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D E C I S I O N
of 8 March 2004

Case Number: T 0089/02 - 3.4.3

Application Number: 95104766.1

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Language of the proceedings: EN

Title of invention:
Deposition process

Applicant:
APPLIED MATERIALS, INC.

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 84

Keyword:
"Main request (not allowable) lack of support by the description"

Decisions cited:
-

Catchword:
-



Case Number: T 0089/02 - 3.4.3

D E C I S I O N
of the Technical Board of Appeal 3.4.3
of 8 March 2004

Appellant: APPLIED MATERIALS, INC.
3050 Bowers Avenue
M/S 2061
Santa Clara
california 95054-3299 (US)

Representative: Zimmermann & Partner
Postfach 33 09 20
D-80069 München (DE)

Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 30 July 2001
refusing European application No. 95104766.1
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: R. K. Shukla
Members: V. L. P. Frank
M. B. Günzel

Summary of Facts and Submissions

I. The appeal lies from the decision of the Examining Division dated 30 July 2001 refusing the European patent application No. 95 104 766.1. The grounds for the refusal were that independent claims 1 and 6 were not clear (Article 84 EPC) and that the subject-matter of independent claim 22 was not new (Article 52(1) and 54(1) and (2) EPC) having regard to the prior art document:

D1: EP-A-0 473 067

II. The appellant (applicant) lodged an appeal against the above decision on 28 September 2001, paying the appeal fee the same day. The statement setting out the grounds of appeal was filed on 7 December 2001 together with amended claims 1 to 29 forming appellant's main request.

III. In response to a communication from the Board under Rule 11(1) RPBA accompanying the summons to oral proceedings the appellant submitted a new main request comprising claims 1 to 25 and an auxiliary request comprising claims 1 to 21.

IV. During the oral proceedings before the Board which took place on 8 March 2004, the appellant replaced his previous requests by a new main request and an auxiliary request, as follows:

(i) Main request:

Grant of a patent on the basis of:

Claims: 1 to 24 of the main request filed during the oral proceedings of 8 March 2004

(ii) Auxiliary request:

Grant of a patent with the following documents:

Claims: 1 to 22 of the auxiliary request filed during the oral proceedings of 8 March 2004

Description: pages 1 to 21, filed during the oral proceedings of 8 March 2004

Drawings: Sheet 1/5 to 5/5, as originally filed

The wording of the independent claims of these requests is as follows:

Main request:

"1. A deposition apparatus for depositing a layer of material on the surface of a wafer comprising:

a deposition chamber (12); and

a susceptor having a susceptor plate (20);

wherein the susceptor plate (20) extends across the deposition chamber (12) and is positioned between an upper portion (22) of the chamber (12) and a lower portion (24) of the chamber (12), further comprising

a deposition gas inlet manifold (30) having at least one passage (104) opening into the lower portion (24) of the deposition chamber (12) and at least one passage (108, 112) opening into the upper portion (22) of the deposition chamber (12)".

"16. A method of depositing a layer of material on a surface of a wafer mounted on the top surface of a susceptor in a deposition chamber, comprising the steps of:

- (i) depositing a layer of the same material to be deposited on the wafer on the back surface of the susceptor by directing a flow of a deposition gas to the lower portion of the deposition chamber; and
- (ii) after depositing a layer of the material on the back surface of the susceptor in step (i), depositing on a surface of the wafer a layer of the same material as deposited on the back surface of the susceptor by directing a flow of a deposition gas to the upper portion of the deposition chamber."

"22. A susceptor for an apparatus for depositing a layer of a material on a wafer obtainable by the following process:

- (a) depositing a layer of silicon of a thickness of about 4 microns on the back surface of the susceptor, wherein a dichlorosilane precursor gas is used for the deposition, and

(b) subsequently depositing a layer of silicon of a thickness of about 2 microns on the silicon layer deposited in step (a), wherein a silane precursor gas is used for the deposition."

Auxiliary request:

Claim 1 of the auxiliary request has been amended with respect to claim 1 of the main request in that it contains the following text at the end of claim 1 of the main request:

"further comprising an infrared temperature sensor (36) facing the back surface of the susceptor plate (20) and adapted to detect radiation emitted from the susceptor plate (20) when the susceptor plate (20) is heated."

Independent claim 15 of the auxiliary request has been amended by the addition of the following text at the end of the corresponding independent claim 16 of the main request

"(iii) monitoring the temperature of the susceptor by means of an infrared temperature sensor which detects radiation emitted from the susceptor when the susceptor is heated."

Independent claim 22 to a susceptor of the main request has been renumbered as claim 20 in the auxiliary request.

V. In the decision under appeal the Examining Division argued as follows:

The independent claim 1 directed to a susceptor plate, the back surface of which is coated with a layer of the same material which is to be deposited on the wafer was considered to lack clarity contrary to the requirements of Article 84 EPC, since it attempted to define the material coated on the susceptor's back surface in terms of the use of the susceptor, namely the material to be deposited on the wafer when the susceptor is used. The independent claim 6 directed to a deposition apparatus comprising a susceptor according to claim 1 was considered to lack clarity for the same reasons as for claim 1.

