

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 E C I S I O N**  
**of 22 September 1994**

**Case Number:** T 0670/93 - 3.4.1

**Application Number:** 89200843.4

**Publication Number:** 0336514

**IPC:** H01L 21/603

**Language of the proceedings:** EN

**Title of invention:**

Method of providing a semiconductor body on a support

**Applicant:**

N.V. Philip's Gloeilampenfabrieken

**Opponent:**

-

**Headword:**

-

**Relevant legal provisions:**

EPC Art. 56

**Keyword:**

"Inventive step: (after introducing a disclaimer, yes)"

"Internal prior art disregarded"

**Decisions cited:**

T 0301/87, T 559/90, T 0946/92

**Catchword:**

-



Case Number: T 0670/93 - 3.4.1

**D E C I S I O N**  
of the Technical Board of Appeal 3.4.1  
of 22 September 1994

**Appellant:** N.V. Philips' Gloeilampenfabrieken  
Groenewoudseweg 1  
NL-5621 BA Eindhoven (NL)

**Representative:** Tangena, Antonius Gerardus  
INTERNATIONAAL OCTROOIBUREAU B.V.  
Prof. Holstlaan 6  
NL-5656 AA Eindhoven (NL)

**Decision under appeal:** Decision of the Examining Division of the European  
Patent Office dated 30 April 1993 refusing  
European patent application No. 89 200 843.4  
pursuant to Article 97(1) EPC.

**Composition of the Board:**

**Chairman:** G. D. Paterson  
**Members:** H. J. Reich  
R. K. Shukla

### Summary of Facts and Submissions

- I. European patent application No. 89 200 843.4 (publication No. 0 336 514) was refused by a decision of the Examining Division.
- II. The reason given for the refusal was that the subject-matter of the single claim as filed did not satisfy the requirements of Articles 52 and 56 EPC having regard to the known method defined in the preamble of the claim, and the following documents:

D1: IBM Technical Disclosure Bulletin, Vol.30, No. 7, December 1987, pages 208 to 209; and

D2: EP-A-0 048 768.

The Examining Division took the following view.

Document D1 discloses the advantages of using rough metal surfaces in thermo-compression bonding and also the formation of such rough surfaces during deposition, i.e. by a particular kind of deposition process of the metal, such as electroplating. Although document D1 concerns bonding of a metal beam lead to a metal contact pad as an example, the teaching of document D1 is generally applicable. It is within the competence of a skilled person to use other processes to form metal layers that produce rough surfaces as well, especially if a surface created by electroplating does not have the necessary degree of roughness required in order to avoid an additional roughening step. Since the suitability of spraying as a process for the deposition of metal layers with rough surfaces is disclosed in the soldering method according to document D2, a skilled person would routinely find a solution to the problem of avoiding the

conventional additional roughening step in the conventional method indicated in the introductory part of the description, from the teachings of documents D1 and D2.

III. The Appellant lodged an appeal against the decision

IV. In a communication annexed to a summons to oral proceedings the Board informed the Appellant of its provisional view that the subject-matter of the original claim might be regarded as obvious in view of documents D1,

D3: GB-A-2 067 117

and the generally known properties of electroplating and flame spraying of aluminium layers derivable from documents:

D4: Winnaker-Küchler: "Chemische Technologie", Bd.4, Carl Hanser Verlag, München 1986, pages 684 to 686;

D5: McGraw-Hill: "Encyclopedia of Science and Technology" 1982, Vol.4, pages 808;

D6: "Ullmans Encyklopädie der Technischen Chemie", Bd.12, Verlag Chemie, Weilheim 1978, page 168; and

D7: McGraw-Hill: "Encyclopedia of Science and Technology" 1982, Vol.8, page 398.

V. Oral proceedings were held on 22 September 1994, at the end of which the Appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of:

1. Description and drawings as filed and according to EP 0 336 514 A1,
2. A single claim as filed during the oral proceedings.

