The opinion in support of the decision being entered today
is *not* binding precedent of the Board

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte ULRICH GOEBEL,
ELMAR HUBER and ALBERT-ANDREAS

Appeal 2006-2671
Application 09/508,572
Technology Center 1700

Decided: April 30, 2007

Before CHUNG K. PAK, CHARLES F. WARREN, and
CATHERINE Q. TIMM, *Administrative Patent Judges*.

WARREN, *Administrative Patent Judge*.

DECISION ON APPEAL

Applicants appeal to the Board from the decision of the Primary Examiner finally rejecting claims 7 through 11 and 13 through 15, all of the claims in the Application, in the Office action mailed January 27, 2004. 35 U.S.C. §§ 6 and 134(a) (2002); 37 C.F.R. § 1.191(a) (2004); *see also* 37 C.F.R. § 41.31(a) (September 2004).

We affirm the decision of the Primary Examiner.

Claims 7 and 13 illustrate Appellants' invention of a substrate board for a micro hybrid integrated circuit, and are representative of the claims on appeal:

7. A substrate board for a micro hybrid integrated circuit, comprising:

a porous ceramic body having cavities, the cavities being infiltrated by a metallic substance, the ceramic body being covered by a metallic skin, the metallic skin having at least one area of a reduced layer thickness, the at least one area forming at least one depression for accommodating components of the micro hybrid integrated circuit.

13. The substrate board according to claim 7, further comprising:

at least one insulating layer arranged on the metallic skin.

The Examiner relies on the evidence in these references:

MacNaughton	US 5,374,592	Dec. 20, 1994
Ninomiya	GB 2 311 414 A	Sep. 24, 1997
Merchant	US 6,157,082	Dec. 5, 2000

Appellants request review of the following grounds of rejection under 35 U.S.C. § 103(a) (Br.[1] 2), the grounds all advanced on appeal:

claims 7 through 11 and 13 through 15 as unpatentable over Merchant in view of Ninomiya (Answer 3-4); and

claims 7 through 11 and 13 through 15 as unpatentable over Merchant in view of MacNaughton (*id.* 5-6).

Appellants argue claims 7 through 9 and 11 as a group, and individually argue claims 10, 13, 14, and 15 with respect to the first ground of rejection. Appellants argue claims 7 through 9, 11, and 14 as a group, and individually argue claims 10, 13, and 15 with respect to the second ground of rejection. Thus, we decide this appeal based on appealed claims

[1] We consider the Brief filed July 8, 2005.

7, 10, 13, and 15 with respect to both grounds of rejection and further on claim 14 with respect to the first ground of rejection. 37 C.F.R. § 41.37(c)(1)(vii) (2005).

Appellants do not contest whether one of ordinary skill in the art would have combined either of Merchant or MacNaughton with Ninomiya with respect to replacing the ceramic bodies of the semiconductor devices of Merchant and of MacNaughton with a porous ceramic body having cavities infiltrated by a metallic substance (Answer 3-4 and 5; Br. 3-4 and 7-8). Thus, the issues on appeal are whether the Examiner has established a prima facie case of obviousness by showing that one of ordinary skill in this art would have found in the disclosure of each of Merchant and MacNaughton the other limitations of claims 7, 10, 13, 14, and 15.

With respect to the other limitations in claim 7, the Examiner contends the ceramic body of each of Merchant and MacNaughton is covered by a metal skin that has at least one area of reduced layer thickness forming at least one depression for accommodating components of a micro hybrid integrated circuit, citing ceramic body 10, metal layer 20, and depression 14 in Fig. 4 of Merchant, and ceramic body 10, metal layer 18, and depression 14 in Fig. 3 of MacNaughton (Answer 3, 5, and 6-7). With respect to claim 10, the Examiner contends the claimed between about 0.1 mm and 0.2 mm thickness of the area of reduced thickness of the metal layer would have been determined by routine experimentation by one of ordinary skill in this art based on the desired end result with respect to the teachings of Merchant or of MacNaughton (*id.* 4 and 5-6).

