



(51) International Patent Classification:
H05K 1/11 (2006.01)

(21) International Application Number:
PCT/IB2011/055072

(22) International Filing Date:
14 November 2011 (14.11.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10191895.1 19 November 2010 (19.11.2010) EP

(71) Applicant (for all designated States except DE, US):
KONINKLIJKE PHILIPS ELECTRONICS N.V. [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).

(71) Applicant (for DE only): **PHILIPS INTELLECTUAL PROPERTY & STANDARDS GMBH** [DE/DE]; Lübeckertordamm 5, 20099 Hamburg (DE).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **DUMOULIN, Raimond, Louis** [NL/NL]; c/o High Tech Campus, Building 44, NL-5656 AE Eindhoven (NL). **ELGER, Gordon, Patrick, Rudolf** [DE/DE]; c/o High Tech Campus, Building 44, NL-5656 AE Eindhoven (NL). **GIJSBERS, Hendrik, Elisabeth, Jozef** [NL/NL]; c/o High Tech Campus, Building 44, NL-5656 AE Eindhoven (NL). **CAERS, Johan, Frans, Justin, Maria** [BE/BE]; c/o High Tech Campus, Building 44, NL-5656 AE Eindhoven (NL).

ZHAO, Xiu, Juan [CN/NL]; c/o High Tech Campus, Building 44, NL-5656 AE Eindhoven (NL). **DE JONG, Adrianus, Marinus** [NL/NL]; c/o High Tech Campus, Building 44, NL-5656 AE Eindhoven (NL).

(74) Agents: **VAN EEUWIJK, Alexander** et al.; High Tech Campus, Building 44, NL-5656 AE Eindhoven (NL).

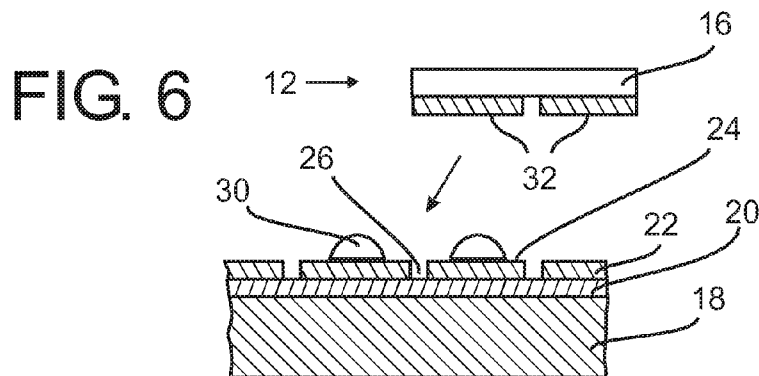
(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: SOLDERING CONNECTION WITH A WETTING AND NON-WETTING METAL LAYER



(57) Abstract: An assembly includes a substrate (10) with a first covering layer (20) and a second covering layer (22). The first covering layer (20) is made from a metal material that is non-wetting for a solder material. The second covering layer (22) is made from a metal material that is wetting for the solder material (30). A cut-out (26) is formed in the second layer (22) forming a solder dam (26) delimiting a soldering pad (24). A component (12) is fixed to the substrate (10) by a soldering connection formed by the solder material (30) between the soldering pad (24) and the component (12).

SOLDERING CONNECTION WITH A WETTING AND NON-WETTING METAL LAYER

5 FIELD OF THE INVENTION

The present invention relates to an assembly including a substrate and a component fixed to the substrate and to a method of forming an assembly of a component on a substrate.

BACKGROUND OF THE INVENTION

10 In a solder connection, a first object, in the present case the component, which may be an optical and/or electrical component, is fixed to a second object, presently termed a substrate, by providing a molten solder material between the two objects. As the solder material solidifies, a mechanically stable connection is formed by adhesion of the solder material to the two objects.

15 The present invention is concerned on one hand with exact placement and alignment of a component on the substrate and on the other hand with obtaining good heat conduction between the component and the substrate. Both aspects are particularly important in optical applications, in particular where the component comprises a light source generating heat that needs to be dissipated.

