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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte HEEJO CHI, NAMJU CHO, and HANGIL SHIN

Appeal 2019-004805
Application 14/466,923
Technology Center 2800

Before BEVERLY A. FRANKLIN, LINDA M. GAUDETTE, and
MONTÉ T. SQUIRE, *Administrative Patent Judges*.

BEVERLY A. FRANKLIN, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Pursuant to 35 U.S.C. § 134(a), Appellant¹ appeals from the Examiner's decision to reject claims 26–29, 31–36, 38–42, and 44–49. We have jurisdiction under 35 U.S.C. § 6(b).

We REVERSE.

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 STATS ChipPAC Pte. Ltd. Appeal Br. 1.

CLAIMED SUBJECT MATTER

Claims 26 and 32 are illustrative of Appellant's subject matter on appeal and are set forth below:

26. A semiconductor device, comprising:

- a substrate as a single material including a base plate and a row of first bodies and a row of second bodies extending from a surface of the base plate, wherein the surface of the base plate completely surrounds each of the row of first bodies and each of the row of second bodies;

- a semiconductor die disposed between the row of first bodies and the row of second bodies;

- an encapsulant deposited around the semiconductor die and over the substrate around each of the row of first bodies and each of the row of second bodies, wherein the encapsulant includes a plurality of first openings extending to each of the row of first bodies and to each of the row of second bodies;

- a conductive layer formed in at least one of the first openings and contacting at least one of the row of first bodies; and

- an insulating layer formed over the encapsulant and extending into the at least one of the first openings over the conductive layer.

32. A semiconductor device, comprising:

- a semiconductor die;

- an encapsulant deposited around the semiconductor die, wherein the encapsulant includes a plurality of first openings arranged in a row and formed from a first surface of the encapsulant partially through the encapsulant;

a conductive layer formed over the first surface of the encapsulant and extending into the first openings in the encapsulant; and

an insulating layer formed over the conductive layer and extending into the first openings over the conductive layer;

wherein the encapsulant includes a plurality of second openings arranged in a row and formed from a second surface of the encapsulant opposite the first surface of the encapsulant partially through the encapsulant and aligned with the first openings and extending to the conductive layer.

REFERENCES

The prior art relied upon by the Examiner is:

Name	Reference	Date
Kinsman	US 2006/0043611 A1	Mar. 2, 2006
O et al. ("O")	US 2008/0283996 A1	Nov. 20, 2008
Kim et al. ("Kim")	US 2009/0039491 A1	Feb. 12, 2009
Zudock et al. ("Zudock")	US 2010/0193928 A1	Aug. 5, 2010
Chen et al. ("Chen")	US 2011/0084382 A1	Apr. 14, 2011

REJECTIONS

1. Claims 32, 35, 39, 42, and 45 are rejected under pre-AIA 35 U.S.C. §102(a)(1) as being anticipated by Kim.

2. Claims 32, 35, and 36 are rejected under pre-AIA 35 U.S.C. §102(a)(1) as being anticipated by Chen.

3. Claims 26–29, 32–36, 39–42, and 45–48 are rejected under pre-AIA 35 U.S.C. §103(a) as being unpatentable over O in view of Kinsman.

4. Claims 38 and 44 are rejected under pre-AIA 35 U.S.C. §103(a) as being unpatentable over Kim in view of Zudock.

5. Claim 38 is rejected under pre-AIA 35 U.S.C. §103(a) as being unpatentable over Chen in view of Zudock.

6. Claims 31, 38, 44, and 49 is rejected under pre-AIA 35 U.S.C. §103(a) as being unpatentable over O and Kinsman as applied to claims 26 and 46 above, further in view of Zudock.

OPINION

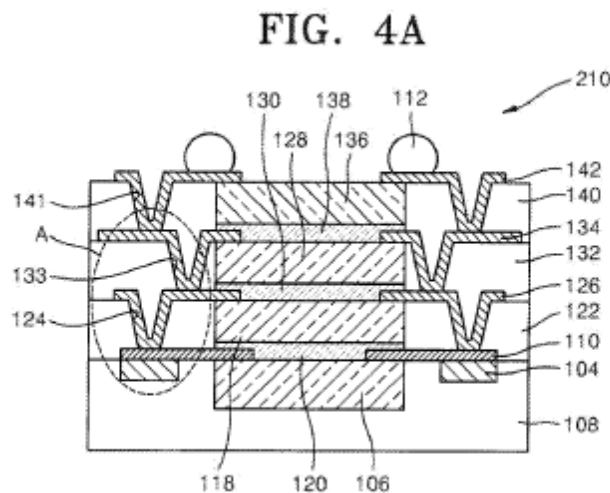
We review the appealed rejections for error based upon the issues Appellant identifies, and in light of the arguments and evidence produced thereon. *Ex parte Frye*, 94 USPQ2d 1072, 1075 (BPAI 2010) (precedential) (cited with approval in *In re Jung*, 637 F.3d 1356, 1365 (Fed. Cir. 2011) (“[I]t has long been the Board’s practice to require an applicant to identify the alleged error in the examiner’s rejections.”). Upon review of the evidence and each of the respective positions set forth in the record, we find that the preponderance of evidence supports Appellant’s position in the record. Accordingly, we reverse each of the Examiner’s rejections on appeal essentially for the reasons set forth in the record by Appellant, and add the following for emphasis.

