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D E C I S I O N
of 15 April 2003

Case Number: T 0972/00 - 3.5.2

Application Number: 90119065.2

Publication Number: 0421430

IPC: H01J 37/32

Language of the proceedings: EN

Title of invention:

A plasma process, method and apparatus

Patentee:

APPLIED MATERIALS, INC.

Opponent:

Institute of Technological Information, Inc.

Headword:

-

Relevant legal provisions:

EPC Art. 54, 56, 83, 84, 123(3)

Keyword:

"Insufficiency of disclosure (no)"
"Late filed grounds of opposition (yes)"
"Clarity (yes)"
"Late filed document (yes)"
"Novelty, inventive step (yes)"

Decisions cited:

G 0009/91, G 0010/91, T 0301/87

Catchword:

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Boards of Appeal

Chambres de recours

Case Number: T 0972/00 - 3.5.2

D E C I S I O N
of the Technical Board of Appeal 3.5.2
of 15 April 2003

Appellant: Institute of Technological Information, Inc.
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Decision under appeal: Interlocutory decision of the Opposition Division
of the European Patent Office posted 2 June 2000
concerning maintenance of European patent
No. 0 421 430 in amended form.

Composition of the Board:

Chairman: W. J. L. Wheeler
Members: J.-M. Cannard
P. Mühlens

Summary of Facts and Submissions

- I. The opponent appealed against the decision of the opposition division concerning the maintenance of European patent No. 0 421 430 in amended form in accordance with the proprietor's first auxiliary request filed on 13 January 2000 during oral proceedings before the opposition division.
- II. Independent claims 1 and 9 of the thus amended patent read as follows:

Claim 1:

"A plasma etching method, comprising the steps of:

- (a) igniting a plasma within a reactor chamber in a plasma reactor (11) by means of an rf power source (15) having a frequency in the range of 30 to 200 MHz;
- (b) maintaining within said reactor chamber a gas pressure in the range 0,067-4 Pa (0.00067-0.04 mbar=(0.5-30 milliTorr)); and
- (c) providing rf power to a powered substrate support electrode (16) upon which a wafer (17) is placed for processing, wherein the power level P is adjusted to maintain said plasma within the reactor chamber and to produce a negative self-bias voltage at the powered electrode that is less than 350 volts to provide a soft plasma etch process."

Claim 9:

"A plasma etching apparatus, comprising:

a plasma reactor (11) having a powered support electrode (16) on which a wafer (17) is supported during processing; and

an rf power supply (15) that produces power P at a level that is sufficient to maintain a plasma within the reactor and at a frequency f in the range 30 to 200 MHz, wherein the power P and frequency f are selected to produce a powered electrode negative self-bias that is less than 350 volts."

Claims 2 to 8 are dependent on claim 1 and claims 10 to 18 are dependent on claim 9.

III. The following documents:

D1: JP-A-62-193126 with a full translation into English,

D2: EP-A-0 263 788,

D3: JP-A-62-125626 with a full translation into English and Japio abstract,

D4: US-A-4 572 759,

D6: JP-A-60-94725 with a partial translation into English,

considered during the proceedings before the opposition division, and

D7: JP-A-62-280379 with a full translation into English,

cited for the first time the appellant's statement of grounds of appeal,

are considered in the present decision.

IV. After summons to oral proceedings, the appellant/opponent informed the Board by letter dated 16 January 2003 that they would not attend the oral proceedings.

V. The oral proceedings were cancelled.

VI. The arguments of the appellant/opponent can be summarised as follows:

Article 100(b) EPC

A self-bias voltage of less than 350 volts could not be obtained throughout the whole frequency range of 30 to 200 MHz specified in claims 1 and 9. There was no disclosure in the patent of how to maintain the desired etch rate throughout the whole range of self-bias voltage less than 350 volts, nor of a match network with a capacitive coupling suitable for use in the lower end, 30 to 39 MHz, of the frequency range specified in the claims.

Articles 84 and 123(3) EPC

The introduction of the word "and" in the phrase "sufficient to maintain a plasma within the reactor and at a frequency f" made claim 9 unclear and extended the

scope of the protection. Claims 1 and 9 did not include all the essential features of the invention, for instance, a powered electrode capacitively coupled to the rf power supply.

