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Datasheet for the decision of 12 December 2007

Case Number: T 1021/07 - 3.4.03

Application Number: 96939276.0

Publication Number: 0812471

IPC: H01L 21/336

Language of the proceedings: EN

Title of invention:
Microwave power SOI-MOSFET with high conductivity metal gate

Applicant:
NXP B.V.

Opponent:
-

Headword:
Microwave power SOI-MOSFET/ NXP B.V.

Relevant legal provisions:
-

Relevant legal provisions (EPC 1973):
EPC Art. 84, 123(2)

Keyword:
"Clarity (yes)"
"Amendment (permissible)"

Decisions cited:
-

Catchword:
-

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Case Number: T 1021/07 - 3.4.03

D E C I S I O N
of the Technical Board of Appeal 3.4.03
of 12 December 2007

Appellant: (Applicant)
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 28 December 2006 refusing European application No. 96939276.0 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: R. Q. Bekkering
Members: E. Wolff
J. Van Moer

Summary of Facts and Submissions

I. European patent application 96939276.0 was refused for the sole request failing to comply with Article 84 and 123(2) EPC.

II. The request was refused inter alia because an amendment of claim 1 was considered to have brought about an impermissible intermediate generalisation by replacing the original wording "forming a retrograde doping profile of a first conductivity type" with "forming a thin silicon layer having a graded doping structure" (Article 123(2) EC), and because of a lack of an unambiguous definition of the conductivity type of parts of the device (Article 84 EPC).

III. The appellant seeks reversal of the decision and the grant of a patent on the basis of a main request or, failing that, an auxiliary request, both filed during the appointed oral proceedings. The appellant further requests that should the board have major objections in relation to novelty and/or inventive step, the case be remitted to the examining division for further prosecution.

III. Claim 1 of the main request reads as follows:

1. A method of manufacturing a high power, microwave frequency SOI MOSFET device comprising the steps of:

(a) forming a SOI structure having an insulated oxide (2) on a substrate (1) and a thin silicon layer (3) on the insulating oxide (2);

(b) doping the thin silicon layer (3) to form a p-, p, p-- graded doping profile (3A,3B,3C) in the thin silicon layer (3) such that a p-- layer (3A) is formed on the insulating oxide (2), a p layer (3B) is formed on the p-- layer (3A) and p- layer (3C) is formed on p layer;

(c) forming a gate oxide (4) on the thin silicon layer;

(d) forming a plurality of highly conductive metal gate fingers on the gate oxide (4), said fingers stretching from a stem (12) in a comb-like configuration;

(e) forming a self-aligned source shield (6) in the thin silicon layer by introducing dopants of p conductivity type in alternate windows between fingers;

(f) forming a source region (7,9) within the self-aligned source shield and forming a drain region (13, 14) in the other windows between the fingers by introducing dopants of n conductivity type, said drain region (13,14) being formed adjacent to one metal gate finger at a side opposite to the source region (7,9);

(g) forming an oxide layer (10) over the structure obtained in the previous step; and

(h) providing metal contacts (11) to the source and drain regions.

Claim 1 of the auxiliary request differs from this merely in that paragraphs e) and f) refer to "between alternate fingers" and "between the other alternate fingers" where the main request refers to "in alternate windows between fingers" and "in the other windows between the fingers".

IV. Summarizing the appellant's arguments, the appellant submitted that the amended claim was clear and the basis for the new paragraph (b) and the newly introduced reference to "windows" in paragraphs (e) and (f) was to be found in the description. The amended claim therefore fulfilled the requirements of Articles 84 and 123(2) EPC.

Reasons for the decision

1. The appeal is admissible.

2. *Clarity (Article 84 EPC)*

2.1 Claim 1, paragraph (b), of the main request refers explicitly to a p-, p, p-- structure for the thin silicon layer 3. In the amended claim 1 before the examining division, the use of the word "graded" had been considered an impermissible intermediate generalisation. Rather than on its own as in the case of that earlier claim 1, the term "graded" is now used in the claim in the context of its own definition as referring to a p-, p, p-- doping profile. Hence its meaning is now clear and its use no longer objectionable.