Rejection 1

We refer to the Examiner’s rejection and stated findings on pages 5–7 in the Final Office Action.

Appellant’s response to the Examiner’s Rejection 1 is set forth on pages 23–25 of the Appeal Brief and on pages 5–6 of the Reply Brief.

Therein, Appellant disputes the Examiner's finding that conductive pattern 110 of Kim is arranged in a row of two that results in a plurality of second openings in encapsulant 122 of Kim. Appellant explains that, in Kim, insulating body 122 is formed over conductive pattern 110 and insulating body 108, and refers to Figure 4A of Kim in this regard (reproduced below).



Kim's Figure 4A

Figure 4A, above, is a cross-sectional view of an embodiment of a semiconductor package according to Kim's disclosure. Kim ¶¶ 20, 71.

Appellant submits that a person skilled in the art would not interpret insulating body 122 of Kim, formed over conductive pattern 110, as a plurality of second openings arranged in a row as recited in Appellant's claim 32. Appellant argues that Kim has no disclosure that conductive pattern 110 is arranged in a row to constitute a plurality of second openings arranged in a row.

In response to Appellant's argument, the Examiner reiterates that Figure 4A of Kim depicts conductive pattern 110 arranged in a row of two, resulting in a plurality of second openings in encapsulant 122. Ans. 30. The

Examiner refers to Appellant's Figure 4m (reproduced below), and states that it depicts the claimed second openings recited in claim 32, showing openings formed in encapsulant 146 that are filled by substrate 138.² Ans. 30. The Examiner concludes that openings created by 110 of Kim, occupying space within the footprint of the encapsulant 122, is interpreted as applicable to second openings recited in claim 32. Ans. 30.

Appellant's Figure 4m is reproduced below.

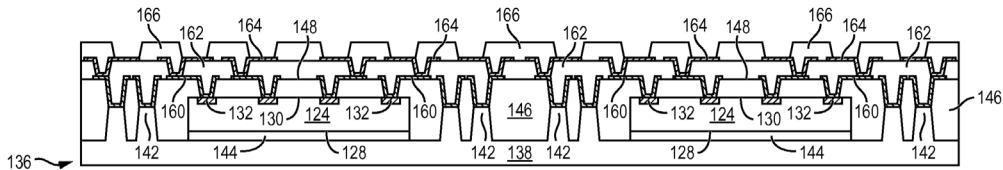


FIG. 4m

Appellant's Figure 4m

Figure 4m, above, illustrates a structure formed in an intermediate step in a process of using a leadframe with integrated bodies to form openings through an encapsulant for vertical interconnect of a semiconductor die, according to Appellant's Specification. Spec. ¶¶ 15, 36, 46.

However, as Appellant states on page 4 of the Appeal Brief, it is Appellant's Figure 4o that depicts the claimed plurality of second openings 172. Appeal Br. 4. Hence, the Examiner's reliance upon Figure 4m is in error, and results in a flawed claim interpretation. A proper claim interpretation is explained below.

Appellant's Figure 4o is reproduced below.

² Paragraph 39 on page 15 of the Specification refers to item 138 as a base plate.

