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D E C I S I O N
of 19 February 2003

Case Number: T 1225/01 - 3.4.2

Application Number: 90916807.2

Publication Number: 0480038

IPC: H05K 3/02, H05K 3/06, H05K 3/38

Language of the proceedings: EN

Title of invention:
Ceramic circuit board

Patentee:
DENKI KAGAKU KOGYO KABUSHIKI KAISHA

Opponent:
Curamik electronics GmbH

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step - confirmed"

Decisions cited:
-

Catchword:
-

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Case Number: T 1225/01 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 19 February 2003

Appellant: (Opponent)
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Respondent: (Proprietor of the patent)
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Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted 29 August 2001 rejecting the opposition filed against European patent No. 0 480 038 pursuant to Article 102(2) EPC.**

Composition of the Board:

Chairman: E. Turrini
Members: A. G. M. Maaswinkel
B. J. Schachenmann

Summary of Facts and Submissions

I. The appellant (opponent) lodged an appeal, received on 24 October 2001, against the decision of the opposition division, dispatched on 29 August 2001 to reject the opposition against the European patent No. 0 480 038 (application No. 90 916 807.2). The fee for the appeal was paid on 24 October 2001. The statement setting out the grounds of appeal was received on 13 December 2001.

II. Opposition had been filed against the patent as a whole on the basis of Article 100(a) EPC, and in particular on the grounds that the subject-matter of the patent was not patentable within the terms of Articles 52 to 57 EPC because it did not involve an inventive step. To support their objections the opponents referred *inter alia* to the following documents:

(D2) DE-C2-23 19 854

(D4) EP-A-0 153 618

(D12) Handbuch der Leiterplattentechnik, Eugen G. Leuze Verlag, second edition, 1982, pages 168 to 173 and page 276.

During the appeal proceedings the parties also made reference to the following documents:

(D13) JP-A-60 177 634, including the corresponding Patent Abstract of Japan and a partial translation filed with by the respondents with a letter of 14 February 2003;

(D14) EP-A-0 115 158, which had been cited during the

examination procedure.

III. On 19 February 2003 oral proceedings were conducted at the requests of both parties.

IV. At the oral proceedings the appellants requested that the decision under appeal be set aside and that the patent be revoked.

V. The respondents requested that the appeal be dismissed and that the patent be maintained as granted, or on the basis of the auxiliary request including claims 1 to 19 filed with the letter dated 15 January 2003.

VI. The wording of independent claim 1 of the main request reads as follows:

"A method for producing a ceramic board, characterized by bonding a metal plate onto a ceramic board through an active metal ingredient-containing brazing material, etching said metal plate to form a metal circuit pattern and removing an unnecessary part of the brazing material by chemical liquor treatment."

Claims 2 to 25 of the main request are dependent claims. The claims of the auxiliary request are not relevant to the present decision.

VII. The arguments of the appellants may be summarised as follows.

The subject-matter of claim 1 of the main request relates to a method for producing a ceramic circuit board in which a metal plate is bonded to a ceramic circuit board through a brazing material containing an

active metal ingredient. This technology was well known at the priority date of the patent in suit and is, for instance, disclosed in documents D4 and D13. As discussed in D4, an important application of this technology relates to the bonding of metal plates onto aluminium nitride (AlN) ceramic substrates, since for this substrate material the direct copper bonding (DCB) technique is not recommended because of the inferior wettability of AlN with brazing materials, see page 2, last paragraph of D4. Therefore the closest prior art for the question of inventive step is the general disclosure of this technique on page 3, second paragraph of D4, where the joining of an AlN substrate and a Cu member by interposing a brazing material including an active metal (Ti, Zr, Hf) is disclosed. Documents D4 and D13 also include an embodiment relating to the production of a patterned metal wiring sheet on the basis of the same technology. In these embodiments, see Figure 2 of D13, the patterned circuit boards are produced by depositing an active metal layer (13) onto plural Cu members (12) and bonding these onto the AlN substrate (11). Because of the plurality of Cu members this is a rather complex method. The technical problem underlying claim 1 of the patent in suit with respect to the general bonding technique known from D4 and the embodiments described in this document and in D13 can therefore be seen in simplifying the production of Cu wiring sheets on AlN ceramic boards. The standard technique for obtaining wiring sheets, known since as early as 1978 as documented by the textbook D12, is by photoetching the desired circuit pattern into the Cu layer. Furthermore document D2, column 10, lines 19 to 29, discusses in the context of the DCB-technique that masking and etching techniques should be carried out *after* the