2.2 The term "retrograde doping profile" was used in claim 1 as originally filed. In the description, the term retrograde is used in the phrase "subsequent retrograde double diffusion or implantation" (page 3, line 27) to describe a process step rather than to describe the doping profile as such. Moreover, the process step described is that of forming the p layer above the p-- layer. The doping profile formed during this step is therefore exactly the opposite of retrograde in its accepted meaning. Thus, in the context of the description, the meaning of the term retrograde is not clear. The lack of clarity engendered by the term "retrograde" was objected to already by the examining division. Replacing "retrograde doping profile" with "graded doping profile" in the manner of the current claim 1 avoids that lack of clarity.

2.3 The description refers (page 4, line 4) to "the source window between gate fingers defining the source regions". The claim now refers to windows in relation to both source and drain regions, i.e., to "alternate windows between fingers" and "other windows between the fingers", respectively, to provide an unambiguous and clear definition of the respective location of both the source and the drain regions between alternate pairs of fingers.

2.4 The original claim referred to "the first conductivity type" and "a second conductivity type". Now that the claim specifically claims a p-, p, p-- structure for the thin silicon layer 3, referring explicitly to p and n conductivity types instead adds to the clarity of the claim.

2.5 The claimed use of molybdenum as a gate material, the conversion of top parts of the molybdenum into a molybdenum nitride skin and the claimed MOSFET device being specifically an LDMOS device in new dependent claims 2, 3 and 4 respectively does not raise any new issues under Article 84 EPC.

2.6 Therefore, in the board's judgement the claims comply with the requirement of clarity under Article 84 EPC.

3. *Amendments (Article 123(2) EPC)*

3.1 Claim 1 now refers in paragraph (b) explicitly to a p-, p, p-- structure for the thin silicon layer 3. The exact wording of paragraph (b) is not as such found in the description as originally filed. Instead, the description describes (page 2, line 28 to page 3, line 1) the thin layer 3 as having "a graded doping structure including a bottom layer 3a of p-- type conductivity ... with a middle layer 3b of p type conductivity and a top layer 3c of p- type conductivity". It would be immediately clear to the skilled person that despite the different wording in description and claims, the structure referred to is the same in both, and no new matter is added by the new wording adopted for paragraph (b) of claim 1.

3.2 The claim as originally filed referred to the source and drain areas being formed adjacent to, and on opposite sides of, the metal gate fingers. The description (page 4, line 4) refers to "the source window between gate fingers defining the source regions". The reference introduced into claim 1 to

"alternate windows between fingers" and "other windows between the fingers" in order to define the respective location of both source and drain regions between alternate pairs of fingers is not only clear, as mentioned earlier, but does not convey any information not originally found in the application as filed.

3.3 Now that the claim specifically claims a p-, p, p-- structure for the thin silicon layer 3, no new subject matter is added by replacing references to "the same" and "opposite" conductivity by specific reference to p and n conductivity respectively.

3.4 For the foregoing reasons the board judges claim 1 of the main request to comply with the requirements of Article 123(2) EPC.

4. *Procedural matters*

4.1 The appellant has argued that the examining division had not raised any objections under the headings novelty or inventive step. Also, the examining division had made a proposal for a claim, subsequently withdrawn, which in the appellant's view should presumably be considered to constitute an allowable claim with novelty and inventive step also having been taken into account. The appellant therefore suggested that the board could determine of these issues itself.

4.2 According to the file, novelty and inventive step have not yet been considered by the examining division. The fact that the examining division has proposed a claim aimed at overcoming objections under Articles 84 and 123 EPC does not provide a clear indication that the

claim concerned was considered, at this stage of the proceedings, to be also new and inventive. Moreover, the examining division subsequently withdrew their proposal so that any speculation whether they considered the claim was new and inventive must now be moot.

4.3 The board considers it inappropriate in a case such as this for the issues of novelty and inventive step to be examined for the first time at the appeal stage, especially in view of the fact that the delay occasioned by the appeal has been kept to a minimum, with the decision in this case issuing less than a year from the date the appeal was filed.

Order

For these reasons it is decided that:

1. The decision of the appeal is set aside.

2. The case is remitted to the examining division for further prosecution based on the main request.

Registrar Chair

S. Sánchez Chiquero R. Bekkering