

Micro-controlled Environment Carrier with Pedestals

FIELD OF THE INVENTION

[01] The invention relates to a component carrier for carrying a component. The invention further relates to a kit comprising a component carrier, a gas-impermeable sealing foil and a down holder plate. The invention also relates to a processing apparatus comprising a component carrier. The invention further relates to a processing method for processing a component.

BACKGROUND OF THE INVENTION

[02] A sintering process is used for producing a component by creating a good bond between a device, such as semiconductor device like a power IC, and its substrate or carrier. Initially, the device to be sintered is positioned onto its substrate or carrier together with a sintering material in between. Subsequently, a pressure is applied using, for instance, an actuator exerting a pressure on the associated component and the sintering material while the device, the sintering material and the substrate or carrier are heated at around 250°-300° C. The sintering process allows the creation of a component characterized by a particularly solid bond between the device and the substrate or carrier.

[03] The devices to be processed may concern chips, DBC's, spacers, heatsinks, sensors, power ICs, flip chips, MEMs, etcetera. Usually, parts of the products to be sintered are made of highly conductive material, like silver or copper, which are not coated with a protective coating. Such metallic parts, exposed to the high temperatures of the sintering process, rapidly oxidize when they are surrounded by an atmosphere containing oxygen. The oxides formed on the metallic parts degrade the quality of the component, i.e. by lowering their electric conductivity. Moreover, at the high temperatures of the sintering process, contaminants are released from the sintering material which may contaminate the component itself. To avoid these problems, the component is generally sintered in a closed chamber where an atmosphere containing mostly an inert gas, like nitrogen, is created. To create this inert atmosphere, the inert gas is injected into the chamber for flushing away the contaminants and the oxygen.

[04] A sintering process commonly comprises three stages: a pre-heating stage where the component is pre-heated, a processing stage where the component is heated at the sintering temperature while a pressure is applied onto it, and a cooling stage, where the component is cooled (let cool) down to room temperature. These three phases can be performed in the same processing chamber or in separate processing chambers. In both cases the atmosphere must be changed at each stage by injecting the inert gas into the chamber which causes the evacuation of the pre-existing atmosphere. Since the processing chamber has usually a considerable volume, changing the atmosphere three times results in a quite time-consuming process which could last longer than the sintering process itself.

[05] Reference is made above to a sintering process. However, there are more

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processes that require heating the component to high temperatures when processing the component. In such methods, the formation of oxides on the component to be processed may lead to disadvantages and quality issues of the component itself so that the limitations, drawbacks and disadvantages of the sintering method described above apply equally well to such other processing methods.

SUMMARY OF THE INVENTION

- [06] It is an objective of the invention to reduce the cycle time for processing a component.
- 10 [07] It is another or alternative objective of the invention to reduce the contamination level of a processed component.
- [08] It is yet another or alternative objective of the invention to prevent undesired chemical reactions, especially oxidation, during the processing of the component due to the presence of oxygen or contaminants in the atmosphere surrounding the component.
- 15 [09] It is yet another or an alternative objective of the invention to reduce the amount of inert gas used for creating an inert atmosphere during processing in a processing apparatus.
- [10] In an aspect the invention provides a a component carrier for carrying one or more components to be processed in a component processing apparatus like a press sintering apparatus, and comprising a component support. The component support comprises one or more positioning openings formed through the component support from a top surface of the component support to a bottom surface of the component support, wherein each positioning opening defines a component position for holding a component to be processed and a component held in the component position is exposed at the top surface of the component support, and, one or more movable pedestals associated with the one or more positioning openings, respectively, wherein each movable pedestal is received within the associated positioning opening for moving along a direction A between the top and bottom surfaces of the component support to bring a top end of the movable pedestal into and out of contact with a component held in the component position defined by the positioning opening for, in operation, carrying and making thermal contact to a respective component during processing of the component(s), and wherein a bottom end of each pedestal is exposed at a bottom surface of the component support for, in operation, making thermal contact to a heat source for heating the pedestal and the respective component when in contact with the pedestal.
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- 35 [11] In an embodiment, the component support comprises a receiving recess associated with the positioning openings, the receiving recess is recessed with respect to the top surface of the component support, and the one or more positioning openings are arranged within the receiving recesses.
- [12] In an embodiment, the top surface of the component support completely surrounds the receiving recess.
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[13] In an embodiment, the component support comprises a carrying member configured to fit within the receiving recess and comprising one or more receiving openings corresponding to the one or more component positions when the carrying member is arranged within the receiving recess, wherein each receiving opening is configured for carrying one component of the one or more components and for allowing the top end of a respective movable pedestal to contact the component.

[14] In an embodiment, the carrying member comprises carrying elements protruding towards an inside of each receiving opening and configured for carrying the one or more components.

[15] In an embodiment, the component carrier comprises a down-holder mask configured to be mounted onto the top surface of the component support, the down-holder mask comprises one or more mask openings configured for allowing access to the component(s), and the mask opening(s) correspond in position to the component position(s) defined by the positioning opening(s) of the component support.