20 US 6,709,898 describes a microelectronic package. In a self-aligning solder embodiment, a microelectronic die is accurately placed on a heat spreader while providing thermal conduction. A first plurality of solder bumps is formed on a wafer by applying a wetting layer to the back surface of the wafer. A removable solder dam, such as a photo resist, is patterned over the wetting layer. The solder bumps may be formed by screen printing a paste
25 into openings of the photo resist and reflowing the paste to form solder bumps. Likewise, a second plurality of solder bumps is formed on the heat spreader with a wetting layer and a removable solder dam. The microelectronic die is then placed on the heat spreader. The heat spreader is then heated to reflow the solder bumps, so that capillary action between the bumps aligns the die on the heat spreader.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an assembly of a component on a substrate and a method for forming such an assembly which allows both exact positioning of the component and good thermal conduction.

5 The object is achieved by an assembly according to claim 1 and a method according to claim 10. Dependent claims refer to preferred embodiments of the invention.

 The substrate on which the component is mounted comprises at least two covering layers arranged on the surface where the component is mounted. It is possible to provide the substrate with only these two layers, e.g. a first layer directly on a substrate material
10 and a second layer directly on the first layer, where the second layer forms an exposed outer layer. However, as will become apparent, the invention is not strictly limited to this two-layer structure; it is possible that further layers are disposed below, in between and/or on top of the first and second covering layers.

 Both the first and second covering layers are made of metal. The first, lower
15 layer is non-wetting for a solder material, and the second outer layer is made from a material that is wetting for the solder material. Wetting describes the ability of the solder material when melted to contact the surface of the layers. For preferred solder materials, which may or may not contain Lead (Pb), and contain one or more of Tin (Sn), Copper (Cu), Silver (Ag), Bismuth (Bi), Indium (In), Zinc (Zn) and Antimony (Sb), the first layer is wetting, such that
20 the solder material spreads on the surface of this layer, whereas the second surface is non-wetting, such that the solder material does not spread on this surface. Examples of such wetting material for the second layer are Gold (Au) and Silver (Ag); examples of the non-wetting material for the first layer are Nickel (Ni), Titanium (Ti), Titanium Tungsten alloy (TiW), Palladium (Pd) and Platinum (Pt).

25 A cut-out is formed in the second layer, such that a solder dam exposing said non-wetting first layer is formed delimiting a portion of the surface as a soldering pad. Such a soldering pad may be of any desired shape, such as rounded, rectangular etc.. At the edges of the soldering pad, the second, wetting layer does no longer cover the first, non-wetting layer, such that solder material is confined to the soldering pad by the adhesive/cohesive intermo-
30 lecular forces governing the wetting/non-wetting behaviour.

 A component is fixed to the substrate by a soldering connection. Soldering material is arranged on the soldering pad and fixes the component to the soldering pad, thus forming a rigid mechanical connection.

The connection thus formed has on one hand the advantage of good thermal contact between the component and the substrate. The solder material and the first and second covering layers are of metal material, such that good heat conduction is ensured.

On the other hand the structure of the assembly allows an efficient manufacturing process while obtaining high precision in positional and directional alignment of the component on the substrate. Alignment of the component may be achieved along the soldering pad, i.e. by the cut-out formed in the second covering layer.

Preferably, both the lower surface of the component contacting the substrate and the upper surface of the substrate contacting the component are flat, planar surfaces. In preferred embodiments, the substrate is a heat spreader, i.e. a body consisting of a metal material for good heat conduction (such as Aluminium (Al), Copper (Cu), etc.) and extends beyond the soldering pad for heat dissipation. The heat spreader may comprise heat dissipation structures such as cooling fins etc.. Further preferred, the component comprises at least one optical element, in particular a light source, reflector and/or a lens. For such an optical element, exact alignment may be critical. In particular for a light source, especially an LED or laser source, both exact alignment and good thermal contact have decisive advantages.

