BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

A		B		C	X

File Number: T 0477/90 - 3.4.1

Application No.: 83 303 324.4

Publication No.: 0 096 596

Title of invention: Microelectric device manufacture

Classification: H01L 21/312

DECISION
of 19 July 1993

Applicant: NEC CORPORATION

Opponent: HOECHST AKTIENGESELLSCHAFT, Frankfurt (Main)

Headword:

EPC Article 56

Keyword: "Inventive step (yes)"

Case Number : T 0477/90 - 3.4.1

DECISION
of the Technical Board of Appeal 3.4.1
of 19 July 1993

Appellant : (Proprietor of the patent)	NEC CORPORATION 7-1, Shiba 5-chome Minato-ku Tokyo 108-01 (JP)
Representative :	Geering, Keith Edwin REDDIE & GROSE 16 Theobalds Road London WC1X 8PL (GB)
Respondent : (Opponent)	HOECHST AKTIENGESELLSCHAFT Werk Kalle-Albert Zentrale Patentabteilung KA D - 65174 Wiesbaden (DE)
Representative :	Neubauer, Hans-Joachim (authorised employee) Hoechst Aktiengesellschaft
Decision under appeal :	**Decision of the Opposition Division of the European Patent Office dated 4 April 1990 revoking European patent No. 0 096 596 pursuant to Article 102(1) EPC.**

Composition of the Board :

Chairman : G.D. Paterson
Members : U.G.O.M. Himmler
R.K. Shukla

Summary of Facts and Submissions

I. European patent No. 0 096 596 designating the Contracting States NL, BE, DE, FR, GB was opposed by the Respondent on the grounds mentioned in Article 100(a) EPC in combination with Articles 52(1), 54 and 56 EPC.

The following documents, which are identified using the same reference numerals as in the opposition proceedings, were relied upon by the Respondent:

D1 = EP-A-0 090 615
D2 = US-A-4 237 208
D3 = IBM Techn. Discl. Bull., Vol. 17, No. 6, (1974), pages 1600 to 1601
D4 = US-A- 4 244 799
D5 = Electrochem. Soc. Extn. Abstr., Vol. 76, No. 2, (1976), pages 743 to 744, Abstract No. 289
D6 = J.Vac.Sci.Technol., Vol. 19, No. 4, (1981), pages 872 to 880
D7 = US-A-4 004 044

D1 is comprised in the state of the art pursuant to Article 54(3) and (4) EPC with respect to the designated States DE, FR and GB. Of the documents which were cited outside the period specified in Article 99 EPC, only D6 was considered to be relevant by the Opposition Division and consequently introduced into the proceedings.

II. In the opposition proceedings, the Appellant (Patentee) filed two versions of independent Claim 1: one for the designated States NL and BE, and the other for the designated States DE, FR and GB.

III. The Opposition Division revoked the patent for all the designated States as lacking an inventive step.

Against this decision the Patentee lodged an appeal and requested cancellation of the decision and maintenance of the patent on the basis of the following documents:

Independent claims:	Claim 1 designated for the Contracting States BE and NL and submitted during oral proceedings on 2 March 1990, Claim 1 designated for the Contracting States DE, FR and GB and submitted during oral proceedings on 2 March 1990;
Dependent claims:	2 to 9 as filed with letter dated 23 January 1989;
Description:	(**α**) EP-B-0 096 596: column 1, line 1 to column 2, line 43; column 3, line 29, second word to column 17, line 32; column 18, lines 1 to 10; column 17, lines 47 to 65; column 18, line 43 to column 28, line 40; (**β**) pages 5, 6 and 35 as filed with letter dated 23 January 1989;
Figures:	sheet 1 of EP-B-0 096 596.

The Appellant requested oral proceedings in case the Board intended to issue an adverse decision.

IV. The Respondent (Opponent) requested rejection of the appeal.

In its letter of 14 January 1993, the Respondent indicated that it would not participate in oral proceedings, having presented all its objections in writing.

