

IC CHIP, HEAD SUSPENSION ASSEMBLY WITH THE IC CHIP,
MANUFACTURING METHOD OF THE IC CHIP AND MANUFACTURING METHOD
OF THE HEAD SUSPENSION ASSEMBLY

FIELD OF THE INVENTION

The present invention relates to an IC (integrated circuit) chip for a thin-film magnetic head element used for a magnetic disk device for example, to a head suspension assembly (HSA) with the IC chip, to a method of manufacturing the IC chip and to a method of manufacturing the HSA.

DESCRIPTION OF THE RELATED ART

In a magnetic disk device, a thin-film magnetic head element for writing magnetic information into and/or reading magnetic information from a magnetic disk is in general formed on a magnetic head slider flying in operation above the rotating magnetic disk. The slider is supported by a suspension made of a resilient thin metal plate extended from one end of each movable arm of the magnetic disk device.

Recently, recording frequency in the magnetic disk rapidly increases to satisfy the requirement for ever increasing data storage capacities and densities in today's magnetic disk devices. In order to realize higher frequency recording, proposed is a HSA structure with a suspension for supporting both a magnetic head slider and a drive IC chip of

a driver circuit for the magnetic head element. According to this structure, since the length of trace conductors from the driver circuit to the magnetic head element can be shortened, generation of unnecessary noises from the trace conductors can be effectively suppressed resulting high frequency recording characteristics to improve.

Such the IC chip may be however heated to a high temperature due to the writing current flowing through it during recording operations. In order to cool the heated IC chip by air flowing from the rotating magnetic disk, the IC chip will be mounted on a surface of the suspension, which counters the magnetic disk surface in operation.

The HSA with the IC chip will have a larger thickness increased by the mounting height of the IC chip. Generally, in the magnetic disk device, in order to increase the record capacity per magnetic disk, both sides of the disk are used for record, and in addition, a plurality of such the magnetic disks are axially mounted. Therefore, two HSAs for writing/reading magnetic information will exist between the two magnetic disks, and thus the whole thickness of the magnetic disk device equipped with the HSAs with IC chips becomes great. This large thickness of the magnetic disk device will become a big problem particularly when the magnetic disk device is mounted in a thin notebook type personal computer.

Therefore, it is required for such IC chip to fabricate as thin as possible.

The C4 (Controlled Collapse Chip Connection) process is a typical process for mounting such IC chip on a suspension. In the C4 process, first, flux for solder material is applied to bump balls of the IC chip and then the IC chip is bonded to connection pads by reflow heat bonding.

If the mounting of the IC chip is performed by the reflow soldering using flux, it is necessary to execute the cleaning process after bonding. Namely, in the C4 bonding process, flux is applied to the suspension at a position to which the IC chip is bonded, in order to promote melting of the solder and temporarily adhere the IC chip to the suspension during reflow soldering. Since the applied flux may have adverse effect of producing out gas for example, the cleaning has to be done after bonding. However, although high accuracy is required in a bending angle of the suspension, this bending angle may unintentionally change during the cleaning process. Thus, it is difficult to use the C4 process in the mounting of the IC chip on the suspension.

The ultrasonic bonding process is one of bonding methods that can be carried out without cleaning process. In the ultrasonic bonding process, no solder bump is used but gold (Au) bumps formed on the IC chip are used. Namely, by applying an appropriate pressure and ultrasonic vibration to

the Au bumps that are contacting with the respective Au pads on the suspension, Au is fused for the bonding. Since no soldering flux is utilized in the ultrasonic bonding process, no cleaning process is necessary.

In the magnetic disk device, generally, since the magnetic head slider flies at extremely low height above the rotating disk for performing reading/writing operations, no dust is allowed to exist. However, according to the ultrasonic bonding process, since the IC chip is strongly caught by an ultrasonic bonding head or nozzle and ultrasonic vibration is applied to the IC chip via the nozzle, damages such as scratches or cracks may be easily produced on the IC chip surface causing a silicon particle falling from this IC chip. This is never allowed in the magnetic disk device. Thus, it is very difficult to determine the conditions for mounting the IC chip using the ultrasonic bonding process.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an IC chip for a thin-film magnetic head element, a HSA with the IC chip, a method of manufacturing the IC chip and a method of manufacturing the HSA, whereby no damage occurs on a body of the IC chip during its mounting process.