desired bond has been established, because otherwise the already structured wiring sheets would have to be handled before the bonding, which was quite problematic in view of the size of the individual structures. Therefore this document not only mentions the problem underlying the claimed subject-matter but also indicates the solution.

The argument by the proprietors that according to the claimed method there were two separated etching and removing steps, wherein the etching was for patterning the Cu layer and in a second step the brazing material was removed, is not persuasive, because this does not exclude that both materials are removed together. Furthermore, if the skilled person in carrying out photoetching of the bonded Cu layer in order to form the circuit pattern observed that there were still remnants of the brazing material between the Cu members after the etching, he would of course know that these must be removed for avoiding short circuits in the finished ceramic circuit board. Therefore the method defined in claim 1 does not involve an inventive step, because firstly the claim language allows for removal of the material in one step or using one compound; and, if the problem is to be seen in the remaining brazing material on the ceramic surface causing short-circuits, the claim does not define a solution for this technical problem but merely repeats the problem by stating that this material must be removed without defining a concrete method step *how* this is carried out. Finally, should the skilled person confronted with the problem of removing the remnants of the brazing material have had some reservation in considering applying chemical agents which are aggressive and environmentally problematic, the only teaching of the patent is that

one should do this just the same, which, of course, is not an invention.

VIII. The arguments of the respondents may be summarised as follows.

The problem underlying the patent in suit is the problem of mass production of wiring boards on ceramic substrates and improving its productivity. Documents D4 and D13 cited by the appellants are documents from the same applicant with the same priority date and are overlapping in their disclosures. It is noted that document D14 is also a document from the same company and dates from the same time period. It therefore illustrates the technical background in this field. In particular document D14 teaches a DCB method of bonding a ceramic substrate with an eutectic Cu layer and thereafter etching the Cu layer for obtaining a wiring circuit. For the discussion of inventive step of the present invention the passage on page 3, line 24 to page 4, line 2 of D14 is highly relevant, where it is stated: "*The etching process is possible because only etchable copper is on the ceramic plate. There is no non-etchable molybdenum paste or brazing paste disposed between the copper and the ceramic as in prior art arrangements*". This shows that at the priority date of document D14, and equally of the documents D4 and D13, the etching of Cu layers *after* bonding the Cu layer onto a ceramic substrate was only exceptionally carried out, namely in connection with the DCB technique, because the problem of non-etchable brazing paste does not exist with the DCB technique. The problem of excess brazing paste overflowing out of the Cu members is also mentioned in D4 on page 3, lines 30 to 31, whence this document teaches to keep the brazing layer as thin as

possible. Furthermore this problem in the production of a printed wiring board is avoided in D4 by first forming the wiring board structure, then depositing a very thin layer of active metal (Ti) and brazing material (Ag) and subsequently joining the plural Cu sheets to the ceramic substrate. The present invention resides in the finding that it is possible to eliminate the remnants of the brazing layer by chemical liquor treatment in a second step without negative consequences for the Cu structure etched in a first step. This is counterintuitive, since the Cu layer is more easily etchable than the active metal containing brazing layer. The skilled person would therefore have feared that removing the brazing remnants would be detrimental to the already etched Cu wiring structure. This unexpected effect is obtained by the method steps of claim 1 according to which, after the bonding of the metal plate to the ceramic substrate, in a first step the metal layer is treated with an etching agent; and in a subsequent second step the remnants of the brazing material are eliminated with a chemical liquor compound. This sequence of steps is clearly disclosed in the patent specification, see page 5, the passage between lines 39 and 47 (first step); and the passage on the same page, starting at line 49 (second step). Since in the prior art there is no disclosure or not even a suggestion that the active metal containing brazing material can be eliminated, it is not necessary to define in the independent claim explicitly the chemical agents to be used, because the core of the invention lays in the two-step method, whereas the agents are disclosed in the patent specification. With the claimed method ceramic circuit boards can be manufactured in a mass production which is a further indication of inventive step.