With respect to claim 13, the Examiner contends insulating layer 12 is on metal layer 20 in Fig. 4 of Merchant and on metal layer 18 in Fig. 3 of MacNaughton (*id.* 4 and 5-6). With respect to claim 14, the Examiner contends metal layer 22 is at least one other metal layer arranged on metal layer 20 in Fig. 4 of Merchant (*id.* 4). And with respect to claim 15, the Examiner contends the electric potential of metal layer 22 is different than that of metal layer 20 and ceramic body 10 in Fig. 4 of Merchant, and the electric potential of at least one other metal layer 20 is different than that of metal layer 18 and ceramic body 10 in Fig. 3 of MacNaughton (*id.* 4 and 6).

With respect to claim 7, Appellants contend opening 14 is etched in insulating layer 12 and then metal layer 20 is deposited on metal layer 18, citing Merchant column 4, lines 5-31, and Fig. 4, arguing the "areas of reduced layer thickness in layer 20, if any, do not form 'at least one depression'" (Br. 3). Appellants contend numerous variations in thickness of metal layer 20 occur within opening 14, arguing "opening 14 is . . . not formed by an area of reduced layer thickness" (*id.* 4). Appellants submit the same contentions with respect to opening 14 and metal layer 18 of Fig. 3 of MacNaughton, citing column 1, lines 37-38, and column 3, lines 17-24 (*id.* 7-8). Appellants contend that neither Merchant nor MacNaughton disclose that areas of reduced thickness accommodate components of a micro hybrid integrated circuit, and both disclose opening 14 is formed to provide interconnection of signal lines between layers of an integrated circuit (*id.* 4 and 8). With respect to claim 10, Appellants contend both Merchant (citing column 1, lines 50-57) and MacNaughton (citing "column 1, lines 50-57 [sic, 45-53]") state unevenness of metal layer 20 is undesirable and discloses

a method to remove any unevenness, thus teaching away from the claimed range (Br. 4-5 and 8-9).

With respect to claim 13, Appellants point out that insulating layer 12 is positioned between substrate 10 and metal layer 20 in Merchant, arguing layer 20 covers layer 10 and is beneath layer 20, not "on" layer 20, and submits the same contentions with respect to substrate 10, insulating layer 12 and metal layer 18 of MacNaughton (Br. 5-6 and 9-10). With respect to claim 14, Appellants contend Merchant's Fig. 4 illustrates an intermediate structure during manufacture of a semiconductor device and not a substrate board for a micro hybrid integrated circuit, pointing out Merchant's Fig. 5 illustrates the completed semiconductor device which does not include additional metal layer 22 of the intermediate structure (*id.* 6). With respect to claim 15, Appellants contend the Examiner has not established that Merchant's metal layer 22 and MacNaughton's metal layer 20 are at a different potential than substrate 10 and metal layers 18 and 20, respectively, as claimed (*id.* 6-7 and 10).

With respect to claim 7, the Examiner responds that as shown in Merchant's Fig. 4 and MacNaughton's Fig. 3, the respective metal layers 20 and 18 each have an area of reduced thickness in opening 14, and thus, the references each teach a structure having "a metallic skin having at least one area of a reduced thickness forming at least one depression" as claimed, regardless of the method of forming the same (Answer 7-8 and 11-12). The Examiner contends the intended use of the claimed substrate board to accommodate components of the micro hybrid integrated circuit does not result in a structural difference which patentably distinguishes the claimed

structure over the references (*id.* 8 and 12). With respect to claim 10, the Examiner contends that rather than teach away from a metal layer of uneven thickness, Merchant and MacNaughton discloses that such layers are in fact known, and thus one of ordinary skill in the art would have arrived at a structure within the claimed thickness range (*id.* 8-9 and 13).

With respect to claim 13, the Examiner contends the claim term "on" can be "defined as 'a function word to indicate position in close proximity with," citing "Merriam-Webster Online Dictionary," arguing insulating layer 12 in Merchant's Fig. 4 and MacNaughton's Fig. 3 "is in close proximity with" metal layers 20 and 18, respectively (*id.* 9 and 13-14). With respect to claim 14, the Examiner contends Merchant's Fig. 4 illustrates metal layer 22 on metal layer 20, citing column 6, lines 16-18 (*id.* 9-10). With respect to claim 15, the Examiner contends that Merchant discloses metal layer 22 can be a different material than substrate 10 and metal skin 20, citing, inter alia, column 4, lines 53-55, and column 5, lines 35-38, and MacNaughton discloses metal layer 20 can be a different material than substrate 10 and metal skin 18, citing, inter alia, column 4, lines 15-23 (*id.* 10 and 14).