Finally, the subject-matter of independent claim 22 directed to a method of depositing a layer of material on a surface of a wafer was considered to lack novelty over the deposition process disclosed in document D1. The prior art apparatus discloses that the material to be deposited on the wafer is also simultaneously deposited on the back surface of the susceptor due to the unwanted flow of deposition gas from the upper portion to the lower portion of the deposition chamber. The wording of claim 22 of the application in suit, however, did not exclude that deposition occurs simultaneously on the wafer and the susceptor's back surface.

VI. The arguments of the appellant can be summarized as follows:

Article 84 - Essential features

The technical problem addressed by the application in suit is to overcome the improper indication of

temperature resulting from a random coating on the back surface of the susceptor during the deposition of a material layer on the wafer, since this affects the temperature measurement done with an infrared pyrometer due to the change of emissivity of the susceptor's back surface.

There is, however, no need to specify the manner in which the temperature of the susceptor is measured in the deposition apparatus and method according to claims 1 and 16 of the main request, since the use of a pyrometer for this purpose is already disclosed in document D1. This feature, therefore, is not an essential feature of the invention, since it does not contribute to the novelty or inventive step of the subject-matter claimed.

Novelty

Document D1 does not disclose a susceptor with a back surface covered by a 6 micron thick silicon layer. In this document the back surface of the susceptor is only covered by unwanted random contamination. The susceptor according to the main or auxiliary request is therefore new having regard to this prior art document.

The same is true for the method of depositing a layer on a surface of a wafer, since document D1 does not disclose that a deposition gas flow is directed to the lower portion of the deposition chamber to deposit a layer on the susceptor's back surface of the same material as the material to be deposited on the upper surface of the wafer.

Independent claim 1 of both requests is directed to an apparatus having a deposition gas inlet manifold which allows to direct the gas flow either to the upper or to the lower portion of the deposition chamber. The deposition apparatus disclosed in document D1 does not allow such redirection of the gas flow. For this reason, the deposition apparatus according to claim 1 is novel over the disclosure of this document.

Reasons for the Decision

1. The appeal is admissible.

2. *Main request - lack of support by the description (Article 84 EPC)*
 - 2.1 As acknowledged in the description of the background art of the patent application in suit, in a conventional single wafer processing apparatus one wafer at a time is supported on a susceptor in a processing chamber. The susceptor divides the chamber into a lower portion below the susceptor and an upper portion above the susceptor, and is generally mounted on a shaft which rotates the susceptor about its centre to achieve a uniform processing of the wafer. A flow of a processing gas, such as a deposition gas, is provided in the upper portion of the chamber and across the surface of the wafer by providing a gas inlet port at one side of the chamber and a gas outlet port at an opposite side. The susceptor is heated to a desired processing temperature which has to be constantly measured and monitored. This is often achieved by means of an infrared temperature sensor which detects the

infrared radiation emitted from the heated susceptor. One problem with this type of processing apparatus is that some of the processing gas, which is often a gas or mixture of gases for depositing a layer of a material on the surface of the wafer, tends to flow around the edge of the susceptor and deposits a layer of the material on the back surface of the susceptor. Since the deposited material is generally different from the material of the susceptor, the deposited layer has an emissivity which is different from that of the emissivity of the susceptor. Thus, once the layer of the material is deposited on the back surface of the susceptor, the infrared temperature sensor detects a change caused by the change in the emissivity of the surface from which the infrared radiation is emitted. This change, however, is interpreted by the temperature measurement system as a change in the susceptor's temperature which actually does not exist (cf. column 1, lines 4 to 47 of the published application).

2.2 In order to provide accurate temperature measurements, in the method described in the application in suit, prior to the deposition of a material on the wafer the same material is deposited on the back surface of the susceptor. The temperature measurement is, therefore, not affected by further material being deposited on the susceptor's back surface during the deposition process on the wafer, since the emissivity of this surface does not change by the material which may be added during the deposition process. Therefore, only changes in the actual temperature of the susceptor 20 are indicated by the infrared temperature sensor 36 (cf. column 10, lines 8 to 31 and Figure 1 of the published application).

2.3 The problem of improper measurement of temperature due to the unwanted coating of the susceptor's back surface, however, only arises when the susceptor's temperature is measured by optical means, e.g. by a pyrometer, since only under these circumstances the emissivity of the susceptor plays a role. When the susceptor's temperature is measured by other means, e.g. by a thermocouple, the susceptor's emissivity has no relevance. The application in suit, moreover, only discloses a deposition apparatus and method in which the temperature is measured by an infrared temperature sensor.

2.4 Furthermore, it follows from the application in suit, that the only problem addressed by the **invention as described** is to provide a method and apparatus which overcomes the problem of improper indication of temperature resulting from a coating applied to the back surface of the susceptor.

The deposition apparatus according to claim 1 and the method of depositing a material according to claim 16, however, do not specify any means for measuring the temperature of the susceptor and thus do not contain the features essential to the only problem disclosed in the application in suit. Thus, the claims define inventions which are different from the inventions as described and are, therefore, not supported by the description as required by Article 84 EPC (cf. T 409/91, OJ EPO, 1994, 653).