Reasons for the Decision

1. The appeal is admissible.

Main request

2. *Inventive step*.

2.1 The patent in suit relates to a method for producing a circuit board comprising a metal plate bonded onto a ceramic substrate through a brazing material including an active metal ingredient. In the decision under appeal the opposition division had considered that the closest prior art is disclosed in document D4. The parties have equally based their analyses on this document with the reservation that the appellants mainly referred to page 3, 2nd paragraph of document D4 which in their submission is the general disclosure of the technique in question.

2.2 Document D4 in its broadest disclosure teaches a method of bonding a ceramic aluminium nitride substrate and a copper member by interposing an active layer with a thickness of 0.5 to 10 µm comprising silver and an active metal (see claim 1 of D4). The method defined in claim 1 of the patent in suit relates to the particular type of ceramic *circuit* boards in which the metal member is a wiring or circuit pattern. Document D4 discloses several examples of manufacturing a ceramic circuit board comprising a ceramic substrate and a Cu wiring sheet. Therefore the skilled person wishing to manufacture a circuit board of this type would as a matter of course consult the *entire* document D4 and in particular those parts disclosing the manufacturing

steps in detail, and not only the part of D4 teaching the general bonding technique of a ceramic substrate and the metal member.

2.3 In the Examples disclosed in D4, the circuit board is obtained by starting from *plural* sheets of Cu member (Examples 1 to 5); or by first forming a Cu wiring sheet by *photoetching* a sheet into the predetermined shape (Example 6); or by first forming a Cu wiring sheet by *blanking* processing a Cu sheet into the predetermined shape (Example 7). These examples have in common that the shape of the Cu wiring structure is formed *before* bonding the wiring sheet to the ceramic substrate, the final step of the manufacturing process being the bonding.

2.4 The subject-matter of claim 1 of the main request differs from the method of producing a ceramic circuit board disclosed in D4 by the features that the original metal plate is firstly bonded to the ceramic substrate plate and in a second step the metal plate is structured by etching and the unnecessary part of the brazing material is removed.

2.5 The objective problem solved by claim 1 of the patent in suit can therefore be seen as providing an alternative manufacturing process to the known method.

2.6 According to the appellants, the person skilled in the art would, in view of the complexity involved in the particular technique in D4 of handling a plurality of prestructured Cu sheets, consider modifying this method by first joining the AlN ceramic substrate and the original Cu member as disclosed on page 3, second paragraph of D4, before applying the standard technique

of photoetching as, for instance, disclosed in document D2, column 10, lines 19 to 29. He would then be aware that any remaining brazing remnants must, of course, be removed from the etched circuit board structure. In addition, in the appellants' submission the method steps defining this measure in claim 1 did not contribute to an inventive step because they were open to interpretation and did not define a clear solution.

2.7 It is common ground that prior to the priority date of the patent in suit photoetching was a widely known technology in the art of manufacturing circuit boards, as for instance documented in the textbook D12. Furthermore document D2 indeed teaches to apply this technique *after* joining the metal with the nonmetallic substrate. However, the joining technique applied in this document is based on forming an eutecticum between the metal and a reactive gas, and therefore provides a direct bond according to the so-called DCB technology. In this technology, the problem of brazing including an active metal forming disturbing remnants by reacting with the ceramic substrate does not exist. This is confirmed by the passage in document D14 cited by the respondents, according to which the etching process is only possible because molybdenum (*which is an active metal*) or brazing paste are not present.

