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Aktenzeichen / Case Number / N° du recours : T 109/87 - 3.3.1

Anmeldenummer / Filing No / N° de la demande : 84 200 668.6

Veröffentlichungs-Nr. / Publication No / N° de la publication : 0 125 730

Bezeichnung der Erfindung: Copper metallization for dielectric materials  
Title of invention:  
Titre de l'invention :

Klassifikation / Classification / Classement : C23C 17/00

**ENTSCHEIDUNG / DECISION**  
vom / of / du 22 April 1988

Anmelder / Applicant / Demandeur : Centralab Inc.

Patentinhaber / Proprietor of the patent /  
Titulaire du brevet :

Einsprechender / Opponent / Opposant :

Stichwort / Headword / Référence : Metallization/Centralab

EPÜ / EPC / CBE Article 56

Kennwort / Keyword / Mot clé : "Inventive step - disregard of features considered to be essential in the prior art"

Leitsatz / Headnote / Sommaire

Europäisches  
Patentamt  
Beschwerdekammern

European Patent  
Office  
Boards of Appeal

Office européen  
des brevets  
Chambres de recours



Case Number : T 109/87 - 3.3.1

**D E C I S I O N**  
of the Technical Board of Appeal 3.3.1  
of 22 April 1988

**Appellant :** Centralab Inc.  
5855 North Glen Park Road  
Milwaukee, Wisconsin 53201 (US)

**Representative :** Pennings, Johannes Franciscus Maria  
International Octrooibureau B.V.  
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**Decision under appeal :** Decision of Examining Division 018  
of the European Patent Office  
dated 18 February 1987 refusing  
European patent application  
No. 84 200 668.6 pursuant to  
Article 97(1) EPC

**Composition of the Board :**

**Chairman :** K.J.A. Jahn  
**Members :** R.W. Andrews  
C.V. Payraudeau

## Summary of Facts and Submissions

- I. European patent application No. 84 200 668.6, filed on 10 May 1984 and published on 21 November 1984 (publication No. 0 125 730) claiming priority of 13 May 1983 from a prior application filed in the United States of America, was refused by a decision of the Examining Division 018 of the European Patent Office dated 18 February 1987. The decision was based on the claim filed 25 October 1986.
- II. The stated ground for the refusal was that the subject-matter of this claim did not involve an inventive step in the light of the disclosure in US-A-2 993 815 (1). The Examining Division considered that the problem underlying both the application-in-suit and this closest prior art was to provide a method of applying a copper metallization on a dielectric or semiconductor body. The only difference between the solution to this problem now proposed and that disclosed in document (1) lay in the temperature at which the first firing of the coated body in an oxidising atmosphere was carried out. The Examining Division considered that a skilled person following the teaching in document (1) and experimenting within the scope of normal laboratory practice to obtain the optimum conditions for the first firing step might well vary the temperature of this step upwardly or downwardly by 50°C or more and thus arrive at the claimed subject-matter without the exercise of any inventive skill or insight.
- III. An appeal was lodged against this decision on 11 March 1987, together with the statement of grounds enclosing an amended statement of claim and payment of the appropriate fee.

The Appellant argued that the purpose of the first firing step in the prior art process was not only to volatilize the fluid suspending vehicle but also to commence the formation of a refractory substrate-to-glass-to-copper oxide bond by at least partially sintering the glass frit. In the present process, even if the glass frit is present, the first firing step is carried out at a temperature below the melting temperature of the glass frit so that no adhesion is formed between the paste comprising copper oxide, glass frit and organic vehicle and the body to which said paste is applied. In view of the requirement in the prior art method that the glass frit must be at least partially sintered a skilled person would not readily use temperatures for the first firing step below the sintering temperature of the glass frit. The present method is a non-obvious improvement over the prior art method as represented by document (1) since it involves a reduced number of steps, the use of glass frit is optional and there is a reduced susceptibility to cracking.