With respect to claim 7, Appellants reply that in Merchant, layer 20 is formed by deposition on layers 18 and 12 in opening 14 and an area of reduced thickness in layer 20, if any, is not "at least one depression," and Fig. 4 cannot be relied on to show that metal layer 20 is reduced in thickness in opening 14 since there is no disclosure that the figure defines precise proportions (Reply Br. 2). Appellants further contend that it is not the method of forming layer 20 which distinguishes Merchant, rather the reference does not disclose layer 20 as having a depression of reduced layer

thickness that can accommodate circuit components, arguing the "unevenness of layer 20 would not be structured so as to accommodate circuit components" as claimed (*id.* 3). In this respect, Appellants contend "[n]ot any depression of any size and any contour can accommodate circuit components" (*id.*). Appellants contend the structure illustrated in Fig. 4 is for the production of a semiconductor device illustrated in Fig. 5, wherein metal layer 22 reflows uniformly in opening 14 to form an electrical contact point within the integrated circuit 9 (*id.* 3-4).

With respect to claim 10, Appellants contend Merchant's purpose of eliminating unwanted unevenness teaches away from the claimed thickness (*id.* 4). With respect to claim 14, Appellants contend the Examiner is relying on Merchant's Fig. 5 which does not meet any of the limitations of claim 7 (*id.* 5). With respect to claim 15, Appellants contend the Examiner has not established a difference in the electrical potential of the specified layers (*id.*).

Appellants reply with the same contentions with respect to MacNaughton (Reply Br. 5-8).

The plain language of independent claim 7 specifies a substrate board for a micro hybrid integrated circuit which comprises at least, inter alia, a ceramic body covered by any metallic skin having at least one area of reduced layer thickness forming any manner of at least one depression of any depth capable of accommodating any manner of components of any manner of micro hybrid integrated circuit. We determine the term "depression" when considered in light of the disclosure in the Specification would have its ordinary, dictionary meaning of "[a]n area that is sunk below

its surroundings; a hollow."[2] The structure of the micro hybrid integrated circuit, including size and contour, is not specified and the components of the integrated circuit can be contact wires. Indeed, there is no disclosure of the size and contour of integrated circuits in the Specification, but wires 8, connecting the micro hybrid integrated circuit to conductive layers of a board, are illustrated components (Specification, e.g., 1:6-26, 4:18-29, and Figs. 1-3). The transitional term "comprising" opens claim 7 to encompass additional elements including any manner of other layers in any manner of arrangement relative to the ceramic body and/or metallic skin layer. *See*, e.g., *Vehicular Technologies Corp. v. Titan Wheel Int'l, Inc.*, 212 F.3d 1377, 1383, 54 USPQ2d 1841, 1845 (Fed. Cir. 2000); *In re Baxter*, 656 F.2d 679, 686-87, 210 USPQ 795, 802-03 (CCPA 1981).

Dependent claim 10 specifies the area of reduced thickness of the metallic skin layer has a thickness of between about 0.1 mm and 0.2 mm. Dependent claim 13 specifies any manner of at least one insulating layer is present in any manner "on" the metallic skin layer. Dependent claim 14 specifies any manner of at least one other metallic layer arranged in any manner "on" the metallic skin layer. With respect to claim 7, 13, and 14, there is no specified perspective with respect to the orientation of the claimed substrate board. Thus, in giving the claim terms their broadest reasonable interpretation, we determine that while one layer is deposited on another layer, after formation the layers can be reasonably considered as being in proximity, that is, "on" one another, without respect to orientation

[2] *See, e.g.*, **depression**, *The American Heritage Dictionary Of The English Language* 488 (4th ed., Boston, Houghton Mifflin Company, 2000).

of the substrate board, as the Examiner argues.[3] There is no limitation in claim 14 specifying the thickness of the other metallic layer or its relationship to the depth of the depression accommodating the components of the integrated circuit. Claim 15, dependent on claim 14, specifies that the layer specified in claim 14 has an electric potential that is different to any extent from that of the ceramic body and the metallic skin layer.

