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D E C I S I O N
of 2 October 1998

Case Number: T 0909/95 - 3.4.1

Application Number: 91300621.9

Publication Number: 0440393

IPC: H01L 21/205

Language of the proceedings: EN

Title of invention:
Improved deposition of a conductive layer for contacts

Applicant:
Motorola Inc.

Opponent:
-

Headword:
deposition of conductive layer for contacts/MOTOROLA INC

Relevant legal provisions:
EPC Art. 123(2), 116
EPC R. 67

Keyword:
"Added subject-matter (yes)"
"Reimbursement of appeal fee (no)"

Decisions cited:
T 0019/87, T 0098/88

Catchword:
-

Case Number: T 0909/95 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 2 October 1998

Appellant: Motorola Inc.
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 26 May 1995 refusing European patent application No. 91 300 621.9 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: G. Davies
Members: H. K. Wolfrum
R. K. Shukla

Summary of Facts and Submissions

I. European patent application No. 91 300 621.9 is entitled "Improved deposition of a conductive layer for contacts". The application was refused by a decision of the examining division dated 26 May 1995, on the grounds that amended claim 7 as filed on 19 August 1993 with a letter dated 13 August 1993 introduced subject-matter extending beyond the content of the application as filed, contrary to the requirements of Article 123(2) EPC.

II. On 7 August 1995 the applicant lodged an appeal against the decision and paid the prescribed fee. A statement of grounds of appeal was filed on 5 September 1995.

The appellant requested

- that the decision of the examining division be set aside in its entirety and the application be granted on the basis of claims 1 to 7 as filed on 19 August 1993;
- that oral proceedings be appointed, if the Board of Appeal should for any reason not be disposed to grant the applicant's preceding request; and
- that the appeal fee should be reimbursed because of an alleged gross procedural violation in the examining division's conduct in the examination procedure.

III. The appellant submitted essentially the following arguments with respect to the alleged procedural violation and the issue of added subject-matter:

III.1 Procedural violation

The applicant was surprised and disappointed by the manner in which the formal refusal of the application was issued by the examining division.
In response to a communication dated 3 June 1993 of the examining division, the applicant responded with a comprehensive reply and submitted a replacement set of claims. Furthermore, the applicant requested that "if the examiner should have any further objection, the examiner is invited, before issuing a formal refusal, to telephone the undersigned representative with a view, if necessary, to arranging an interview."
Enquiring as to the status of the application in various telephone conversations with the responsible EPO formalities officer in 1994 and in early 1995, the representative was informed that a communication could soon be expected and that (unofficially) it could be expected to be favourable.

Having expected a communication allowing the application, or at least inviting him to arrange an interview to resolve any outstanding matter, he was taken aback to receive the formal decision to refuse the application as the next action of the EPO, ignoring the request for an interview. The examining division's conduct as outlined above constituted a gross procedural violation justifying the refund of the appeal fee.

III.2 Added subject-matter

Claim 7 is supported by the application as filed, which includes a discussion of a chamber, a temperature measuring point, and temperature ranges within which the temperature of the temperature measuring point must lie during the deposition steps. The fact that the apparatus may have additional components is considered

irrelevant. Although the specification includes an embodiment with a plurality of temperature measuring points, the claims need not be limited only to the specific embodiments described.

IV. Independent claims 1 and 7 read as follows :

"1. A method for making a semiconductor device structure comprising the steps of:
providing a semiconductor substrate having a surface with an exposed portion thereof;
placing the substrate in a furnace, said furnace having a chamber with a chamber wall and being capable of receiving a plurality of semiconductor substrates, wherein the furnace has a plurality of temperature measuring points near the chamber wall;
raising the temperature of the furnace such that temperatures of the plurality of temperature measuring points lie within a first chamber temperature range and a temperature of at least one of the temperature measuring points lies outside a second temperature range,
wherein the second chamber temperature range lies within and is narrower than the first chamber temperature range;
depositing a relatively thin layer of material for use as a conductor on at least the exposed portion of the surface of the substrate while the temperatures of the plurality of temperature measuring points lie within the first chamber temperature range and a temperature of at least one of the temperature measuring points lies outside the second temperature range;
allowing the temperatures of the plurality of temperature measuring points to adjust such that the temperatures of the plurality of temperature measuring points lie within the second chamber temperature range; and

depositing a relatively thick layer of material for use as a conductor on the relatively thin layer of material while the temperatures of the plurality of temperature measuring points lie within the second chamber temperature range."