VI. This single Claim reads as follows:

"A method of providing a semiconductor body on a support with the interposition of a metal layer of aluminium, in which the adherence is effected in that the semiconductor body and the support are pressed against each other during the supply of heat at the area of the metal layer, characterized in that the metal layer of aluminium is applied to the support by flame spraying, and in that surface of the semiconductor body on which the support is pressed has no metal layer upon it."

VII. In support of his request the Appellant made essentially the following submissions:

- (a) The method defined in the preamble of Claim 1 and the corresponding technical statements in the introductory part of the description form an internal prior art which was not available to the public before the priority date of the present application. Therefore it has to be disregarded in examining inventive step; see also decisions T 301/87; T 559/90 and T 946/92. Hence, before the priority date of the present invention a skilled person did not know, that an aluminium layer which is provided with notches, has an increased deformability which promotes the adhesion of the aluminium layer to the semiconductor body.

- (b) The method defined in the preamble of the claim is disclosed in document D3 which forms the closest prior art. This known method has the disadvantage that two aluminium layers must be applied, one on the semiconductor body and one on the support. The present invention avoids this disadvantage in that aluminium is deposited only on the support by flame spraying.
- (c) Document D1 does not disclose the use of aluminium, and teaches to increase adhesion of two metal surfaces by providing on both the surfaces the same roughness of 1 to 2  $\mu\text{m}$  so that they mate together and the initial area of intimate contact, plastic deformation and solid state diffusion are enhanced; see document D1, page 209, paragraph 2. Since semiconductor material does not show any plastic deformation or solid state diffusion under thermo-compression conditions, document D1 would represent a remote field of technology which is not relevant to the present invention.
- (d) Using the teaching of document D1 in bonding a semiconductor body to a metal layer, a skilled person would continue to electroplate a metal onto the substrate until the resulting roughness of 1 to 2  $\mu\text{m}$  is obtained so as to make the deposited metal with a lapped and etched back surface of a semiconductor body having an identical roughness value. Document D1 does not suggest to improve bonding by providing on one surface a 50 times higher roughness, such as 50 to 100  $\mu\text{m}$  obtained by flame spraying.
- (e) In the method disclosed in document D2, a flame sprayed Cu, Ni, Sn or Ag layer contacts an Sn-Pb-solder layer which is interposed between the plasma

sprayed metal layer and the semiconductor body. Soldering being a technique which is essentially different from thermo-compression bonding, document D2 does not provide a hint to a skilled person to use a flame sprayed metal layer in thermo-compression bonding. Also documents D4 to D7 are silent about such use.

- (f) Since the surface of an aluminium layer is always covered by a hard oxide layer, a skilled person would not expect that the compression of a rough aluminium surface may result in an appropriate contact area, and therefore would not even have any incentive to make use of aluminium in the method disclosed in document D1.

VIII. At the conclusion of the oral proceedings, the decision was announced that the decision of the Examining Division is set aside and that the case is remitted to the first instance with the order to grant a patent with the text as requested by the applicant.

### **Reasons for the Decision**

#### 1. *Amendment*

In order to distinguish the invention more clearly from the cited prior art, the present single claim comprises in addition to its wording as originally disclosed, the feature:

"and in that the surface of the semiconductor body on which the support is pressed has no metal layer upon it."

The application as filed is concerned with the bonding of a "semiconductor body" to a support. In its context the term "semiconductor body" is clearly intended to refer to a body of semiconductor material, without any additional metal layer on it. The above amendment clarifies that the claimed invention is concerned solely with such an arrangement, and is therefore allowable under Article 123(2) EPC.

