UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte SHAHRAM MOSTAFAZADEH
and JOSEPH O. SMITH

Appeal 2007-4270
Reissue Application 10/044,162
Patent 6,117,710
Technology Center 2800

Decided: 28 February 2008

Before JOHN C. MARTIN, LEE E. BARRETT, and MARK NAGUMO, *Administrative Patent Judges*.

BARRETT, *Administrative Patent Judge*.

DECISION ON APPEAL

This is a decision on appeal under 35 U.S.C. § 134(a) from the final rejection of claims 1 and 4-15. Claims 2 and 3 have been canceled. We have jurisdiction pursuant to 35 U.S.C. § 6(b).

We reverse but enter new grounds of rejection.

REISSUE

This application was filed January 11, 2002, for reissue of U.S. Patent 6,117,710 ('710 patent), entitled "Plastic Package with Exposed Die and Method of Making Same," issued September 12, 2000, to Shahram Mostafazadeh and Joseph O. Smith, based on Application 09/195,350, filed November 18, 1998, which is a division of Application 08/798,967, filed February 11, 1997, now U.S. Patent 5,894,108, issued April 13, 1999.

BACKGROUND

The claims are directed to a method for producing a molded plastic integrated circuit package having an exposed die.

Figures 5 to 7 of the '710 patent are reproduced below.

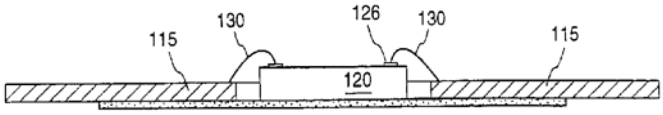

FIG. 5

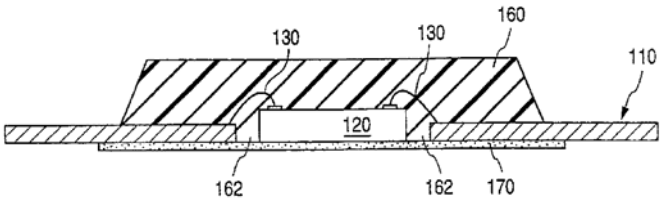

FIG. 6

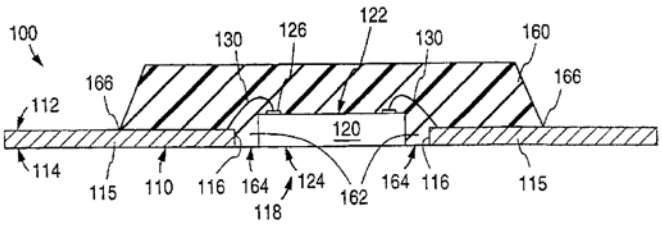

FIG. 7

Figure 5 shows the structure after the step of mounting a lead frame 110 with radial leads 115 and an integrated circuit die 120 to adhesive tape 170, and after the subsequent step of electrically connecting wires 130 from die bond pads 126 to the leads 115. Figure 6 shows the package after the next step of forming a plastic casing 160 over the lead frame 110, the die 120, and wires 130, with intervening portions 162 of the plastic casing material filling the gaps. Figure 7 shows the package structure after a final step of removing the adhesive tape 179 thereby exposing the die 120, the lower surfaces of the lead frame 110, and the lower surface of portions 162 of the casing, all of which are co-planar.

Claim 1 is reproduced below (underlining indicates matter added during reissue, 37 C.F.R. § 1.173(d)):

> 1. A method for producing an electrical device comprising the steps of:
>
> forming a flat lead frame including a plurality of leads extending radially from a central opening, the lead frame having opposing upper and lower surfaces;
>
> mounting the lead frame and an integrated circuit die onto a strip of adhesive tape such that a lower surface of the die contacts the adhesive tape and the die is located in the central opening, and the lower surface of the lead frame also contacts the adhesive tape;
>
> <u>electrically connecting bond pads on a top surface of the die to associated lead frame leads using wire bonding with the adhesive tape in place such that the adhesive tape holds the die and lead frame in place during the wire bonding operation;</u>

> forming a plastic casing over an upper surface of the die and the upper surface of the lead frame wherein the plastic casing comes into contact with the adhesive tape such that a lower surface of the plastic casing is substantially co-planar with the lower surfaces of the lead frame and the die; and
>
> removing the adhesive tape after forming the plastic casing to expose the lower surfaces of the die and the lead frame, whereby exposed surfaces of the lead frame directly form the only externally exposed and accessible I/O contacts for the package and plastic material fills at least portions of gaps between adjacent leads, such that the lower surface of the package is substantially co-planar and includes exposed portions of the plastic casing, the lead frame and the die.

THE REFERENCES[1]

Lin	5,200,362	Apr. 6, 1993
Ogawa	5,252,855	Oct. 12, 1993

THE REJECTION

Claims 1 and 4-15 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Lin and Ogawa.

The Examiner finds that Lin teaches the method of independent claim 1 except that it does not teach the limitation of the lead frame having a

[1] The Examiner refers to Melton, U.S. Patent 5,844,315, issued December 1, 1998, based on an application filed March 26, 1996, in the response to the arguments, but it is not part of the statement of the rejection. Melton is applied in a new ground of rejection, *infra*.

"central opening" (Final Rejection 3). The Examiner concludes that it would have been obvious to one of ordinary skill in the art to provide Lin with a lead frame having a central opening as taught by Ogawa "because the lead frame of Ogawa et al. would provide the formed package of Lin et al. with the die being hold [sic] during electrical connection and a thinner thickness product" (Final Rejection 4).