According to the present invention, an IC chip having a first surface (front surface) and a second surface (back

surface) opposite to the front surface includes a circuit for a thin-film magnetic head element, connection terminals of the circuit formed on its front surface, and a protection layer formed on at least a part of its back surface.

Also, according to the present invention, a HSA includes a magnetic head slider with at least one thin-film magnetic head element, an IC chip with a circuit for the at least one thin-film magnetic head element, and a suspension for supporting the magnetic head slider and the IC chip. The IC chip has a first surface (front surface), a second surface (back surface) opposite to the front surface, and connection terminals of the circuit formed on its front surface. The IC chip further has a protection layer formed on at least a part of its back surface.

The protection layer is formed on at least a part of the back surface of the IC chip. Thus, in case of mounting this IC chip on the suspension by picking up and holding its back surface with the nozzle, if the protection layer is prepared in the portion to be picked up and held, the nozzle will not directly touch the silicon body of the IC chip. Therefore, damages such as scratches or cracks are never occurred on the silicon body of the IC chip resulting that a silicon particle falling from the IC chip can be effectively prevented.

It is preferred that the protection layer is made of a

metal material or resin material.

It is also preferred that the protection layer is a layer for coating the whole of the back surface, a layer for coating only a part of the back surface, or a layer for providing at least one component on the back surface.

It is preferred that the suspension includes a resilient load beam, a resilient flexure supported by the load beam, and a trace conductor member formed on the suspension, the IC chip being mounted on the trace conductor member.

According to the present invention, furthermore, a method of manufacturing an IC chip from a wafer having one surface and the other surface opposite to the one surface includes a step of forming semiconductor ICs and connection electrodes for the IC chips in the wafer from the one surface, a step of polishing the other surface to decrease a thickness of the wafer, a step of forming a protection layer on at least a part of the other surface of the wafer, and a step of cutting the wafer to have separated individual IC chips.

Many semiconductor ICs and connection electrodes for the IC chips are formed in the wafer from its one surface. Then, the other surface of the wafer is polished in order to decrease a thickness of the IC chip as thin as possible. Thereafter, a protection layer is formed on at least a part of the polished surface of the wafer and then the wafer is diced to have separated individual IC chips. Since the protection

layer is formed on at least a part of the back surface of the IC chip, in case of mounting this IC chip on the suspension by picking up and holding its back surface with the nozzle, the nozzle will not directly touch the silicon body of the IC chip if the protection layer is prepared in the portion to be picked up and held. Therefore, damages such as scratches or cracks are never occurred on the silicon body of the IC chip resulting that a silicon particle falling from the IC chip can be effectively prevented.

According to the present invention, in addition, a method of manufacturing a HSA includes a step of forming an IC chip with a circuit for a thin-film magnetic head element, and a step of mounting a magnetic head slider with at least one thin-film magnetic head element and the IC chip on a suspension. The IC chip has a first surface (front surface), a second surface (back surface) opposite to the front surface, and connection terminals of the circuit, formed on the front surface. The IC chip further has a protection layer formed on at least a part of the back surface. This IC chip is mounted on the suspension by ultrasonic bonding using Au or Cu bumps.

When the IC chip is mounted on the suspension by ultrasonic bonding using Au or Cu bumps, the back surface of the IC chip is picked up and pressed by the nozzle. However, since the protection layer is formed on at least a part of the back surface of the IC chip, damages such as scratches or

cracks are never occurred on the silicon body of the IC chip resulting that a silicon particle falling from the IC chip can be effectively prevented.

It is preferred that the IC chip is fabricated, from a wafer with one surface and the other surface opposite to the one surface, by forming semiconductor integrated circuits and connection electrodes for the IC chips in the wafer from the one surface, by polishing the other surface to decrease a thickness of the wafer, by forming a protection layer on at least a part of the other surface of the wafer, and by cutting the wafer to have separated individual IC chips.