V. The two versions of independent Claims 1 respectively for **NL** + **BE** and **DE** + **FR** + **GB** read as follows:

For NL and BE:

"A method of forming a pattern in the manufacture of microelectric devices, the method comprising the steps of forming on an etchable substrate an organic polymer layer which can be etched by dry etching; forming on the organic polymer layer a resist film comprising a polymer having at least one substituted silyl group selected from trialkylsilyl-, dimethylphenylsilyl- and trialkoxysilyl groups; forming a desired pattern in the resist film by optical lithography, X-ray lithography or electron-beam lithography, the number of said substituted silyl groups in the patterned resist film being at least $10^{16}/cm^2$; etching the organic polymer layer by dry etching using an oxygen-containing gas with the patterned resist film as a mask; and etching the substrate with the unetched areas of the organic polymer layer as a mask."

For DE and FR and GB:

"A method of forming a pattern in the manufacture of microelectric devices, the method comprising the steps of forming on an etchable substrate an organic polymer layer which can be etched by dry etching; forming on the organic polymer layer a resist film comprising a polymer having at least one substituted silyl group selected from trialkylsilyl-, dimethylphenylsilyl- and trialkoxysilyl groups connected to the polymer backbone chain other than directly by their silicon atoms; forming a desired pattern in the resist film by optical lithography, X-ray lithography or electron-beam lithography, the number of said substituted silyl groups in the patterned resist film being at least $10^{16}/cm^2$; etching the organic polymer layer by dry etching using an oxygen-containing gas with the patterned resist film as a mask; and etching the substrate with the unetched areas of the organic polymer layer as a mask."

VI. The Opposition Division revoked the patent on the ground of lack of inventive step essentially for the following reasons:

Document D3 discloses a two-layer process wherein the top layer is an unspecified organosilicon polymer which is resistant to Reactive Ion Etching (RIE), and functions as a negative electron-beam resist developable with cyclohexane. The essential difference between the disclosure of document D3 and the subject-matter of the independent claims is the use of a resist film comprising a specifically defined polymer

> "having at least one substituted silyl group selected from trialkylsilyl-, dimethylphenylsilyl- and trialkoxysilyl groups".

Document D6 leads to resistant films of polymers as covered by the independent claims, since trimethylsilyl and dimethylphenylsilyl are explicitly disclosed therein, and the skilled person would realise that such polymers are useful in a two-layer process as disclosed in document D3.

The further feature that the minimum concentration of substituted silyl groups in the patterned resist film is at least $10^{16}/cm^2$, would readily be obtained by routine experiments without the exercise of inventive skill.

VII. The Respondent's arguments in support of his request for rejection of the appeal can be summarised as follows:

Document D3 merely left open which specific material was to be used as the organosilicon polymer layer. However, the skilled person could obtain information about suitable monomers from document D6. Those monomers - and consequently also the resulting polymers - comprise trimethylsilyl and dimethylphenysilyl groups as defined in Claim 1 of the patent in suit. Document D6 explicitly discloses these monomers as being polymerisable monomers. As both documents were concerned with the same technical field it was obvious for the skilled person to combine the teachings of D3 and D6.

VIII. The Appellant essentially contested that the skilled person would take into consideration document D6 when engaged in the problem of the two-layer process of document D3 which can be considered as the closest state of the art.

IX. In a communication pursuant to Article 11(2) RPBA accompanying the summons to oral proceedings, the Board discussed the subject-matter of the independent claims in connection with the question of inventive step having regard to the disclosures in D3 and D6.

X. In its response to the above communication, the Appellant highlighted the differences between the claimed invention and the prior art as disclosed in D6, and reiterated that a combination of the teachings of D6 with that of D3 was not obvious.

XI. The Board having considered the arguments submitted by the parties in writing came to the conclusion that the appeal was well founded, and consequently, allowable. Moreover, since the Respondent had informed the Board that it was not going to attend the oral proceedings, the latter were therefore cancelled.

Reasons for the Decision

1. In the Board's view the only documents relevant for the assessment of inventive step in the subject-matter of the independent Claims 1 are documents D3 and D6.