Alternatively, the Examiner finds that Ogawa teaches the method of claim 1 except that it does not teach the limitations of "forming a plastic casing over an upper surface of the die and the upper surface of the lead frame" and "removing the adhesive tape after molding the plastic casing" (because it does not teach forming a casing, it does not have any steps after forming the casing) (Final Rejection 4). The Examiner concludes that it would have been obvious to provide Ogawa with a plastic casing as taught by Lin "because the plastic casing would provide the process of Ogawa et al. with complete semiconductor package device" (Final Rejection 5).

The Examiner concludes that the proposed combination also meets the method of independent claim 7.

As to independent claim 15, the Examiner further notes that Lin discloses that the traces can be severed to disconnect the device, which indicates that the leads can be cut flush with the casing (Final Rejection 6).

DISCUSSION

Obviousness findings of fact

Every obviousness determination is based on the four factual inquiries of *Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966): (1) the scope and content of the prior art; (2) the differences between the prior art and the claimed invention; (3) the level of ordinary skill in the art; and (4) any objective evidence of nonobviousness.

Scope of the prior art

There is no dispute that the references are within the scope of the prior art; i.e., that they are from analogous art. *See Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 1535 (Fed. Cir. 1983) ("The scope of the prior art has been defined as that 'reasonably pertinent to the particular problem with which the inventor was involved.'").

Content of the references

Lin

Lin discloses a method for fabricating a semiconductor device. Figures 2 to 4 of Lin are reproduced on the next page.

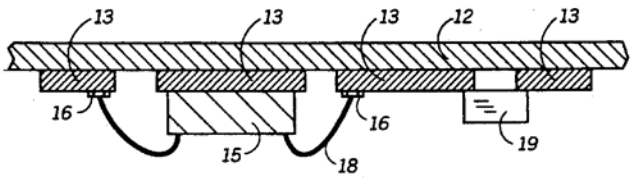

FIG.2

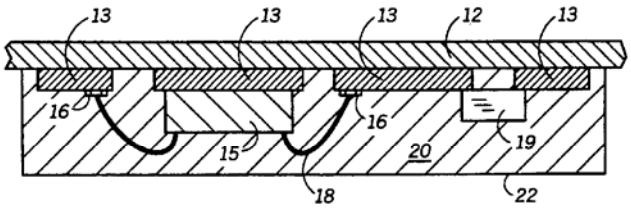

FIG.3

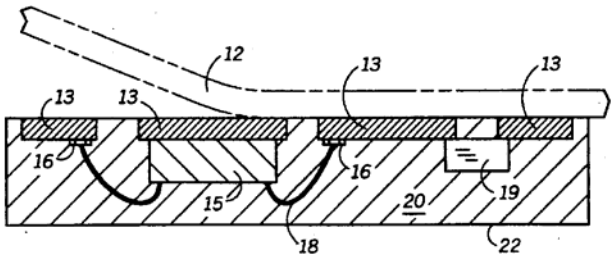

FIG.4

Figure 2 shows a pattern of conductive traces 13 on a transfer film 12 of flexible material. A semiconductor device die 15 is mounted on a rectangular trace 13[2] and is electrically connected to the pattern of conductive traces by wirebonds 18 (col. 2, ll. 55-66). Figure 3 shows the semiconductor device die 15 and the wirebonds 18 after they are encapsulated by an encapsulating resin 22 to form a protective body 22

[2] The structure which the semiconductor die is attached to for support is known in the art as a "die attach pad" and is also called a "header" or "paddle" when it is formed as part of a lead frame.

(col. 3, ll. 13-32). Figure 4 shows the transfer film 12 being peeled off to expose the surfaces of the traces 13 and the body 22 (col. 3, ll. 33-38).

Lin discloses that the pattern of conductive traces 13 is formed on a transfer film 12 of flexible material by one of several methods: (1) a copper foil is laminated to the transfer film and is subsequently patterned using photolithographic patterning and etching; (2) evaporating a layer of metal or other conductor onto the surface of the transfer film and then patterning that evaporated layer; or (3) a pattern of traces is formed from a thin sheet of metal and then laminated to the transfer film (col. 2, ll. 25-54). The trace upon which the device die 15 is mounted can be contacted by a heat sink (col. 3, ll. 54-63). Lin states that "[n]o thick device 'header' or leadframe is necessary for mounting the device die, and so the thickness 't' is minimized" (col. 3, ll. 56-58).

Ogawa

The Examiner relies on the description of the prior art in Figure 5 of Ogawa. Figure 5 of Ogawa is reproduced below.

FIGURE 5 (PRIOR ART)

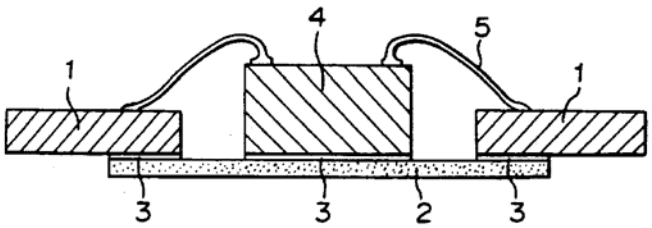

Figure 5 shows a resin film 2 with a resin-type adhesive 3 which serves as a mounting member for a semiconductor element 4 and the inner lead 1 of a lead frame (col. 1, l. 66 to col. 2, l. 9). The semiconductor element 4 and the leads 1 are electrically connected by wires 5 (col. 2, ll. 9-14). Ogawa explains the problems with such a construction:

> [T]he conventional lead frame is of such a construction that the resin film 2 is directly joined with the inner lead 1 made of a copper alloy or an iron alloy by means of the resin type adhesive 3. In general, however, the adhesive force between the resin type adhesive agent and these metal materials is not necessarily sufficient. On account of this, it is apprehended that, due to shear stress to be exerted at the time of bending work of the lead during the assembling step of the semiconductor package, or thermal stress to be applied under various heating environment, or else, adhesiveness at the above-mentioned adhesive interface becomes decreased to bring about very fine gaps between them. In such case, when moisture-adsorption takes place in the package, water is condensed in these small gaps, and this condensed water, when heated again, becomes vaporized to expand its volume to lead to a possible danger of bringing about cracks in the semiconductor package.

