



Description

Wiring substrate of a semiconductor component comprising external contact pads for external contacts
5 and method for producing the same

The invention relates to a wiring substrate of a semiconductor component comprising external contact pads for external contacts, and to methods for
10 producing the same. In this case, solder balls are preferably intended to be applied as external contacts to the external contact pads.

Wiring substrates of this type are used for
15 semiconductor component housings, also known as BGA housings (ball grid array) or as LBGA housings (large ball grid array).

One of the problems of said wiring substrates is the
20 reliability with which a connection between the external contact pads of the wiring substrate and a superordinate circuit board can be produced. In the event of cyclic thermal loadings, cyclic mechanical shear loadings are exerted on the solder connections on
25 account of the presence of different materials having different coefficients of thermal expansion. In the event of vibration loadings, pressure fluctuations occur in addition to the shear loadings of the cyclic thermal stresses, and may in total lead to microcracks
30 or to the failure of the connection.

Many different methods are used in the prior art in order to improve the reliability of the solder ball connections to superordinate circuit boards. Some
35 methods are based on the configuration of the solder connections in order to reduce the mechanical loading. Other methods attempt to adapt the material properties of the housing packages in such a way that said mechanical loadings are reduced, such as e.g. by



inserting semiconductor chip adhesive layers. Some of these solutions have the disadvantage that the adaptation of the housing substrates is very greatly dependent on the specific embodiment of the housings.

5 These solutions require additional complex and expensive fabrication methods. These problems are also exasperated if a transition is made to smaller distances between the soldering contacts and to smaller connection pitches.

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Moreover, a transition from lead-containing to lead-free solder materials, on account of different properties of the respective materials, will be more likely to increase rather than reduce the problems with
15 regard to the loading limits of solder balls as external contacts. Further possibilities for solving the problems consist in introducing an additional material in the form of an underfiller between the wiring substrate of the housing and the superordinate
20 circuit board. However, this requires an additional process step during the production of circuit boards and makes it more difficult to exchange or repair assemblies on the circuit boards.

25 Further solution approaches in the prior art provide for embodying the contacts themselves in flexible fashion, e.g. by means of the external contacts forming spring elements or being embodied from flexible materials in the form of elastomer balls with rubber-
30 elastic cores. However, these variants with flexible contacts are highly cost-intensive and unsuitable for mass production. Moreover, reliability problems arise due to the low degree of robustness of said spring elements or elastomer balls as external contacts.

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The document: "Stress free area array structures for flipchips and chip scale devices" from R. Fillian et al. 14th European micro electronics and packaging

conference and exhibition, Friedrichshafen, Germany, 23 - 25 June 2003, pages 308 - 312, discloses flip-chip components, semiconductor chip size housings and BGA housings which have solder balls which are arranged
5 over an air-filled cavity, as is shown in figure 1 therein, or are arranged over a cavity filled with an elastic material. So-called "floating pad" solder balls of this type require a very complex cost-intensive fabrication method based on a specific military
10 application and are therefore likewise not suitable for mass production. In principle, the cavities or the elastomer-filled cavities are realized by application of additional complex layers to the wiring substrate.

15 It is an object of the invention to specify a wiring substrate of a semiconductor component comprising external contact pads for external contacts, and to provide a method for producing the same by means of which it is possible to increase the reliability for
20 components with solder balls as external contacts. Moreover, it is an object of the invention to specify a method which is suitable for the mass production of inexpensive semiconductor components.

25 This object is achieved by means of the subject matter of the independent claims. Advantageous development of the invention emerge from the dependent claims.

The invention provides a wiring substrate of a
30 semiconductor component comprising external contact pads for fitting external contacts. For this purpose, the rigid wiring substrate comprises an underside with a wiring structure and a top side with cutouts. A rubber-elastic material is arranged in the cutouts,
35 wherein external contact pads are arranged on the rubber-elastic material.