"7. A method for making a semiconductor device structure comprising the steps of:
providing a semiconductor substrate having a surface with an exposed portion thereof;
placing the substrate in a chamber with a chamber wall, wherein a temperature measuring point is located near the chamber wall;
raising the temperature of the chamber such that the temperature of the temperature measuring point lies within a first chamber temperature range and outside a second temperature range,
wherein the second chamber temperature range lies within and is narrower than the first chamber temperature range;
depositing a relatively thin layer of material for use as a conductor on at least the exposed portion of the surface of the substrate while the temperature of the temperature measuring point lies within the first chamber temperature range and outside the second temperature range;
adjusting the temperature of the temperature measuring point such that the temperature of the temperature measuring point lies within the second chamber temperature range; and
depositing a relatively thick layer of material for use as a conductor on the relatively thin layer of conductive material while the temperature of the temperature measuring point lies within the second chamber temperature range."

V. In its decision the examining division held with respect to claim 7 that, due to the provision of a single temperature measuring point for establishing the temperature in a first or second temperature range, the definitions provided by claim 7 no longer refer to temperature ranges which concern the spatial homogeneity of the temperature along the chamber (as this cannot be effected by a single temperature measuring point) but would have to be interpreted as referring to temperature ranges defining homogeneity in time (i.e. between different batches).

The division considered that such a method was not clearly foreseen nor suggested by the originally-filed application documents.

VI. In a communication accompanying a summons to oral proceedings, the Board expressed its provisional view that there was no procedural violation committed.

Moreover, the Board gave reasons for its preliminary opinion that claim 7 as well as dependent claim 5 of the request on file introduced added subject-matter (Article 123(2) EPC) so that the request as a whole was considered not to be allowable.

Finally, by making reference to documents

D1: DE-A-35 04 199;

D2: SID Int. Symp. 1989, Digest of Technical Papers, pages 159 to 162;

D3: Derwent Publications, accession number 87-311974 & SU-A-845 680 (15 April 1987); and

D4: Silicon Processing for the VLSI Era (Silicon Processing), page 170,

the Board considered the claimed subject-matter, as far as it was regarded as having a basis in the original disclosure, as lacking an inventive step (Articles 52(1) and 56 EPC).

VII. By a letter dated 25 August 1998 and received on 31 August 1998 the appellant informed the Board that it would not appear at the oral proceedings scheduled for 23 October 1998 and did not wish the oral proceedings to be rescheduled.

Furthermore, the appellant asked for a decision on the application as it presently stands.

VIII. By a notification of 16 September 1998 the appellant was informed that the oral proceedings have been cancelled.

Reasons for the Decision

1. The appeal is admissible.

2. *Added subject-matter (Article 123(2) EPC)*

2.1 The present application is directed to a method of making a semiconductor device and more specifically to the deposition of conductive material onto an exposed surface of a semiconductor substrate to form electrical contacts to the substrate. This deposition is effected at elevated temperatures in the chamber (in the original claims named "wafer area") of a furnace.

According to the original description (cf. in particular page 2, lines 2 to 13; page 5, lines 3 to 21 and 29 to 33; and page 6, lines 5-13 and 25-33), the invention as filed is based on the following problem and solution principles :

- when forming the contact from a material such as polysilicon, the average grain size has a significant impact on the electrical characteristics of the deposited material;

- the grain size, in turn, is dependent on the temperature of deposition so that it is desirable to provide a specific temperature with narrow tolerance to all deposition locations within the furnace in order to obtain a consistent grain size, in particular when a plurality of substrates is treated in a single batch;

- it takes, however, a fairly long time (in the order of an hour) to heat the furnace to the required temperature of deposition **and** to obtain the requisite uniformity of temperature throughout the furnace;

- in the meantime, the exposed surface of the (monocrystalline) semiconductor substrate tends to become significantly oxidised, resulting in contact resistances which are undesirably high and vary widely;

- in order to avoid significant oxidation of the exposed substrate, but at the same time obtain deposited material of consistent grain size, the deposition is effected in two steps:

a first thin layer of the conductive material is deposited when the chamber/furnace is in principle at the requisite temperature level but has not yet reached the ideal uniformity of temperature throughout the chamber (i.e. when the temperature is in "a first temperature range") [the thin layer preventing or slowing down further oxidation], followed by the deposition of a thick layer of conductive material, once the requisite temperature uniformity has been obtained (i.e. when the temperature is in "a second, narrower temperature range").

It is further evident from the description (cf. figure 4; page 4, lines 26 to 33; and page 5, lines 29 to 33) that the uniformity of temperature (i.e. the "temperature ranges") is monitored by making use of temperature gauges distributed along the chamber/ furnace. Even the general summary of the invention as given on page 3, lines 9 to 17, referring to a stabilizing of the temperature, has to be interpreted in the light of the specific embodiment which exclusively concerns a method employing temperature measurement at a plurality of temperature measuring points.

In the most general definition, as given by original claim 1, the invention is defined as requiring the steps of "raising the temperature to **all** points within the wafer area to a first temperature range, said first temperature range including a first temperature", and "stabilizing the temperature to **all** points within the wafer area to a second temperature range, ..., said second temperature range including the first temperature" [emphasis added].

