

Internal distribution code:

- (A) [ ] Publication in OJ  
(B) [ ] To Chairmen and Members  
(C) [X] To Chairmen

**D E C I S I O N**  
of 5 November 1996

Case Number: T 0480/95 - 3.4.2

Application Number: 86116308.7

Publication Number: 0233333

IPC: G03F 7/26

Language of the proceedings: EN

Title of invention:  
Method of treating photoresists

Patentee:  
USHIO DENKI

Opponent:  
FUSION SYSTEMS CORPORATION

Headword:  
-

Relevant legal provisions:  
EPC Art. 54, 56

Keyword:  
"Opposition withdrawn"  
"Letter between contracting firms - availability to the public  
(no)"  
"Prior public use - insufficient evidence"  
"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 0480/95 - 3.4.2

**D E C I S I O N**  
of the Technical Board of Appeal 3.4.2  
of 5 November 1996

**Appellant:**  
(Proprietor of the patent)

USHIO DENKI  
Asahi-Tokai Building 19  
No. 6-1, 2-chome Ote-machi  
Chiyoda-ku  
Tokyo 100 (JP)

**Representative:**

Lang, Friedrich, Dipl.-Ing.  
Patentanwälte Weber & Heim  
Irmgardstrasse 3  
81479 München (DE)

**Respondent:**  
(Opponent)

FUSION SYSTEMS CORPORATION  
7600 Standish Place  
Rockville, Maryland 20855 (US)

**Representative:**

Prinz, Egon, Dipl.-Ing.  
Prinz & Partner  
Manzingerweg 7  
81241 München (DE)

**Decision under appeal:**

Decision of the Opposition Division of the  
European Patent Office posted 24 March 1995  
revoking European patent No. 0 233 333 pursuant  
to Article 102(1) EPC.

**Composition of the Board:**

**Chairman:** E. Turrini  
**Members:** W. W. G. Hofmann  
M. Lewenton

## Summary of Facts and Submissions

- I. The Appellants (Proprietors of the patent) lodged an appeal against the decision of the Opposition Division on the revocation of the patent No. 0 233 333 (application number 86 116 308.7).

Opposition had been filed against the patent as a whole and based on Article 100(a) EPC.

The Opposition Division held that the grounds for opposition mentioned in Article 100(a) EPC prejudiced the maintenance of the patent, having regard to the documents

- (L) "Solid State Technology", October 1984, equipment frontiers, pages 83 to 84, and
- (Q) Letter from Fusion Semiconductor Systems to Valvo Röhren- und Halbleiterwerke der Philips GmbH.

Further documents presented during the opposition procedure and listed in the decision of the Opposition Division are

- (B) Operation and Maintenance Manual , 150PC Photostabilizer, Manual 73781, Fusion Semiconductor Systems, 15 June 1985;
- (C) "Microelectronic Engineering" 3 (1985), pages 329 to 337;
- (D) "Solid State Technology", August 1985, equipment frontiers, pages 83 to 84;
- (E) "Fusion Systems Shipped Data", page 1;

- (F) Affidavit of R.D. Wooten of 29 October 1993;
- (G) Affidavit of J. C. Matthews of 29 October 1993;
- (H) JP-A-59-114794 (+ English translation of claims);
- (i) JP-A-59-203399 (+ English translation of claims);
- (I) Affidavit of C. H. Wood of 4 December 1994;
- (II) Affidavit of J. C. Matthews of 18 January 1995;
- (J) Handwritten notes "PROM" 3.3;
- (K) Sales list;
- (M), (N), (O), (P) Graphs of F 300 D Bulb;
- (R) Handwritten notes "PROM" 3.4, "PROM" 3.3 of 3.2;
- (T) Proceedings of the Microelectronics Seminar  
INTERFACE '81, pages 40 - 49;
- (W) Fusion Semiconductor Systems, Monthly Report May  
1985;
- (X) Fusion Semiconductor Systems, Monthly Report  
October 1984.

The Appellants filed the following document:

- (Y) Letter of Dr. F. Zimmermann to patent agents  
Weber&Heim of 12 September 1995.