This wiring substrate according to the invention

differs from the previous solutions by virtue of the fact that no additional layers are to be applied to the wiring substrate, rather the wiring substrate itself serves to provide cutouts which can be filled with a
5 corresponding rubber-elastic material, on the top side of which metallic external contact pads can be provided, which are also permitted, for their part, to take up rigid external contacts and nevertheless enable the external contacts to yield to pressure cyclic
10 loadings and cyclic thermal loadings by virtue of the fact that the rubber-elastic material in the cutouts is compressed and extended, and is likewise able to react to shear loadings by virtue of the fact that the rubber-elastic material in the cutouts permits tilting
15 movements of the metallic contact pads.

In one preferred embodiment of the invention, the top side of the rubber-elastic material together with the top side of the wiring substrate forms a coplanar area.
20 Said coplanar area has the advantage that, without transitions, it is possible to produce an arbitrary wiring structure and feed lines to external contact pads, to contact pads and/or to through contacts with high precision and without additional fabrication
25 steps.

The cutouts in the substrate can be provided by simply pressing rubber-elastic material pads at the positions provided for external contacts into a precursor of the
30 substrate. In order to bring about a coplanar area in this case, the substrate material of the precursor is merely preheated to form a composition having a high viscosity. Consequently, the formation of cutouts and the filling thereof can be realized by simple printing
35 technology and do not require complicated lithographic coating, alignment, exposure, development, fixing and mounting methods.

In a further preferred embodiment of the invention, the rubber-elastic material comprises silicones, silicone elastomers, and/or gels, and closed-pore soft-porous materials. These materials have the advantage that they
5 can securely anchor the metallic external contact pads, on the one hand, and the advantage, on the other hand, that they have a compliance and can therefore compensate for inaccuracies and differences in diameter of the solder balls. What is more, they can withstand
10 impacts, pressure cyclic loadings, and also shear loadings, during corresponding thermal cyclic tests.

In this case, it is relatively unimportant what form the cutouts assume when the elastic material is pressed
15 into the top side of the high-viscosity precursor of the substrate material. It may even be advantageous for the cutouts of a single wiring substrate to have different depths. Where the pressure cyclic loading or the shear cyclic loading is particularly high, it is
20 possible to provide deeper cutouts in the substrate by preparing rubber-elastic material pads having a larger volume prior to being pressed into the high-viscosity material of the substrate.

25 A further feature of the present invention is that the areal extent of the cutout filled with rubber-elastic material is greater than the areal extent of the metallic external contact pads. In the case of this measure according to the invention, the effect of the
30 rubber-elastic material is increased further since a compliance between the edge of the metallic contact pads and the edge of the cutouts is also ensured.

In a further preferred embodiment of the invention, the
35 wiring substrate has feed lines from the wiring structure to the external contact pads. Said feed lines can be made smaller in comparison with the areal extent of the external contact pads, with the result that they

can follow the compliance of the rubber-elastic material in the cutouts without tearing or breaking.

Moreover, the wiring substrate may have through
5 contacts through the wiring substrate which are
connected to the feed lines and thus enable an
electrical access to the external contact pads. Since
the elasticity of the passage lines is not so great
that they can follow a rubber-elastic deformation,
10 these relatively rigid through contacts are arranged in
the vicinity of the rubber-elastic material pads. Said
through contacts are then connected to the external
contact pads via the feed lines.

15 A further possibility for broadening the applicability
of the rubber-elastic material under an external
contact pad involves accommodating conductive particles
in the rubber-elastic material. Said conductive
particles must firstly have a high deformability, must
20 additionally have a high compliance, and, finally, they
must adapt to the expected great movements of the
external contact pads. So-called "carbon nanotubes" are
suitable for such a contact-making task, without
impairing the rubber-elastic properties of the material
25 below the external contact pads.