- IV. With a reply to a communication from the Board of Appeal the Appellant submitted an amended statement of claim and three amended pages of the description.

The Appellant requests that the decision under appeal be set aside and a patent granted on the basis of the amended Claims 1 and 2 and page 3 filed on 11 March 1988 further amended as agreed by telephone and confirmed in writing on 21 April 1988, pages 2 and 9 of the description filed on 11 March 1988, pages 1, 4 to 8 and 10, filed on 22 May 1986 and Figure 1 as originally filed. The present Claims 1 and 2 read as follows:

"1. A method of providing a copper metallization on a dielectric or semiconductive body or a body consisting of alternate layers of a dielectric or a semiconductor and

base metal electrode, comprising mixing copper oxide powder and a reduction-resistant glass frit, said mixture having at most 15% by weight of glass frit, dispersing the mixture in a solution of an organic vehicle in a solvent to produce a paste, applying the paste to the body and drying it to remove the solvent, first firing the coated body in an oxidising atmosphere and firing the coated body a second time after the first firing in an atmosphere which is reducing as to the copper oxide, said second firing being at a temperature from 700 to 1050°C for from 5 to 120 minutes to convert the copper oxide to metallic copper and to form a bond between the copper metal and the body, characterized in that the first firing is carried out at a temperature of from 200 to 450°C during a time sufficient to remove all or part of the organic vehicle.

2. A method of providing a copper metallization on a dielectric or semiconductive body or a body consisting of alternate layers of a dielectric or a semiconductor and base metal electrode, comprising producing a paste consisting essentially of copper oxide powder dispersed in a solution of an organic vehicle in a solvent, applying the paste to the body and drying it to remove the solvent, first firing the coated body in an oxidizing atmosphere at a temperature of from 200 to 450°C during a time sufficient to remove all or part of the organic vehicle and firing the coated body a second time after the first firing in an atmosphere which is reducing as to the copper oxide, said second firing being at a temperature from 700 to 1050°C for from 5 to 120 minutes to convert the copper oxide to metallic copper and to form a bond between the copper metal and the body".

**Reasons for the Decision**

1. The appeal complies with the requirements of Articles 106 to 108 and Rule 64 EPC and is, therefore, admissible.
2. There are no formal objections to the current version of the claims since they are adequately supported by the original disclosure. Claim 1 represents a combination of Claims 1 and 4 as originally filed and Claim 2 a combination of Claims 11 and 14 as originally filed. The expression "a body consisting of alternative layers of a dielectric or semiconductor and base metal electrode" in both claims finds support in original Claim 17 and on page 8, lines 33 to 37 of the original description. The description has been amended to bring it into agreement with the amended statement of claim.
3. The application relates to a process for providing a copper metallization on a dielectric or semiconductive body or a body consisting of alternative layers of a dielectric or semiconductor and base metal electrode. A process for forming a conductive copper layer is disclosed in document (1). This prior art process comprises applying a paste consisting of copper oxide and a glass frit dispersed in a volatile and decomposable fluid suspending medium to a refractory body, firing the coated body in an oxidising atmosphere until said glass frit is partially sintered and wets the refractory substrate and said suspending medium is volatilized and then firing said body in a reducing atmosphere until sintering of the glass frit is completed (cf. Claim 1). The first firing is carried out at temperatures ranging from, for example, 500° to 1050°C; a temperature of 750°C being preferred. The firing in the

reducing atmosphere is performed at temperatures ranging from, for example 600°C to 1050°C, preferably at a temperature of 850°C (cf. column 4, lines 4 to 15 and 25 to 39).

In the light of this closest prior art the technical problem underlying the application in suit may be seen in providing an alternative process for applying a copper metallization to a dielectric or semiconductive body by which a satisfactory bond is formed between the copper metallization and the dielectric or semiconductive body.