II. In the appeal proceedings, with the letter of 26 March 1996, the Respondents (Opponents) withdrew the opposition.

III. The Appellants requested that the decision under appeal be set aside and the patent maintained as granted. For the case that this request could not be allowed, they requested oral proceedings.

IV. The wording of the sole claim as granted reads as follows:

"A method of enhancing the thermal stability of a developed photoresist pattern on a semiconductor wafer which is capable of generating a gas upon exposure to ultraviolet radiation, comprising the steps of:

exposing the photoresist pattern to ultraviolet radiation of an intensity sufficiently low as to generate and release said gas at the beginning of the exposure, without formation of bubbles, deformation of the photoresist pattern or deformation of the photoresist film, and then increasing the intensity of said ultraviolet radiation while continuing to expose said photoresist pattern to said ultraviolet radiation without deformation by said gas generated and released at said beginning of exposure."

V. The Appellants essentially argued as follows:

In its decision, the Opposition Division relied on document Q (together with document L) for coming to the conclusion that the subject-matter of the claim lacked an inventive step. However, Q does not constitute prior art since it is a letter in connection with a contractual relationship between the two firms Fusion and Valvo, and in particular in connection with a notice of insufficiencies and defects detected in the contractor's product. The content of such a letter is generally strictly confidential, be this confidentiality expressly mentioned or not. Thus, it would have been the obligation of the Opponents to

prove that the letter was nevertheless available to the public, which they were not able to do. Although proof from the Appellants' side is not necessary, the Appellants submit document Y which shows that the letter Q was indeed kept confidential.

Thus, Q cannot be relied on for the judgment of novelty and inventive step.

VI. The Respondents did not file any arguments or requests.

#### Reasons for the Decision

1. The appeal is admissible.
2. *The documents on file*

Of all the documents cited above, only B, C, D, H, I, L and T are clearly publications published before the priority date of the present patent.

Most of the other documents are declarations or notes related to the claimed prior public use of the photostabilizers 150PC and 126PC of Fusion Semiconductor Systems and not claiming in any way to be publications (E, F, G, I, II, J, K, M, N, O, P, R, Y).

No proof is on file relating to the public nature of the monthly reports W and X of Fusion Semiconductor Systems. Judging from their content, it is more likely that they are only internal papers of this firm. In the absence of proof of the contrary, they cannot be considered as having been published before the present priority date.

Document Q, relied upon by the Opposition Division as a prepublication decisive for the evaluation of inventive step, is a letter from Fusion Semiconductor Systems to Valvo Röhren- und Halbleiterwerke. It is apparent from this letter that Fusion had sold a 126PC photostabilizer to Valvo and Valvo had given notice of processing problems (blistering effects) occurring in the use of this apparatus. In this letter, Fusion gives advice as to the way in which a certain programmed memory (3.3 PROM) solves the said processing problems.

In agreement with the arguments of the Appellants, the Board considers this letter as a typical example of correspondence between contracting firms which is confidential by its very nature. It is not apparent that any side could have been interested in communicating the content of this letter to the outside, and it is very improbable that any member of the public could have had access to this letter. (This has to be distinguished from the case of a product sold to another firm, where, depending on the circumstances, the product might or (usually) might not be kept concealed from the public.) Since confidentiality is implicit in the nature of such a letter, the onus would have been on the Respondents to show that it had nevertheless been available to the public, which they did not, or were not able to do. The Appellants, on the other hand, have filed a declaration of Dr. Zimmermann (document Y) who had been involved in dealing with the said contract between Fusion and Valvo, showing that letters of the type of document Q were kept confidential.

By withdrawing the opposition, the Respondents have indicated that they refrain from any further attempt to substantiate the availability to the public of the document Q, and similarly of the monthly reports W and X.

Thus, neither one of documents W, X and Q constitutes state of the art in the sense of Article 54(2) EPC.

3. Prior public use of the photostabilizers 150PC and 126PC of Fusion Semiconductor Systems, the latter one in the form of both an original model and an amended model, was claimed during the opposition procedure.