Such carbon nanotubes are hollow tubes having a single-
walled or multiwalled hexagonal arrangement of carbon
atoms and have a diameter of between a few nanometers
30 and a few hundred nanometers. Since carbon nanotubes
have no grain boundaries over their length of ten
nanometers to a few millimeters, their deformability
and elasticity and compliance are significantly greater
than in the case of metal particles that are
35 incorporated in customary electrically conductive
plastic connections. The current-carrying capacity of
the carbon nanotubes, with a value of 1×10^9 A/cm², is
significantly greater as well. What is more, owing to

the lack of grain boundaries, the tensile strength is extremely high and, with a value of between 5×10^{10} Pa to 5×10^{13} Pa, is two or more orders of magnitude higher than in the case of customary metal particles, with the result that an interruption of the contact capability, if such carbon nanotubes are mixed with a rubber-elastic material, extremely low.

A further embodiment of the invention provides for the external contact pads to have a solder coating of a lead-free soldering material. Said lead-free soldering material firstly improves the environmental compatibility and facilitates the recycling of such wiring substrates, and furthermore has the advantage that external contacts composed of solder balls can be connected to the external contact pads in an extremely simple manner.

In a further embodiment of the invention, a semiconductor chip is arranged on the wiring structure of the wiring substrate, which semiconductor chip can be connected by its flip-chip contacts directly to contact pads of the wiring structure. In the case of a semiconductor chip with contact areas on the active top side, said contact areas with the wiring structure are electrically connected to the wiring structure of the wiring substrate via corresponding bonding connections. For the method of operation and the interaction between a superordinate circuit board and the external contacts of the semiconductor component, it is not crucial whether the semiconductor chip is equipped with flip-chip contacts or with bonding connections.

All that is crucial is that the substrate carrying the external contact areas is mechanically closely connected to the semiconductor chip via the plastic housing composition, so that expansion differences between the semiconductor material and the

superordinate circuit board, which usually comprises a fiber-reinforced epoxy resin, also affects the solder connection between the wiring substrate of the semiconductor component and the superordinate circuit board. A rubber-elastic compliance according to the invention of the external contact pads can alleviate the mechanical stress between semiconductor component and superordinate circuit board to an extent such that the risk of a faulty contact or of a tearing away of an external contact is avoided.

A method for producing a wiring substrate of a semiconductor component comprising external contact pads for fitting external contacts has the following method steps. The first step involves producing a baseplate with through contacts at predetermined positions, wherein the baseplate comprises a precursor of a polymer plastic. Afterward, a layer composed of rubber-elastic material is selectively applied to a top side of the baseplate, wherein the layer comprises rubber-elastic material pads that are spaced apart from one another. A copper film is then laminated with pressing in of the rubber-elastic material pads with the aid of the external contact pads onto the precursor of the polymer plastic of the baseplate. During this lamination, a coplanar interface is formed between copper film and top side of the baseplate. Afterward, the copper film can be structured to form external contact pads and feeds to the through contacts. This structuring is effected by means of lithography and etching technology. The polymer plastic of the baseplate is then cured with formation of a rigid self-supporting wiring substrate.

This method has the advantage that the rubber-elastic material pads can be realized by relatively coarse application techniques, such as printing techniques. Such printing techniques are known as jet printing

technique, as screen printing technique or as stencil printing technique and yield a pattern of rubber-elastic material pads on the baseplate. The copper film is supported by corresponding lamination tools during the pressing of said rubber-elastic material pads into the high-viscosity plastic composition of the baseplate. The thickness of the plastic film can therefore correspond to the thickness of the external contact pads.

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After the pressing of the external contact pads or of the rubber-elastic material into the substrate, the copper film can practically be structured into the feeds and external contact pads. Prior to this structuring or else after this structuring, the polymer plastic of the baseplate is cured with formation of a rigid self-supporting wiring substrate. During this curing, the chain molecules of the polymer crosslink to form a spatial pattern that is mechanically extremely stable.

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In an alternative method for producing a wiring substrate of a semiconductor component comprising external contact pads for fitting external contacts, the first step likewise involves providing a baseplate with through contacts at predetermined positions. In this case, the baseplate represents a precursor of a polymer plastic. Such precursors are polymer plastics which are not yet completely crosslinked and therefore have, at relatively low temperatures, a softening point at which the rigid precursor of a polymer plastic undergoes transition to a composition having a high viscosity. Said precursor is solid at room temperature, with the result that a layer composed of rubber-elastic material can be selectively applied to the baseplate, to the top side of the baseplate. In this case, the layer has rubber-elastic material pads which are spaced apart from one another and are arranged at

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predetermined positions of the baseplate.