We find Merchant would have disclosed to one of ordinary skill in this art semiconductor integrated circuit devices having, inter alia, aluminum or aluminum alloy conductive interconnect layers in contacts or vias (Merchant, e.g., col. 1, ll. 13-32, and col. 2, ll. 58-62). Merchant acknowledges it was known that the thickness of aluminum alloy conductive layers in contact or via openings is uneven, resulting in "thinner regions" (*id.*, col. 1, ll. 50-57). Merchant further acknowledges it was known that aluminum alloys would not reflow and properly fill the contact or via if oxidized, and addresses the problem by protecting the metal from oxidation with a protective layer during manufacture (*id.*, e.g., col. 2, ll. 2-46).

Merchant's semiconductor device includes a substrate having a recess at least a portion of which is covered over with a conductive metal layer that fills "at least a portion of the recess," and a metal protective layer on the conductive layer that is "at least partially diffused in the conductive layer" (Merchant, col. 2, ll. 31-38). Merchant discloses an embodiment in which "the aluminum or aluminum alloy layer fills at least the portion of the recess and forms a contact," wherein the at least partially filled recess is "a via that

[3] In addition to the dictionary reference cited by the Examiner (*see above* p. 6), *see, e.g.*, **on** and **proximity**, *The American Heritage Dictionary Of The*

provides inter-layer connectivity . . . or a contact for a terminal . . . of a semiconductor device" (*id.*, col. 3, ll. 3-9). One of ordinary skill in this art would have reasonably inferred the conductive layer in this embodiment includes the protective metal layer (*see id.*, e.g., col. 2, ll. 31-38, col. 7, ll. 37-39, and col. 8, ll. 45-48).[4]

Merchant illustrates in Fig. 3, a cross-sectional view of device of Fig. 1 with "a conductive layer partially deposited in the via;" in Fig. 4, a cross-section of device of Fig. 3 "with a metal protective layer deposited over the conductive layer prior to its diffusion in the conductive layer;" and in Fig. 5, a cross-section of the device of Fig. 4 "after the device has been subjected to a reflow process" (Merchant, col. 3, ll. 48-55). Merchant's Fig. 3 shows substrate 10 with contact or via opening 14 formed through insulating layer 12, on which barrier layer 18 is "uniformly deposited," and then conductive metal layer 20 is deposited and reflowed to "uniformly fill and contact the sides of the opening 14" (*id.*, col. 4, ll. 5-18 and 44-65). We find one of ordinary skill in this art in light of this disclosure would have found from Merchant's Fig. 3 that a portion of conductive metal layer 20 has a depression extending into opening 14 which covers the sides of the opening and is of reduced thickness compared to the portion of the layer extending

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English Language 1228,1412.

[4] It is well settled that a reference stands for all of the specific teachings thereof as well as the inferences one of ordinary skill in this art would have reasonably been expected to draw therefrom, *see In re Fritch*, 972 F.2d 1260, 1264-65, 23 USPQ2d 1780, 1782-83 (Fed. Cir. 1992); *In re Preda*, 401 F.2d 825, 826, 159 USPQ 342, 344 (CCPA 1968), presuming skill on the part of this person. *In re Sovish*, 769 F.2d 738, 743, 226 USPQ 771, 774 (Fed. Cir. 1985).

over insulating layer 12, even though, as Appellants point out, the precise dimensions of the thicknesses of the portions of the layer are not disclosed by Merchant.

We find one of ordinary skill in this art would have found from Merchant's Fig. 4, which shows protective metal layer 22 deposited on conductive metal layer 20 (*id.*, col. 4, l. 66, to col. 5, l. 1), that protective layer 22 covers all of conductive metal layer 20 including the depression in layer 20 extending into opening 14. Protective layer 22 can be selected from a number of metals and metal alloys (*id.*, col. 5, ll. 14-63). In Merchant's Fig. 5, conductive metal layer 20, with protective metal layer 22 thereon, is subjected to reflow "such that [conductive metal layer 20] uniformly fills the opening 14" (*id.*, col. 5, l. 64, to col. 6, l. 23).

We find MacNaughton would have disclosed to one of ordinary skill in this art semiconductor integrated circuit devices having an aluminum conductive interconnect layer in a vias (MacNaughton, e.g., col. 1, ll. 16-30). Merchant acknowledges it was known that the thickness of the conductive layers in via openings is uneven, resulting in "thinner regions" (*id.*, col. 1, ll. 45-53). MacNaughton addresses this problem by forming a continuous aluminum conductive layer at a low temperature and depositing a second aluminum layer thereon at a higher temperature to form the conductive layer of the device (*id.*, col. 2, ll. 39-48). In MacNaughton's method, opening 14 is formed in insulating layer 12 on substrate 10, all of which is covered with barrier layer 16 as illustrated in Fig. 1 (*id.*, col. 3, ll. 8-22).