The 150PC and the original model of the 126PC need not be considered in the context of prior use since they are sufficiently described in the prepublished documents B, D and L.

The amended model of the 126PC photostabilizer is distinguished from the original model by the fact that the exposure of each photoresist is controlled by switching the lamp on and off, instead of opening and closing shutters while the lamp continuously remains in operation. As evidence for the prior use, for the features of this model and for the teaching its use provides for the public, the Respondents relied on the affidavit of Mr. J. C. Matthews (document II) and the non-published documents X, I (with attachments thereto), J, K, Q and R to which reference is made therein.

According to this affidavit, the amended apparatus was sold to the firms cited in the document K and was furthermore used in the Applications Laboratory of Fusion Semiconductor Systems where the use could be witnessed by interested visitors. Document K is an informal list of firms, in which nothing indicates when and by whom it was prepared and what it deals with. More written evidence as well as hearing witnesses would be required to clarify the circumstances of these sales. The same applies even more regarding the demonstrations in the Applications Laboratory of Fusion Semiconductor Systems.



It would have been the obligation of the Respondents to produce the lacking evidence, which could only come from their firm. However, by withdrawing their opposition, the Respondents have indicated that they will not submit further evidence or contribute to the taking thereof.

In addition to the lack of proof for the prior public use of the amended model of the 126PC photostabilizer, it is also doubtful in how far the teaching of such prior use would have corresponded to the method claimed in the present patent. This question will be dealt with in paragraph 4.8 below.

#### 4. Novelty

##### 4.1 Interpretation of the claim

The Board agrees with the opinion of the Opposition Division and the Appellants regarding the fact that the steps of exposing the photoresist pattern to ultraviolet radiation as defined in the claim are to be understood in the sense that the exposure to the increasing intensity immediately succeeds the exposure to the low intensity. This follows from the fact that the step of increasing intensity is connected to the step of low intensity by using the expression "while continuing to expose". The continuity of exposure thus includes the steps of low and of increasing intensity. This interpretation is also supported by the Figures 4 (a), (b) and (c) of the drawing where the time dependence of the whole exposure is shown as a continuous curve.

4.2 Document B is an operation manual of the 150PC photostabilizer of Fusion Semiconductor Systems. It describes a method of enhancing the thermal stability of a developed photoresist pattern on a semiconductor

wafer which is capable of generating a gas upon exposure to ultraviolet radiation (see in particular chapters 1.2.1 and 1.2.2 on pages 1-1 to 1-3, and page 4-7, paragraph 3). This known method comprises a step of exposing the photoresist pattern to ultraviolet radiation so as to generate the gas resulting from the destruction of the photoactive compounds ("flash exposure"), and comprises a further step of exposing the photoresist pattern to an increasing intensity of ultraviolet radiation (see also Figure 4-3 on page 4-9).

However, as is also shown in Figure 4-3, contrary to the method of the present claim, the two exposure steps do not form one continuous exposure to the ultraviolet radiation, but are separated by an interval of time. Moreover, no information is given as to the intensity and duration of the flash exposure in its relationship to the time required for the release of the gas from the photoresist film. Even assuming that the flash exposure uses only one of the two magnetrons (see page 5-3, last paragraph), the intensity might still be too high to allow innocuous release of the gas from the photoresist during the period of flash exposure itself.

4.3 A similar teaching is contained in document C (see in particular chapter 3. from its beginning on page 330 to the first paragraph on page 331). This document also relates to photostabilization by deep UV exposure and also refers in particular to the Microstabilizer 150PC of Fusion Semiconductor Systems. It is mentioned that gas is generated upon the exposure to ultraviolet radiation.

However, a flash or flood pre-exposure is applied which is separated from the real photostabilization exposure by a certain time interval, and no particular limit for the intensity of the pre-exposure is given.