Article 100(a) EPC

Document D7, which merely differed from the subject-matter of claims 1 and 9 by not having a power supply having a frequency in the range of 30 to 200 MHz, was highly relevant. According to the patent in suit, typical conventional plasma reactors could have a power supply at a frequency of 30 MHz. It was obvious to use in D7 a power supply having a frequency of 30 MHz or the frequencies disclosed in documents D3 and D4, which overlapped the claimed range of 30 to 200 MHz. Claims 1 and 9, which did not include all the essential features of the invention, did not solve the technical problem. The subject-matter of claims 1 and 9 also lacked novelty or an inventive step in view of documents D1 to D4, and D6.

- VII. The arguments of the respondent/proprietor can be summarised as follows:

Article 100(b) EPC

The objection according to which a negative self-bias voltage could not be obtained throughout the whole frequency range specified in the claims was raised for the first time in the opponent's letter dated 29 October 1988. Being *prima facie* not relevant, this late filed ground had not to be admitted in the opposition proceedings. The objection that the opposed patent did not disclose a match network for use in the

frequency range of 30 to 39 MHz was raised for the first time in appeal proceedings. It was a fresh ground of opposition which was not admissible because the patentee did not give approval for it to be considered.

Article 84 EPC

The introduction of the word "and" in claim 9 was merely a correction in accordance with Rule 88 EPC. Article 102(3) did not allow objections to be based under Article 84 EPC when they did not arise out of the amendments made.

Article 100(a) EPC

D7 was cited for the first time in the statement of grounds of appeal. It was *prima facie* not highly relevant because it did not disclose a frequency range of 30 to 200 MHz, and in any case it was not more relevant than D1. D7 should not be admitted into the proceedings.

- VIII. The appellant requested that the decision under appeal be set aside and the patent be revoked.
- IX. The respondent requested that the appeal be dismissed and that the patent be maintained as amended according to the decision under appeal.

Reasons for the Decision

1. The appeal is admissible.
2. *Alleged insufficiency of disclosure*
 - 2.1 Insufficiency of disclosure introduced as ground of opposition during the opposition proceedings after expiry of the 9 month period for filing an opposition.

The opponent, referring to the description of the patent (column 6, lines 28 to 43), argued (letter of 29 October 1998) that a self-bias voltage at the powered electrode of less than 350 volts was not obtainable for the whole frequency range (30 to 200 MHz) specified in claims 1 and 9. In view of the passage quoted by the opponent it may be true that a self-bias voltage of less than 350 volts cannot be obtained for the whole of said range of frequencies, for an etch rate of 250 nm and for a given power level, but it does not appear from the description that a bias voltage of less than 350 volts cannot be obtained for frequencies within the claimed frequency range for other etch rates, or for other power levels. Since an etch rate, and in particular 250 nm, is not mentioned, and the dependence of the self-bias voltage on the power level is specified in claims 1 and 9, the opponent's argument does not appear *prima facie* to prove that the patent in suit does not provide an enabling disclosure of the invention for the whole ambit of claims 1 and 9 in a manner sufficiently clear and complete for it to be carried out by the skilled person. The Board thus comes to the conclusion that the opposition division had exercised its discretionary power correctly when it declared the new ground of opposition to be inadmissible.

2.2 Insufficiency of disclosure introduced as ground of opposition during the appeal proceedings.

In the statement of grounds of appeal, the opponent argued for the first time that a match network providing a capacitive coupling of the rf power supply with the powered substrate support electrode which was suitable for use with frequencies in the range of 30 to 39 MHz was not disclosed in the opposed patent. Accordingly, the patent did not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a skilled person throughout the scope of the claims. Providing a suitable match network involves technical measures which are totally different from those involved in obtaining an etch rate and a bias voltage in a plasma etching apparatus. Thus, this objection constitutes a fresh ground, which, being outside "the legal and factual framework" of the opposition, cannot be considered in the appeal proceedings without the approval of the patentee, see decisions G 9/91 and G 10/91 of the Enlarged Board of Appeal, especially points 6 and 18 of the reasons. Since it is clear from the patentee's letter of 7 May 2001, page 8, 2nd paragraph that such approval has not been given, this objection cannot be taken into consideration.

