BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

Internal distribution code:
(A) [ ] Publication in OJ
(B) [ ] To Chairmen and Members
(C) [X] To Chairmen

D E C I S I O N
of 25 November 1999

Case Number: T 0834/95 - 3.4.3

Application Number: 90122393.3

Publication Number: 0433695

IPC: H01L 23/495

Language of the proceedings: EN

Title of invention:
Integrated circuit device and method to prevent cracking during surface mount

Applicant:
Texas Instruments Incorporated

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step: no"
"Problem widely recognised in the art; use of known properties of a material in solving the same problem"

Decisions cited:
-

Catchword:

-

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0834/95 - 3.4.3

D E C I S I O N
of the Technical Board of Appeal 3.4.3
of 25 November 1999

Appellant: Texas Instruments Incorporated
13500 North Central Expressway
Dallas
Texas 75265 (US)

Representative: Leiser, Gottfried, Dipl.-Ing.
Prinz & Partner GbR
Manzingerweg 7
81241 München (DE)

Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 23 May 1995 refusing European patent application No. 90 122 393.3 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: R. K. Shukla
Members: M. Chomentowski
M. J. Vogel

Summary of Facts and Submissions

I. European patent application No. 90 122 393.3 (publication No. 0 433 695) was refused by a decision of the examining division, dated 23 May 1995, on the ground of lack of inventive step having regard to the documents

D1: Patent Abstracts of Japan, 13 (558), (E-858) & JP-A-1-231333;

D2: Patent Abstracts of Japan, 12 (447), (E-685) & JP-A-63-175457;

D3: Patent Abstracts of Japan, 10 (184), (E-415) & JP-A-61-32445;

D4: Patent Abstracts of Japan, 13 (513), (E-847) & JP-A-1-208846;

D5: Patent Abstracts of Japan, 13 (544), (E-855) & JP-A-1-225141; and

D6: Patent Abstracts of Japan, 08 (107), (E-245) & JP-A-59-22349.

Claim 1 of the main request forming the basis of the decision reads as follows:

"1. A semiconductor packaged device of the type based on a packaging technique having no chip support pad, comprising:

an integrated circuit having an active face and a

backside, the active face attached to a leadframe having no chip support pad; and

a plastic encapsulant encapsulating the integrated circuit and lead frame, leaving leadfingers of the leadframe exposed;

characterized by

a polyimide coating on the backside of the integrated circuit adhering the integrated circuit to the encapsulant."

The only further independent claim 7 concerned a method of making a semiconductor packaged device of the type based on a packaging technique having no chip support pad.

The examining division took the following view with respect to claim 1 of the main request:

A semiconductor packaged device of the type based on a packaging technique having no chip support pad is known from document D1, comprising:

an integrated circuit (14) having an active face and a backside, the active face attached to a leadframe (11) having no chip support pad; and

a plastic encapsulant (17) encapsulating the integrated circuit (14) and lead frame (11), leaving leadfingers (12) of the leadframe exposed.

However, contrary to the semiconductor packaged device

of present claim 1, there is in the known device no polyimide coating on the backside of the integrated circuit.

According to the description of the application in suit, the known semiconductor packaged device, which comprises a lead-on-chip leadframe having no die support pad and an integrated circuit adhered to it forming a self supporting structure, has a problem in that, when mounting such a device to a printed circuit board by reflow solder, the heat generated can enhance the state of thermal mismatch between the dissimilar materials in the integrated circuit package creating high stresses in the encapsulating material; this can result in delamination at the surface of the integrated circuit and the surface of the encapsulating material, thereby leading to package cracking.

The problem of package cracking has been widely recognized in the technical field of the present patent application, and is mentioned in each of the documents D2 to D6 for a variety of different packaging structures, in particular with respect to surface mounting or reflow soldering (cf. documents D2, D4 and D5). Moreover, the problem of peeling or delamination is mentioned in documents D4 and D5.

Hence, the skilled person encountering problems of package cracking or delamination in the device known from document D1 and looking to the prior art to find known solutions will find the documents D2 to D6 relevant. The common teaching of the documents D2 to D6 is that a film of polyimide provided either directly between the backside of the chip and the encapsulating

material (cf. documents D2 or D3) or between a metal chip support pad and the encapsulating material (cf. documents D4, D5 or D6) improves adhesion to the package (cf. document D4 or D5) and solves the problem of package cracking (cf. documents D2 to D6) due to the heat resistant properties of the polyimide film.

