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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte DAN OKAMOTO
and HIROYUKI SADA

Appeal 2018-003705
Application 14/301,942
Technology Center 2800

Before ADRIENE LEPIANE HANLON, WESLEY B. DERRICK, and
LILAN REN, *Administrative Patent Judges*.

HANLON, *Administrative Patent Judge*.

DECISION ON APPEAL

A. STATEMENT OF THE CASE

The Appellant¹ filed an appeal under 35 U.S.C. § 134(a) from an Examiner's decision rejecting claims 1–14 and 21–25. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM-IN-PART.

¹ We use the word “Appellant” to refer to “applicant” as defined in 37 C.F.R. § 1.42. Appellant identifies the real party in interest as Texas Instruments Incorporated. Appeal Brief dated July 27, 2017 (“Br.”), at 3.

Independent claims 1 and 9 are reproduced below from the Claims Appendix to the Appeal Brief. The limitations at issue are italicized.

1. An intermediate product produced in the fabrication of a quad flat no lead (“QFN”) package comprising:

a plurality of dies, each die having a thickness substantially the same as a predetermined die thickness and having a first side and an opposite second side, said first side of each said die lying substantially in a first plane, said second side of each said die lying substantially in a second plane; and

a plurality of spaced apart and electrically unconnected conductive pads, each having a thickness substantially equal to said predetermined die thickness and having a first side and an opposite second side, said plurality of conductive pads comprising a plurality of conductive pad groups that are each associated with a different one of said plurality of dies, said first side of each conductive pad lying substantially in said first plane, said second side of each of said conductive pads lying substantially in said second plane, each of the conductive pads having a first end portion proximate to the corresponding die and extending along a length in a direction parallel to the first plane to a second end portion spaced from the first end portion, the length between said first end portion to said second end portion of each conductive pad being greater than the thickness between said first side and said second side of the conductive pad;

wherein said plurality of dies and said plurality of conductive pads are separated by a plurality of voids.

Br. 46.

9. A quad flat no lead (“QFN”) package comprising:

a die having an active side positioned substantially in a first plane and a backside positioned substantially in a second plane parallel to said first plane;

a plurality of separate conductive pads each having a first side positioned substantially in said first plane and a second side positioned substantially in said second plane, each of the separate conductive pads having a first end portion proximate the die and extending along a length in a direction parallel to the first side to a

second end portion spaced from the die, *the length between said first end portion to said second end portion of the conductive pad being greater than a distance between the first side and the second side of the conductive pad*; and

mold compound positioned between said first and second planes in voids between said conductive pads and said dies, the mold compound surrounding sides of the die and sides of the conductive pads and covering the first end and the second end of the conductive pads.

Br. 49.

The claims on appeal stand rejected as follows:

(1) claims 1–6, 8, 9, 12–14, 21, and 23–25 under 35 U.S.C. § 103 as unpatentable over Pagaila et al.² in view of Viswanathan et al.;³ and

(2) claims 7, 10, 11, and 22 under 35 U.S.C. § 103 as unpatentable over Pagaila in view of Viswanathan, further in view of Ootsuki et al.⁴

B. DISCUSSION

1. Claims 1–8

The Examiner finds Pagaila discloses an intermediate product produced in the fabrication of a quad flat no lead package comprising, *inter alia*, a plurality of dies 124 (Pagaila Fig. 5i) and a plurality of spaced apart and electrically unconnected conductive pads 172 (Pagaila Fig. 5i) “wherein said plurality of dies and said plurality of conductive pads are separated by a plurality of voids (peripheral region 166, Figures 5c, 5d, 5i, Paragraph[] 53).” Non-Final Act. 3.⁵

The Appellant argues that Through Organic Vias (“TOVs”) or conductive pads 172 are formed in the semiconductor wafer *before it is singulated*. Br. 14

² US 2012/0217643 A1, published August 30, 2012 (“Pagaila”).