3. *Alleged lack of clarity of the amendment in claim 9*

3.1 The present claims differ from the claims as granted only in that the word "and" has been introduced in claim 9, which thus specifies an rf power supply (15) that produces power P at a level that is sufficient to maintain a plasma within the reactor **and** at a frequency f in the range 30 to 200 MHz. This feature is disclosed in the application as filed (see for instance column 6, lines 3 to 8; column 7, lines 29 to 33) and recited in granted claim 9. Moreover, the introduction

of the word "and" in claim 9 has not rendered the claim unclear, or altered its meaning at all, or made it inconsistent with the description. It has simply made the claim easier to understand. The Board is satisfied that the amendment made in the claims satisfies the requirements of Article 84 EPC and does not contravene Article 123(2) or (3) EPC.

3.2 The opponent also objected that amended claim 9 was not clear because it did not include all the technical features necessary to realize the invention, in particular a capacitive coupling of the powered support electrode to the rf power supply. The Board judges that this objection has no connection with the amendment made, which merely relates to the frequency of the rf power supply, and therefore cannot be allowed under Article 102(3) EPC (see T 301/87, OJ 1990,335, section 3 of the reasons).

4. *Document D7*

4.1 D7 discloses a plasma etching apparatus, and a method for operating it, in which a rf power supply of 500W generates a plasma and produces a powered electrode negative self-bias voltage that is less than 350 volts to provide a soft plasma etch process. However, D7 does not disclose any frequency range for the rf power, and more specifically not a frequency in the range 30 to 200 MHz as recited in claims 1 and 9, which is an essential feature of a plasma etching apparatus as claimed in claim 9 and disclosed in the opposed patent at column 6, lines 28 to 42.

4.2 As explained in the patent in suit (column 4, lines 32 to 48), the most common frequency used in a conventional plasma reactor is the standard frequency of 13.56 MHz, but this frequency is not chosen for the purpose of reducing the self-bias voltage to provide a

soft plasma etch process. In the etching devices according to D3 and D4, the frequency source generating the plasma is distinct from the source which applies the self-bias voltage to the substrate electrode. It thus appears unlikely to the Board that the skilled person would seriously contemplate applying the typical frequency range of the conventional plasma reactor referred to in the patent in suit, or using the frequency range disclosed in D3 or D4, in the etching device according to Figure 1 of D7, in which the same power source generates the plasma and the bias voltage.

4.3 D7 was cited for the first time in the statement of grounds of appeal. No reasons have been given by the appellant for the late filing of D7. This late filing cannot be justified by the amendment made in claim 9 which does not alter the scope of the claims.

4.4 Given these circumstances, and the fact that D7 does not appear to be highly relevant, i.e. highly likely to prejudice maintenance of the patent, it will not be considered further.

5. *Novelty and inventive step of independent claims 1 and 9*

5.1 The opponent argued that the subject-matter of independent claims 1 and 9 was not novel in view of the disclosure of any of the documents D1 to D4 and D6, or lacks an inventive step in view of the teachings of these documents. However, for the reasons which follow, the Board is satisfied that claims 1 and 9 define novel subject-matter involving an inventive step in view of the prior art documents cited in the statement of grounds of opposition.

- 5.2 The plasma etching methods and devices according to D1, D3 and D4 differ from the method of claim 1 and the apparatus of claim 9 in that the frequency source which generates the plasma in these devices is distinct from the source which applies a self-bias voltage to the substrate support electrode. D2, which does not relate to a plasma etching method or a corresponding apparatus, and D6, which concerns a dry-etching apparatus, do not disclose a self-bias voltage of a powered substrate support electrode as recited in claims 1 and 9.
- 5.3 Starting from D1, or D3, or D4, the problem underlying the present invention could be seen as providing a plasma etching method and apparatus to provide a soft plasma etch process. The claimed solution to this problem cannot be found in any of the cited prior art documents, or in any combination of them, because a rf power supply that produces power P at a level which is sufficient to maintain a plasma within the reactor chamber, wherein the power P is selected to produce a powered electrode negative self-bias that is less than 350 volts, is neither disclosed nor suggested in any of these documents.
6. In view of the foregoing, the Board judges that the subject-matter of claims 1 and 9 amended according to the decision under appeal is novel and involves an inventive step within the meaning of Article 56 EPC.
7. The Board concludes therefore that the grounds for opposition mentioned in Article 100 EPC do not prejudice the maintenance of the patent in amended form.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

D. Sauter

W.J.L. Wheeler