As an alternative to the above method, rather than a metal film being laminated on, a copper-coated film is then prepared, the metal coating of which has already been structured and has metallic external contact pads. The arrangement of the external contact pads on the film corresponds to the arrangement of the rubber-elastic material pads on the baseplate, with which the structured metal-coated film is then aligned. In this case, it is advantageous for the film material itself to have a transparent plastic, thereby facilitating the alignment. Afterward, during lamination, the rubber-elastic material pads on the top side of the baseplate and the external contact pads are pressed into the precursor of the polymer plastic of the baseplate. For this purpose, the baseplate is heated to the softening point of the precursor of the polymer plastic. A coplanar boundary layer arises between film and top side of the base layer in the process.

After this step, the external contact connection areas of the external contact pads are uncovered. This can be effected, on the one hand, by the corresponding regions of the copper-coated film being uncovered by means of the carrier film being resolved at the locations of the external contact pads through photolithographic steps, or by stripping the carrier film from the coplanar boundary layer. Finally, the polymer plastic of the baseplate can be cured with formation of a rigid self-supporting wiring substrate. During this curing, the precursor of the polymer plastic is crosslinked to a greater extent and thus acquires a greater dimensional stability.

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In a further variant of the method, the rubber-elastic material pads are not prepared on the baseplate, but rather are applied on corresponding prepared metallic

external contact pads of a structured metal-coated and possibly transparent plastic carrier film. This composite film, which already has external contact pads and the rubber-elastic material pads, can then be
5 laminated onto the surface, with penetration of the rubber-elastic material pads into the precursor of the polymer plastic of the baseplate. After curing of the baseplate, the transparent plastic carrier film can subsequently be stripped from the coplanar boundary
10 layer that is formed between film and top side of the baseplate.

In all three method variants, a self-supporting wiring substrate finally arises on whose underside a wiring
15 structure can be applied which is connected to the through contacts and enables bondings to a semiconductor chip to be applied. Furthermore, soldering resist layers can be applied both on the top side and on the underside of the self-supporting wiring
20 substrate in order to leave free only the external contact pads on the top side and corresponding contact pads for connections to the semiconductor chips to be applied. These contact pads are arranged differently on the wiring substrate depending on whether a
25 semiconductor chip is to be connected directly by its flip-chip contacts on the wiring structure, or whether a semiconductor chip is to be connected via bonding connections to the wiring substrate and the wiring structure situated thereon.

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In all three methods for pressing the rubber-elastic material pads into the material of the baseplate, a pattern of cutouts filled with rubber-elastic material is created in the wiring substrate, as a result of
35 which the thickness of the wiring substrate is not increased and no additional coatings whatsoever of the wiring substrate is required for producing a rubber-elastic region below an external contact pad.

With this method, wiring substrates which do not require any additional rubber-elastic structures that increase the thickness of the substrate can be produced
5 by cost-effective method steps, and a mechanical decoupling between semiconductor component and superordinate circuit board is nevertheless made possible. Since the dimensions of the rubber-elastic material pads can be chosen freely, it is also possible
10 to attain different depths of the cutouts filled with rubber-elastic material in the wiring substrate.

To summarize, it can be established that with the wiring substrate according to the invention of a
15 semiconductor component, the forces that act between the semiconductor component housing and a superordinate printed circuit board or circuit board can be taken up better because a rubber-elastic layer is in each case integrated into the wiring substrate below the external
20 contact pads at the housing. Since said layer is embedded into the basic body or the baseplate of the wiring substrate and is provided at corresponding positions there as early as during the production of the substrate, the production of such rubber-elastic
25 patterns is simplified and thus becomes more cost-effective.