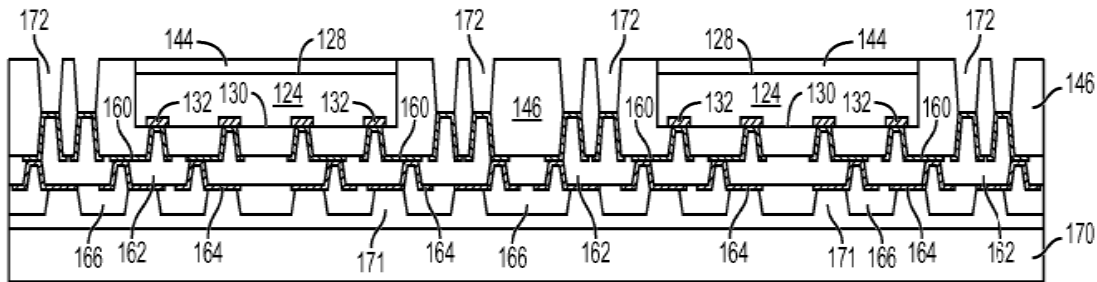


FIG. 4o

Appellant's Figure 4o

The plurality of second openings 172 are shown above in Figure 4o. Claim 32 recites that the encapsulant 146 includes a plurality of second openings 172 arranged in a row and formed from a second surface of the encapsulant 146 opposite the first surface of the encapsulant 146 partially through the encapsulant 146 and aligned with the first openings 154 and extending to the conductive layer 160. We agree with Appellant that the Examiner has not made sufficient findings to support the anticipation rejection regarding these claim elements. The Examiner misconstrues the elements of claim 32 by erroneously relying upon Appellant's Figure 4m, and therefore does not make the necessary fact findings sufficient to support the rejection. We thus reverse Rejection 1.

Rejection 2

We refer to the Examiner's stated findings for Rejection 2 made on pages 7-9 in the Final Office Action.

Appellant's response to the Examiner's Rejection 2 is set forth on pages 23–24 of the Appeal Brief. Therein, Appellant submits that Chen does not teach that Chen's encapsulant includes a plurality of second openings arranged in a row and formed from a second surface of the encapsulant opposite the first surface of the encapsulant partially through the encapsulant and aligned with the first openings and extending to the conductive layer. Appellant states that the Examiner identifies the space occupied by redistribution layer 102b in Chen as the second openings recited in claim 32. Appellant argues that in Chen, fill material layer 104 is formed over redistribution layer 102b as shown in Figure 4E of Chen. Figure 4E of Chen is reproduced below.

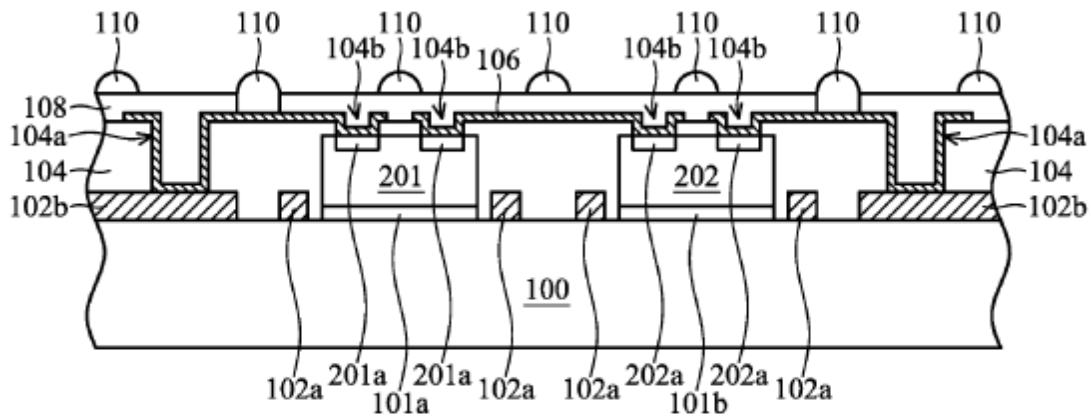


FIG. 4E

Figure 4E of Chen

Figure 4E, above, depicts a cross section of an embodiment of a method for fabricating a chip package according to Chen's disclosure. Chen ¶¶ 14, 33.

Appellant argues that one skilled in the art would not interpret Chen's fill material layer 104, formed over redistribution layer 102b, as a plurality of second openings arranged in a row because Chen has no disclosure that redistribution layer 102b is arranged in a row to constitute a plurality of second openings arranged in a row as claimed. Appeal Br. 23–24. We agree. Notably, in response to this argument, the Examiner again erroneously relies upon Appellant's Figure 4m when interpreting the elements of claim 32 (Ans. 31–32), and as a result, does not make the needed fact findings to support the anticipation rejection for certain claim elements for the reasons provided by Appellant in the record. We therefore reverse Rejection 2.

Rejection 3

We can focus on independent claim 26 in making our determinations herein.

We refer to the Examiner's conclusions and stated findings for Rejection 3 made on pages 10–26 in the Final Office Action. Therein, the Examiner acknowledges that O does not teach a row of first bodies and a row of second bodies. The Examiner relies upon O for teaching a first body (left protruding body of 31 contacting 33 shown in Figure 6 of O) and a second body (right protruding body of 31 contacting 33). Final Act. 10. The Examiner relies upon Kinsman for teaching a row of first bodies and a row of second bodies, and refers to supports 150 shown in Figure 4 of

Kinsman. Final Act. 12–13. The Examiner concludes it would have been obvious to have modified the device of O, to include a row of first bodies and a row of second bodies extending from a surface of the base plate, wherein the surface of the base plate completely surrounds each of the row of first bodies and each of the row of second bodies, a semiconductor die disposed between the row of first bodies and the row of second bodies, an encapsulant deposited around the semiconductor die and over the substrate around each of the row of first bodies and each of the row of second bodies, wherein the encapsulant includes a plurality of first openings extending to each of the row of first bodies and to each of the row of second bodies, as taught by Kinsman, in order to decrease the lateral width of the semiconductor device and save valuable real estate in electronic devices (Kinsman ¶ 30). Final Act. 12–13.

