Thermode unit for semiconductor components

Description

The invention relates to a thermode unit for connecting and/or electrically contacting a first semiconductor component to/with a support element and/or a second semiconductor component by heating an adhesive while applying pressure, wherein the thermode unit comprises a main body and a heating head unit which can be displaced along the longitudinal axis thereof and is designed to press the first semiconductor component against the support element and/or the second semiconductor component during a heat transfer to the first semiconductor component, according to the preamble of claim 1.

In order to produce microelectronic assemblies, semiconductor components such as silicon chips are mounted on support substrates, which may have an antenna, or on further semiconductor components which may again be silicon chips. In order to mount the semiconductor components in this way, contact adhesives are often used not just to fix the semiconductor component but at the same time to produce an electrical contact between connection points on the chip and on the support substrate or a further chip. The contact adhesives or solders used for this are usually cured by means of thermode units at elevated temperature while applying pressure.

Thermode elements used for this usually have, as disclosed for example in US 4,736,882, a heating body at the bottom which can be displaced downwards and upwards along the vertical in order to apply pressure to or release the pressure on the components to be connected and the adhesives arranged therebetween during a heat transfer operation. In order to carry out the displacement movement of the heating body, such thermode

elements usually have a simple mounting of a guide part which is connected to the heating body.

With the increasing miniaturisation of the semiconductor components to be mounted, there is an increasing risk that such small semiconductor components will be destroyed when pressure is applied by the heating body. This leads to malfunctions of the mounted semiconductor components.

With the known thermode elements to date, semiconductor components are usually pressed with a force of more than 2 N during the curing and heating operation, said force being exerted by the pressure applied to the semiconductor component. Lower forces cannot be set due to the design of thermode elements to date. This particularly affects very small semiconductor components, wherein precise guidance of the displaceable heating body is critical in order to meet the requirement of a high level of plane-parallelism between the underside of the heating body and the upper side of the semiconductor component to be mounted.

Accordingly, the object of the present invention is to provide a thermode unit for connecting and/or electrically contacting a first semiconductor component to/with a support element and/or a further semiconductor component, which allows curing of the adhesives used while subjecting the semiconductor component to a pressing force of less than 2 N.

This object is achieved according to the features of claim 1.

One essential point of the invention consists in that, in a thermode unit for connecting and/or electrically contacting a first semiconductor component to/with a support element or a second semiconductor component by

heating an adhesive while applying pressure, a guide part which can be displaced with a displaceable heating head unit along the longitudinal axis is mounted on its longitudinal side within the main body of the thermode element in a linear manner by means of ball bearings or roller bearings, and the guide part is designed in a piston-like manner at its first end which faces away from the heating head unit, wherein the piston-like end is spaced apart by an air gap from an inner wall of a piston accommodating chamber of complementary shape which is arranged in the main body. This allows almost friction-free mounting of the heating head unit, which comprises a heating body at the bottom, within the main body of the thermode unit and thus allows the setting of very small forces of the heating head unit which is connected to the guide part and presses downwards during the adhesive curing operation. In this way, pressing force values for the pressing of the first semiconductor component against the support element or the second semiconductor component of less than 2 N, preferably 0.5 - 2 N, can be obtained, while the necessary plane-parallelism of the heating head units can be achieved in an assembly or mounting space of very small dimensions.

Due to the linear guidance by means of ball bearings or roller bearings, the high guidance precision which is necessary in the case of very small semiconductor components during the displacement of the heating head unit is ensured while maintaining very low friction forces.

In the piston accommodating chamber, the pneumatic pressure is varied in order to build up a pneumatic compression cylinder as a displacement drive, which is characterised inter alia in that an air gap is generated between an inner wall of the piston accommodating chamber and the piston-like end on account of the overpressure. This means that the piston does not touch the inner wall

and thus almost no friction forces occur during a displacement movement of the guide part.

To vary the pressure within the piston accommodating chamber, the latter is connected to a pressure valve.

In order to achieve the linear mounting by means of ball bearings or roller bearings, the guide part has on its longitudinal side a first rail with an essentially rectangular cross section which is mounted by means of ball bearings within a second rail of the same length with an essentially U-shaped cross section which is fixed to the main body.

According to one preferred embodiment, the guide part and/or the first rail is/are connected to variable weight elements in order to set a downward-acting pressing pressure. To this end, the weight elements are arranged within a holding container attached laterally to the first rail or the guide part. This means that the piston within the piston accommodating chamber does not touch the inner wall of the piston accommodating chamber even when it is difficult to produce an annular gap generated by the air gap between the piston and the inner wall. This situation may arise for example on account of manufacturing tolerances. In order to maintain the annular gap, a high air pressure would then be provided within the piston accommodating chamber, and thus a high air consumption due to air escaping from the bottom of the annular gap. This can be compensated by the weight elements designed as calibrating weights. In particular, precise calibration of a plurality of thermode elements arranged next to one another can be achieved by means of such calibrating weights.

Preferably, the heating head unit comprises a heating body at the bottom which can be contacted with the first semiconductor component, a fixing part which is connected

to an end of the guide part facing towards the first semiconductor component, and a heat-insulating part arranged between the fixing part and the heating body. In order to set the optimal force to be exerted on the semiconductor component to be mounted, the heating body, the piston accommodating chamber and the piston itself are arranged along a common axis.

Further advantageous embodiments emerge from the dependent claims.

Advantages and expedient features can be found in the following description in conjunction with the drawing.