[16] In an embodiment, the down-holder mask further comprises positioning pins protruding from a bottom surface of the down-holder mask and configured for fitting in positioning bores formed in the top surface of the component support.

[17] In an embodiment, a gas inlet and a gas outlet are provided in the receiving recess, and wherein the gas inlet and gas outlet are in fluid connection with a gas inlet connection and a gas outlet connection, respectively, through one or more gas ducts, wherein the gas inlet connection is configured for connecting to a gas source and the gas outlet connection is configured for connecting to a gas drain to provide a continuous gas flow to the one or more components.

[18] In an embodiment, the component carrier is configured for holding a gas-impermeable foil, sheet or film completely covering the carried one or more components and creating a closed cavity for the one or more components.

[19] In an embodiment, when the down-holder mask is mounted onto the top surface of the component support, the gas-impermeable foil, sheet, or film is clamped between the down-holder mask and the top surface of the component support.

[20] In another aspect the invention provides a component carrier for carrying one or more components to be processed in a component processing apparatus like a press sintering apparatus, optionally according to any one of the preceding claims, wherein the component carrier comprises

- a component support comprising one or more positioning openings formed in the component support at a top surface of the component support, wherein each positioning opening defines a component position within the positioning opening for holding a component to be processed and a component held in the component position within the positioning opening is exposed at the top surface of the component support; and

- two gas inlet connections in fluid communication with the positioning openings of the component support for passing gas from a gas source, connected, in use, to one of the

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gas inlet connections, to the positioning openings for purging the positioning openings, wherein each gas inlet connection is configured to be closed off when not connected to the gas source.

5 [21] In an embodiment, the component support comprises gas ducts connected to each positioning opening for providing fluid connection between the gas inlet connections and the positioning openings.

10 [22] In an embodiment, the component support comprises two gas outlet connections in fluid communication with the positioning openings of the component support for passing gas from the positioning openings to a gas drain, connected, in use, to one of the gas outlet connections for purging the positioning openings, wherein each gas outlet connection is configured to be closed off when not connected to the gas drain.

[23] In another aspect, the invention provides a method for processing a component in a processing apparatus, wherein the method comprising employing a component carrier.

15 BRIEF DESCRIPTION OF THE DRAWINGS

[24] Further features and advantages of the invention will become apparent from the description of the invention by way of non-limiting and non-exclusive embodiments. These embodiments are not to be construed as limiting the scope of protection. The person skilled in the art will realize that other alternatives and equivalent embodiments of the invention can be conceived and reduced to practice without departing from the scope of the present invention. Embodiments of the invention will be described with reference to the accompanying drawings, in which like or same reference symbols denote like, same or corresponding parts, and in which

Figure 1 schematically shows a component processing apparatus;

25 Figures 2A and 2B shows a schematic perspective view and a cross section, respectively, of a component carrier to be used in the component processing apparatus.

Figures 3A and 3B schematically show a perspective view and a cross section, respectively, of a component carrier to be used in the component processing apparatus, according to embodiments of the invention.

30 Figures 4A and 4B schematically show a perspective view and a cross section, respectively, of a component carrier to be used in the component processing apparatus, according to embodiments of the invention.

Figures 5A and 5B schematically show the cross section of the component carrier depicted in figures 3A to 4B, during the pre-heating stage of the process and during the processing stage of the process, respectively.

Figures 6A and 6B schematically show perspective views of a component carrier to be used in the component processing apparatus, according to embodiments of the invention.

Figures 7A, 7B and 7C schematically show cross sections along different planes of the component carrier of figures 6A and 6B .

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DETAILED DESCRIPTION OF EMBODIMENTS

[25] Figure 1 schematically shows a component processing apparatus 10 according to an embodiment of the invention. The component processing apparatus 10, such as a sintering apparatus or a packaging apparatus for sintering or packaging a component, respectively, comprises a pre-heating station 11 for pre-heating the component, a processing station 12 for processing the component, and a cooling station 13 for cooling the component after processing. The processing apparatus 10 further includes a transferring device, i.e. a gripper device connected to a transfer conveyor, a robotic arm, a crane, a linear X-Y table, or the like, for carrying one or more components 20.1, 20.2 to be processed and for transferring said products 20.1, 20.2 through the different stations 11, 12, and 13 of the processing apparatus. The one or more components 20.1, 20.2 to be processed, for instance, power ICs provided on their carrier or substrate together with a sintering material in between power ICs and substrate, are positioned and placed onto a component carrier 200. The transferring device 14 sequentially transfers the carrier 200 carrying the one or more components 20.1, 20.2 into the stations 11, 12, and 13 of the processing apparatus 10.