2. None of the documents cited in the European Search Report discloses a thermo-compression bonding method wherein a surface of a semiconductor body which has no metal layer upon it, is pressed on an aluminium layer which is deposited on a substrate by flame spraying. Thus, the subject-matter of the claim is considered to be novel in the sense of Article 54 EPC.
3. *Inventive step*
- 3.1 The Board agrees with the Appellant's submission in paragraph VIII-(a) in that the description, column 1, lines 1 to 23 represents internal state of the art. There is no evidence on file that the corresponding subject-matter was available to the public. Hence, for examining inventive step, document D3 forms the closest prior art and discloses the method as defined by the preamble of the claim, i.e.

"a method of providing a semiconductor body (see D3, 3 in the Figure) on a support (1) with the interposition of a metal layer of aluminium (2; page 1, lines 58 and 59), in which the adherence is effected in that the semiconductor body and the support are pressed against each other during the supply of heat at the area of the metal layer (page 1, lines 38 to 40)":



3.2 Starting from the closest prior art disclosed in document D3, the objective problem underlying the present invention is to technically simplify this conventional method.

3.3 The problem is solved in that:

- (a) "the surface of the semiconductor body on which the support is pressed has no metal layer upon it"; and
- (b) "the metal layer of aluminium is applied to the support by flame spraying".

3.4 Document D3 teaches diffusion bonding between a thin aluminium layer coated on the relevant surface of the semiconductor body by vacuum evaporation and subsequent firing, and the surface of an aluminium thick film on a substrate. Hence, adhesion is achieved between two metal surfaces of the identical material. Document D1 also concerns thermo-compression bonding of two metal surfaces. There is no evidence on file, that it was known to the skilled person before the priority date of the present invention that it is indeed feasible to adhere a metal surface directly to a semiconductor surface by thermocompression bonding. In the Board's view, since the prior art explains the adhering effect to be produced by solid state diffusion between the two metal surfaces pressed together, a skilled person has no reason to dispense with the conventional thin aluminium film on the semiconductor surface when the aluminium surface on the support has an appropriate roughness with a view to producing a satisfactory bond.

3.5 In the soldering method disclosed in document D2, aluminium is not mentioned at all and adhesion to the semiconductor surface is realised via a liquid Pb-Zn -

phase, from which no conclusions can be drawn as to the adhesive properties of solid aluminium with regard to semiconductor material.

3.6 In the conventional method of document D3 adhesion to the semiconductor material is realised by **metallic** aluminium evaporated onto the semiconductor surface under vacuum conditions. Though a skilled person may conclude therefrom that the vacuum avoids oxidation almost completely and semiconductor material and metallic aluminium adhere to each other, the Board regards it not obvious for a skilled person to realise an adhesive semiconductor-metallic aluminium contact by a direct thermocompression bond of a semiconductor surface to a flame sprayed aluminium layer having an oxidised surface. The generally known properties of flame sprayed aluminium layers disclosed in document D4 to D7 essentially deal with surface roughness and are totally silent about the adhesion forces exercised by the resulting surfaces. In the Board's view, a skilled person would not foresee that in thermocompression bonding the elastic deformation of the extremely rough aluminium surface such as known to result from flame spraying, cracks the oxide layer and makes its influence in impeding adhesion negligible, so that a sufficiently large contact area between metallic aluminium and semiconductor material may be realised.

3.7 As indicated in detail above - excluding the statements in the description of the application with regard to its technical starting point from the examination of inventive step as an internal prior art; see paragraph 3.1 above - the Board holds it to be not obvious to a skilled person to simplify bonding of a semiconductor body on a support according to distinguishing feature (a) in paragraph 3.3 above by the measure claimed in distinguishing feature (b).

3.8 For the above reasons, the subject-matter of the claim is considered to involve an inventive step in the sense of Article 56 EPC.

4. Thus, the single claim is allowable under Article 52(1) EPC.

**Order**

**For these reasons it is decided that:**

1. The decision of the Examining Division is set aside.
2. The case is remitted to the first instance with the order to grant a patent with text as requested by the applicant (see paragraph V).

The Registrar:

The Chairman:

M. Beer

G. D. Paterson