When external forces act on the solder contact, the rubber-elastic layer below the external contact pads
30 permits a limited excursion, preferably in the Z-direction, and thus enables stress absorption or damping in the event of vibration loadings. The thickness of the rubber-elastic layer can be varied depending on the required stress, in order thus to
35 achieve an optimum balance between robustness and flexibility of the connection. Within a component, too, it is possible to vary the thickness in order to relieve the loading on relatively highly stressed

contacts, e.g. external contacts in the corners of a wiring substrate.

Consequently, the following advantages are afforded in
5 summary:

1. A higher reliability of the connection, particularly in drop tests that bring about a tensile loading in the Z-direction, but also in
10 temperature cycle tests at a printed circuit board level.
2. Contact-connection during testing is improved on account of the external contact pads mounted in rubber-elastic fashion.
- 15 3. For the end customer, underfilling of the interspace between semiconductor component housing and superordinate circuit board is obviated, so that the semiconductor components can be fitted on the superordinate circuit board by their external
20 contacts in a simpler manner.
4. The production process for such rubber-elastically cushioned external contact pads can be performed cost-effectively.

25 Consequently, a stress-absorbing layer is created in the wiring substrate or in a substrate interposer within the external contact pads or the ball pads and a partial mechanical decoupling of housing and superordinate circuit board is thus achieved.

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The invention will now be explained in more detail with reference to the accompanying figures.

figure 1 shows a schematic cross section through a
35 portion of a wiring substrate;

figure 2 shows a schematic cross section through a baseplate of a precursor of a polymer

plastic;

figure 3 shows a schematic cross section through the
baseplate in accordance with figure 1 after
5 application of rubber-elastic material pads;

figure 4 shows a schematic cross section through the
baseplate in accordance with figure 2 after
10 application of a metal film;

figure 5 shows a schematic cross section through the
baseplate in accordance with figure 4 after
pressing of the rubber-elastic material pads
into the baseplate;

figure 6 shows a schematic cross section through the
baseplate after structuring of the metal film
to form cutout pads and feed lines;

figure 7 shows a schematic cross section through a
wiring substrate according to the invention;

figure 8 shows a schematic cross section through a
portion of a semiconductor component of a
first embodiment of the invention, mounted
25 onto a superordinate circuit board;

figure 9 shows a schematic cross section through a
portion of a semiconductor component of a
second embodiment of the invention, mounted
30 onto a superordinate circuit board.

Figure 1 shows a schematic cross section through a
portion of a wiring substrate 5. The wiring substrate 5
35 has a baseplate 24 having a top side 7 and an underside
6. A rubber-elastic material 9 is introduced into the
baseplate 24 from the top side 7, which material forms
a rubber-elastic material pad 25 and fills a cutout 8

in the top side 7 of the wiring substrate 5.

The rubber-elastic material pad 25 incorporated into the baseplate 24 has a top side 10 forming a coplanar area 11 with the top side 7 of the wiring substrate 5. A metallic external contact pad 3 is arranged on the coplanar area 11 of the wiring substrate 5 in the region of the rubber-elastic material pads 25. The areal extent 13 of the external contact pad 3 is less than the areal extent 12 of the rubber-elastic material pad 25.

Since the rubber-elastic material pad 25 is compliant, shear loadings on account of thermal strains or vibration loadings which act on the external contact pads 3 can be reduced and/or damped. For this purpose, the depth t of the cutouts 8 of a wiring substrate 5 of a semiconductor component can be adapted to the expected loadings, with the result that e.g. corner contacts are buffered with a thicker rubber-elastic layer than external contacts 4 in the center of the semiconductor component.

A feed line (not visible in this cross section) connects the external contact pad 3 and thus the external contact 4 fitted onto the latter to a wiring structure 15 arranged on the underside 6 of the wiring substrate 5. The top side 7 of the wiring substrate 5 is covered with an upper soldering resist layer 28 in such a way that it leaves free the external contact pads 3 carrying the external contacts 4. On the underside 6, the wiring structure 15 is protected against damage by a lower soldering resist layer 29. The advantages of such a wiring substrate 5 with external contact 4 mounted in rubber-elastic fashion have already been discussed above and are therefore omitted at this juncture.