[26] In a first stage, the carrier 200 is transferred onto a pre-heating platform 111 of the pre-heating station 11 where the one or more components 20.1, 20.2 are pre-heated. At least a part of the pre-heating platform 111 comprises a heating element configured for heating up to about 300°C and for transferring heat to the components 20.1 and 20.2. When the product reaches a predetermined temperature, lower than the temperature of the heating element, the component carrier 200 is transferred by the transferring device 14 onto a heating platform 121 of the processing station 12 where the one or more components 20.1, 20.2 are heated to their process temperature and processed by providing pressure onto them. At least a part of the heating platform 121 comprises a heating element configured for heating up to about 300° C and for rapidly transferring heat to the components 20.1 and 20.2. Pressure is provided by a press tool 120, included in the processing station 12, configured and arranged for applying force onto the components 20.1 and 20.2 held by the carrier 200 by lowering a movable insert member 120.1 and 120.2 associated with each component 20.1 and 20.2, respectively. Optionally, instead of comprising a movable insert member 120.1 and 120.2 associated with each component 20.1 and 20.2, the press tool 120 comprises a single movable insert member, having a large surface, configured for being lowered on all the components held on the component carrier 200 so as to exert a pressure on all the components at once. A movable insert member may be any kind of solid means movable along a direction, which is configured and arranged for receiving, at one of its end, a force or pressure and for transferring said force or pressure to an element placed at its other end. After processing, the component carrier 200 is transferred by the transferring device 14 onto a supporting platform 131 of the cooling station 13 where the one or more processed components 20.1 and 20.2 are cooled down. Finally, the component carrier 200 holding the one or more components 20.1 and 20.2 are transferred by the transferring device

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14 to an outside of the processing apparatus 10 for further handling.

[27] Figure 2A shows a schematic perspective view of the component carrier 200 to be used in the component processing apparatus 10. Figure 2B shows a cross section of the component carrier 200 of figure 2A having component(s) mounted thereon. The cross section shown in figure 2B is obtained by projecting the component carrier 200 of figure 2A, in the mounted configuration, onto the plane B.

[28] The component carrier 200 comprises a component support 210 having a substantially planar top surface 210a facing a first direction A1 directed toward the press tool 120 when the component carrier 200 is in the processing station 12 and a bottom surface 210b facing a second direction A2 opposed to the first direction A1.

[29] Positioning openings 213, each one defining a component position, are formed in the top surface 210a of the component support 210 so as to put in communication the top surface 210a and the bottom surface 210b of the component support 210. The component carrier 200 is configured to carry a component in correspondence with each component position.

[30] When carried on the component carrier, each component is exposed to the top surface 210a of the component support 210 allowing the insert members of the press tool 120 to access the component(s) and to apply force onto it(them) when the component carrier 200 is in the processing station 12, i.e. during the processing of the component(s) 20.

[31] The component carrier 200 further comprises movable pedestals 212 slidably mounted in the positioning openings 213. The movable pedestals 212 are configured for moving along a line A perpendicular to the top surface 210a.

[32] The movable pedestals 212 are made of a thermally conductive material and are configured for contacting or moving away from the components 20 during the different stages of the processing of the component(s). In addition, a bottom end 212b of each movable pedestal 212, facing the second direction A2, is configured for contacting a heat source mounted in one or more stations of the processing apparatus 10, i.e. the bottom end 212b of each movable pedestal 212 is configured to contact the pre-heating platform 111 of the pre-heating station 11 or the heating platform 121 of the processing station 12.

[33] When the movable pedestals 212 contact a heat source and are in contact with the component(s), as when the component carrier 200 is in the processing station 12, heat is transferred by contact to the component(s) 20. On the contrary, when the movable pedestals 212 contact a heat source and are not in contact with the component(s), as when the component carrier 200 is in the pre-heating station 11, heat is transferred to the component(s) 20 by radiation or convection.

[34] The movable pedestals 212 are further configured for carrying on their top end 212a the components 20 while the components 20 are not contacting the component support 210, i.e. during processing in the processing station 12 of the processing apparatus 10. The functioning of the movable pedestals during the whole processing of the

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component(s) will be described later in detail.

[35] Figure 3A shows a schematic perspective view of the component carrier 200 to be used in the component processing apparatus 10 according to various examples of the invention. Figure 3B shows a cross section of the component carrier 200 of figure 3A
5 obtained by projecting the component carrier 200 of figure 3A, in the mounted configuration, onto the plane B.

[36] The component carrier 200 comprises a component support 210 similar to the component support 210 of the component carrier 200 of Figs 2A and 2B. With respect to the component support 210 of Figs 2A and 2B, the component support 210 of this embodiment
10 further comprises a receiving recess 211 formed in the top surface 210a of the component support 210. Optionally, the top surface 210a completely surrounds the receiving recess 211, as shown in figures 3A and 3B.

[37] Similarly to the component carrier 200 of figures 2A and 2B, movable pedestals 212 are slidably mounted in the positioning openings 213 formed in the bottom
15 surface 211a of the receiving recess 211. For the detailed description of the component carrier 200 and of its functioning, reference is made to the description of the component carrier 200 disclosed in relation to Figs. 2A and 2B.