Col. 2, ll. 15-34.

Ogawa overcomes the problem of insufficient adhesive force by providing an anodic oxide film 6 on the lead frame having as its principal structure an aggregate of acicular crystals 7 (Fig. 2; col. 4, ll. 29-39). The adhesive 3 penetrates into the gaps formed by the crystals 7 and solidifies thereby increasing the resistance to peeling (col. 4, ll. 39-47).

Differences

The Examiner finds that the difference between the subject matter of independent claim 1 and Lin is that Lin does not teach a lead frame having "a central opening."

We find that the differences between the subject matter of independent claim 1 and Lin are that Lin does not teach mounting the integrated circuit die to the adhesive tape (transfer film) "such that a lower surface of the die contacts the adhesive tape" and such that the die is exposed when the transfer film is removed.

The Examiner finds that the differences between the subject matter of independent claim 1 and Ogawa are that Ogawa does not teach "forming a plastic casing" over the die and lead frame, and thus does not teach removing the adhesive tape after forming a plastic casing. The Examiner finds that Ogawa teaches removing the adhesive tape.

We find that the differences between the subject matter of independent claim 1 and Ogawa are: (1) Ogawa does not teach the formation of a plastic casing, as noted by the Examiner; and (2) the resin film 2 is permanently attached in Ogawa, so Ogawa does not teach and would not suggest the limitation of "removing the adhesive tape after forming the plastic casing to expose the lower surfaces of the die and the lead frame . . . ," even if Ogawa taught forming a plastic casing.

Claim 7 is similar to claim 1.

Claim 15 is similar to claim 7, but also recites that the leads are cut "substantially flush with an associated side surface of the casing." Lin discloses cutting the leads, but does not expressly teach cutting the leads flush with the sides of the casing.

Level of ordinary skill in the art

Although examiners seldom make an express finding as to the level of ordinary skill in the art, the level of ordinary skill in the art is evidenced by the references. *See In re Oelrich*, 579 F.2d 86, 91 (CCPA 1978) ("the PTO usually must evaluate both the scope and content of the prior art and the level of ordinary skill solely on the cold words of the literature"); *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (the Board did not err in adopting the approach that the level of skill in the art was best determined by the references of record). Skill in the art is presumed. *See In re Sovish*, 769 F.2d 738, 743 (Fed. Cir. 1985).

In analyzing whether it would have been obvious to one of ordinary skill in the art to make a modification or combination, there does not have to be an express teaching, suggestion, or motivation (TSM) in a published article or issued patent. *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1741 (2007). "As our precedents make clear, however, the analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ." *Id.* "A person of ordinary skill is also a person of ordinary creativity, not an automaton." *Id.* at 1742.

The skilled artisan can rely on common sense. *Id.* at 1742-43. Thus, one of ordinary skill in the art looking at a prior reference must be presumed to have the ability to make certain changes without an express teaching.

Objective evidence of nonobviousness

No objective evidence of nonobviousness has been presented.

Rejections

Lin as modified with the lead frame of Ogawa

The rejection requires some interpretation. The Examiner finds (Advisory Action 2; Ans. 9) that Lin teaches a "lead frame" because, *inter alia*, it states that "[i]n yet another embodiment, a pattern of traces is formed from a thin sheet of metal and that pattern of traces is then laminated to the transfer film" (col. 2, ll. 51-54). The Examiner finds that the pattern of traces 13 does not have a "central opening." However, the plurality of leads (i.e., lead frame) formed by pattern of traces 13 in Lin clearly has a central opening as seen in Figure 8; although there is a square die attach pad (also 13) in the opening, the limitation of a "central opening" by itself does not preclude structure inside the opening. Therefore, the actual difference between Lin and the subject matter of claims 1, 7, and 15 is that there is a die attach pad in the central opening of the plurality of leads (i.e., lead frame) in Lin and the die contacts the die attach pad, so that Lin does not teach that "the lower surface of the die contacts the adhesive tape" and that that the die is exposed when the transfer film is removed.

The Examiner's conclusion that it would have been obvious to provide Lin with a lead frame having a central opening as taught by Ogawa to produce a "thinner thickness product" also requires some interpretation. What the Examiner apparently intends is that it would have been obvious to eliminate the die attach pad in Lin so that "the lower surface of the die contacts the adhesive tape," because this would lead to a thinner package. This is consistent with Appellants' understanding: "It is suspected that the Examiner's theory is that the resulting package would be thinner because there is no metal under the die." (Reply Br. 2.) The Examiner has two reasons for the modification. *First*, Figure 5 of Ogawa teaches a lead frame and a semiconductor die attached with adhesive directly to a resin film 2 without a die attach pad (also called a "header" or "paddle" when it is part of a lead frame). The Examiner finds that Ogawa shows an uncompleted package and that after a subsequent (undisclosed) step of forming a plastic casing, the resin film 2 would be removed, just as the transfer film 12 of Lin is removed (Ans. 13-14), so that the bottom of the semiconductor die is exposed. Therefore, the Examiner reasons that it would have been obvious to eliminate the die attach pad (trace 13) in Lin in view of the teachings in Ogawa. *Second*, the Examiner finds that Lin's statement that "[n]o thick device 'header' or leadframe is necessary for mounting the device die, and so the thickness 't' is minimized" (col. 3, ll. 56-58), "could be understood as the 'header' or 'part' of the lead frame that [is] used <u>for mounting the device die</u> is <u>not</u> needed" (Ans. 10). That is, the Examiner finds that Lin suggests that

the die could be mounted directly to the transfer film 12 without a header and, therefore, the die would be exposed when the film is removed.

