

Candidate's Answer Paper

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Dear Sirs,

I reply to the Communication dated..... Please replace pages of the specification with the correspondingly numbered new pages filed herewith in triplicate.

Amendments to Claims

Claim 1 has been restricted to the embodiment described in the paragraph bridging pages 5 and 6 of the description. The chemical oxidisation step (b) is readily identifiable at page 2 paragraph 2 of DI. Incorporating these steps into claim 1 is acceptable under Art 123 (2) EPC. The description clearly refers to DI in this context (page 5 last line) and leaves no doubt that protection may be sought for such features. Reference to the oxidisation (b) in claim 1 does not therefore contravene Art 123 (2) EPC (T689/90).

Basis for claim 2 can be found at page 6 lines 3 to 5. Claim 3 corresponds to original claim 4 and to page 4 lines 1 to 3 of the description. Claim 4 finds basis at page 4 lines 8-9. Claim 5 finds basis at page 4 lines 4-5. Claim 6 corresponds to original claim 2.

Claim 7 finds basis at page 1 lines 24 to 25 and at page 8 lines 24-25. A skilled person would surely have understood from these passages that perforated circuit boards are within the scope of the invention.

Novelty

DI does not disclose step (c) of claim 1. In DI the oxidised boards are laminated without treatment with an acidic reducing agent.

DII does not disclose step (b) or step (c) of claim 1.

DIII does not disclose step (b) or step (c) of claim 1.

Claim 1 is therefore novel. Claims 2 to 7 are dependent on claim 1 and can therefore also be considered novel (Guidelines C-IV-9.5a).

As regards claim 8, the printed circuit board specified therein is novel per se. As explained below, an inherent result of the process of claim 1 is that it provides circuit boards resistant to haloing. Such resistance indicates that the circuit boards obtainable by the process of claim 1 are chemically different to circuit boards which are not prepared by the process of claim 1 and which are accordingly less resistant to haloing.

Inventive Step

The problem/solution approach is used for assessing inventive step (Guidelines C-IV-9.5).

Closest Prior Art

The present invention, as defined in the amended claims, is concerned with printed circuit boards in which generation of haloing can be completely prevented or considerably reduced (see description on page 6 lines 6-7). The closest prior art is thus clearly DI, as DI also addresses the problem of reduced haloing (see page 1 line 25 to page 2 line 1 of DI). Neither DII nor DIII mention haloing at all. A skilled person seeking to provide printed circuit boards with reduced haloing would therefore have started from DI rather than from DII or DIII.

Technical Problem and Solution thereto

The technical problem solved by the present invention, in view of DI, is to provide printed circuit boards with reduced haloing which retain a high interlaminar peel value (see page 6 lines 6-7 and Table 2 on page 10 of the description).

The solution to this problem lies in step (c) of claim 1, in which the oxidised copper surface is treated with a particular acidic solution of a specified reducing agent.

The pH of the solution is particularly crucial. That is evident from Table 2 on page 10 of the description. Circuits C5 and C6 were treated with an alkaline reducing agent and suffered considerable haloing. In contrast, the circuits of Examples 2 and 3, which were treated with similar solutions but within the pH range specified in step (c) of claim 1, suffered no haloing whatsoever.

The improved haloing resistance achieved by the present invention is evident from a comparison of the data in Table 2 of the present application with that in the Example of DI. The best result achieved in DI was a haloing breadth 64 μm . In contrast, the circuit boards of Examples 2 and 3 of the present invention suffered no haloing whatsoever but retained high interlaminar peel values.

Claimed Invention not obvious

There is no suggestion in DI that improved haloing resistance can be achieved by treatment with an aqueous reducing agent having a pH of from 1 to 6 as specified in step (c) of claim 1. Indeed, the teaching in DI that the second oxidising solution should have a higher alkalinity than the first (page 2 lines 8-9 of DI) would have dissuaded a skilled person from subsequently treating the metal with an acidic solution.