D3: This document is concerned with a **two-layer process** in which a semiconductor substrate 10 is first coated with a polymer layer 12. An organo silicon overlay polymer layer 14, which can be cross-linked by electron beam radiation is deposited on the surface of this polymer layer 12, and is selectively exposed to electron-beam radiation. The unirradiated areas are then developed by dissolving them in cyclohexanone. During the subsequent reactive ion etching using the patterned upper layer 14 as a mask, the cross-linked areas of the upper layer 14 are resistant to reactive ion etching, whereas the unmasked areas of the polymer layer 12 are removed by reactive ion etching. Thus the organo silicon polymer layer 14 works as a negative resist.

D6: This document refers to resist layer materials for X-ray lithography which are developable using a plasma. All of the discussed materials comprise a polymer host and a **polymerisable** monomer guest which is locked into the host by incident X-radiation. In part IV of the document monomer guest compounds are described which contain silyl groups as specified in Claims 1. All these silyl groups containing monomers are polymerised by breaking up the double bond when irradiated. The unexposed areas of the resist are removed by subjecting the resist to an oxygen plasma etching.

The main difference between the subject-matter according to the wording of Claim 1 and the subject-matter of D6 is that D6 starts with a mixture of a host polymer and a silyl group containing guest monomer as a resist. However, according to the wording of Claim 1 the resist layer comprises a polymer having at least one substituted silyl group. So it is clear from the wording of Claim 1 as well as from the examples in the description (cf. e.g. column 5, lines 50 ff, column 7, lines 55 ff, column 9, lines 23 ff, column 11, lines 32 ff) that the claimed method starts from a polymer as a resist and not from a monomer containing a silyl group.

2. *Inventive step*

The only issue to be considered in the present appeal is the question of inventive step in the subject-matter of the independent Claims 1 of both versions.

2.1 Claim 1 in the version for NL and BE:

The method according to Claim 1 is distinguished from that disclosed in D3 by the following features:

(a) the polymer of the resist film has at least one substituted silyl group; and

(b) the number of the substituted silyl group in the patterned resist film is at least $10^{16}/cm^2$.

Concerning the distinguishing feature (a), in the Board's view the use of the plasma-developed resist known from D6 as the upper layer 14 in the process according to D3 would not lead to the claimed subject-matter since the resist according to the teaching of D6 must include the silyl group as a monomer prior to X-ray irradiation. In the process as claimed, on the other hand, the resist film comprises a polymer with a substantial silyl group prior to irradiation.

Concerning the distinguishing feature (b), there is no disclosure of this feature in any of the cited documents. As is evident from the various examples and comparative experiments described, and as shown in Figure 1 in the application in suit, the minimum value of the silyl groups per unit area is of technical importance and merit because it gives a critical level of silicon in the patterned resist below which the resist is continuously eroded during the dry etching of the immediately underlying thick organic layer, but above which such erosion reduces to substantially zero so that the patterned resist remains an effective mask for the etching of the thick layer. The lower limit for the substituted silyl group as in feature (b), with a view to improving resistance to dry-etching, in the Board's opinion, is not rendered obvious by D6.

In view of the above considerations, in the Board's judgment, the subject-matter of Claim 1 in the version for NL and BE involves an inventive step within the meaning of Article 56 EPC.

2.2 Claim 1 in the version for DE, FR and GB also comprises the above-mentioned features (a) and (b), so that the above considerations are applicable to Claim 1 in this version as well, and the claimed subject-matter therefore involves an inventive step.

3. *Dependent Claims 2 to 9*

Dependent Claims 2 to 9 relate to specific embodiments of the methods as defined in the independent Claims 1 for the Contracting States NL and BE and for DE, FR and GB respectively, so that the dependent claims also contain patentable subject-matter.

Order

For these reasons, it is decided that:

1. The decision of the Opposition Division is set aside.

2. The case is remitted to the first instance with an order to maintain the patent in amended form with the documents as identified under point III of this decision.

The Registrar: The Chairman:

M. Beer G.D. Paterson