Although the Board concurs with the appellant that the use of an infrared sensor to measure the susceptor's

temperature does not contribute to the novelty or inventiveness of the claimed subject-matter, the contribution to the state of the art made by the present invention resides in the combination of the provision of a coating layer on the susceptor's back surface and the infrared temperature measurement.

For the foregoing reasons, the appellant's main request is not allowable.

3. *Auxiliary request*

3.1 Amendments and clarity

3.1.1 In the decision under appeal, there were no objections raised against the claims under Article 123(2) EPC, and the Board is also satisfied that the claims as amended during the examination proceedings complied with Article 123(2) EPC.

The amendments introduced in the course of the appeal proceedings to independent claims 1, 15 and 20 of the auxiliary request are based on the application documents as originally filed (cf. column 3, lines 33 to 47; column 4, line 55 to column 5, line 3; column 9, lines 13 to 44; column 10, lines 34 to 52; column 11, lines 14 to 51). The description was amended for consistency with the claims.

The Board is, therefore, satisfied that the requirement of Article 123(2) EPC is satisfied.

3.1.2 The deposition apparatus according to claim 1 and the method of depositing a layer of material according to

claim 15 specify that the susceptor's temperature is measured by an infrared temperature sensor which detects the radiation emitted by the susceptor when heated. The invention defined by the claims of the auxiliary request corresponds, therefore, to the invention as described in the application in suit and the claims are supported by the description as required by Article 84 EPC.

- 3.1.3 The Examining Division refused the application *inter alia* for the reason that the independent claim to a susceptor lacked clarity (Article 84 EPC), since it specified that '*the back surface of the susceptor plate (20) is coated with a layer of the material to be deposited on the wafer*'. It argued that this specification attempted to define the material coated on the susceptor's back surface in terms of the use of the susceptor, namely the material to be deposited on the wafer when the susceptor is used. Furthermore, the independent claim to a deposition apparatus was also considered as lacking clarity, since it comprised a susceptor according to the independent claim to a susceptor.

However, the above objection of lack of clarity no longer applies, since the independent claim to a susceptor according to the auxiliary request specifies that the susceptor's back surface is covered by a 6 μm thick silicon layer obtainable by the process specified in the claim. The coating material on the susceptor is thus specified without any reference to a material which might be deposited on a wafer.

The deposition apparatus according to independent claim 1 of the auxiliary request comprises *inter alia* a deposition gas inlet manifold having passages opening into the upper and lower portions of the deposition chamber which allow, consequently, to direct the deposition gas flow independently into each of these chamber portions. The reference to the susceptor's feature which was objected by the Examining Division as lacking clarity has been deleted from the claim.

The requirement of clarity according to Article 84 EPC is, therefore, fulfilled.

3.2 Novelty

3.2.1 Document D1 discloses a deposition apparatus of the above mentioned kind in which an additional gas such as hydrogen or nitrogen may be injected into the deposition chamber through a gas inlet 19 provided at the bottom of the chamber. The gas flows from the chamber's lower portion into its upper portion, thereby preventing that the deposition gases penetrate into the lower portion and deposit on the susceptor's back surface (cf. D1, column 4, lines 44 to 48 and Figure 1).

According to document D1, the wafer pedestal is made of an opaque material that can withstand the processing temperatures and absorbs the light emitted by the heating lamps. It is further disclosed that the pedestal may be made of silicon carbide coated graphite (cf. column 4, lines 22 to 27).

3.2.2 However, document D1 does not disclose a deposition apparatus having a deposition gas inlet manifold as

specified in claim 1 of the auxiliary request nor does it disclose a deposition method in which in a first step the back surface of the susceptor is coated with the same material which is also to be deposited on the wafer as specified in claim 15.

3.2.3 With respect to claim 20 directed to a susceptor obtainable by the process specified in the claim, the Board notes that document D1 does not disclose a susceptor coated with a 6 μm thick layer of silicon.

3.2.4 The subject-matters of independent claims 1, 15 and 20 according to the auxiliary request are, therefore, new over the disclosure of document D1.

3.3 Inventive step

3.3.1 The problem addressed in the application in suit, namely the improper temperature measurement due to the unwanted deposition of material on the susceptor's back surface, is solved in document D1 in a completely different manner than in the present application, namely by preventing the deposition by the injection of an additional gas flow. For this reason, the deposition apparatus and method as claimed in claims 1 and 15 are not obvious having regard to document D1.

3.3.2 There is, moreover, no apparent reason to replace the silicon carbide coating of the susceptor disclosed in document D1 by a 6 μm thick silicon coating as specified in claim 20. As described in the application in suit, the use of such a susceptor in a deposition apparatus enables an accurate measurement of

temperature by an infrared sensor when a coating of silicon is to be provided on a wafer.

- 3.4 The Board is, therefore, satisfied that the claims according to the appellant's auxiliary request fulfil the requirements of the EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the Examining Division with the order to grant a patent with the following documents:

Claims and description of the auxiliary request filed during the oral proceedings of 8 March 2004

Figures as originally filed

The Registrar:

The Chairman:

D. Meyfarth

R. K. Shukla