It is preferred that the protection layer is made of a metal material or resin material.

It is also preferred that the protection layer is formed as a layer for coating the whole of the back surface, a layer for coating only a part of the back surface, or a layer for providing at least one component on the back surface.

Further objects and advantages of the present invention will be apparent from the following description of the preferred embodiments of the invention as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a plane view of a preferred embodiment of a HSA according to the present invention;

Fig. 2 shows an oblique view schematically illustrating the structure of an IC chip according to the embodiment shown in Fig. 1;

Figs. 3a to 3h show oblique views schematically illustrating manufacturing processes of the IC chip according to the embodiment shown in Fig. 1; and

Figs. 4a to 4e show sectional views illustrating a part of manufacturing processes of the HSA according to the embodiment shown in Fig. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 schematically illustrates a head suspension assembly (HSA) as a preferred embodiment of the present invention.

As shown in the figure, the HSA is assembled by fixing a slider 11 having a thin-film magnetic head element to a top end section of a suspension 10, and by mounting a drive IC chip 12 on a middle location of this suspension 10. The slider 11 and the drive IC chip 12 are fixed on a surface of the suspension 10, which will oppose to the magnetic disk surface in operation. This surface of the suspension is called hereinafter as a slider-attached surface.

The suspension 10 is substantially constituted by a resilient flexure 13 for carrying the slider 11 at its tongue located near its top end section and supports the drive IC

chip 12 at its middle section, a resilient load beam 14 for supporting and fixing the flexure 13, and a base plate 15 formed at a base end section of the load beam 14.

The load beam 14 has elasticity for suppressing the slider 11 toward the direction of the magnetic disk in operation. The flexure 13 has the flexible tongue centered by a dimple formed on the load beam 14 and has elasticity for supporting the slider 11 flexibly by this tongue. As will be noted, in this embodiment, the suspension 10 has a three-pieces structure constituted by individual components of the flexure 13, the load beam 14 and the base plate 15. In such three-pieces structure, stiffness of the flexure 13 is set to be lower than that of the load beam 14.

In the drive IC chip 12, an integrated driver circuit constituting a head amplifier of the magnetic head element is formed. Although it is mere examples, the size of the IC chip 12 may be $1.0\text{ mm} \times 1.0\text{ mm} \times 0.15\text{ mm}$ or $1.5\text{ mm} \times 1.5\text{ mm} \times 0.25\text{ mm}$. The fixed position of the IC chip 12 on the suspension 10 is in this embodiment determined so as to improve heat radiation characteristics and electromagnetic characteristics and to make mounting of the IC chip easy.

The flexure 13 is made of in this embodiment a stainless steel plate (for example SUS304TA) with a thickness of about 25 μm . This flexure 13 has a uniform width smaller than that of the load beam 14.

A trace conductor layer 16 of a thin-film pattern that constitutes necessary number of input/output signal lines is formed on the flexure 13 along its length. One end of the trace conductor 16 is connected to slider-connection pads for making electrical connection with the magnetic head slider 11 formed at the top end section of the flexure 13, and the other end of the trace conductor 16 (the base plate 15 side) is connected via the IC chip 12 to external connection pads 17 which will be connected to external circuits.

The load beam 14 is made of in this embodiment a resilient stainless steel plate with a thickness of about 60-65 μm and supports the flexure 13 along its whole length. This load beam 14 has a shape with a width that narrows with approaching to its top end. Fixing of the flexure 13 to the load beam 14 is achieved by means of a plurality of welded spots.

The base plate 15 is made of a stainless steel or iron and is fixed to the base end section of the load beam 14 by welding. The suspension 10 will be attached to each movable arm (not shown) by fixing an attachment part 18 of the base plate 15 to the movable arm.

In modification, the suspension may be formed in a two-pieces structure with a base plate and a flexure-load beam instead of the three-pieces structure with the flexure 13, the load beam 14 and the base plate 15.