³ US 2013/0320515 A1, published December 5, 2013 (“Viswanathan”).

⁴ US 5,652,461, issued July 29, 1997 (“Ootsuki”).

⁵ Non-Final Office Action dated April 10, 2017.

(citing Pagaila Figs. 3i, 3j, 4d, 5j; Pagaila ¶¶ 49, 51, 60). Therefore, the Appellant argues that Pagaila “teaches away from the plurality of dies and the plurality of conductive pads being separated *by a plurality of voids*, as required by Claim 1.” Br. 14 (emphasis added).

The Appellant’s argument is persuasive of reversible error. The Examiner finds that conductive TOVs 172 in Pagaila Figure 5i correspond to the claimed electrically unconnected conductive pads and peripheral region 166 in Pagaila Figure 5c corresponds to the claimed voids. Non-Final Act. 3.

According to Pagaila’s process, an organic insulating material 168 is deposited in peripheral region 166. Pagaila ¶ 55; Pagaila Fig. 5d. A portion of organic material 168 is removed to form side-by-side vias 170. Pagaila ¶ 56; Pagaila Fig. 5e. Pagaila discloses that an electrically conductive material is subsequently deposited into vias 170 to form side-by-side full conductive TOVs 172. Pagaila ¶ 57; Pagaila Fig. 5g. Thus, organic insulating material 168 is disposed between semiconductor die 124 and conductive TOVs 172. *See* Pagaila Fig. 5g. Thereafter, a saw blade or laser cutting tool cuts a center area of organic material 168 between side-by-side conductive TOVs 172 to completely sever and singulate semiconductor die 124. Pagaila ¶ 60; Pagaila Fig. 5j.

The Examiner contends that the Appellant’s originally filed Specification does not define “void” as “an absolute absence of any other intervening elements,” including air. Ans. 5.⁶ Therefore, the Examiner finds that conductive TOVs 172 in Pagaila, which are formed in peripheral region or voids 166, satisfy the claim

⁶ Examiner’s Answer dated November 30, 2017.

limitation “wherein said plurality of dies and said plurality of conductive pads are separated by a plurality of voids.”⁷ Ans. 5.

The Examiner’s interpretation of “void” is not supported by the record. Turning to the Specification, the Appellant discloses that “[m]old compound 150 is positioned between the first and second planes *in voids* between the conductive pads 130 and the dies 120.” Spec. ¶ 19 (emphasis added). Thus, although the Appellant does not provide an express definition of the term “void” in the Specification, we find that one of ordinary skill in the art would have understood that the term “void,” as used in the Appellant’s Specification, is a hole or cavity. In Pagaila, peripheral region or voids 166 are filled with organic material 168 and conductive material (i.e., conductive TOVs 172). Once conductive TOVs 172 are formed in Pagaila’s device, there are no voids, holes, or cavities between semiconductor die 124 and conductive TOVs 172.⁸ See Pagaila Figs. 5g–5i.

In the alternative, the Examiner concludes that “the claim language is broad enough that the plurality of die 124 and *non-adjacent, unconnected* contact pads 172 separated from one another by laser cutting tool 178 . . . additionally read on the claim.” Ans. 6 (citing Pagaila ¶ 60; Pagaila Fig. 5j) (emphasis added).

Claim 1 recites that the intermediate product comprises, *inter alia*, “a plurality of spaced apart and *electrically unconnected* conductive pads.” Br. 46. In Pagaila Figure 5j, however, conductive TOVs 172 are *electrically connected* to die 124. See Spec. ¶ 31 (disclosing that electrically connecting is done by welding

⁷ Br. 46.

⁸ We find that Pagaila discloses, in one embodiment, a product comprising a plurality of dies 124 and a plurality of conductive pads 172, with no voids 166 (Pagaila Fig. 5i) and, in another embodiment, a product comprising a plurality of dies 124 and a plurality of voids 166, with no conductive pads 172 (Pagaila Fig. 5c).

a first end of each bond wire to the active surface of each die and welding the second end of each bond wire to the first surface of each associated conductor pad). Thus, the product depicted in Pagaila Figure 5j does not fall within the scope of claim 1.