Preferably, a cut-out in the second covering layer is formed by first providing a complete layer and then ablating the layer to form the cut-out. While in principal different methods for removing the second layer for forming the solder dam are possible, it is particularly preferred to use a directed beam for ablating the second layer. This could be a particle beam, such as e.g. an electron beam, but preferably laser irradiation is used. Direction of such a beam, in particular a laser beam, may be effected in a very exact manner by optical means. Thus, positioning of the soldering pad on the surface of the substrate may be easily achieved with very high precision.

After the soldering pad is formed, it is preferred to fix the component to the soldering pad by reflow soldering. In reflow soldering, solder material is dosed on the soldering pad and the component is placed on top. The soldering pad is then heated to melt the solder material for forming the soldering connection. It is particularly preferred to place the component loosely on the soldering pad, i.e. setting it on the soldering pad and solder material without fixing it in position and orientation. During reflow soldering, i.e. heating and melting the solder material, the loosely placed component will automatically align itself on the solder pad by intermolecular forces acting between the solder material and the component. Thus, the component will automatically achieve a defined position aligned relative to the borders of the soldering pad, i.e. the soldering dam. In this way, a rigid mechanical connection may be

achieved, the precision of which is mainly dependent on the exact formation of the soldering dam, which may be achieved relatively easily to a high degree of precision.

According to a preferred embodiment of the invention, the component is fixed to the substrate not only at a single soldering pad, but at a plurality of soldering pads. Each of the soldering pads are preferably formed next to each other on the surface of the substrate by forming, as described above, cut-outs in the second, wetting covering layer. Thus, individual soldering pads may be separated by solder dams. Providing a plurality of soldering pads can contribute to exact alignment of the component. Further, for covering a larger surface evenly with soldering material it has proven advantageous to separate portions of the surface into different soldering pads to achieve better uniformity of the distribution of the solder material. In particular, it is preferred to provide on each soldering pad substantially the same amount of solder material per unit surface of the soldering pad. In a preferred case of soldering pads of equal size surface, the amount of solder material will thus be at least substantially equal (where "substantially" equal is understood to mean that the amount of solder material on a given soldering pad will not differ by more than 20% from the average amount over all soldering pads of the same component, preferably by no more than 10%). Such equal distribution of the solder material minimizes the possible amount of tilt of the component relative to the surface of substrate, which is particularly important in optical applications.

The lower surface of the component, i.e. the surface facing the soldering pads, will preferably comprise a metal material with wetting properties for the solder material. It is further preferred that on the lower component surface, one or more soldering pads are formed. Particularly, it is preferred that the number, size and arrangement of the positioning pads on the component correspond to the number, size and arrangement of soldering pads formed on the substrate. This serves to provide exact positioning. Individual positioning pads on the lower surface of the component may again be delimited by solder dams exposing non-wetting material, e.g. ceramic material of the component.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will become apparent from the following description of preferred embodiments, in which:

Fig. 1 shows a perspective view of a substrate with covering layers;

Figs. 2, 3 show sectional views (not to scale) of the substrate of fig. 1 with the section taken along line A..A;

Fig. 4 shows a perspective view of placement of a component on the substrate;

Fig. 5 shows a sectional view (not to scale) with the section taken along line A..A in fig. 4

Figs. 6-8 show different steps of placement of the component in sectional views (not to scale) with the section taken along line A..A in fig. 4.

5

DETAILED DESCRIPTION OF EMBODIMENTS

Fig. 1 shows a heat sink as a substrate 10, onto which an electro/optical component 12 (see fig. 4) is to be mounted. In a first embodiment, the electro/optical component 12 is an LED module comprising four high power LEDs 14 mounted on a ceramic plate 16.

10

The substrate 10, as shown in the cross-sectional view of fig. 2, is comprised of a main body 18 of Copper (Cu) or another material of good heat conduction which is covered by a first covering layer 20, which in the present example is a Nickel layer, on top of which a second covering layer 22, which in the present example is a Gold (Au) layer, is provided.