As aforementioned, the slider 11 with the magnetic head element is mounted on the tongue of the flexure 13 at the top end section of the suspension 10. The trace conductor layer 16 which includes the necessary number of the input/output signal lines passes both sides of the slider 11 and turns back at the top end section of the flexure 13 to the slider-connection pads so as to be electrically connected with input/output electrodes of the slider 11. The insulation material layer made of the resin covers the connected part.

The drive IC chip 12 is mounted on the slider-attached surface at the middle length location of the suspension 10. The IC chip 12 in this embodiment is formed by a bear chip and mounted on and connected to chip-connection pads formed on the way of the trace conductor layer 16 that is formed on the flexure 13 of the suspension 10 via an insulation material layer.

An underfill is filled in a clearance between the bottom surface of the IC chip 12 and the trace conductor layer surface so as to improve heat radiation characteristics, to improve mechanical strength of this area, and to cover a part of the IC chip 12.

The IC chip 12 in this embodiment is a bump bonding bear chip and has a protection layer 19 covering the whole of a back surface of the IC chip 12 opposite to a front surface on which connection terminals are formed, as shown in Fig. 2.

This protection layer 19 may be a metal material layer or a resin material layer.

The metal material protection layer 19 may be formed by a single layer of Al or by a two-layered structure of Au/Cu, with a thickness of a few μm .

The resin material protection layer 19 may be formed by a layer of polyimide such as PIQ or PIX of Hitachi Chemical Co., Ltd., or a layer of resist such as OMR or OFPR of Tokyo Ohka Kogyo Co., Ltd., with a thickness of about 1-10 μm .

Figs. 3a to 3h schematically illustrate manufacturing processes of the IC chip in this embodiment.

On a front surface of a single-crystal wafer 30 shown in Fig. 3a, ICs (integrated circuits) formed from many transistors, diodes, capacitors and resistors, conductor patterns, and connection electrodes for electrically connecting the ICs are fabricated by the known integration technology. Repeating a pattern formation process, a diffusion process and a metallization process as shown Figs. 3b and 3c performs this formation. Reference numeral 31 in Fig. 3d represents thus fabricated ICs, conductor patterns and connection electrodes.

Then, a back surface portion 32 of the wafer 30 with a partial thickness, which is shown in Fig. 3d, is removed by polishing the back surface 30b of the wafer 30. Thus, as shown in Fig. 3e, the total thickness of the wafer 30 is

reduced so that the thickness of the IC chip becomes as thin as possible.

After this back surface polishing process, the protection layer 32 made of the aforementioned material is coated on the whole of the polished back surface 30b of the wafer 30 by deposition, sputtering or plating for example, as shown in Fig. 3f.

Then, the wafer 30 is diced as shown in Fig. 3g to have separated individual IC chips 12 as shown in Fig. 3h.

According to this manufacturing process of the IC chip for the thin-film magnetic head, since the coating process is performed after the back surface polishing process for thinning the IC chip, the protection layer can be easily formed on the back surface of the IC chip. As a result, manufacturing cost of the IC chip can be reduced.

Hereinafter, bonding of thus fabricated IC ship 12 to the suspension according to the present invention will be described with reference to Figs. 4a to 4e.

As shown in Fig. 4a, on the flexure 13 that is made of stainless steel plate, the thin-film conductive pattern is formed by a well-known method similar to the patterning method of forming a printed circuit board on a thin metal plate such as a flexible printed circuit (FPC).

For example, the conductive pattern is formed by sequentially depositing a first insulation material layer 40

made of a resin such as polyimide with a thickness of about 5 μm , a patterned Cu (copper) layer (conductive layer) 41 with a thickness of about 4 μm , and a second insulation material layer 42 made of a resin such as polyimide with a thickness of about 5 μm on the flexure 13 in this order. Within the regions of the slider-connection pads to the magnetic head slider, external-connection pads to the external circuit and chip-connection pads 43 to the IC chip 12, only an Au layer 44 is deposited on the Cu layer 41 and there is no second insulation material layer on the Au layer 44.

As shown in Fig. 4b, bumps 45 of Au balls are preliminarily made on connection terminals (not shown) formed on the bottom face of the IC chip 12. This IC chip 12 is picked up by an ultrasonic bonding head or nozzle 46 that is in contact with the top face of the IC chip by the bonding head as shown in Fig. 4b, and aligned with the chip-connection pads 43 of the thin-film conductive pattern.