Figures 2 to 7 show schematic cross sections through individual components during the production of a wiring substrate for semiconductor components. Components having the same functions as in figure 1 are identified by identical reference symbols in figures 1 to 7 and are not discussed separately. The production of such wiring substrates can be undertaken independently of semiconductor chip manufacturers by supplier companies that have previously supplied metallic leadframes.

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Figure 2 shows a schematic cross section through a baseplate 24 composed of a precursor of a polymer plastic. The baseplate 24 has a top side 7 and an underside 6. From the top side 7 to the underside 6, through contacts 16 are arranged at envisaged positions in the baseplate 24. Said through contacts 16 serve for connecting the external contact pads to be produced on the top side 7 of the baseplate 24 to a wiring structure to be produced on the underside 6 of the baseplate 24.

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Figure 3 shows a schematic cross section through the baseplate 24 in accordance with figure 1 after application of rubber-elastic material pads 25. Said rubber-elastic material pads 25 may have a different thickness in order thus to produce cutouts of different depths in the baseplate 24 which are filled with rubber-elastic material 9.

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Figure 4 shows a schematic cross section through the baseplate 24 in accordance with figure 2 after application of a metal film 26. Said metal film 26 is applied in order subsequently to be laminated onto the surface 7 of the baseplate 24. During the lamination operation, the baseplate 24 composed of a precursor of a polymeric plastic is heated to form a composition having high viscosity and the metal film 26 is laminated on with pressing of the rubber-elastic metal

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pads 25 into the baseplate 24. A connection between the through contact 16 and the metal film 26 is also provided in the process.

5 Figure 5 shows a schematic cross section through the baseplate 24 in accordance with figure 4 after pressing of the rubber-elastic material pads 25 into the baseplate 24, giving rise to a coplanar surface 11 comprising the top sides 10 of the rubber-elastic
10 material pads 25 and the top side 7 of the baseplate 24. When the rubber-elastic material pads 25 are pressed into the high-viscosity precursor of the polymer plastic of the baseplate 24, the rubber-elastic metal pads 25 penetrate into the baseplate 24 as far as
15 a depth t . Even though the depth t is identical in this example for the three rubber-elastic metal pads 25 shown, it can nevertheless, as already mentioned above, also be different and depend on the expected loading of the external contact pads 3 to be fitted.

20 Figure 6 shows a schematic cross section through the baseplate 24 after structuring of the metal film 26 from figure 5 to form external contact pads 3 and feed lines 14. The feed lines 14 are narrow conductor tracks
25 which connect the external contact pads 3 to corresponding through contacts 16 which are positioned in such a way that they do not adversely affect the deformability of the rubber-elastic metal pads 25. In order to achieve a high deformability of the rubber-
30 elastic material pads 25, the latter are produced from insulating silicones, silicone elastomers, gels or soft-porous insulating materials and are not suitable for the conduction of the electric current. In a variation of the rubber-elastic material pads 25 shown
35 in figure 6, said pads may be filled with correspondingly compliantly electrically conductive particles, known as carbon nanotubes in the literature, with the result that through contacts 16 can also be

provided underneath, i.e. in the region of the rubber-elastic metal pads 25, in the baseplate 24.

Figure 7 shows a schematic cross section through a wiring substrate 5 in accordance with one embodiment of the invention. The precursor of a wiring substrate 5 as shown in figure 6 is completed by the application of an upper soldering resist layer 28 to the top side 7 of the wiring plate 5 whilst leaving free the external contact pads 3. In addition, the wiring structure 15 is applied to the underside 6 and, for its part, can be protected against damage by a lower soldering resist layer 29. This lower wiring structure 15 serves to electrically connect the external contact pads 3 on the top side 7 of the wiring substrate to a semiconductor chip on the underside 6 of the wiring substrate 5 via the through contacts 16.

