BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

Internal distribution code:
(A) [ ] Publication in OJ
(B) [ ] To Chairmen and Members
(C) [ ] To Chairmen
(D) [X] No distribution

D E C I S I O N
of 26 June 2003

Case Number: T 0724/00 - 3.2.7

Application Number: 93308579.7

Publication Number: 0595624

IPC: C23C 14/34

Language of the proceedings: EN

Title of invention:
Film forming apparatus for filling fine pores of a substrate

Applicant:
NIHON SHINKU GIJUTSU KABUSHIKI KAISHA

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0724/00 - 3.2.7

D E C I S I O N
of the Technical Board of Appeal 3.2.7
of 26 June 2003

Appellant: NIHON SHINKU GIJUTSU KABUSHIKI KAISHA
2500, Hagizono
Chigasaki-shi
Kanagawa-ken (JP

Representative: Cross, Rupert Edward Blount
BOULT WADE TENNANT
Verulam Gardens
70 Gray's Inn Road
London WC1X 8BT (GB)

Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 28 January 2000 refusing European application No. 93308579.7 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: A. Burkhart
Members: H. E. Hahn
C. Holtz

Summary of Facts and Submissions

I. The appellant (applicant) lodged an appeal against the decision of the Examining Division to refuse the European patent application No. 93 308 579.7.

II. The Examining Division held that the subject-matter of the independent apparatus claims 1 and 2 and the method claims 6 and 7 of the main request lacked unity while the system of claim 1 and the method of claim 6 of the auxiliary request were considered to lack an inventive step.

III. The most relevant documents of the available prior art are considered to be:

D5: EP-A-0 440 377

D6: Thin Film Processes, 1978, Academic Press Inc., Florida, USA, ISBN 0-12-728250-5, pages 60-61 and 148-152

D7: US-A-4 824 544

IV. Oral proceedings before the Board of Appeal were held on 26 June 2003.

(i) The appellant requested that the decision under appeal be set aside and a patent be granted on the basis of claims 1 to 8 filed on 18 June 2003 as "Amended Main Request".

(ii) The independent claims 1 and 5 under consideration read as follows:

"1. A combination of a target (9) and a substrate (11) and a magnetron sputtering apparatus for filling pores of the substrate, wherein the apparatus comprises a vacuum chamber (5) to be evacuated, means for introducing discharge gas into the vacuum chamber (5), means for controlling the internal gas pressure of the vacuum chamber (5) to be no higher than 1×10^{-1} Pa, target and substrate electrodes (8,10) oppositely arranged in the vacuum chamber (5) and respectively mounted with the target (9) and the substrate (11), the target (9) and the substrate (11) being arranged without interposing any electrode or obstacle therebetween, and a magnet (16) provided on the backside of the target electrode (8), wherein the target (9) and the substrate (11) are separated from each other with a distance at least greater than the diameter of the substrate (11)."

"5. A method of filling pores in a substrate by sputtering, the method comprising the steps of: mounting a target (9) and a substrate (11) respectively on a target and a substrate electrode (8,10) oppositely arranged and in a vacuum chamber (5), the target (9) and the substrate (11) being arranged without interposing any electrode or obstacle therebetween, a magnet (16) being provided on the backside of the target electrode (8);

holding the internal gas pressure level of the vacuum chamber (5) to be no higher than 1 x 10^{-1} Pa;
and
generating an electric discharge in the vacuum chamber (5) to sputter atoms from the target (9) to hit the substrate (11);
wherein the target (9) and the substrate (11) are separated from each other by a distance at least greater than the diameter of the substrate (11)."

(iii) The appellant argued essentially as follows:

Document D5 is concerned with collimated deposition, which is a fundamentally different technique to that claimed in the present application. The skilled person would not gain any assistance from the prior art in this regard because the prior art is completely silent regarding the advantages/disadvantages of collimated and non-collimated deposition. In particular, document D6 does not seek to address the problem of dust generation when using a collimator. In any event, there is no teaching or suggestion in either document D5 or D6 to arrange the target and the substrate so that they are separated from each other by a distance at least greater than the diameter of the substrate and to provide a gas pressure of no higher than 1 x 10^{-1} Pa. Document D5 actually teaches away from the said minimum distance feature. There is also no indication in either document that a combination of these features,

together with the absence of a collimator or the like would provide any expectation of success.

Reasons for the Decision

Original disclosure - Article 123(2) EPC

1. The independent claims 1 and 5 of the sole request are both based on the subject-matter of the originally filed claim 1. The additional features "a magnetron sputtering apparatus" and "a magnet (16) provided on the backside of the target electrode (8)" of claims 1 and 5 can be found at and/or be derived from page 8, line 20 to page 9, line 3 and lines 19 to 21, and figures 3 to 5 of the originally filed specification. Similarly, the further feature added to claims 1 and 5 "the target (9) and the substrate (11) being arranged without interposing any electrode or obstacle therebetween" can be derived from the embodiments according to figures 3 to 5 taking account of the object of the originally filed application, i.e. to provide an apparatus without generation of dust (cf. page 4, lines 20 to 24).