Then, as shown in Fig. 4c, the IC chip 12 with the protection layer 19 is depressed toward a direction of an arrow 47 until the Au ball bumps 45 of the IC chip 12 contact the respective chip-connection pads 43 of the thin-film conductive pattern, and also ultrasonic vibration along directions of an arrow 48 (lateral directions) is applied from the ultrasonic head 46.

The depression with a constant pressure (load) and the

application of ultrasonic vibration result fused bonding of the Au ball bumps 45 of the IC chip 12 with the Au layer 44 of the chip-connection pads 43.

Thus, as shown in Fig. 4d, electrical connection between the connection terminals of the IC chip 12 and the chip-connection pads 43 is achieved.

Then, as shown in Fig. 4e, an underfill 49 in liquid state for improving heat radiation characteristics, improving mechanical strength of this area, and covering a part of the IC chip 12 is injected into a clearance between the bottom face of the IC chip 12 and the surface of the thin-film conductive pattern. The underfill 49 is good heat conductivity material made of for example mixture of a resin such as epoxy resin and insulation material with good heat conductivity. The underfill 49 will be cured during a heat and dry process executed later.

The underfill resin with good heat conductivity composing the underfill layer 49 may be for example a resin such as epoxy resin containing fused silica (heat conductivity ratio of about $50.4 \times 10^{-6} \text{ W/m}\cdot^{\circ}\text{C}$), a resin containing alumina (heat conductivity ratio of about $168 \times 10^{-6} \text{ W/m}\cdot^{\circ}\text{C}$), a resin containing crystal silica (heat conductivity ratio of about $147 \times 10^{-6} \text{ W/m}\cdot^{\circ}\text{C}$), or a resin containing aluminum nitride (heat conductivity ratio of about $168 \times 10^{-6} \text{ W/m}\cdot^{\circ}\text{C}$).

According to the embodiment, since the Au ball bumps 45

of the IC chip 12 are electrically and mechanically bonded with the Au layer 44 of the chip-connection pads 43 by the ultrasonic fused bonding, no temporal fixing of the IC chip nor reflow soldering is required. In the ultrasonic bonding process, since vibration of the ultrasonic bonding head 46 is applied to the IC chip 12, friction will always occur between the back surface of the IC chip 12 and the nozzle 46 for picking up the IC chip 12. In order to suppress the friction, stronger bonding force of the nozzle 46 is required.

According to the conventional IC chip, since its silicon body is exposed to the back surface, damages such as scratches or cracks were easily produced on the back surface of the IC chip due to the strong bonding force of the nozzle. Whereas, according to this embodiment, since the protection layer 19 is coated on the whole back surface of the silicon body of the IC chip 12, the nozzle 46 will not directly touch the silicon body of the IC chip 12. Thus, no damage is occurred on the silicon body of the IC chip during its mounting process resulting that a silicon particle falling from the IC chip can be effectively prevented.

In case that the back surface of the silicon body of the IC chip 12 is coated by the metal material protection layer 19, not only damages on the chip surface can be prevented from occurring but also a transfer efficiency of ultrasonic vibration can be prevented from lowering. Moreover,

because the metal material has a good heat conduction rate in comparison with IC material such as silicon, the protection layer 19 also acts as a heat sink for the IC chip to effectively dissipate the generated heat.

In case that the back surface is coated by the resin material protection layer 19, although the transfer efficiency of ultrasonic vibration and the heat conduction rate are lower than these of the metal material layer, coating of the protection layer can be easily performed and a particle falling due to the ultrasonic vibration can be prevented more completely.

In addition, according to the embodiment, no transfer process of solder flux and also no reflow soldering process are needed, and therefore no cleaning process is needed. Furthermore, no damage is occurred on the back surface of the silicon body of the IC chip during its mounting process resulting that a silicon particle falling from the IC chip due to the damage can be effectively prevented.