Based on the foregoing, the Examiner reversibly erred in finding that Pagaila discloses a product comprising a plurality of dies and a plurality of electrically unconnected conductive pads wherein the dies and the conductive pads are *separated by a plurality of voids* as recited in claim 1. The Examiner does not rely on Viswanathan or Ootsuki to cure the deficiency in Pagaila identified above. Therefore, the obviousness rejection of claims 1–6 and 8 based on the combination of Pagaila and Viswanathan and the rejection of claim 7 based on the combination of Pagaila, Viswanathan, and Ootsuki are not sustained.

2. Claims 9 and 21

The Examiner finds Pagaila discloses a quad flat no lead package comprising a die, a plurality of conductive pads, and mold compound in voids between the conductive pads and the die. Non-Final Act. 6. The Examiner finds the conductive pads have first and second end portions as claimed, wherein the first end portion is proximate the die and extends along a length in a direction parallel to the first side of the conductive pad to the second end portion which is spaced from the die. Non-Final Act. 6. The Examiner, however, finds Pagaila does not disclose that the length between the first and second end portions of the conductive pad is greater than the thickness of the conductive pad as recited in claim 9. Non-Final Act. 6.

The Examiner finds Viswanathan discloses a similar device wherein a die structure 41/25 lies within the same planes as a plurality of conductive pads 32. Non-Final Act. 6. The Examiner finds conductive pads 32 have a length greater

than a thickness as recited in claim 9. Non-Final Act. 6–7. The Examiner concludes that it would have been obvious to one of ordinary skill in the art to modify the length of the conductive pads in Pagaila as disclosed in Viswanathan. Non-Final Act. 7.

The Appellant argues that a void does not separate the dies from the TOVs (i.e., conductive pads 172) in Pagaila as recited in claim 9. Br. 24–25.

The Appellant’s argument is not persuasive of reversible error. Claim 9 recites that “mold compound [is] *positioned . . . in voids* between said conductive pads and said dies.” Br. 49 (emphasis added). Thus, the voids are filled by mold compound in the device recited in claim 9. Similarly, the Examiner finds that organic insulating material 168, corresponding to the claimed mold compound, is positioned in voids between conductive pads 172 and die 124. Non-Final Act. 6; *see also* Pagaila Fig. 5i.

The Appellant also argues that Pagaila teaches away from the claimed invention by teaching that the length of vias 170, and thus conductive pads 172, is not greater than their thickness. Br. 24. However, the Appellant does not direct us to any teaching in Pagaila that would have led one of ordinary skill in the art away from the modification proposed by the Examiner. The mere fact that Pagaila does not disclose that conductive pads 172 have the claimed length is not sufficient to support a finding that Pagaila teaches away from the proposed modification. *See* Ans. 9 (explaining that “simply having a feature that is different than a claimed limitation does not ‘teach away’ from said limitation”); *see also Syntex (U.S.A.) LLC v. Apotex, Inc.*, 407 F.3d 1371, 1380 (Fed. Cir. 2005) (stating that “a prior art reference that does not specifically refer to one element of a combination does not, per se, teach away”).

Turning to Viswanathan, the Appellant argues that Viswanathan, like Pagaila, does not teach that the length of the conductive pads is greater than their thickness as recited in claim 9. Br. 25.

The Examiner, however, finds Viswanathan discloses a lower profile package. Non-Final Act. 7 (citing Viswanathan ¶ 16). In that regard, the Examiner finds Viswanathan Figure 6c shows that the length between first and second end portions of conductive pad 32 is greater than the thickness of conductive pad 32.⁹ Non-Final Act. 17; Ans. 7–8, 13. The Examiner also finds that “it is known that a greater cross sectional area reduces the resistance of a connection.” Non-Final Act. 7. For that additional reason, the Examiner concludes that it would have been obvious to one of ordinary skill in the art to modify the length of Pagaila’s conductive pads as claimed. Non-Final Act. 7. Significantly, the Appellant has failed to establish otherwise.