[38] In an embodiment, the component support 210 of Figs. 3A and 3B is configured for receiving a carrying member 220 on a bottom surface 211a of the receiving recess 211.

[39] The carrying member 220 is a substantially planar element configured for carrying one or more components 20 and is configured to fit into the receiving recess 211 of the component support 210. One or more receiving openings 221 are formed in the carrying member 220 in correspondence to the component positions defined by the positioning
20 openings 213 of the component support 210.

[40] When the carrying member 220 is fitted into the receiving recess 211, the positions of the receiving openings 221 correspond to the position of the positioning openings 213 formed in the bottom surface 211a of the receiving recess 211, i.e. to the component positions. In this embodiment, the component(s) are carried on at a position of the receiving openings 221 of the carrying member 220, i.e. each receiving opening 221 of
30 the carrying member 220 defines a component position for carrying one component.

[41] Optionally, the component(s) 20 are carried on carrying protrusions 222 protruding towards an inside of each receiving openings 221. The carrying protrusions 222 are usually located in correspondence to the four edges of the receiving openings 221. However, the person skilled in the art will realize that said protrusions can be formed at any
35 position within the related receiving opening without altering the scope of the present invention.

[42] The carrying protrusions 222 are configured so that, when the carrying member 220 is fitted into the receiving recess 211 of the component support 210, the height of the carried components measured along the axis A does not exceed the level of the top
40 surface 210a of the component support 210.

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[43] The use of the carrying member 220 for carrying the component(s) 20 allows a more precise and stable positioning of the components on the component carrier 200.

[44] In another embodiment, the component carrier 200 of Figs. 3A and 3B further comprises a down-holder mask 230 configured to be mounted onto the top surface 210a of the component support 210. The down-holder mask 230 comprises one or more mask openings 231 configured for allowing the insert members of the press tool 120 to access the component(s) and to apply force thereon when the component carrier 200 is in the processing station 12, i.e. during the processing of the component.

[45] When the down-holder mask is mounted on the top surface 210a of the component support 210, positions of the one or more mask openings 231 correspond to the component positions defined by the positioning openings 213 formed in the bottom surface 211a of the receiving recess 211.

[46] The down-holder mask 230 provides guidance to the insert members of the press tool 120 for accessing the component(s) 20 and for applying force onto (it)them. The presence of the down-holder mask 230 also prevents that a force is applied to the component(s) in case of misalignment of the component carrier 200 with the press tool 120 of the processing station 12. Indeed, if the mask opening(s) 231 are not aligned with the insert members of the press tool 120, because of a misalignment of the component carrier 200 when provided to the processing station 12 of the processing apparatus 10, a top surface of the down-holder mask 230 act as a stop element for the movement of the insert member(s) towards the components 20 to be processed.

[47] In case the carrying member 220 is used for carrying the component(s), when the down-holder mask 230 is mounted onto the top surface 210a of the component support 210, thereby covering the carrying member 220 fitted in the receiving recess 211, the weight of the down-holder mask 230 prevents the carrying member 220 from moving along the vertical direction A. To provide further stability to the carrying member 220, the down-holder mask 230 may be fixed to the component support 210 by means of screws, bolts, or any other suitable fastening means.

[48] When the component carrier 200 comprising the component support 210, the carrying member 220, and the down-holder mask 230 is in the mounted configuration, the mask openings 231 of the down-holder mask 230, the receiving openings 221 of the carrying member 220, and the positioning openings 213 of the component support 210 are aligned so that their positions substantially correspond.

[49] Figure 4A shows a schematic perspective view of the component carrier 200 to be used in the component processing apparatus 10 according to various examples of the invention. Figure 4B shows a cross section of the component carrier 200 of figure 4A obtained by projecting the component carrier 200 of figure 4A, in the mounted configuration, onto the plane B. The component carrier 200 of figures 4A and 4B is similar to the component carrier 200 of figures 3A and 3B to which reference is made.

[50] In addition to the features of the component carrier 200 of figures 3A and 3B,

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the component carrier 200 of figures 4A and 4B further comprises a recess gas inlet 214 formed in the bottom surface 211a of the receiving recess 211 and configured for allowing the introduction of a gas, usually an inert gas such as nitrogen, N₂, into the receiving recess 211.

5 [51] Additionally, a recess gas outlet 215 is formed in the bottom surface 211a of the receiving recess 211 and is configured for allowing the extraction of the gas from the receiving recess.

[52] The recess gas inlet 214 is provided at a first side 200a of the component support 210 and the recess gas outlet 215 is provided at a second side 200b of the component support 210, wherein the first side 200a opposes the second side 200b. Optionally, the recess gas inlet and/or outlet comprise a plurality of gas inlet and/or outlet nozzles (not shown) distributed along a side of the bottom surface 211a of the receiving recess 211.

[53] The component support 210 can further comprise a carrier gas inlet connection 216 and a carrier gas outlet connection 217 placed on the top surface 210a of the component support 210 and configured for connecting to a gas source and to a gas drain, respectively, of the processing apparatus 10.