Appellants argue that: (1) Lin does not disclose a "lead frame"; (2) a person of ordinary skill in the art would not be motivated to substitute a lead frame for the thin film conductive layer disclosed by Lin; and (3) the combination of Ogawa with Lin would necessarily include the resin film 2.

Appellants argue that Lin does not disclose a "lead frame" and so does not meet the limitations of "forming a flat lead frame" (claim 1) or "providing a lead frame" (claims 7 and 15), and then mounting the lead frame on a transfer strip (Appeal Br. 4). It is argued that one skilled in the art would understand the term "lead frame" to mean a "self-supporting sheet metal framework" used in semiconductor packaging and to exclude thin metal foils and deposited conductive layers on a transfer film as disclosed by Lin (Appeal Br. 4-5). As to Lin's disclosure at column 2, lines 51-54, that the pattern of traces can be formed from a thin sheet of metal that is then laminated to transfer film, Appellants argue that although lead frames are formed from relatively thin sheets of metal they are not the thin sheets of metal discussed in Lin (Appeal Br. 5). Appellants argue that Lin states that "[n]o thick device 'header' or leadframe is necessary for mounting the device die, and so the thickness 't' is minimized" (col. 3, ll. 56-58), which indicates that the traces of thin metal in Lin are not a "lead frame" and that Lin teaches away from the use of a "lead frame" (Appeal Br. 5, 7).

Appellants contend that Lin's pattern of leads is not a "lead frame" (Br. 5). We find that Lin's statement that "[i]n yet another embodiment, a pattern of traces is formed from a thin sheet of metal and that pattern of traces is then laminated to the transfer film" (col. 2, ll. 51-54) describes a lead frame because the pattern of traces is separately formed from a sheet of metal and then laminated to the transfer film, which we find necessarily requires that the pattern of traces be self-supporting so that the traces maintain their relative positions until and during attachment to the transfer film.

Appellants further argue that Lin's pattern of traces thus formed does not constitute a lead frame because "as is notoriously well known in the art, lead frames strips or panels *generally have skirts, tie bars, rails and/or other structures that* support the leads and rails or other structures that *may be used by the handling equipment* during fabrication and packaging" (Br. 5) (emphasis added) and that "[s]uch skirts and rails are trimmed away at some point in the packaging process (generally after the package has been molded in molded packages"). *Id*. Lin's Figure 9 shows plural patterns of traces connected together by a bus line 52 that is used during electrolytic plating of the traces and then removed after package fabrication (col. 4, ll. 48-65). Appellants argue that the bus line and traces shown in this figure do not form a lead frame because they are not handled by the handling equipment, which instead contacts the transfer film 50 (Br. 5). This argument is unconvincing for two reasons. First, the assertion that lead frames

“generally” have skirts, tie bars, rails and/or other structures that may be used by the handling equipment during fabrication and packaging is unsupported by evidence and also appears to concede that not all lead frames include such handling structure. Second, assuming such structure is required, Appellant’s argument fails to take into account that the step of transferring patterns of traces made from a metal sheet to the Figure 9 support film presumably would involve handling equipment that directly contacts the patterns of traces, such as by contacting bus line 52. Furthermore, if such contact is not inherent, it would have been obvious.

There appears to be no dispute that "laminating" the pattern of traces to the film implicitly requires an adhesive as in Ogawa. The fact that Lin discloses alternative embodiments wherein the metal is formed from a foil or evaporated onto the transfer film and then patterned, which embodiments may not be lead frames, does not negate the lead frame teaching.

Because we find that Lin discloses a lead frame as an alternative to thin metal foil films, it is not necessary to address Appellants' arguments (at Appeal Br. 6-8) why a person of ordinary skill in the art would not be motivated to replace the thin film foil in Lin with the lead frame in Ogawa.

Lin does not teach the limitations of independent claims 1, 7, and 15 that "the lower surface of the die contacts the adhesive tape" and that after the adhesive tape is removed the die is exposed because the semiconductor device die is attached to a die attach pad. The rejection provides two reasons for eliminating the die attach pad in Lin: (1) Ogawa discloses attaching the

semiconductor die to a film 2 without a die attach pad and the film is removed after forming the plastic casing just as in Lin; and (2) Lin suggests that a header (die attach pad) is not required.

Appellants argue the purpose of Ogawa is to permanently adhere a resin film 2 to the bottom surface of a lead frame in order to eliminate the need for a die attach pad and, thus, any reasonable combination of Lin and Ogawa would necessarily include the resin film 2 (Appeal Br. 8).

The Examiner interprets Ogawa's statement that the adhesive force "is not necessarily sufficient" (col. 2, ll. 20-21) to mean that the resin film 2 is removed after forming the plastic casing and is not a permanent part of the final package (Ans. 11-14). The Examiner finds that Lin's steps of molding the plastic casing and then peeling off the tape are suitable for use with Ogawa because its adhesive force "is not necessarily sufficient" (Ans. 15).

We agree with Appellants that the film 2 in Ogawa is intended to be permanent. Ogawa explains that the adhesion may be decreased when bending the leads during the assembly step of the semiconductor package or because of thermal stress under various heating environments (col. 2, ll. 15-34). This explains adhesion problems with the package, which clearly indicates that the film 2 is intended to be permanent. The fact that Figure 5 of Ogawa resembles Figure 2 of Lin does not imply that the film 2 in Ogawa can or should be removed as the transfer film 12 is in Lin. Since Ogawa does not teach removing the film 2, it does not teach "removing the adhesive

tape" so that the lower surface of the die is exposed and does not suggest eliminating the die attach pad in Lin.