15

It should be emphasized that the sectional views shown in the figures are not drawn to scale. The layer thickness here appears much larger than it actually is as compared to the thickness of the body 18 for illustrative purposes. The covering layers 20 and 22 may be provided on the body 18 in a plurality of different ways, such as electrolytic plating or electrode-less plating processes. Their thickness will generally range from 0.01 μm to 10 μm . Thicker layers will work also, but at increased cost. The covering layers 20, 22 are on one hand provided for corrosion protection. On the other hand, they are used to mount the component 12 onto the flat upper surface of the substrate 10 as will be described.

20

The connection to the component 12 will be made by means of a solder connection using a solder material. A variety of different solder materials, including Lead-containing as well as Lead-free solder material may be used. Preferred solder materials are predominantly (i.e. above 60 %) based on Tin (Sn), such as e.g. SAC based solders, SnAg based solders, or SnAu based solders.

25

For the above mentioned materials, the first layer 20 consisting of Nickel is non-wetting and the second layer 22 consisting of Gold is wetting, i.e. the solder material, when melted, will contact the second Gold layer easily (small contact angle of a drop of liquid material on the surface), whereas the first Nickel layer will not be easily contacted (large contact angle).

30

As will be explained below, these properties direct the flow of molten solder material in configurations where both wetting and non-wetting surfaces are involved. Here, the solder material will follow the wetting surface material and will not run out into the bordering surface areas of non-wetting material. For using this effect, it is necessary that the second layer 22 is better wetting than the first layer 20, i.e. is more easily contacted by the solder material.

This wetting/non-wetting property of the first and second layers 20, 22 is used to advantage as follows: On the surface of the substrate 10, soldering pads 24 are formed delimited by soldering dams 26. The soldering dams 26 are formed by partially removing the second layer 22 forming longitudinal grooves 26 where the first Nickel layer 20 is exposed. The thus formed soldering pads 24 have a surface comprised of the Gold layer 22 and are bordered on all sides by exposed Nickel material of the first layer 20.

The grooves 26, where the material of the second layer 22 has been completely removed to expose the first layer 20 beneath are preferably formed by irradiation with a laser beam 28. Intensity and duration of the laser irradiation should be carefully controlled to securely remove, within the grooves 26, the second layer 22. Generally, the process will be controlled to evaporate within the grooves 26 the second layer 22 completely and also a part of the first layer 20. However, at least a minimal thickness of the first layer 20 will be left. Such treatment may easily be achieved to a high degree of precision using a high intensity laser 28 directed by suitably controlled optics. Here, any type of laser system capable to ablate the layer 22 may be used. Preferably, a laser system based on short pulses and matching frequencies of laser light is employed.

The grooves 26 need to be provided in a width sufficient to ensure that soldering material provided on each soldering pad 24 will, due to the non-wetting properties of the first Nickel layer 20, not spread beyond the solder dam. Generally, this should be ensured by providing grooves of e. g. 30 μm to 500 μm thickness.

After the solder pads 24 are thus formed, solder material 30 is then dosed onto the solder pads 24 (fig. 4, fig. 5). In the preferred example, as shown in the figures, four solder pads 24 of equal size are formed. Also, about equal amounts of solder material 30 are dosed onto each of the solder pads 24. The solder material 30 may be applied as blobs of solder paste or, alternatively, in a printing process.

As shown in fig. 4, fig. 6, the component 12 is then placed onto the thus prepared substrate 10. Below the ceramic plate 16 of the component 12, positioning pads 32 are

formed which equal in size, number and arrangement the four solder pads 24 formed on the surface of the substrate 10.

As shown in fig. 7, the component 12 is loosely placed onto the surface of substrate 10 to then be fixed in a reflow soldering process. The placement of the component 12 need not be exact. An offset between the soldering pads 24 and positioning pads 32 is tolerable.