Consequently, it is considered that the skilled person would fully recognize the role played by polyimide in preventing both package cracking and delamination - either when placed between a metal chip support and an encapsulating material or when placed directly between the integrated circuit and the encapsulating material - and would advantageously utilize the adhesive and heat-resistant properties of a polyimide film on the surface of the integrated circuit chip of document D1 in order to provide a package that does not crack during surface mounting. In accordance with the teaching of document D6, this polyimide film may be provided in particular on the backside of the active face of the integrated circuit.

Therefore, the subject-matter of claim 1 lacks an inventive step.

Moreover, the examining division found that the subject-matter of the process claim 7 of the main request was not inventive for the same reasons, and that the dependent claims did not provide inventive matter.

Furthermore, the subject-matters of the auxiliary requests were not found allowable because the amendments in the text were not considered as changing

the technical content of the claims.

II. The applicant lodged an appeal against this decision on 25 July 1995 paying the appeal fee the same day. The statement of the grounds of appeal was filed on 29 September 1995.

III. With the appellant's (applicant's) letter dated 21 October 1999 in preparation for the oral proceedings, a new set of claims, new pages of the description and new sheets 3/4 and 4/4 of the drawings were filed.

The word "on" of the characterizing portion of claim 1 of the main request forming the basis for the decision under appeal has been replaced by "completely covering" in the new claim 1, so that the characterizing portion of the new claim, i.e. the only part of the claim which has been modified, reads as follows:.

"characterized by

a polyamide coating completely covering the backside of the integrated circuit adhering the integrated circuit to the encapsulant."

A corresponding amendment is made in the new process claim 7.

IV. Oral proceedings took place on 25 November 1999.

V. The appellant requested that the decision under appeal be set aside and that a European patent be granted on the basis of the following patent application

documents:

Claims: 1 to 12 filed with appellant's letter dated 21 October 1999;

Description: pages 5 to 8 as filed;
pages 1, 2 and 2a as filed with appellant's letter of 6 October 1993;
pages 3, 4, 9 and 10 as filed with appellant's letter dated 21 October 1999;

Drawings: Sheets 1/4 and 2/4, renumbered from 1/6 and 2/6 as filed;
Sheets 3/4 and 4/4, as filed with appellant's letter dated 21 October 1999.

The appellant submitted essentially the following arguments in support of his request:

The device of document D1 is without a chip support pad and is thus the only device of this kind among the documents cited in the decision under appeal, so that it belongs to a new technical field different from that of the devices known from the other documents D2 to D6, which all have a supporting pad. Consequently, the person skilled in the art of document D1 would not take into account the problems which have been recognized in the known devices or the measures employed for the solution thereof.

Moreover, in the particular structure of the semiconductor packaged device of document D1, where the active face of the integrated circuit is attached to a leadframe having no chip support pad, whereby a plastic

encapsulant encapsulating the integrated circuit and lead frame leaves leadfingers of the leadframe exposed, the problem of package cracking known for the other known devices would not be expected to occur.

Therefore, the combination of the teaching of document D1 with that of any of the documents D2 to D6 was not obvious to the skilled person, so that the subject-matter of the claims involves an inventive step.

Reasons for the Decision

1. The appeal is admissible.

2. *Inventive step*

2.1 It is first to be noted that, in the opinion of the Board, the amendment of the claim resulting in present claim 1, i.e. the supplementary feature that the polyimide coating on the backside of the integrated circuit adhering the integrated circuit to the encapsulant completely covers said backside, does not change in substance the relevance of the reasoning in the decision under appeal.

Thus, the first part of claim 1 has remained unamended and it still concerns a semiconductor packaged device of the type employing a packaging technique having no chip support pad, as known from document D1 (see the abstract), which is regarded as the prior art coming closest to the invention. The device known from document D1 comprises:

an integrated circuit (14) having an active face and a backside, the active face attached to a leadframe (11) having no chip support pad; and

an encapsulant (17) encapsulating the integrated circuit (14) and lead frame (11), leaving leadfingers (12) of the leadframe exposed.

However, contrary to the semiconductor packaged device of present claim 1, in the known device, there is no polyimide coating on the backside of the integrated circuit (14) adhering the integrated circuit to the encapsulant.