The dependent claims 2 to 4 and 6 to 8 are based on the originally filed claims 2 to 4.

Hence the requirements of Article 123(2) EPC are met for the claims 1 to 8.

Novelty

2. Documents D5 and D7 disclose a magnetron sputtering apparatus, adapted to fill fine pores of a substrate, wherein the apparatus comprises a vacuum chamber to be evacuated, means for supplying a discharge gas and for controlling the internal gas pressure, target and substrate electrodes (cf. D5, Figures 1, 3a, and 12 to 14; D7, figures 1 to 2, column 4, line 4 to column 5, line 53; and abstract in the present application, page 4, lines 8 to 14), and a collimator (filter) having a plurality of elongated small bores which filter is arranged between the target and the substrate of the magnetron sputtering apparatus so as to allow only those particles having a specific angle of incidence È to hit the substrate.

The subject-matter of claims 1 and 5 is distinguished from the disclosure of D5 or D7 by the features of a) that the gas pressure of the vacuum chamber (5) is no higher than 1×10^{-1} Pa; b) that the target (9) and substrate (11) are arranged without interposing any electrode or obstacle e.g. collimator therebetween; and c) that the target and the substrate are separated from each other, with a distance at least greater than the diameter of the substrate (11).

2.1 Document D6 represents a standard text book which does not disclose a magnetron sputtering apparatus in combination with the problem of filling holes in the substrate, let alone a specific distance between the target and the substrate being at least the substrate diameter.

2.2 The other documents cited in the search report either do not disclose a magnetron sputtering apparatus, or do not disclose that the target and the substrate are separated from each other with a distance at least greater than the diameter of the substrate, or do not disclose any pressure value during the sputtering process.

2.3 Therefore, the subject-matter of claims 1 and 5 is novel with respect to the disclosure of the available documents.

3. *Inventive step*

3.1 Closest prior art

The closest prior art is represented by document D5, identified in the present application at page 4, line 9, which similarly to D7 discloses a magnetron sputtering apparatus comprising a collimator between the target and the substrate in order to fill holes having a certain aspect ratio without the formation of voids. The collimator has, however, the disadvantage of generating dust onto the sputtered material.

3.2 Problem to be solved

The Board concurs with the applicant that the problem to be solved is to provide a sputtering apparatus that is free from the problems of conventional sputtering techniques in filling fine pores (particularly filling of holes or narrow trenches of certain aspect ratios) and capable of effectively filling said fine pores of a substrate without generating dust.

3.3 Solution to the problem

The problem is solved by the combination of a target and a substrate and a magnetron sputtering apparatus as defined in claim 1 and the process of using the same as defined in claim 5, in particular by the combination of the features a), b) and c) (see point 2 above).

3.4 The Board considers that the subject-matter of the independent claims 1 and 5 is not obvious to the person skilled in the art for the following reasons:

Taking account of the available documents the solution according to feature b) to the aforementioned technical problem chosen, i.e. to remove the collimator, is not considered to be the first choice.

This is due to the fact that none of the documents submitted addresses the problem of generating dust when using a collimator between the target and the substrate of a magnetron sputtering apparatus. The skilled person does not know the source of the dust generation and thus has no conclusive reason to remove the collimator - which represents an essential feature according to the disclosure of documents D5 and D7 - from the magnetron sputtering apparatus.

Even if the person skilled in the art identified the collimator as a source of the dust generation, the removal of the collimator for the purpose of avoiding dust falling on the substrate would not represent the only possibility for him, since he could clean the collimator after coating a certain number of substrates

or replace the collimator after coating a certain number of substrates.

The first step necessary, i.e. the provision of feature b), in order to arrive at the subject-matter claimed is thus not considered to be obvious.

There is also not any hint in the submitted documents for the second necessary step - an optimisation of the distance between the target and the substrate including an adaptation of the pressure in order to remove all those sputtered atoms which do not meet the angle of incident requirement based on the aspect ratio of the holes.

The Board concurs with the view of the appellant that the skilled person has no reason for increasing the distance between the target and the substrate. The distance according to the examples of document D5 is 7 cm between a 28.6 cm target and a 20 cm wafer. Even if the physical principles, such as disclosed in document D6 (e.g. the relationship between the pressure and the mean free path of the sputtered atoms, or the relationship between the aspect ratio of the holes to be filled and the angle of incidence of the sputtered atoms) are known, this does not lead the skilled person to the provision of the combination of features a), b) and c).

3.5 Therefore, the subject-matter of the independent claims 1 and 5 involves an inventive step within the meaning of Article 56 EPC.

3.6 The same applies to the subject-matter of the dependent claims 2 to 4 and 6 to 8 which define further preferred embodiments of the combination and the process according to claims 1 and 5, respectively.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to grant a patent in the following version:

Claims: 1 to 8 as filed on 18 June 2003 as "Amended Main Request";

Description: pages 1 to 13 as submitted in the oral proceedings on 26 June 2003;

Drawings: Figures 1 to 6 as originally filed.

The Registrar: The Chairman:

D. Spigarelli A. Burkhart