In the subsequent reflow soldering process, the whole assembly is heated to melt the solder material 30. Due to the wetting/non-wetting properties, intermolecular forces act between the solder material 30 and the positioning pads 32 to exactly align positioning pads 32 on soldering pads 24, and thus very accurately aligning component 12 onto the surface of the substrate 10 (see fig. 8). Thus, by the final soldering connection between the soldering pads 24 of the substrate 10 and the positioning pads 32 of the component 12, a mechanically stable soldering connection is formed fixing the component 12 to the substrate 10. Thermal contact of the component 12 to the substrate 10 is excellent due to good heat conduction properties of the involved metal materials. Also, the degree of precision achieved in positioning of the component 12 largely corresponds to the degree of precision achieved with the ablating laser 28, so that positional accuracy of the component 12 is very high.

The intermolecular forces acting between the solder material 30 and positioning pads 32 will correct, as illustrated in fig. 7/fig. 8, any linear misalignment as well as a rotation of the component 12 with regard to the substrate 10 (as long as the initial positioning is precise enough to have largely overlapping positioning pads 32 and soldering pads 24, which should be easy to achieve). By providing substantially the same amount of solder material 30 on each soldering pad 24, four uniform solder connections are formed leading to exact alignment of the component 12 without tilt relative to the surface of the substrate 10.

The above described method and type of connection formed may be used in different connections. In the above first example, the electro-optical component 12 is an LED module 12 to be mounted to a heat sink 10. Alternatively, a plurality of such LED modules 12 may be mounted to the same heat sink, preferably side by side on the same surface. In this case, solder pads 24 are formed not only for a first LED module 12, but also for other LED modules to be mounted. All LED modules 12 may then be fixed to the heat sink 10 at the same time by a single reflow soldering process. Thus, a module of multiple LED light sources may be obtained, where the individual light sources are aligned with high precision and a good thermal contact is ensured.

In a further embodiment, the substrate 10 is an outer surface of a water cooler. Instead of LED modules 12 as shown in the above examples, a plurality of laser modules are mounted on the surface of the substrate 10. Again, the good thermal contact allows efficient cooling of the laser modules by the water cooler. Additionally, the very exact alignment allows forming a uniform laser light zone in front of the assembly.

In the yet further embodiment, the substrate 10 is a standoff including a flat mounting surface for a group of laser modules as well as a mounting surface for micro lenses. Both can be fixed to the standoff by the described method, so that very exact placement and thus good optical alignment is achieved.

While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the invention is not limited to the disclosed embodiments.

For example, other layer materials besides Gold and Nickel may be used, as long as the wettability of the second layer 22 is substantially better than the wettability of the first layer 20.

In all cases where an electrical component 12 is mounted to the substrate 10, the solder connection may be used as a purely mechanical contact, but could also serve as an electrical contact, e.g. for providing operating power to an LED module 12.

The substrate 10 may be a printed circuit board (PCB), preferably a metal core printed circuit board (MC-PCB), where electrically isolated from the metal layers 20, 22 conductive tracks are provided for electrical connection of the mounted component(s).

Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word “comprising” does not exclude other elements, and the indefinite article “a” or “an” does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope.

CLAIMS:

1. Assembly including
 - a substrate (10) comprising at least a first covering layer (20) and a second covering layer (22) disposed further outside than said first covering layer (20),
 - where said first covering layer (20) is made from a metal material that is non-wetting
 - 5 for a solder material (30),
 - where said second covering layer (22) is made from a metal material that is wetting for said solder material (30),
 - where at least one cut-out (26) is formed in said second layer (22) forming a solder dam (26) delimiting at least one soldering pad (24),
 - 10 - where a component (12) is fixed to said substrate (10) by a soldering connection formed by said solder material (30) between said soldering pad (24) and said component (12).
2. Assembly according to claim 1, where
 - said substrate (10) is a heat spreader.
 - 15
3. Assembly according to one of the above claims, where
 - said component (12) comprises at least one optical component (14), in particular a light source, reflector, and/or a lens.
- 20 4. Assembly according to one of the above claims, where
 - said first layer (20) mainly consists of a material chosen from the group containing Nickel (Ni), Titanium (Ti), Titanium Tungsten alloy (TiW), Palladium (Pd), and Platinum (Pt).
- 25 5. Assembly according to one of the above claims, where
 - said second layer (22) mainly consists of a material chosen from the group containing Gold (Au) and Silver (Ag).