We also disagree with the Examiner's interpretation that Lin's statement that "[n]o thick device 'header' or leadframe is necessary for mounting the device die, and so the thickness 't' is minimized" (col. 3, ll. 56-58), "could be understood as the 'header' or 'part' of the lead frame that [is] used <u>for mounting the device die</u> is <u>not</u> needed" (Ans. 10). The statement that "[n]o thick device 'header' or leadframe is necessary for mounting the device die" does not say that no header or lead frame is necessary; it states that no "thick" header or lead frame is necessary. The header (the square die attach pad) in Lin can be very thin in the two embodiments where it is made of a thin foil or evaporated onto the transfer film 12. Lin does not suggest eliminating the die attach pad so that the die is exposed after the transfer film 12 is removed.

Therefore, the Examiner has not established that would have been obvious to one of ordinary skill in the art to eliminate the die attach pad in Lin so that the "lower surface of the die contacts the adhesive tape" and that after "removing the adhesive tape" the lower surface of the die is exposed. This reason for the rejection of the claims 1 and 4-15 is reversed.

Ogawa as modified to have a plastic casing in view of Lin

The Examiner alternatively concludes that Ogawa would necessarily be encapsulated and finds that Ogawa discloses the resin film 2 in Ogawa is intended to be removed after molding a plastic case, as in Lin (Ans. 11-16).

Appellants do not contest that it would have been expected to provide Ogawa with a plastic casing, but argue that nothing in Ogawa standing alone, or in combination with Lin, would remotely suggest a casing of the type recited in the claims (Appeal Br. 8). It is argued that the resin film support member is intended to be permanent structure which is integrated into the final package and that the Examiner errs in concluding that resin film 2 may be peeled off (Appeal Br. 8-11). Appellants argue that the resin film 2 would be encapsulated in the final package as shown by Figures 1 and 2 in the Reply Brief (Reply Br. 3-5).

As discussed, *supra*, we agree with Appellants that the film 2 in Ogawa is intended to be permanent. Thus, there is no teaching or reason to remove the film in Ogawa to leave the lower surface of the die exposed. We agree with Appellants that the package in Ogawa would be encapsulated as shown by Figures 1 and 2 in the Reply Brief. This reason for the rejection of the claims 1 and 4-15 is reversed.

NEW GROUNDS OF REJECTION

1.

Claims 1 and 4-15 are rejected under 35 U.S.C. § 103(a) as unpatentable over Lin, Ogawa, and Miles, U.S. Patent 5,696,666. Lin and Ogawa and the level of ordinary skill in the art have been discussed, *supra*.

With regard to independent claims 1, 7, and 15, Lin discloses a lead frame laminated to a transfer film 12 (col. 2, ll. 51-54), but does not expressly describe laminating using an adhesive tape. This limitation is not

argued. We found *supra* at page 16 that laminating using an adhesive is implied. In the alternative, for this rejection, we conclude that laminating using an adhesive at least would have been obvious to a person having ordinary skill in the art. In addition, Figure 5 of Ogawa discloses attaching a lead frame and a die to a film using an adhesive layer which provides motivation for laminating the die and the lead frame of Lin's alternative embodiment (col. 2, ll. 51–54) to the transfer film 12 utilizing an adhesive.

A further difference between Lin and the subject matter of claims 1, 7, and 15 is that there is a die attach pad in the central opening of the pattern of traces Lin and the die contacts the die attach pad, so that Lin does not teach that "the lower surface of the die contacts the adhesive tape" and that that the die is exposed when the transfer film is removed.

Miles discloses an encapsulated integrated circuit package which has an exposed die after forming the plastic casing. Figure 3 of Miles is reproduced below.

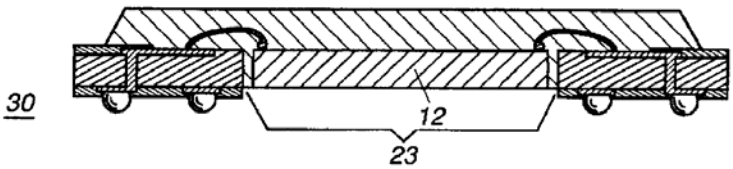

FIG. 3

Figure 3 shows a die 12 located in the central opening of a printed circuit board (PCB) substrate (col. 2, ll. 3-12), with the die attached by wires to the PCB substrate and the die, the wires and the top of the substrate being

encapsulated and the die being exposed. Miles discloses applying a vacuum to the back surface of the die to hold it in place during encapsulation (col. 3, ll. 21-24), rather than using a tape as a molding support as in Lin.

Miles explains that eliminating the die attach pad to expose the die has the advantage of making the package less susceptible to moisture absorption and "[a]s an added benefit of having the back surface of the die exposed to the atmosphere, heat generated by the die, which must typically be drawn from the chip through the package interconnects and added heat sinks, is more directly and efficiently dissipated" (col. 2, ll. 18-22). Miles also discloses that the height of the package is reduced because the top of the die is close to the level of the top of the substrate (col. 2, ll. 27-34).

One of ordinary skill in the semiconductor packaging art would have been motivated to eliminate the die attach pad trace 13 in Lin so that the die directly contacts the transfer film 12 and so that the die is exposed when the film is removed for the advantages of an exposed die and a reduced package thickness as taught by Miles. One of ordinary skill in the art would have recognized the transfer film in Lin and the vacuum means in Miles as equivalent means for holding the die in position during encapsulation and preventing encapsulant from getting on the bottom surface of the trace 13 in Lin or the die 12 in Miles.