A skilled person seeking to prepare a circuit board having improved haloing resistance while retaining high interlaminar peel values would not therefore have modified DI in this regard. Claim 1 is therefore inventive over DI.

Neither DII nor DIII refer to haloing resistance. Further, neither document discloses the treatment specified in step (c) of claim 1. Thus, neither DII nor DIII would have assisted a skilled person in modifying DI as set out above. Claim 1 is therefore inventive over DI taken with DII and/or DIII.

Claims 2 to 7 are dependant on claim 1 and can be considered inventive by virtue of this dependency (Guidelines C-IV-9.5a). As regards claim 8, the circuit boards specified therein have improved haloing resistance, as explained above. Claim 8 is thus inventive for the reasons set out above. Should the Examiner consider that the circuit boards of claim 8 are merely an obvious desiderata (or goal), his attention is drawn to Decision T595/90, where it was held that such desiderata are patentable if there was previously no known method of making them and the patent application provides the first way of making the products in an inventive manner.

Points from Communication

- 1) Claim I now specifies both mechanical and chemical treatment. This objection therefore no longer applies.
- 2-4) The comments above under the headings "novelty" and "inventive step" explain why the claims, as now amended, are novel and inventive in view of DI, DII and DIII.
- 5) The application no longer refers to the fluorohydrocarbon plasma and this objection no longer applies.
- 6) Amended claims are attached.
- 7) See comments above under the heading "inventive step".
- 8) Each independent claim now contains all essential features.
- 9) See comments above under heading "amendments to claims."

Favourable reconsideration is requested. Should the Examiner contemplate refusal of the application, I request Oral Proceedings.

Your faithfully

A.B. Representative

CLAIMS

1. A process for manufacturing printed circuit boards of at least one dielectric substrate material and at least one copper layer adhered to at least one surface of the said substrate by the following steps:
 - (a) mechanically pre-treating a copper foil or layer;
 - (b) treating the thus obtained pre-treated layer by (i) oxidising the copper circuit with a first aqueous alkaline sodium chlorite solution, (ii) etching the first oxidised circuit thus obtained with a diluted acidic solution thereby removing at least part of the CuO contained in the surface of this layer and (iii) oxidising the said first oxidised and etched circuit with a second aqueous sodium chlorite solution having a higher alkalinity than the first;
 - (c) treating the thus obtained oxidised copper surface with an aqueous solution of a reducing agent having a pH of from 1 to 6 and containing zinc formaldehyde sulphoxylate and/or sodium hypophosphite;
 - (d) bringing the thus obtained surface of the copper foil or layer into contact with at least one surface of the substrate; and
 - (e) thereby forming an adhesive bond between the said surfaces.
2. A process according to claim 1, wherein step (c) is conducted at from 40 to 90° C using a solution containing the reducing agent in an amount of from 5 to 30 g/l.
3. A process according to claim 1 or 2, wherein the copper foil or layer is pre-treated in step (a) by impinging on its surface(s) a pressurised stream of a slurry or suspension of metal oxide particles.
4. A process according to claim 3, wherein the average particle size of the metal oxide particles is less than 100 μm .
5. A process according to claim 3 or 4 wherein the metal oxide particles are aluminium oxide particles.
6. A process according to any one of the preceding claims, wherein the dielectric substrate is a prepreg of a thermosetting resin which is finally cured in step (e).
7. A process according to any one of the preceding claims, further comprising providing the circuit board with perforations which allow for connections through the dielectric substrate material.
8. A printed circuit board obtainable by a process according to any one of the preceding claims.

Note to Examiner

- 1) Claim 1 has been restricted to processes containing mechanical & chemical treatments. The description (p. 5 lines 31-32) suggests that mechanical pre-treatment is essential prior to the oxidisation & reduction steps. Thus, omitting the mechanical pre-treatment from claim 1, or specifying it as optional, could constitute added subject matter (T 331/87).
- 2) The product-by-process claim is justified in the response.