2.2 The subject-matter of claim 1 is thus distinguished from the device of document D1 in that there is a polyimide coating covering the backside of the integrated circuit adhering the integrated circuit to the encapsulant.

It follows from the description of the application in suit (see page 1, second paragraph), that the semiconductor packaged device such as known from document D1 suffers from the following problems:

When mounting such a device to a printed circuit board by reflow solder, the heat generated during reflow solder can enhance the state of thermal mismatch between the dissimilar materials in the integrated circuit package creating high stresses in the encapsulating material. Additionally, at reflow solder temperature (typically about 215°C to 260°C) any moisture that may have been absorbed by the

encapsulating materials is converted to steam; the stream pressure can be such that it delaminates the surface of the integrated circuit and the surface of the encapsulating material; the loss of adhesion under such conditions causes a high stress concentration in the encapsulant at the corner of the integrated circuit; this often leads to package cracking. As the area of the integrated circuit increases, cracking of the integrated circuit package in devices such as the lead-on-chip devices resulting from reflow solder increases.

The objective problem addressed by the present invention is thus to provide a lead-on-chip package that is resistant to cracking and delamination.

2.3 As set forth here above (see item I of Facts and submissions), the problem of delamination and the related problem of package cracking have been widely recognized in the technical field of the present patent application, and is mentioned in various forms in the documents D2 to D6 for a variety of different packaging structures, *inter alia* with respect to surface mounting or reflow soldering.

Hence, the skilled person encountering problems of package cracking in device known from document D1 and looking to the prior art for known solutions will find the documents D2 to D6 relevant.

The common teaching of the documents D2 to D6 is that a film of polyimide is to be provided either directly between the backside of the chip and the encapsulating material (cf. documents D2 or D3) or between a metal

chip support pad and the encapsulating material (cf. documents D4, D5 or D6), this improving adhesion to the package (cf. documents D4 or D5) and, using the heat resistant properties of the polyimide film, solving the problem of package cracking (cf. documents D4 to D6).

Consequently, it is considered that the skilled person fully recognizes the role played by polyimide in preventing both package cracking and delamination - either when placed between a metal chip support pad and an encapsulating material or when placed directly between the integrated circuit and the encapsulating material - and would advantageously utilize the adhesive and heat-resistant properties of a polyimide film on the surface of the integrated circuit chip of document D1 in order to provide a package that does not crack during surface mounting. In accordance with the teaching of document D6, this polyimide film may be provided in particular on the active face of the integrated circuit.

2.4 In support of the inventive step, the appellant has submitted that the device of document D1 is without chip support pad and is thus the only device of this kind among the documents cited in the decision under appeal, so that the skilled person would not look for a solution to his problems in documents D2 to D6, which all employ a lead frame with a chip supporting pad.

However, this argument is not found convincing for the following reasons:

It is not credible that the person skilled in the art of document D1 would not be aware of the packages of

documents D2 to D6, since the packaged semiconductor devices according to documents D2 to D6, as the device of document D1, are packages with an encapsulant encapsulating a semiconductor device, and which thus at least in this respect belong to the same technical field.

Moreover, since the problems of delamination and package cracking are known to be caused by thermal mismatch between dissimilar materials in a packaged device and by the moisture contained in the encapsulant, the skilled person when confronted with these problems in the encapsulated packaged semiconductor device of document D1 would look for the solution in the field of encapsulated packaged semiconductor devices where these problems are known to occur. The teachings of documents D2 to D6 would therefore be regarded by the skilled person as relevant to his problems.

2.5 The appellant has additionally argued that the skilled person, because of the particular structure of the semiconductor packaged device of document D1, which is of the type based on a packaging technique having no chip support pad and with the active face of the integrated circuit attached to a leadframe having no chip support pad, would not be aware that problems of cracking known for the other known devices would occur.

However, this argument is not found convincing, since the skilled person would come across the problem during the routine surface-mounting of the device onto a printed circuit board by reflow soldering technique.

2.6 In view of the above, it was obvious for the skilled person to provide a film of polyimide covering the whole surface of the backside of the chip, thereby arriving in an obvious way at the device of present claim 1.

2.7 For the foregoing reasons, in the Board's judgement, the subject-matter of present claim 1 does not involve an inventive step in the sense of Article 56 EPC.

Consequently, claim 1 is not patentable in the sense of Article 52(1) EPC.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

D. Spigarelli R. Shukla