Appellant argues that O describes a different type of structure, i.e. the portion of substrate 31 outside cavity 32 is a continuous surface around cavity 32. O, Figure 5. Appeal Br. 8. Appellant states that cavity 32 in O is formed in substrate 31, and chip 37 is mounted in the cavity so that redistribution pads 33 are about the same level as chip pads 39. O, Figure 6. Appeal Br. 10. Appellant states that the Examiner believes that a person of ordinary skill in the art could produce multiple devices from O using the structure as described in Kinsman. Appellant states that the Examiner believes O is extendable to a row of the first bodies and a row of the second bodies to decrease the lateral width of the semiconductor device and save valuable real estate in electronic devices as suggested by Kinsman. Appellants disagree and argue that the Examiner is piecemealing references

together and extrapolating outcomes without basis from the references or reasonable rationale in the mind of the person skilled in the art. Reply Br. 2.

Appellant argues that O's structure does not have the same requirements as Kinsman, and O has no purpose for individual supports 150 in substrate 31. Appeal Br. 11. Appellant states that O is not concerned with a capillary wire bonding tool, and O does not describe making electrical connection to circuits within substrate 31. Reply Br. 2. Appellant argues that even if O uses a capillary wire bonding tool, cavity 32 makes redistribution pads 33 the same level as chip pads 39 and solves the spacing problem from Kinsman. Appellant states that because O's redistribution pads 33 formed on substrate 31 perform only the function of redistributing chip pads 39, redistribution pads 33 are formed to be larger than chip pads 39 (O ¶ 34). Reply Br. 2. Appellants states that accordingly, pitch P2 of O's redistribution pads 33 is greater than pitch P1 of chip pads 39. *Id.* Appellant states that there is no reasonable rationale to make the proposed modification especially because there would be no decrease in lateral width of chip 37 by making individual supports under redistribution pads 33. Appeal Br. 11.

We are persuaded by the aforementioned arguments. Setting forth a *prima facie* case of obviousness requires establishing that the applied prior art would have provided one of ordinary skill in the art with an apparent reason to modify the prior art to arrive at the claimed invention. *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007). On this record, the Examiner's proposed modification of O appears to be premised on an impermissible use of hindsight after review of Appellant's disclosure rather than on a supported reason to modify O available to an ordinarily skilled

artisan and consistent with the teachings thereof. *KSR*, 550 U.S. at 421 (cautioning that the fact finder must be aware “of the distortion caused by hindsight bias and must be cautious of arguments reliant upon *ex post* reasoning”; citing *Graham v. John Deere Co.*, 383 U.S. 1, 36 (1966) (warning against a “temptation to read into the prior art the teachings of the invention in issue”)).

In view of the above, we reverse Rejection 3. Rejection 5 involves a rejection of claim 38 which depends upon claim 32, and therefore we also reverse Rejection 5 for the same reasons. Rejection 6 involves the combination of O in view of Kinsman, further in view of Zudock and therefore involves the same deficiencies discussed with regard to Rejection 3, and therefore we also reverse Rejection 6.

Rejection 4

Claims 38 and 44 are rejected as being obvious over Kim in view of Zudock in Rejection 4. Claim 38 depends upon claim 32. Claim 44 depends upon claim 39. These dependent claims fall with respective independent claims 32 and 39, and therefore we reverse Rejection 4 for same reasons that we reversed Rejections 1 and 2.

CONCLUSION

We reverse the Examiner’s decision.

DECISION SUMMARY

In summary:

Claims Rejected	35 U.S.C. §	Reference(s)/Basis	Reversed	Affirmed
32, 35, 39, 42, 45	102(a)(1)	Kim	32, 35, 39, 42, 45	
32, 35, 36	102(a)(1)	Chen	32, 35, 36	
26–29, 32–36, 39–42, 45–48	103(a)	O, Kinsman	26–29, 32–36, 39–42, 45–48	
38, 44	103(a)	Kim, Zudock	38, 44	
38	103(a)	Chen, Zudock	38	
31, 38, 44, 49	103(a)	O, Kinsman, Zudock	31, 38, 44, 49	
Overall Outcome			26–29, 31–36, 38–42, 44–49	

REVERSED