2.2 Claim 7 on file includes :

(a) the provision of a single temperature measuring point, by the feature "wherein a temperature measuring point is located near the chamber wall";

(b) the steps of "raising the temperature of the chamber such that the temperature of the temperature measuring point lies within a first temperature range" and "adjusting the temperature .. of the temperature measuring point such that ... [it] lies within a second temperature range"; and

(c) the requirement that the temperature during the first deposition step lies within the first chamber temperature range and outside the second chamber temperature range within which the second deposition step is performed.

2.3 Claim 7, thus, seeks protection for a method where spatial uniformity of temperature is not required and the deposition of material is carried out at temperatures measured at a single measuring point, whereas it is clear from point 2.1 above that the invention as disclosed is concerned exclusively with a method employing spatial uniformity of temperature (within a second temperature range) within the furnace during the second deposition step.

Moreover, since it is impossible to monitor a temperature distribution within a chamber/ furnace by using only a single temperature point at a fixed location, the definition given by claim 7 on file can only mean that the first deposition step is performed when the temperature observed at the temperature measuring point lies within a (predetermined) first temperature range. Thus, the claimed subject-matter

would provide protection for any method in which the first deposition step is performed when the single temperature measuring point indicates a temperature which lies in the predetermined first range, regardless of which temperature might occur at that time at other points of the chamber/ furnace.

This is, however, in clear contrast to the original disclosure which requires (cf. for instance original claim 1) that **all** points of the chamber/ furnace lie within the first temperature range when the first deposition step is performed.

2.4 Although the appellant is in principle right that, for the purpose of having a basis of disclosure, claims need not (necessarily) be limited to specifically described embodiments, this does not apply in the present case, in which in fact none of the originally-filed claims mentions a single temperature measuring point.

In the present case, the only disclosure concerning the provision of a temperature measuring point is given by the description of the specific embodiment. From this description it is evident that a plurality of temperature measuring points is used to monitor the temperature variation or uniformity along the extension of the chamber/ furnace. Since it is impossible to establish or monitor the occurrence of a desired temperature variation or uniformity at various locations within the chamber at any given point of time from a single measuring point, the provision of more than one measuring point is apparently an indispensable feature for performing a method according to the invention as it is disclosed.

2.5 Further added subject-matter is introduced by claim 5 on file, in particular as far as this claim directly refers to claim 1.

The original disclosure (cf. page 5, lines 3 to 13 and 26 to 33) refers to the specific temperature ranges defined in claim 5 on file only in the context of the deposition of polysilicon. Thus, the additional features given in claim 5 have been disclosed only in combination with those given in present claims 2 and 3. In fact, it is not plausible that for any other conductive material the temperature ranges specified in claim 5 on file would be suitable.

2.6 For these reasons, the Board considers that claims 5 and 7 of the request on file introduce added subject-matter so that the application as amended does not comply with the requirements of Article 123(2) EPC.

3. *Reimbursement of the appeal fee*

3.1 Although the appellant may have reasons not to be fully satisfied by the course of events during the examination procedure, the Board does not consider that any procedural violation took place.

3.2 With regard to the applicant's complaint that, contrary to his request, he was not invited to an interview before a decision had been taken, it is to be noted that the EPC does not foresee an interview (with a member of the examining division) and that a request for an interview is clearly not a request for formal oral proceedings provided by Article 116 EPC (cf. decisions T 19/87 [OJ EPO 1988, 268] or T 98/88 ["Case law of the Boards of Appeal of the European Patent Office", 1996, page 194]).

There is no obligation upon an examiner or examining division to grant a request for an interview, in particular when, as set out in the "Guidelines for Examination in the European Patent Office" part C-VI, 6.1a, the examiner believes that no useful purpose would be served by such an interview.

In the present case, it is evident from the reasons in paragraph 4.3 of the decision under appeal that the examining division did not see any useful purpose in an interview.

3.3 Moreover, although the Board has no reason to doubt the applicant's account of the information given to him in the telephone conversations with the formalities officer, neither this information nor the course of the examination procedure actually deprived the applicant of any right in pursuing the application. In particular, since the application was refused on grounds or evidence which were communicated to the applicant, the applicant's right to be heard before the issue of an adverse decision was also respected in accordance with Article 113(1) EPC.

The degree to which the applicant was taken by surprise by the decision has to be judged in the light of the fact that the second communication ended with an unambiguous warning that the rejection of the application was to be envisaged.

3.4 According to Rule 67 EPC the appeal fee is to be reimbursed where the Board considers the appeal to be allowable, if reimbursement is equitable by reason of a substantial procedural violation.

In the present case, the Board considers neither the appeal to be allowable nor a substantial procedural violation to have been committed by the examining division. Accordingly the request for the refund of the appeal fee cannot be granted.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:	The Chairman:
M. Beer	G. Davies