[54] The carrier gas inlet connection 216 is provided at the first side 200a of the component support 210 and the carrier gas outlet connection 217 is provided at the second side 200b of the component support 210. The person skilled in the art will understand that the carrier gas inlet connection 216 and the carrier gas outlet connection 217 can be placed on a bottom surface 210b of the component support in an alternative embodiment and that the carrier gas inlet connection 216 and the carrier gas outlet connection 217 can be located on the second side 200b and first side 200a of the component support 210, respectively, without altering the scope of the invention. In addition, the number of carrier gas inlet connection 216 and the number of carrier gas outlet connection 217 are not limited to one, as shown in figures 4A and 4B.

[55] One or more gas ducts 218 formed within the component support 210 are configured for providing a fluid connection between the carrier gas inlet connection 216 and the recess gas inlet 214 and between the recess gas outlet 215 and the carrier gas outlet connection 217. When the gas is introduced into the carrier gas inlet connection 216, it flows within the gas duct 218 and enters the receiving recess 211 through the recess gas inlet 214 as a gas flow (not shown) through the receiving recess to the gas outlet 215. Then, the gas flow leaves the receiving recess 211 through the recess gas outlet 215, and flows through the gas duct 222 toward the carrier gas outlet connection 217.

[56] To contain the gas within the receiving recess 211, a gas-impermeable foil, sheet, or film 250, for instance Teflon, is provided and attached onto the top surface 210a of the component support 210 so as to completely cover the component(s) 20 carried on the component carrier 200 or, eventually, on the carrying member 220.

40 [57] If the component carrier 200 comprises the down-holder mask 230, the down-

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holder mask is further configured for holding the gas-impermeable foil, sheet, or film 250, for instance Teflon, so that the gas-impermeable foil, sheet, or film 250 completely covers the components 20 carried on the component carrier or, eventually, on the carrying member 220. When the down-holder mask 230 is mounted onto the component support 210, the gas-impermeable foil, sheet, or film is clamped between the down-holder mask 230 and the top surface 210a of the component support 210. In this case, the gas-impermeable foil, sheet, or film 250 and the down-holder mask 230 itself act as sealing elements and prevent leakages of the gas introduced into the receiving recess 211. In addition, the gas is contained within the receiving recess 211 by the movable pedestals 212 which are mounted in the positioning openings 213 of the component support.

[58] Since the components 20 are not sealably carried on component carrier 200 or, eventually, on the carrying member 220, i.e. on the carrying protrusions 222, the gas provided to the receiving recess 211 is free to circulate all around the components, i.e. in a space comprised between the components and the sealing foil, film, or sheet 250 and in a space comprised between the components and the movable pedestal 212.

[59] The gas is provided to the components before the component carrier 200 is in the processing station 12, i.e. when the movable pedestal(s) 212 and the component(s) 20 are not in contact with each other. In this way, the inert gas flowing from the recess gas inlet 214 to the recess gas outlet 215 allows to create an atmosphere, mainly composed of the inert gas, all around the component(s) 20. In addition, the presence of the inert gas flow allows the extraction of oxygen and contaminants that are detrimental for the correct processing of the components 20 and that may be hazardous for the environment outside the component carrier 200.

[60] Figures 5A and 5B show the cross section depicted in Fig. 4B of the component carrier 200 during the pre-heating stage of the process and during the processing stage of the process, respectively. In figure 5A the component carrier 200 is provided onto the pre-heating platform 111 of the pre-heating station 11 and in figure 5B the component carrier 200 is provided onto the heating platform 121 of the heating station 12.

[61] In a method for processing a component, one or more components 20 are provided onto the component carrier 200. Each component is placed at a component position corresponding to an associated positioning opening 213 of the component support 210.

[62] Optionally, one or more components 20 are provided onto the carrying member 220 of the component carrier 200. Each component is placed at a component position corresponding to an associated receiving opening 221 of the carrying member 220. If carrying protrusions 222 are present, the components are provided onto the carrying protrusions 222. Then, the carrying member 220 is provided onto the receiving recess 211 of the component support 210.

[63] When the components are carried either on the component carrier 200 or on the carrying member 220, the gas-impermeable foil, sheet or film 250 is provided and attached

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onto the top surface 210a of the component support 210 so as to completely cover the components 20.

[64] Optionally, the down-holder mask 230 is provided onto the gas-impermeable foil, sheet or film 250 and eventually fixed by means of fastening means, i.e. screws, bolts or the like, onto the top surface 210a of the component support 210. The weight of the down-holder mask 230 and/or the fastening of the down-holder mask 230 to the component support 210 and the presence of the sealing foil, film, or sheet 250 provides sealability to the receiving recess 211.

[65] Alternatively, sealability of the receiving recess 211 is ensured by the presence, between the top surface 210a of the component support 210 and the gas-impermeable foil, sheet, or film 250, of a sealing element, i.e. O-rings or the like, running along the whole perimeter of the top surface 210a.