6. Assembly according to one of the above claims, where
- said solder material (30) contains one or more of the materials chosen from the group containing Tin (Sn), Copper (Cu), Silver (Ag), Bismuth (Bi), Indium (In), Zinc (Zn), and Antimony (Sb).

5

7. Assembly according to one of the above claims, where
- a plurality of soldering pads (24) are formed on said substrate (10),
 - and said component (12) is fixed to each of said soldering pads (24) by a soldering connection.

10

8. Assembly according to claim 7, where
- for each of said soldering pads (24) the amount of solder material (30) per unit surface is at least substantially equal.

15

9. Assembly according to one of the above claims, where
- one or more soldering pads (24) are formed on said substrate (10),
 - and one or more positioning pads (32) are formed on said component (12) facing said soldering pads (24),
 - where the number, size and arrangement of said soldering pads (24) and said positioning pads (32) correspond to provide exact positioning.

20

10. Method of forming an assembly of a component (12) on a substrate (10), including

25

- providing said substrate (10) with a first covering layer (20) and a second covering layer (22) disposed further outside than said first covering layer (20),
- where said first covering layer (20) is made from a metal material that is non-wetting for a solder material (30),
- and where said second covering layer (22) is made from a metal material that is wetting for said solder material (30),
- creating at least one cut-out in said second covering layer (22) forming a solder dam (26) delimiting at least one soldering pad (24),
- providing said solder material (30) on said soldering pad (24),
- fixing said component (12) to said substrate (10) by creating a soldering connection of said solder material (30) between said soldering pad (24) and said component (12).

30

11. Method according to claim 10, including

- fixing said component (12) to said soldering pad (24) by reflow soldering.

5 12. Method according to claim 11, including

- placing said component (12) loosely on said soldering pad (24),
- where during reflow soldering said component (12) is aligned in a defined position on said substrate (10) by forces acting between said solder material (30) and said component (12).

10

13. Method according to one of claims 10-12, including

- creating said cut-out (26) by laser irradiation of said covering second layer (22).