- 4.4 The teaching of document D also relates to the 150PC photostabilizer of Fusion Semiconductor Systems and does not go beyond the teaching of documents B or C.
- 4.5 Documents H and i do not relate to the photostabilization of developed photoresist patterns, but to an electrodeless discharge lamp and to a power supply therefor.
- 4.6 Document L describes the 126PC photostabilizer of Fusion Semiconductor Systems in its original form. No pre-exposure is mentioned, and the UV exposure of the photoresist starts at once with full intensity when the shutters are opened.
- 4.7 Document T deals with postbake of photoresist patterns, but does not mention photostabilization.
- 4.8 In addition to the doubts, mentioned above in paragraph 3, concerning the public nature of the use of the amended model of the 126PC photostabilizer, the Board also wishes to discuss the teaching that could have been obtained from such use.

No prepublished document mentions the said amended model. It is apparent from the other documents on file that in this model each photostabilizing exposure was started by switching on the lamp (instead of opening a shutter), and that it took about 10 seconds for the lamp to ramp up to peak intensity.

However, the time dependence of the intensity of the lamp is not controlled, but is predetermined by the type of lamp used. It seems that in the amended 126PC photostabilizers lamps of the type F 200 D were used. In the view of the Board, it is not clear from the evidence on file in how far the warm-up characteristic of these lamps corresponds to the feature that the

photoresist is exposed to radiation of an intensity sufficiently low just to generate and release the gas, but not to form bubbles or deformations at the beginning of the exposure, before subsequently increasing the intensity. Such correspondence between the amended 126PC photostabilizer and the subject-matter of the patent was denied by the Appellants.

Moreover, it must be borne in mind that the present claim is directed to a method, whereas the object allegedly sold to several firms was an apparatus. More evidence would be required to show where, when and under what circumstances the public could not only see the apparatus, but also be informed of the method according to which it worked, as far as the details of the exposure of the photoresist to UV radiation are concerned.

However, since the Respondents have withdrawn the opposition, no further evidence, be it from documents or from witnesses, can be expected. Thus, no proof has been provided that a method corresponding to the one claimed in the present patent, or even similar to it, has been made available to the public before the priority date of the patent.

4.9 For these reasons, the subject-matter of the claim is new in the sense of Article 54 EPC.

5. *Inventive step*

5.1 The Board considers document C as representing the closest prior art since, in addition to describing photostabilization of photoresist patterns, it mentions the problem of "crater formation" and "blister formation" caused by nitrogen gas produced during the UV exposure.

Starting from this prior art, the problem solved by the present subject-matter is to treat the photoresist film more effectively and shorten the time required for the treatment (see column 2, lines 7 to 11 of the patent description).

This is achieved according to the claim by choosing a continuous exposure of the photoresist, starting with sufficiently low intensity so as to generate and release the gas at the beginning of the exposure, and then increasing the intensity.

- 5.2 It was not obvious for a skilled person to modify the known procedure so as to arrive at the claimed method since the apparatuses performing the procedure and described in C are not suited for such modifications. Neither the VEECO apparatus PSS-200, nor the FUSION apparatus 150PC (further described in document B) is equipped for control of the lamp intensity, and in both apparatuses constructional features (separate pre-exposure stage (Süss contact exposure tool) or lamp restart delay of 10 seconds) make it impossible to shift the "flood" or "flash" exposure time closer to the photostabilizing exposure. Moreover, the delay between the pre-exposure and the photostabilizing exposure was apparently also necessary for allowing the gas, at first produced in excess, to percolate through the photoresist material (cf C, page 331, line 16). None of the prepublications on file suggests such concentration of pre-exposure and photostabilizing exposure into one continuous step.

5.3 The amended model of the 126PC photostabilizer, the prior use of which was claimed by the Respondents during the opposition procedure, cannot be taken into account since, as already stated above in paragraph 4.8, there remain basic uncertainties as to the public nature of this use and the characteristics of the method steps that have actually been made available to the public.

5.4 For these reasons, the method according to the claim involves an inventive step in the sense of Article 56 EPC.

The claim is therefore allowable (Article 52(1) EPC).

## Order

for these reasons it is decided that:

1. The decision under appeal is set aside.
2. The patent is maintained unamended.

The Registrar:

The Chairman:

P. Martorana

E. Turrini