The single figure shows, in a perspective cross-sectional diagram, a thermode unit according to one embodiment of the invention.

The thermode unit 1 shown in the figure can be used to mount, that is to say fix and electrically contact, RFID chips on UHF antennas, which are arranged for example on a chip card, in order to produce an RFID transponder.

The thermode element 1 comprises a main body 2 with a longitudinal axis 2a and a heating head unit 3 at the bottom which consists of the actual heating body 4, a heat-insulating part 5 and a fixing part 6 for fixing the heating head unit 3 on a guide part 7. The fixing part 6 is arranged at a lower end 7a of the guide part 7.

The guide part 7 extends within the main body 2 as far as the upper end 7b thereof, which is designed in a piston-like manner. The piston 7b formed thereby is mounted in a displaceable manner within a piston accommodating chamber 8, which is arranged within the main body 2.

Between inner walls 8a of the piston accommodating chamber 8 and the piston 7b, there is an air gap (not

shown here) which is produced on account of a variable pneumatic overpressure of 1 - 6 bar which prevails in the piston accommodating chamber 8.

In order to generate the variable pneumatic pressure within the piston accommodating chamber 8, air can be introduced into the piston accommodating chamber via a pneumatic connection 9, which is connected to a proportional pressure valve (not shown here). This gives rise to a displacement of the piston 7b and thus to an upward or downward movement of the heating body 4.

The heating body preferably has a surface area of 13 × 13 mm on its underside, as is necessary for very small silicon chips.

A rail 7c which is connected to the guide part 7 and has a length of preferably 30 mm is connected within a U-shaped rail 11 fixedly connected to the main body 2, in such a way that a linear ball-bearing mount acts between the two rails 7c and 11 when the rail 7c is displaced relative to the rail 11. In order to fix the rail 11 to the main body 2, screw connections 10a, 10b, 10c and 10d are arranged therein.

In order to calibrate a plurality of thermode elements arranged next to one another, calibrating weights 14 which can be varied in number are arranged within a container 12 attached to the side. The container 12 is connected to the guide part 7 and the rail 7c via connecting elements 13a and 13b.

The second rail 11 preferably has the same length as the first rail 7c, in order to obtain a high level of guidance precision during the displacement of the guide part and thus of the heating head unit 3.

Both the piston accommodating chamber 8 and the actual piston 7b and the heating head unit 3 are arranged along the common longitudinal axis 2a of the main body 2, in order to exert an optimal downward force which is uniformly distributed over the surface of the semiconductor component to be mounted.

All the features disclosed in the application documents are claimed as essential to the invention in so far as they are novel individually or in combination with respect to the prior art.

List of references

1	thermode unit
2	main body
2a	longitudinal axis of the main body
3	heating head unit
4	heating body
5	insulating part
6	fixing part
7	guide part
7a	lower end of the guide part
7b	upper end of the guide part
7c	first rail
8	piston accommodating chamber
8a	inner walls of the piston accommodating chamber
9	pneumatic connection
10a, 10b, 10c, 10d	screw connections
11	second rail
12	container
13a, 13b	connecting elements
14	calibrating weights

Claims

1. Thermode unit for connecting and/or electrically contacting a first semiconductor component to/with a support element and/or a second semiconductor component by heating an adhesive while applying pressure, wherein the thermode unit (1) comprises a main body (2) and a heating head unit (3) which can be displaced along the longitudinal axis (2a) thereof and is designed to press the first semiconductor component against the support element and/or the second semiconductor component during a heat transfer to the first semiconductor component,
characterised in that
a guide part (7) which can be displaced with the heating head unit (3) along the longitudinal axis (2) is mounted on its longitudinal side within the main body (2) in a linear manner by means of ball bearings or roller bearings, and
the guide part (7) is designed in a piston-like manner at its first end (7b) which faces away from the heating head unit (3) and which is spaced apart by an air gap from an inner wall (8a) of a piston accommodating chamber (8) of complementary shape which is arranged in the main body (2).

2. Thermode unit according to claim 1, characterised in that a variable pneumatic pressure for displacing the piston-like end (7b) of the guide part (7) along the longitudinal axis (2a) of the main body (2) can be set by means of a pressure valve within the piston accommodating chamber (8).

3. Thermode unit according to claim 1 or 2, characterised in that the guide part (7) has on its longitudinal side a first rail (7c) with an essentially rectangular cross section which is mounted by means of ball bearings within a second rail (11) of the same

length with an essentially U-shaped cross section which is fixed to the main body (2).

4. Thermode unit according to one of the preceding claims, characterised in that the guide part (7) and/or the first rail (7c) is/are connected to variable weight elements (14) in order to set a downward-acting pressing pressure.

5. Thermode unit according to claim 4, characterised in that the weight elements (14) are arranged within a holding container (12) attached laterally to the first rail (7c) or the guide part (7).

6. Thermode unit according to one of the preceding claims, characterised in that the heating head unit (3) comprises a heating body (4) which can be contacted with the first semiconductor component, a fixing part (6) which is connected to an end (7a) of the guide part (7) facing towards the first semiconductor component, and a heat-insulating part (5) arranged between the fixing part (6) and the heating body (4).

7. Thermode unit according to claim 6, characterised in that the piston accommodating chamber (8), the piston-like end (7b) and the heating body (4) are arranged along a common axis (2a).

8. Thermode unit according to one of the preceding claims, characterised in that the first semiconductor component is an RFID chip and the support element is a support having an antenna on its upper side.