Lin discloses forming a plastic casing as recited in claim 6.

With regard to claims 4 and 5, Lin discloses a metal sheet we find to be a lead frame at column 2, lines 51-54, but does not disclose how the lead

frame is formed. Ogawa discloses that a lead frame can be formed by etching, as recited in claim 4, or by punching, which is the same as stamping recited in claim 5 (Ogawa, col. 1, ll. 13-16). A person of ordinary skill in the art would have been motivated to form the lead frame in Lin by etching or stamping because these are conventional lead frame manufacturing methods as taught by Ogawa.

With regard to claim 8, Lin discloses that the trace 13 upon which the die 15 is attached can be contacted by a heat sink (col. 3, ll. 58-63). Since the traces of the package are intended to be soldered to a circuit board, it would be apparent to one skilled in the art that the heat sink may be formed on the circuit board. Miles discloses that an exposed die allows heat to be more directly and efficiently dissipated (col. 2, ll. 18-22). One of ordinary skill in the art would have been motivated to contact the lower surface of an exposed die directly with a heat sink formed on a circuit board, as recited in claim 8, for the purpose of more efficient cooling of the die.

One of ordinary skill in the art would readily appreciate that the metal traces 13 in Lin are intended to have solder applied to them as recited in claims 9 and 13-15, and are intended to be soldered to a circuit board as recited in claim 10.

With regard to claims 11, 12, and 15, Lin discloses that the traces can be severed along the line 54 in Figure 5 to electrically disconnect the individual devices before or after the transfer film is removed (col. 4, ll. 62-65). Figure 5 shows a gap between the lines 54 and the edges of the

package. Appellants argue that Lin does not teach or reasonably suggest an arrangement where the traces are substantially flush with side surfaces of the plastic casing as recited in claims 11, 12, and 15 (Appeal Br. 11-12). Drawings are not necessarily to scale, but we agree that Lin does not expressly disclose trimming the leads to be flush with the sides of the casing. However, the rejection is based on obviousness and obviousness is determined from the viewpoint of one of ordinary skill in the art. One of ordinary skill in the art would have been motivated to trim the leads flush with the sides of the casing, as recited in claims 11, 12, and 15 to minimize the external dimensions of the package and to eliminate leads extending past the edges, which would interfere with handling and mounting.

2.

Claims 1 and 4-15 are rejected under 35 U.S.C. § 103(a) as unpatentable over Melton, U.S. Patent 5,844,315 and Lin.

Melton was applied earlier in the prosecution of this reissue application. On November 22, 2004, Appellants amended claim 1 to recite "whereby exposed portions of the lead frame form the only externally exposed and accessible I/O contacts for the package" and added independent claim 7, which contained the limitation "whereby exposed portions of the leads form the only externally accessible I/O contacts for a resulting integrated circuit package" to distinguish over Melton. Melton discloses metallic bumps as externally accessible I/O contacts in addition to the exposed portions of the lead frame. On May 2, 2005, Appellants filed a

declaration by co-inventor Mostafazadeh under 37 C.F.R. § 1.131 dated November 29, 2004, to antedate Melton. Melton was filed on March 26, 1996, and the parent application of the instant patent was filed on February 11, 1997. The Examiner withdrew reliance on Melton in a Final Rejection entered May 17, 2005. After an amendment, the Examiner entered a non-Final Rejection on September 7, 2005, and held that the declaration was ineffective to antedate Melton because although it alleges conception prior to March 26, 1996, it does not provide any evidence of diligence. Subsequent rejections relying on Melton were entered on October 31, 2005, January 31, 2006, and May 17, 2006. Applicants filed an amendment on June 7, 2006, amending the relevant limitation in claim 1 to read "whereby exposed [portions] <u>surfaces</u> of the lead frame <u>directly</u> form the only externally <u>exposed and</u> accessible I/O contacts for the package" (claim 1) (deleted matter in brackets and added matter underlined); amending the relevant limitation in claim 7 to read "whereby exposed [portions] <u>surfaces</u> of the leads <u>directly</u> form the only externally <u>exposed and</u> accessible direct I/O contacts for a resulting integrated circuit package" (claim 7); and adding claim 15, which is a combination of claims 7, 9, and 12. In the last Final Rejection, the Examiner entered the present rejection over Lin and Ogawa.

We agree with the Examiner that the laboratory notebook attached to the Rule 131 Mostafazadeh declaration establishes conception, but not an actual reduction to practice because no device was actually constructed. The

declaration is insufficient to antedate Melton it provides no evidence of "due diligence from prior to said date [of the reference] to a subsequent [actual] reduction to practice or to the filing of the application [constructive reduction to practice]," 37 C.F.R. § 1.131. Thus, Melton is prior art unless and until it is antedated.

Figures 4 to 6 of Melton are reproduced below.