[66] When the component carrier 200 carrying the component(s) 20 is mounted, the component carrier 200 is provided to the different stations of the processing apparatus 10 for processing, as described above.

[67] During the whole processing, the component carrier 200 is continuously connected to a gas source and a gas drain, so as to create an inert-gas atmosphere and a continuous gas flow F around the product. The connection is kept also during the transfers between the stations of the processing apparatus 10. An inert gas, usually nitrogen, N₂, is introduced from the gas source into the receiving recess 211 through the carrier gas inlet connection 216 and is extracted from the receiving recess 211 through the carrier gas outlet connection 217. In this way, as described above, the inert gas flows within the gas ducts 218 to the recess gas inlets 214 and, hence, enters the receiving recess 211.

[68] The gas flow passes over, under and along the components 20, transports away the contamination generated by the components and removes the oxygen present in the receiving recess 211. The gas flow leaves the receiving recess 211 through the recess gas outlet 215 and flows toward the carrier gas outlet connection 217.

[69] As a result, during all the processing stages and during the transfers between the stations of the processing apparatus 10, the atmosphere surrounding the components mainly comprises the inert gas, i.e. N₂. This allows the prevention of oxidation of (metallic) component parts and the removal of contaminants released from the components themselves.

[70] Once the component carrier 200 is mounted and once the gas connections has established, the component carrier 200 is transferred to the pre-heating station 11 of the processing apparatus 10 so that the bottom surface 210b of the component support 210 is provided onto a pre-heating plate 111 of the pre-heating station 11, as shown in figure 5A.

[71] The pre-heating plate 111 comprises at least one pre-heating plate opening 112 located in correspondence to the positioning openings 213 of the component support 210. The at least one pre-heating plate opening 112 is configured so as to allow the movable pedestals 212 to remain free from contact with the component and to make contact, with their bottom end 212b, with a heating element 113 placed below the pre-heating plate 111.

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[72] The heating element 113 is configured for heating up to about 250-300° C and for transferring heat to the thermally conductive movable pedestals 212. Optionally, the heating element 113 is configured for heating up to a temperature lower than 250-300° C, so as to prevent the thermally conductive movable pedestals 212 from reaching a temperature higher than the temperature needed in the pre-heating stage. As a result, when the component carrier 200 is carried on the pre-heating plate 111, a space is defined between each movable pedestal 212 and the associated component 20 and the movable pedestals 212 are heated up to a temperature lower than the temperature of the heating element 113, based on the time spent by the component carrier 200 in the pre-heating station 11. Heat is transferred by convection and/or radiation from the movable pedestals 212 to the components 20 which heat up at a desired predetermined temperature, lower than the temperature of the movable pedestal/heating element.

[73] When the components 20 reach the predetermined temperature, the component carrier 200 is transferred to the processing station so that the bottom surface 210b of the component support 210 is provided onto a heating plate 121. The heating plate 121 comprises a heating portion 121a configured for heating up to about 250-300° C. The heating plate 121 is configured so that, when the component carrier 200 is provided to the processing station 12, the position of the heating portion 121a of the heating plate 121 corresponds to the position of the movable pedestals 212 of the component carrier 200.

[74] When the component carrier 200 is provided onto the heating plate 121, the movable pedestals 212 are pushed towards and make contact with the component(s) 20, as shown in figure 5B. In their movement toward the component(s) 20, the movable pedestals 212 contact the component(s) 20 which are then are slightly lifted and supported on a top end 212a of the movable pedestals 212. The thermally conductive movable pedestals 212, in contact with the heating portion 121a of the heating plate 121, rapidly heat up to the temperature of the heating portion 121a, at about 250-300° C, and transfer, by contact, the heat to the component(s) 20 which rapidly reach the same temperature.

[75] For processing the component, pressure is provided to the component(s) by a press tool 120, included in the processing station 12, configured and arranged for applying pressure onto the components by lowering movable insert member(s) onto each component to make contact and apply pressure. The component(s) 20 are maintained under pressure and temperature conditions until the components are processed. A component generally comprises two elements like a device, such as semiconductor device like a power IC, and its substrate or carrier which are bond during sintering by applying pressure and temperature to a sintering material placed between said two elements.

[76] After processing, the component carrier 200 is transferred to the cooling station 13 for cooling down. Subsequently, the component carrier 200 is transferred to the outside of the processing apparatus 10 for further handling.

[77] Figures 6A and 6B show perspective views of a component carrier 200 to be

used in the component processing apparatus 10. For clarity, in figure 6A, the down-holder mask 230 and foil 250 are shown separately from the rest of the component carrier 200, while figure 6B shows the component carrier 200 having the down-holder mask 230 mounted thereon. Figures 7A and 7B show cross sections of the component carrier 200 of figures 6A and 6B along different axes.

[78] The functioning and the features of the component carrier 200 of figures 6A, 6B, 7A, and 7B are similar to the functioning and features of the component carrier 200 shown in figures 4A and 4B to which reference is made.