2.8 In the opinion of the board it is therefore not *a priori* plausible that the skilled person *would* consider modifying the process of manufacturing a ceramic circuit board as disclosed in document D4 in Examples 1 to 6, in particular because this document teaches three different ways of preparing the Cu wiring member which all have to be carried out *before* bonding it to the

ceramic substrate. In this respect the teaching of D4 is quite unambiguous.

2.9 On the assumption that the skilled person would nevertheless attempt to first join a metal member with a ceramic substrate and then to apply the known method of photoetching using the usual etching agents to form the wiring pattern in the metal layer he would be faced with a patterned circuit board with remnants of the brazing material between the etched parts, i.e. with a useless product. For the typical person skilled in the art, this finding together with the teaching of D4 that the circuit wiring preparation of the metal layer should be carried out *before* the bonding would be a convincing argument against reversing the etching and bonding sequence.

2.10 In any case, the skilled person would find that first carrying out a bonding step and subsequently a photoetching step as known from the DCB technology would lead to a poor product. Furthermore, since in the prior art on file no teaching can be found as how to remove such brazing remnants in a technically feasible way he would also not have any further impetus to pursue the method of document D4 with reversing its process steps.

2.11 Therefore in the assessment of the board, although the skilled person might in principle contemplate reversing the process steps in the method disclosed in D4 since the reverse steps are also carried out in the related DCB technology, he would after trying out this alternative process discard it because of the disappointing result and the remaining problem, for which, furthermore, no simple solution was available in

the literature.

3. As noted in point 2.6 *supra*, in the opinion of the appellants claim 1 does not define the solution to the technical problem in terms of concrete technical features. During the oral proceedings the appellants furthermore argued that the sequence of steps and the use of two different chemical agents are not unambiguously defined in the claim so that no argument in favour of inventive step can be deducted therefrom.

3.1 Apart from the fact that lack of clarity is no ground for opposition, the board does not share this view as far as inventive step is concerned. Claim 1 of the patent in suit defines a manufacturing method. The sequence in which the method steps are defined in the claim (*bonding; etching; removing*) is quite clear, and there is no serious doubt about the skilled person not having problems in understanding their chronological order. Furthermore, even should he have the slightest doubt he would find ample support for the chronological sequence of steps throughout the patent specification.

3.2 The board can also not agree with the objection that the claim was silent about a concrete method step as to *how* the brazing remnants are removed, and that the claim did not define therefore a solution, which definition was required for establishing an inventive step. The board disagrees because the claimed invention is not confined to the single step of "removing brazing remnants from a ceramic surface" but refers to a modification of a prior art manufacturing process and *in addition* provides this particular step in the modified process whereby a ceramic circuit board of good quality is obtained. Furthermore, in the opinion

of the board it is not correct to assume that claim 1 did not define any restrictions with respect to the compounds to be used. The first compound should be an agent for etching the metal; the second compound should have the property of removing the unnecessary part of the brazing material. Therefore, since the invention rather resides in the finding that two agents can be used in sequence, the first to be selected to etch the metal and the second to be selected for removing the remnants, the definition of these agents in functional terms appears justified. In any case the embodiments in the patent specification offer ample information of concrete examples.

4. With respect to document D13, it was never contested that it discloses a similar process as document D4 albeit in less detail. Therefore the considerations made with respect to D4 equally apply to D13.

5.1 Hence, in the opinion of the board, the subject-matter of claim 1 is not obtainable by a combination of prior art documents in an obvious way.

5.2 Claims 2 to 25 are appended to claim 1 and equally involve an inventive step.

Auxiliary request

Since the main request of the respondents is allowable there is no need to address the auxiliary request.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

P. Martorana E. Turrini