The Appellant also argues that Viswanathan’s device is not similar to Pagaila’s device because conductive pad 32 and die 41 lie within different planes. Br. 25.

The Appellant’s argument is not persuasive of reversible error. The Examiner finds that Viswanathan discloses a similar device wherein *die structure 41/25*, not die 41 alone, lies within the same planes as conductive pads 31, 32. Non-Final Act. 16. That is, the Examiner finds that Pagaila and Viswanathan are from a related art, and thus their teachings are combinable. *See* Ans. 12 (finding that Viswanathan is analogous art). The mere fact that the bottom surface of die 41 (Viswanathan Fig. 3B) or the top surface of die 41 (Viswanathan Fig. 4B) does not

⁹ The Examiner also finds that the Appellant’s admitted prior art shows conductive pad 16 having a length greater than its width. Ans. 13.

lie in the same plane as the bottom surface of conductive pads 31, 32 (Viswanathan Fig. 3B) or the top surface of conductive pads 31, 32 (Viswanathan Fig. 4B), respectively, does not establish otherwise.

Finally, referring to Viswanathan Figure 2, the Appellant argues that “one of ordinary skill in the art would not combine a teaching that the separated dies 41 do not contain contact pads 31, 32 . . . with a teaching [in Pagaila] that the separated dies 124 contain contact pads 150, 172.” Br. 26.

The Appellant’s argument is not persuasive of reversible error. Viswanathan Figure 2 is a schematic side view of an embodiment of a partially packaged semiconductor device. Viswanathan ¶ 8. Viswanathan Figure 3C, like Pagaila Figures 4d and 5j, clearly shows that dies 41 are electrically connected to conductive pads 31, 32.

Based on the foregoing, a preponderance of the evidence supports the Examiner’s conclusion of obviousness. Therefore, the obviousness rejection of claim 9 is sustained.

In response to the obviousness rejection of claim 21, the Appellant relies on the same arguments presented in support of the patentability of claim 9. For the reasons set forth above, the Appellant’s arguments are not persuasive of reversible error. Therefore, the obviousness rejection of claim 21 is also sustained.

3. Claims 10–14 and 22–25

As for claims 10–14 and 22–25, the Appellant merely recites the claim elements and generally contends that neither Pagaila nor Viswanathan, either alone or in combination, teaches or suggests the element(s) recited in each of the claims. *See, e.g.*, Br. 27–30. The Appellant does not direct us to any error in the Examiner’s factual findings or legal conclusions in the rejections of any of claims 10–14 and 22–25. Therefore, the obviousness rejection of claims 12–14 and 23–25

based on the combination of Pagaila and Viswanathan and the obviousness rejection of claims 10, 11, and 22 based on the combination of Pagaila, Viswanathan, and Ootsuki are sustained. *See In re Lovin*, 652 F.3d 1349, 1357 (Fed. Cir. 2011) (holding that 37 C.F.R. § 41.37 “require[s] more substantive arguments in an appeal brief than a mere recitation of the claim elements and a naked assertion that the corresponding elements were not found in the prior art”).

C. CONCLUSION

The Examiner’s decision is affirmed-in-part.

Claims Rejected	35 U.S.C. §	Rejection(s)/Basis	Affirmed	Reversed
1–6, 8, 9, 12–14, 21, 23–25	103	Pagaila, Viswanathan	9, 12–14, 21, 23–25	1–6, 8
7, 10, 11, 22	103	Pagaila, Viswanathan, Ootsuki	10, 11, 22	7
Overall Outcome			9–14, 21–25	1–8

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).

AFFIRMED-IN-PART