First aluminum layer 18 is deposited over barrier layer 16 to a depth which ensures that a complete layer is formed in opening 14 as illustrated in Fig. 2 (*id.*, col. 3, ll. 23-51). We find one of ordinary skill in this art in light of this disclosure would have found from MacNaughton's Fig. 3 that a portion of aluminum layer 18 has a depression extending into opening 14 which covers the sides of the opening and is of reduced thickness compared to the portion of the layer extending over insulating layer 12, even though, as Appellants point out, the precise dimensions of the thicknesses of the portions of the layer are not disclosed by MacNaughton. Second aluminum layer 20 is formed over first layer 18, completely filling opening 14, "giving an approximately planar upper surface" (*id.*, col. 3, l. 60, to col. 4, l. 5). MacNaughton discloses that "nucleation of the aluminum in layer 20 onto the extremely small grains formed in layer 18 minimizes the growth of large grains, and can reduce or eliminate the random voiding problem caused by occasional large grain growth" (*id.*, col. 4, ll. 15-23; *see also* col. 3, ll. 34-41).

On this record, we agree with the Examiner that, prima facie, each of Merchant and MacNaughton would have disclosed to one of ordinary skill in this art the limitations with respect to the layers on the substrate board specified by claims 7, 10, 13, 14, and 15. With respect to claim 7, we agree with the Examiner that, contrary to Appellants' contentions, the portion of each of conductive metal layer 20 of Merchant's Fig. 4 and of conductive metal layer 18 of MacNaughton's Fig. 3 in respective openings 14 is in fact a depression in the metal layer that is of reduced thickness with respect to the portion of the layer on insulating layer 12. Merchant's Fig. 3 and

MacNaughton's Fig. 2 also illustrate this structure. The portion of the conductive metal layers in opening 14 are disclosed in each reference to be continuous.

We are not convinced by Appellants' contentions, with respect to claims 7 and 14, that the structures illustrated in each of Merchant's Figs. 3 and 4 and of MacNaughton's Figs. 2 and 3 are merely intermediates in a manufacturing process, and that openings 14 thereof would not accommodate components of a micro hybrid integrated circuit. We determine that one of ordinary skill in this art would have recognized that the structures illustrated in each of the figures have a portion of opening 14 filled with a conductive metal layer which can function as contacts or vias for semiconductor integrated circuit devices, and would have used the structures for this purpose. Thus, this person would have recognized that the partially filled opening 14 in the illustrated structures can function as a contact accommodating connect wire 8 components of a micro hybrid integrated circuit.

With respect to claim 10, we disagree with Appellants' contention one of ordinary skill in the art would have been led away from the claimed layer thickness range of the metallic skin layer depression by the problem of unevenness in the conductive metal layer in vias and contacts known in the art as acknowledged by Merchant and MacNaughton. Indeed, Appellants do not identify any disclosure in either reference rebutting the Examiner's contention that unevenness is not a problem in the continuous conductive metal layers formed in opening 14 of the illustrated structures by the methods disclosed in the references.

With respect to claim 13, we agree with the Examiner that the relative positions of insulating layer 12 and the conductive metal layers in the illustrated structures of Merchant and MacNaughton satisfy the limitation of this claim as we have interpreted it above. We note that Appellants did not contest the Examiner's interpretation of the claim term "on" in the Reply Brief.

With respect to claim 15, we agree with the Examiner's finding that the first conductive layer has a different electric potential than the second conductive layer employed in the illustrated structured in Merchant and MacNaughton. Indeed, the differences in grain size between the two aluminum layers in MacNaughton would result in such a difference.

Accordingly, based on our consideration of the totality of the record before us, we have weighed the evidence of obviousness found in the combined teachings of Merchant and Ninomiya and of or MacNaughton and Ninomiya with Appellants' countervailing evidence of and argument for nonobviousness and conclude that the claimed invention encompassed by appealed claims 7 through 11 and 13 through 15 would have been obvious as a matter of law under 35 U.S.C. § 103(a).

The Primary Examiner's decision is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv) (2006).

AFFIRMED

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