Article 125 for the reasons previously discussed.

In this connection, the fact that the Appellant had more than six months between receiving the new documents and the issue of the Decision of the Opposition Division, in which he "could" have filed observations on such new documents, does not constitute an "opportunity" within the meaning of Article 113(1) EPC if, as in the present case, the Appellant was in effect discouraged from filing such observations. Thus, this Board does not agree with the finding in Decision T 22/89, in similar circumstances, that the appellant in that case "had ample time (i.e. several months) to file observations if he had so wished", and that Article 113(1) EPC had not therefore been contravened.

Even if this Board was to follow Decision T 22/89 and to consider that in the present case Article 113(1) EPC had not (at least on a literal interpretation) been contravened, in the Board's view the procedure followed by the Opposition Division in the present case was not a fair procedure, and the principle of good faith governing the relationship between the EPO and parties to proceedings before it was violated in the particular circumstances of this case, having regard to the failure by the Opposition

Division to invite observations from the Appellant before the Decision dated 21 June 1990 was issued.

- 2.5 The Board would make the following additional observations on the procedure followed by the Opposition Division in this case:

The Board is aware that the new documents and arguments filed with the Respondent's letter dated 30 October 1989 were sent to the Appellant under cover of Form 2937.2 by a Formalities Officer and not by a member of the Opposition Division itself, in accordance with the usual practice. Such practice seems very understandable, since it is clearly impractical for a technical examiner of an Opposition Division to study every letter filed in opposition proceedings before the EPO and to decide whether observations in reply should be invited, before it is sent to other parties. Nevertheless, the use of Form 2937.2 in this context, which has a choice of two boxes which may be crossed, seems inappropriate, since it (probably wrongly) implies that in appropriate cases the appellant will be invited to file observations within a specified period, and not just to "take note".

- 2.6 For the reasons set out above, if this appeal had been allowable the Board would have ordered a refund of the appeal fee under Rule 67 EPC in view of the substantial procedural violation which occurred.

Order

For these reasons, it is decided that:

1. The appeal is dismissed.
2. The Appellant's request for a refund of the appeal fee is refused.

The Registrar:

The Chairman:

M. Beer

G.D. Paterson