Figure 8 shows a schematic cross section through a portion of a semiconductor component 1 of a first embodiment of the invention, which is mounted onto a superordinate circuit board 30. Components with the same functions as in the previous figures are identified by identical reference symbols and are not discussed separately. The wiring substrate 5 with its rubber-elastically cushioned external contact pad 3 has an external contact 4. Said external contact 4 is connected via the external contact pads 3 to a feed line 14, and also a through contact 16 of a wiring structure 15 on the underside 6 of the wiring substrate 5. The wiring structure 15 has contact pads 27, which are connected to a flip-chip contact 21 of a semiconductor chip 17 in this semiconductor component 1 of the first embodiment of the invention.

The external contact 4, for its part, is connected to a solder pad 31 of a conductor track structure 32 on the top side 33 of the superordinate circuit board 30. By

means of the rubber-elastic material pad 25 buried in the wiring substrate 5 of the semiconductor component 1, pressure cyclic loadings in the form of vibrations and shear loadings as a result of thermal stresses can
5 be rubber-elastically cushioned and absorbed, with the result that this connection between the semiconductor component 1 and the superordinate circuit board 30 via such a rubber-elastically cushioned external contact 4 have a higher reliability.

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Figure 9 shows a schematic cross section through a portion of a semiconductor component 2 of a second embodiment of the invention, which is mounted onto a superordinate circuit board 30. Components having the
15 same functions as in figure 8 are identified by identical reference symbols and are not discussed separately.

This second embodiment of a semiconductor component 2 according to the invention differs from the semiconductor component shown in figure 8 by virtue of the fact that the active top side 22 of the semiconductor chip 18 has contact areas 23 which are connected via a bonding connection 19 to the contact
20 pad 27 of the wiring structure 15 on the underside 6 of the wiring substrate 5. Furthermore, the rear side 34 of the semiconductor chip 18 is mechanically connected to the wiring substrate 5 by means of an adhesive layer 35. The semiconductor chip 18 with the bonding
25 connection 19, and also the structures on the underside 6 of the wiring substrate 5 are surrounded by a plastic housing composition 20 that protects the entire construction of the semiconductor component 2 against
30 damage.

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Patent claims

1. A wiring substrate of a semiconductor component (1, 2) comprising external contact pads (3) for fitting
5 external contacts (4), wherein the rigid wiring substrate (5) comprises an underside (6) with a wiring structure (15) and a top side (7) with cutouts (8), and wherein a rubber-elastic material (9) is arranged in the cutouts (8) and the external contact pads (3) are
10 arranged on the rubber-elastic material (9).

2. The wiring substrate as claimed in claim 1, characterized in that
a top side (10) of the rubber-elastic material (9)
15 together with the top side (7) of the wiring substrate (5) form a coplanar area (11).

3. The wiring substrate as claimed in claim 1 or claim 2,
20 characterized in that
the rubber-elastic material (9) comprises silicones, silicone elastomers, gels or closed-pore soft-porous materials.

25 4. The wiring substrate as claimed in one of the preceding claims, characterized in that
the cutouts (11) in a single wiring substrate (5) comprises different depths (t).
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5. The wiring substrate as claimed in one of the preceding claims, characterized in that
an areal extent (12) of the cutouts (8) filled with
35 rubber-elastic material (9) is greater than the areal extent (13) of the external contact pads (3).

6. The wiring substrate as claimed in one of the

preceding claims,
characterized in that
the wiring substrate (5) comprises feed lines (14) from
the wiring structure (15) to external contact pads (3).

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7. The wiring substrate as claimed in one of the
preceding claims,
characterized in that
the wiring substrate (5) comprises through contacts
10 (16) through the wiring substrate (5) which are
electrically connected to feed lines (14) to the
external contact pads (3).

8. The wiring substrate as claimed in one of the
15 preceding claims,
characterized in that
the external contact pads (3) comprise a solder coating
of a lead-free soldering material.

20 9. The wiring substrate as claimed in one of the
preceding claims,
characterized in that
a semiconductor chip (17) is arranged on the wiring
structure (15).

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10. The wiring substrate as claimed in one of the
preceding claims,
characterized in that
a semiconductor chip (17) with flip-chip contacts (21)
30 is arranged on the wiring structure (15).