According to the patent application this problem is essentially solved by applying a paste consisting of copper oxide powder and optionally up to 15% by weight of a glass frit dispersed in a solution of an organic vehicle in a solvent to a dielectric or semiconductive body or a body consisting of alternate layers of a dielectric or semiconductor and base metal electrode, drying the coated body to remove the solvent, firing it in an oxidising atmosphere at a temperature of 200°C to 450°C to remove all or part of the organic vehicle, and then firing the body in an atmosphere which is reducing as to the copper oxide at a temperature of 700° to 1050°C for from 5 to 120 minutes.

In the light of the Examples the Board is satisfied that the technical problem as defined above is plausibly solved.

4. After examination of the cited prior art the Board has reached the conclusion that this technical teaching is not disclosed and the claimed subject-matter is, therefore, novel. Since novelty is not disputed it is not necessary to consider this matter in detail.

5. It still remains to be examined whether the requirement of inventive step is met by the claimed subject-matter.
- 5.1. Document (1) clearly teaches that the minimum temperature for the first firing step is determined by the volatilization temperature of the suspending medium used to form the paste from the copper oxide and glass frit and the temperature required to commence formation of the refractory substrate-to-glass-to-copper oxide bond. This bonding temperature is dependent upon the temperature required to partially sinter the glass and to cause wetting of the refractory substrate and at least part of the copper oxide by the glass (cf. column 3, line 75 to column 4, line 8). Thus, the skilled person would conclude from the disclosure of this document that it is absolutely essential to at least partially sinter the glass frit in the first firing step in an oxidising atmosphere in order to obtain a satisfactory bond between the copper metallization and the refractory substrate.

However, in the process according to the present Claim 1 the maximum temperature of the first firing step is selected to be below the melting or softening temperature of the glass frit (cf. page 6, lines 30 to 34 of the application). The sole purpose of this first firing being to remove all or part of the organic vehicle used to prepare the paste from the copper oxide and glass frit (cf. page 6, lines 27 to 30 of the application). The bond between the copper metallization and dielectric or semiconductive body is only formed during the final firing step in an atmosphere which is reducing as to the copper oxide at temperatures in the range of 700° to 1050°C.

Since it was considered to be absolutely essential to partially sinter the glass frit in the known process, a skilled person, in seeking a solution to the above-defined



technical problem, would not have considered ignoring this mandatory requirement of the prior art process to arrive at the present solution. Therefore, in the Board's judgement the subject-matter of the present Claim 1 involves an inventive step.

- 5.2. Although the use of glass frit appears to create strains at the metallization-substrate interface which sometimes results in cracks in the dielectric upon thermal cycling and the glass frit is vulnerable to chemical attack which may occur during subsequent processing of the component, its presence in the paste used to coat the refractory substrate was, nevertheless, regarded as essential in the prior art process for the formation of a satisfactory bond between the copper metallization and dielectric or semiconductive body. Therefore, it must be considered surprising that a solution to the technical problem underlying the application in suit of providing an alternative process for applying a copper metallization to a dielectric or semiconductive body or a body consisting of alternate layers of a dielectric or semiconductor and a base metal would lie in the omission of an ingredient which was considered to be absolutely necessary for obtaining satisfactory results using the prior art process. Thus, in the view of the Board, the subject-matter of the present Claim 2 also involves an inventive step.

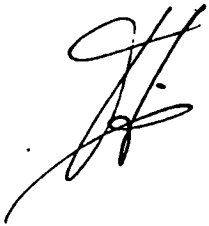
#### Order

For the above reasons, it is decided that:

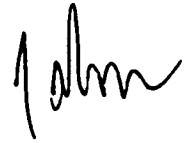
1. The decision under appeal is set aside.

2. The case is remitted to the Examining Division with the order to grant a patent on the basis of the amended Claims 1 and 2 and page 3 filed on 11 March 1988 further amended as agreed by telephone and confirmed in writing on 21 April 1988, pages 2 and 9 of the description filed on 11 March 1988, pages 1, 4 to 8 and 10 of the description filed on 22 May 1986 and Figure 1 as originally filed.

The Registrar:



The Chairman:



R.A.  
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