FIG. 1

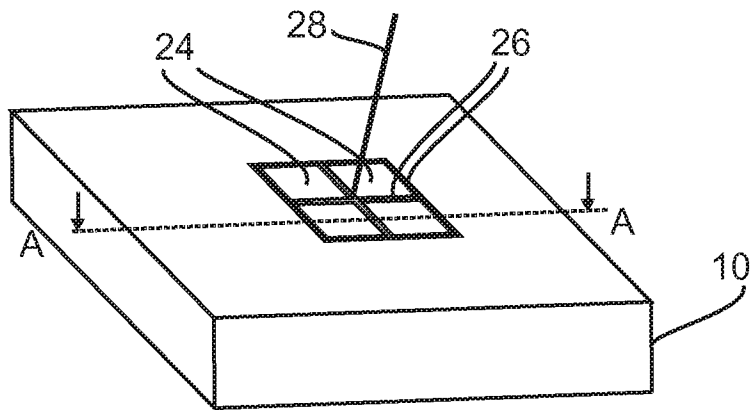


FIG. 3

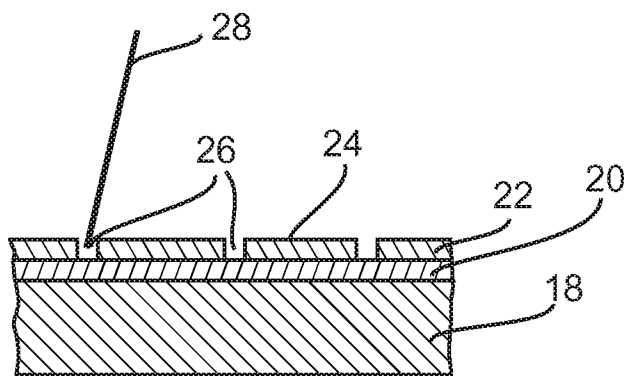


FIG. 2

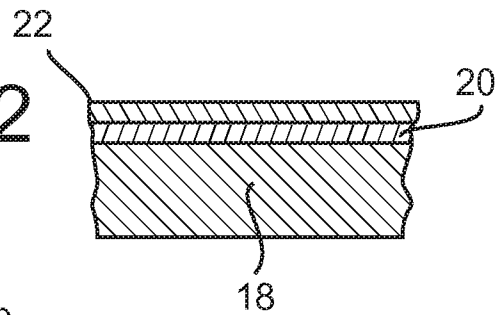


FIG. 4

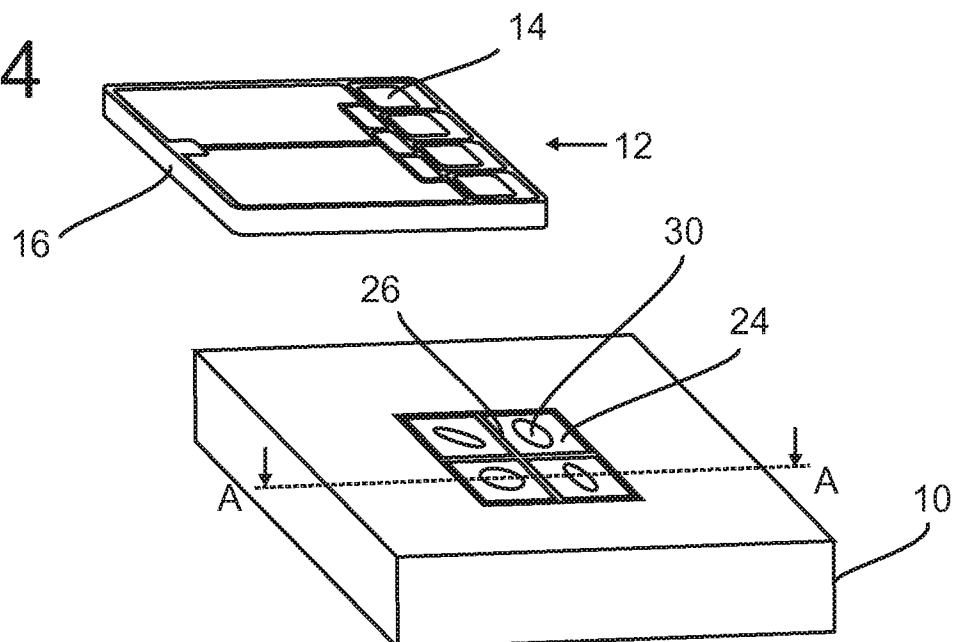


FIG. 5

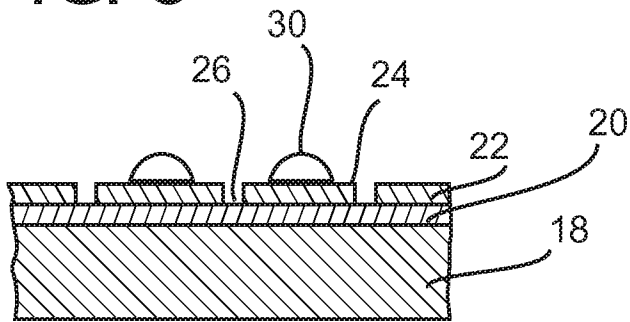


FIG. 6

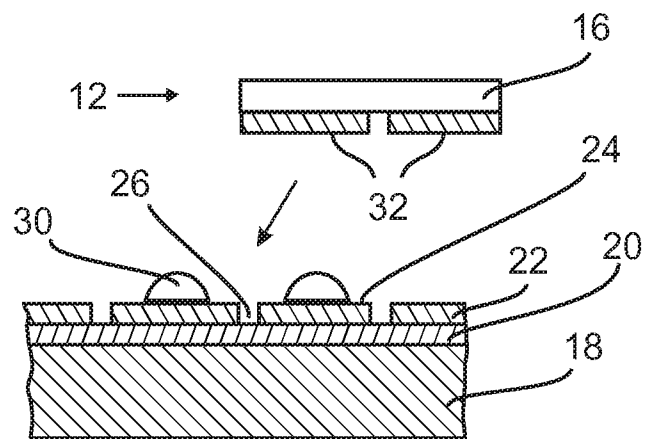


FIG. 7

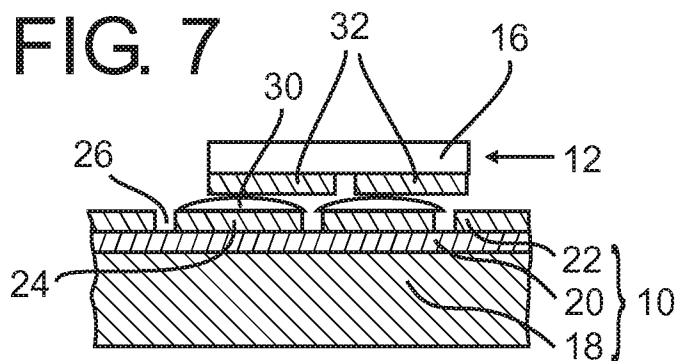
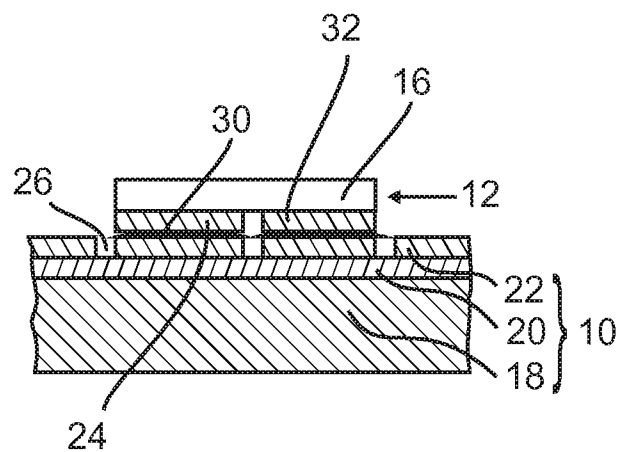


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2011/055072

A. CLASSIFICATION OF SUBJECT MATTER
INV. H05K1/11
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H05K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 362 435 B1 (DOWNEY JOEL FRANKLIN [US] ET AL) 26 March 2002 (2002-03-26)	1-3,7,8, 10-12
Y	column 3, line 66 - column 4, line 22; figure 2	9
	column 4, lines 45-64; figure 4	
	column 5, lines 15-30; figure 6	

Y	US 4 600 970 A (BAUER JOHN A [US]) 15 July 1986 (1986-07-15)	9
	column 3, line 54 - column 5, line 11; figure 4	

	-/--	

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

13 February 2012

Date of mailing of the international search report

22/02/2012

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Batev, Petio

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2011/055072

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	ANONYMOUS: "Laser defined solderable area for circuit boards", RESEARCH DISCLOSURE, MASON PUBLICATIONS, HAMPSHIRE, GB, vol. 433, no. 8, 1 May 2000 (2000-05-01), XP007126054, ISSN: 0374-4353 the whole document -----	1-8, 10-13
X	US 3 851 223 A (YONEZUKA M ET AL) 26 November 1974 (1974-11-26) column 1, lines 57-67 column 2, lines 20-59; figures 1,2b,3,4 -----	1-8,10

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2011/055072

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 6362435	B1	26-03-2002	NONE	

US 4600970	A	15-07-1986	NONE	

US 3851223	A	26-11-1974	JP 48061959 A	30-08-1973
			US 3851223 A	26-11-1974