FIG. 4

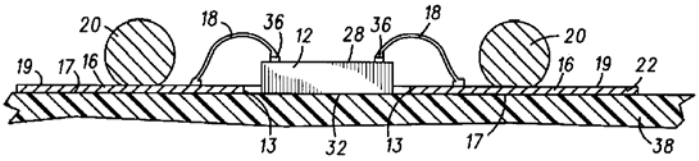

FIG. 5

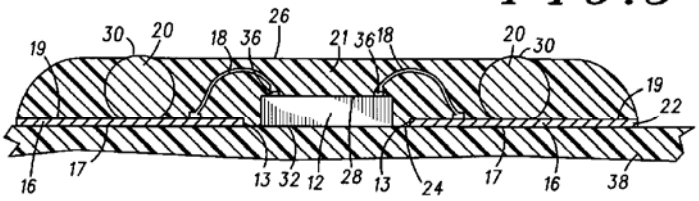

FIG. 6

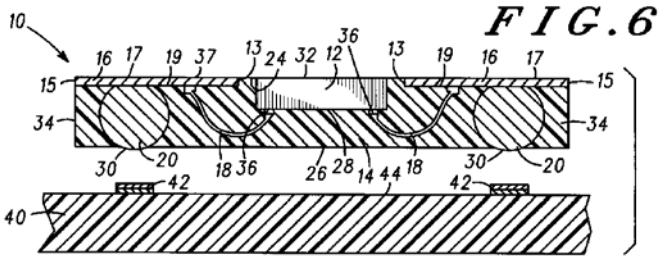

Figure 4 shows an integrated circuit die 12 and a lead frame 22 placed on an adhesive tape 38, wire leads 18 connected from the die bond pads 36 of the die to the leads 16 of the lead frame 22, and metallic bumps 20 attached to the leads 16. Figure 5 shows a layer of encapsulant over the

active face 28 of the die 16, inner face 24 of the leads 16, wire leads 18, and a portion of metallic bumps 20, as well as a portion of the adhesive tape 38 to form a preform 21 (col. 3, ll. 46-63). Figure 6 shows the assembly after the adhesive tape 38 has been removed and after the preform 21 and leads 16 are trimmed to reduce the size and weight of the package (col. 3, l. 64 to col. 4, l. 14), and before the bumps 20 are attached to the bond pads 42 of printed circuit board substrate.

Melton discloses that metallic bumps 20 are attached to the metallic leads 16 so that the bumps protrude from the polymeric encapsulant to allow each metallic bump 20 to be attached to a bond pad or solder bump on a printed circuit board (col. 3, ll. 57-63). The metallic bumps 20 are "externally exposed and accessible I/O contacts" in addition to the exposed surfaces of leads 16. Thus, Melton does not meet the negative limitations, "whereby exposed surfaces of the lead frame directly form the only externally exposed and accessible I/O contacts for the package" (claim 1), "whereby exposed surfaces of the lead frame directly form the only externally exposed and accessible direct I/O contacts for a resulting integrated circuit package" (claim 7), and "whereby exposed portions of the leads directly form the only externally accessible I/O contacts for a resulting integrated circuit package" (claim 15).

A person of ordinary skill in the semiconductor packaging art would have been motivated to omit the bumps 20 in Melton if their function was not required, as in the semiconductor package of Lin which lacks the extra

bumps shown in Melton. One of ordinary skill in the art would have been motivated to eliminate the bumps in Melton given the teachings of Lin so that the lower surfaces of the leads would be the only exposed I/O contacts.

Melton discloses forming a plastic casing as recited in claim 6.

With regard to claims 4 and 5, Melton describes formation of the lead frame by etching, as recited in claim 4, or by stamping, as recited in claim 5 (col. 2, ll. 43-45).

With regard to claim 8, Lin discloses that the trace 13 upon which the die 15 is attached can be contacted by a heat sink (col. 3, ll. 58-63). Since the traces of the package are intended to be soldered to a circuit board, it would have been apparent to one skilled in the art that the heat sink may be formed on the circuit board. One of ordinary skill in the art would have been motivated to contact the lower surface of the die in Melton with a heat sink formed on a circuit board for the known purpose of cooling the die in view of the teachings in Lin.

One of ordinary skill in the art would appreciate that the traces 13 on the package in Lin are intended to have solder applied to them as recited in claims 9 and 13-15, and are intended to be soldered to a circuit board as recited in claim 10. Thus, one of ordinary skill in the art would have appreciated that the outer surfaces 17 of leads 16 in Figure 6 of Melton could be soldered in view of Lin. Furthermore, we find that one of ordinary skill in the art had sufficient knowledge to know to apply solder to the outer surfaces of the leads in Melton even without a reference.

With regard to claims 11, 12, and 15, Melton discloses that the leads are trimmed even with the edge of the package body to reduce the size and weight of the package (col. 3, l. 67 to col. 4, l. 14).

CONCLUSION

The rejection of claims 1 and 4-15 is reversed.

New grounds of rejection have been entered as to claims 1 and 4-15.

This decision contains new grounds of rejection pursuant to 37 CFR § 41.50(b). 37 CFR § 41.50(b) provides that "[a] new ground of rejection pursuant to this paragraph shall not be considered final for judicial review."

37 CFR § 41.50(b) also provides that the appellant, WITHIN TWO MONTHS FROM THE DATE OF THE DECISION, must exercise one of the following two options with respect to the new ground of rejection to avoid termination of the appeal as to the rejected claims:

> (1) *Reopen prosecution*. Submit an appropriate amendment of the claims so rejected or new evidence relating to the claims so rejected, or both, and have the matter reconsidered by the examiner, in which event the proceeding will be remanded to the examiner. . . .
>
> (2) *Request rehearing*. Request that the proceeding be reheard under § 41.52 by the Board upon the same record. . . .

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

<u>REVERSED - 37 CFR § 41.50(b)</u>

MARTIN, *Administrative Patent Judge*, dissenting.

I join in the entry of the new grounds of rejection. However, I respectfully dissent from the majority's reversal of the Examiner's rejection of the appealed claims.

For the reasons given in Majority opinion, I agree that the claimed "lead frame" either (1) reads on Lin's pattern of traces when formed from a metal sheet or (2) if "lead frame" implies the presence of a skirt, tie bars, rails and/or other supporting structures, would have been have been obvious over Lin's pattern of traces when formed from a metal sheet.

Appellants do not deny that Ogawa's lead frame 1 (Fig.1) has a central opening that receives a die 4 or that the die and the lead frame are directly attached to the resin film 2 by means of an adhesive resin 3 such that the bottom surface of the die lies in the same plane as the bottom surface of the lead frame.