[79] The component carrier 200 of figures 6A and 6B comprises a plurality of members stacked one onto the other, namely a component support 210, a carrying member 220, and a down-holder mask 230. The component support 210, the carrying member 220, and the down-holder mask 230 are kept together by their weight or may be fixed one to the other by means of fastening means 207 like screws, bolts or the like, when the component carrier 200 is in the mounted configuration.

[80] The component support 210 of the component carrier 200 of figures 6A, 6B, 7A, and 7B further comprises additional first and second lateral areas 211b.1 and 211b.2, at the first 200a and second 200b sides of the component carrier 200, respectively. The first and second additional lateral areas 211b.1 and 211b.2 are recessed with respect to the top surface 210a of the component support 210 and are configured for allowing the mounting of carrier gas inlet/outlet connections. The component carrier 200 comprises a first carrier gas inlet connection 216 and a first carrier gas outlet connection 217 provided on the first lateral area 211b.1 proximal to the first part 200a and the second part 200b, respectively, of the component carrier 200. A second carrier gas inlet connections 216' and a second carrier gas outlet connection 217' are provided on the second lateral area 211b.2 proximal to the second part 200b and the first part 200a, respectively, of the component carrier 200.

[81] Similarly to the description of the component carrier 200 of figures 4A and 4B, the first carrier gas inlet connection 216 and the second carrier gas inlet connections 216' are configured for allowing the introduction of a gas into the receiving recess 211 and the first carrier gas outlet connection 217 and the second carrier gas outlet connection 217' are configured for allowing the extraction of the gas from the receiving recess 211. The first and second carrier gas inlet/outlet connections 216 and 217 are configured for connecting to a gas source and to a gas drain, respectively.

[82] In figures 6A and 6B, the component carrier 200 is configured for carrying eight components, i.e. the carrying member 220 includes eight receiving openings 221, the component support 210 includes eight positioning openings 213 and eight movable pedestals 212 and the down-holder mask 230 includes eight mask openings 231. However, the person skilled in the art will understand that a number of components to be processed different from eight can be implemented in the component carrier 200 without altering the scope of the invention.

[83] A movable pedestal 212, made of a thermally conductive material and

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comprising a top part 212a and a bottom part 212b, is slidably mounted in each positioning opening 213 of the component support 210. In relation to the functioning (i.e. movement) and features of the moveable pedestal 220 reference is made to the description made in relation to any previous figure. The top end 212a of the movable pedestal has a size larger than the size of the associated positioning opening, whereas the bottom end 212b of the movable pedestal 212 is configured to fit and slide within the associated positioning opening 213. The top end 212a of the movable pedestal 212 faces the component carried onto the carrying protrusions 222. When the movable pedestal moves away from the component 20, the top end 212a of the movable pedestal 212 engages with the bottom surface 211a of the receiving recess 211 surrounding each positioning opening 213 so as to prevent the movable pedestal 212 from sliding out from the associated positioning opening 213, as shown in figures 7A and 7B.

[84] The component support 210 optionally includes supporting elements 224 provided on the bottom surface 210b of the component support 210 and configured for supporting the component carrier 200 when it is provided onto a surface. Additionally, the first and second carrier gas inlet/outlet connection 216 and 217 further includes a mechanic valve 260 (only shown for the gas outlet connection) which allows the control of the flow of gas to/from the receiving recess 211. When the component carrier 200 is not connected to a gas source or drain, the valve spring 261 maintains the valve 260 in a shut position, therefore preventing the passage of gas to/from the receiving recess 211. On the contrary, when the component carrier 200 is connected to a gas source or drain, the valve spring 261 is pushed down, thereby opening the valve 260, therefore allowing the passage of gas to/from the receiving recess 211. The component carrier 200 is connected with a gas source or drain when the gas source or drain of the processing apparatus 10 is connected to the carrier gas inlet(s)/outlet(s), respectively.

[85] Optionally, the gas inlet(s) 216 have entrance nozzles both on the top surface 210a of the component support 210 and on the bottom surface 210b of the component support 210. In this case, the valve 260 is used for determining whether the passage of gas is allowed through the nozzles located on the top surface 210a or on the bottom surface 210b of the component support 210. The mechanism of the functioning of the valve 260 for controlling whether the gas flow is allowed through the nozzles located on the top surface 210a or on the bottom surface 210b of the component support 210 is similar to the functioning of the valve 260 described above.

[86] Similarly to the component carrier 200 of figures 4A and 4B, a sealing foil, film, or sheet of gas-impermeable material 250, for instance Teflon, is clamped between the down-holder mask 230 and the top surface 210a of the component support 210. With respect to the down-holder plate 230 disclosed in relation to figures 4A and 3B, the down-holder mask 230 further comprises positioning pins 233 protruding from a bottom surface 230b of the down holder plate 230 towards the top surface 210a of the component support 210. The positioning pins 233 are configured to fit in positioning bores 223 formed

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in the top surface 210a of the component support 210 and to allow the correct positioning of the down-holder plate 230 onto the component support 210. The down-holder mask 230 has a substantially planar shape comprising curved edges 234 around substantially the whole perimeter that further facilitate the positioning of the down-holder mask 230 onto the
5 component support 210.