11. The wiring substrate as claimed in one of claims 1
to 7,
characterized in that
35 a semiconductor chip (17) with bonding connections (19)
to the wiring structure (15) is arranged on the wiring
structure (15).

12. A semiconductor component comprising a semiconductor chip (17) and a wiring substrate (5) comprising external contacts (3???) arranged on external contact pads (3), wherein the rigid wiring
5 substrate (5) comprises an underside (6) with the semiconductor chip (17) and a wiring structure (15) and a top side (7) with cutouts (8), and wherein a rubber-elastic material (9) is arranged in the cutouts (8) and the external contact pads (3) are arranged on the
10 rubber-elastic material (10).

13. The semiconductor component as claimed in claim 12,
characterized in that
15 the semiconductor chip (17) on the wiring substrate (5) is embedded into a plastic housing composition (20).

14. The semiconductor component as claimed in claim 12 or claim 13,
20 characterized in that
the semiconductor chip (17) comprises flip-chip contacts (21) which are electrically connected to the wiring structure (15).

25 15. The semiconductor component as claimed in claim 12 or claim 13,
characterized in that
the semiconductor chip (17) comprises on its active top side (22) contact areas (23) which are electrically
30 connected to the wiring structure (15) via bonding connections (19).

16. A method for producing a wiring substrate (5) of a semiconductor component (1, 2) comprising external
35 contact pads (3) for fitting external contacts (4), wherein the method comprises the following method steps:

- production of a baseplate (24) with through

- contacts (16) at predetermined positions, wherein the baseplate (24) comprises a precursor of a polymer plastic,
- selective application of a layer composed of rubber-elastic material (9) to a top side (7) of the baseplate (24), wherein the layer comprises rubber-elastic material pads (25) that are spaced apart from one another,
 - lamination of a copper film (26) with pressing of the rubber-elastic material pads (25) with the external contact pads (3) into the precursor of the polymer plastic of the baseplate (24) and formation of a coplanar boundary layer (11) between copper film (26) and top side (7) of the baseplate (24),
 - structuring of the copper film (26) to form external contact pads (3) and feed lines (14) to the through contacts (16),
 - curing of the polymer plastic of the baseplate (24) with formation of a rigid self-supporting wiring substrate (5).
17. A method for producing a wiring substrate (5) of a semiconductor component (1, 2) comprising external contact pads (3) for fitting external contacts (4), wherein the method comprises the following method steps:
- production of a baseplate (24) with through contacts (16) at predetermined positions, wherein the baseplate (24) comprises a precursor of a polymer plastic,
 - selective application of a layer composed of rubber-elastic material (9) to a top side (7) of the baseplate (24), wherein the layer comprises rubber-elastic material pads (25) that are spaced apart from one another,
 - lamination of a copper-coated film structured with external contact pads (3) with alignment of the

- external contact pads (3), wherein the arrangement of the external contact pads (3) corresponds to the rubber-elastic material pads (25),
- pressing of the rubber-elastic material pads (25) with the external contact pads (3) into the precursor of the polymer plastic of the baseplate (24) with formation of a coplanar boundary layer (11) between film and top side (7) of the base layer (24),
 - uncovering of the external contact pads (3),
 - curing of the polymer plastic of the baseplate (24) with formation of a rigid self-supporting wiring substrate (5).
18. The method as claimed in claim 16 or claim 17, characterized in that an upper soldering resist layer (28) is applied to the top side (7) of the self-supporting wiring substrate (5) with the external contact pads (3) being uncovered.
19. The method as claimed in one of claims 16 to 18, characterized in that a solder layer is applied selectively to the external contact pads (3).
20. The method as claimed in one of claims 16 to 19, characterized in that the underside (6) of the self-supporting wiring substrate (5) is coated with a wiring structure (15).
21. The method as claimed in one of claims 16 to 20, characterized in that the underside (6) of the self-supporting wiring substrate (5) is coated with a soldering resist layer whilst leaving free contact pads (27) of the wiring structure (15).