My colleagues and I have a different understanding of how the Examiner has proposed to modify Lin in view of Ogawa. They state that "[w]hat the Examiner apparently intends is that it would have been obvious to eliminate the die attach pad in Lin so that 'the lower surface of the die contacts the adhesive tape,' because this would lead to a thinner package." I understand the Examiner's position instead to be that it would have been obvious to *substitute* Ogawa's lead frame, with its central opening, for Lin's pattern of traces, which the Examiner correctly characterizes as a "lead

frame." The Examiner explained the proposed modification of Lin as follows in the Final Action:

> It would have been obvious to one of ordinary skill in the art at the time of the invention to provide the method of Lin et al. with a lead frame with a central opening of Ogawa et al. because the lead frame of Ogawa et al. would provide the formed package of Lin et al. with the die being hold [sic – held] during the electrical connection and a thinner thickness product."

Final Action 4; Answer 6. Appellants understood the Examiner to be proposing to substitute Ogawa's lead frame for Lin's pattern of traces. *See, e.g.*, Br. 6 ("The outstanding office action then takes the position that it would be obvious to provide the method of Lin with a led [sic] frame of Ogawa in order to form a thinner package."). *See also* Br. 7, heading 3 ("Those or [sic] ordinary skill in the art would not be motivated to substitute a lead flame (which is relatively thick) for the thin film conductive layer disclosed by Lin to provide a thinner package.").

The Answer does not question Appellant's interpretation of the rejection as requiring substitution of Ogawa's lead frame for Lin's pattern of traces. Instead, the Examiner explains, for example:

> In response to appellant's argument (pages 6-8) that a person of ordinary skill in the art would not be motivated to replace the thin film foil described by Lin with the lead frame of Ogawa, the fact that appellant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. *See Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

Answer 11 (underlining omitted).

Despite the fact that the Examiner and Appellants framed the issue as one of substitution, I would affirm the rejection on the ground that it would have been obvious in view of Ogawa's teaching of a lead frame that has a central opening for receiving the die to *modify* Lin's lead by omitting the die attach pad in order to reduce the thickness of the package, which is the motivation asserted by the Examiner for combining the teachings of Lin and Ogawa. *See Leapfrog Enter., Inc. v. Fisher-Price, Inc.*, 485 F.3d 1157, 1162 (Fed. Cir. 2007) (holding it "obvious to combine the Bevan device with the SSR to update it using modern electronic components in order to gain the commonly understood benefits of such adaptation, such as decreased size, increased reliability, simplified operation, and reduced cost"); *DyStar Textilfarben GmbH & Co. Deutschland KG v. C.H. Patrick Co.*, 464 F.3d 1356, 1368 (Fed. Cir. 2006) ("[A]n implicit motivation to combine exists not only when a suggestion may be gleaned from the prior art as a whole, but when the 'improvement' is technology-independent and the combination of references results in a product or process that is more desirable, for example because it is stronger, cheaper, cleaner, faster, lighter, smaller, more durable, or more efficient."). *See also KSR Int'l Co. v. Teleflex, Inc.*, 127 S. Ct. 1727, 1742 (2007) ("A person of ordinary skill is . . . a person of ordinary creativity, not an automaton.").

Modifying Lin by removing the die attach pad would not render Lin's invention unsuitable for its intended purpose. The only electrical function

Lin attributes to the die attach pad is the *optional* function of providing electrical contact between the die and a conductor on the substrate:

> The semiconductor die can be affixed to a portion of the pattern of conductive traces, for example by solder, conductive epoxy, or the like or can be attached to the pattern only by the interconnecting means 18. If the die is attached to a portion of the pattern of conductive traces, that portion can be used, if necessary, as an electrical contact to a substrate of the semiconductor device die.

Lin, col. 2, ll. 59-66.

Lin also explains that the die attach pad can be used as heat conductor: "In addition to making contact to the conductive traces for the purpose of making electrical contact, some of the traces, such as trace 13 upon which device die 15 is mounted, can be contacted by a heat sink (not shown) in order to conduct heat away form the die during operation." Col. 3, ll. 58-63). A person having ordinary skill in the art would have recognized that this heat sink function would remain (and perhaps even be improved slightly) when the die attach pad is omitted, thereby bringing the die into direct contact with the heat sink.

Modifying Lin by eliminating the die attach pad yields a package that satisfies all of the limitations of at least claim 1, including the step of "mounting the lead frame and an integrated circuit die onto a strip of adhesive tape such that a lower surface of the die contacts the adhesive tape and the die is located in the central opening, and the lower surface of the lead frame also contacts the adhesive tape."

It is immaterial that the references do not indicate that it would be desirable to expose the die surface directly to the atmosphere. It is sufficient that the claim limitations are satisfied when Lin is modified in the above manner for the purpose of reducing the thickness of the package. *See In re Icon Health and Fitness Inc.*, 496 F.3d 1374, 1380 (Fed. Cir. 2007) ("When analyzing Icon's application, we consider a variety of sources that may have led one skilled in the art to combine the teachings of Damark and Teague. Indeed, 'any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.'") (quoting *KSR*, 127 S. Ct. at 1742). As a result, it is immaterial whether Ogawa's support layer permanently covers the die (as argued by Appellants and found by the majority) or is temporary and thus results in exposure of a die surface to the atmosphere (as argued by the Examiner).

Furthermore, because the foregoing obviousness rationale does not involve replacing Lin's pattern of traces with Ogawa's lead frame, Appellants' argument that combining the reference teachings in that manner will result in an increase in the thickness of the package due to the thickness of Ogawa's lead frame (Br. 8) is not relevant.

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