[87] The component carrier 200 of figures 6A and 6B is used in the component processing method described in relation to figures 1, 5A, and 5B to which reference is made.

CLAIMS

1. A component carrier (200) for carrying one or more components (20) to be processed in a component processing apparatus like a press sintering apparatus, and comprising a component support (210),
5 wherein the component support comprises:
- one or more positioning openings (213) formed through the component support from a top surface (210a) of the component support to a bottom surface (210b) of the component support, wherein each positioning opening defines a component position for holding a component to be processed and a component held in the component position is exposed at the top surface of the component support, and,
10 - one or more movable pedestals (212) associated with the one or more positioning openings, respectively,
wherein each movable pedestal is received within the associated positioning opening for moving along a direction A between the top and bottom surfaces of the component support to bring a top end (212a) of the movable pedestal into and out of contact with a component held in the component position defined by the positioning opening for, in operation, carrying and making thermal contact to a respective component during processing of the component(s), and
15 wherein a bottom end (212b) of each pedestal is exposed at a bottom surface (210b) of the component support for, in operation, making thermal contact to a heat source for heating the pedestal and the respective component when in contact with the pedestal.
2. The component carrier of the preceding claim, wherein the component support comprises a receiving recesses (211) associated with the positioning openings (213), the receiving recess is recessed with respect to the top surface of the component support, and the one or more positioning openings are arranged within the receiving recesses.
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3. The component carrier of the preceding claim, wherein the top surface of the component support completely surrounds the receiving recess.
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4. The component carrier of the preceding claim, wherein the component support comprises a carrying member (220) configured to fit within the receiving recess and comprising one or more receiving openings (221) corresponding to the one or more component positions when the carrying member is arranged within the receiving recess, wherein each receiving opening is configured for carrying one component of the one or more components and for allowing the top end of a respective movable pedestal to contact the component.
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5. The component carrier of the preceding claim, wherein the carrying member comprises carrying elements (222) protruding towards an inside of each receiving opening and configured for carrying the one or more components.

5 6. The component carrier of any one of claims 2 - 5, wherein the component carrier further comprises a down-holder mask (230) configured to be mounted onto the top surface of the component support, the down-holder mask comprises one or more mask opening (231) configured for allowing access to the component(s), and the mask opening(s) correspond in position to the component position(s) defined by the positioning opening(s) of the component support.

7. The component carrier of the preceding claim, wherein the down-holder mask further comprises positioning pins (233) protruding from a bottom surface (230b) of the down-holder mask and configured for fitting in positioning bores (223) formed in the top surface of the component support.

8. The component carrier of any one of claims 2 - 7, wherein a gas inlet (214) and a gas outlet (215) are provided in the receiving recess, and wherein the gas inlet and gas outlet are in fluid connection with a gas inlet connection (216) and a gas outlet connection (217), respectively, through one or more gas ducts (218),

wherein the gas inlet connection is configured for connecting to a gas source and the gas outlet connection is configured for connecting to a gas drain to provide a continuous gas flow to the one or more components.

9. The component carrier of any one of claims 3 - 8, wherein the component carrier is configured for holding a gas-impermeable foil, sheet or film (250) completely covering the carried one or more components and creating a closed cavity for the one or more components.

10. The component carrier of the preceding claim, wherein, when the down-holder mask is mounted onto the top surface of the component support, the gas-impermeable foil, sheet, or film is clamped between the down-holder mask and the top surface of the component support.

11. A component carrier (200) for carrying one or more components (20) to be processed in a component processing apparatus like a press sintering apparatus, optionally according to any one of the preceding claims,

wherein the component carrier comprises

- a component support (210) comprising one or more positioning openings (213) formed in the component support at a top surface (210a) of the component support, wherein

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each positioning opening defines a component position within the positioning opening for holding a component to be processed and a component held in the component position within the positioning opening is exposed at the top surface of the component support; and

- 5 - two gas inlet connections (216) in fluid communication with the positioning openings of the component support for passing gas from a gas source, connected, in use, to one of the gas inlet connections, to the positioning openings for purging the positioning openings, wherein each gas inlet connection is configured to be closed off when not connected to the gas source.

- 10 **12.** The component carrier according to the preceding claim, wherein the component support comprises gas ducts (218) connected to each positioning opening for providing fluid connection between the gas inlet connections and the positioning openings.

- 15 **13.** The component carrier according to any one of the preceding two claims, wherein the component support comprises two gas outlet connections (217) in fluid communication with the positioning openings of the component support for passing gas from the positioning openings to a gas drain, connected, in use, to one of the gas outlet connections for purging the positioning openings, wherein each gas outlet connection is configured to be closed off when not connected to the gas drain.

- 20 **14.** A method for processing a component in a processing apparatus (10), wherein the method comprising employing a component carrier according to any one of the preceding claims .