In the aforementioned embodiment, the protection layer 19 is formed to coat the whole back surface of the silicon body of the IC chip 12. However, according to the present invention, the protection layer may be formed on a part of the back surface of the silicon body of the IC chip so that the nozzle does not directly touch the silicon body. Namely, the protection layer is formed to coat only a partial area on the

back surface used for the bonding of the nozzle during the bonding process or to make at least one component in an area on the back surface used for the bonding of the nozzle during the bonding process. Thus, no damage is occurred on the back surface of the silicon body of the IC chip during its mounting process resulting that a silicon particle falling from the IC chip due to the damage can be prevented.

In the aforementioned embodiment, the Au ball bumps 45 of the IC chip 12 and the Au layer 44 of the chip-connection pads 43 are bonded by ultrasonic bonding. However, the present invention can be achieved by ultrasonic bonding using Cu balls and a Cu layer or using another metal balls and another metal layer instead of the Au balls and the Au layer. In modifications, the bumps may be formed on the chip-connection pads of the thin-film conductive pattern.

Many widely different embodiments of the present invention may be constructed without departing from the spirit and scope of the present invention. It should be understood that the present invention is not limited to the specific embodiments described in the specification, except as defined in the appended claims.



WHAT IS CLAIMED IS:

1. An IC chip having a first surface and a second surface opposite to said first surface, comprising:
a circuit for a thin-film magnetic head element;
connection terminals of said circuit, formed on said first surface; and
a protection layer formed on at least a part of said second surface.
2. The IC chip as claimed in claim 1, wherein said protection layer is made of a metal material.
3. The IC chip as claimed in claim 1, wherein said protection layer is made of a resin material.
4. The IC chip as claimed in claim 1, wherein said protection layer is a layer for coating the whole of said second surface.
5. The IC chip as claimed in claim 1, wherein said protection layer is a layer for coating only a part of said second surface.
6. The IC chip as claimed in claim 1, wherein said protection layer is a layer for providing at least one



component on said second surface.

7. A head suspension assembly comprising:

a magnetic head slider with at least one thin-film magnetic head element;

an IC chip with a circuit for said at least one thin-film magnetic head element, said IC chip having a first surface, a second surface opposite to said first surface, and connection terminals of said circuit, formed on said first surface, said IC chip further having a protection layer formed on at least a part of said second surface; and

a suspension for supporting said magnetic head slider and said IC chip.

8. The head suspension assembly as claimed in claim 7, wherein said protection layer is made of a metal material.

9. The head suspension assembly as claimed in claim 7, wherein said protection layer is made of a resin material.

10. The head suspension assembly as claimed in claim 7, wherein said protection layer is a layer for coating the whole of said second surface.

11. The head suspension assembly as claimed in claim 7,



wherein said protection layer is a layer for coating only a part of said second surface.

12. The head suspension assembly as claimed in claim 7, wherein said protection layer is a layer for providing at least one component on said second surface.

13. The head suspension assembly as claimed in claim 7, wherein said suspension includes a resilient load beam, a resilient flexure supported by said load beam, and a trace conductor member formed on said suspension, said IC chip being mounted on said trace conductor member.

14. A method of manufacturing an IC chip from a wafer having one surface and the other surface opposite to said one surface, said method comprising the steps of:

forming semiconductor integrated circuits and connection electrodes for the IC chips in said wafer from said one surface;

polishing said the other surface to decrease a thickness of said wafer;

forming a protection layer on at least a part of said the other surface of said wafer; and

cutting said wafer to have separated individual IC chips.



15. The method as claimed in claim 14, wherein said protection layer is made of a metal material.

16. The method as claimed in claim 14, wherein said protection layer is made of a resin material.

17. The method as claimed in claim 14, wherein said protection layer is a layer for coating the whole of said second surface.

18. The method as claimed in claim 14, wherein said protection layer is a layer for coating only a part of said second surface.

19. The method as claimed in claim 14, wherein said protection layer is a layer for providing at least one component on said second surface.

20. A method of manufacturing a head suspension assembly comprising the steps of:

forming an IC chip with a circuit for a thin-film magnetic head element, said IC chip having a first surface, a second surface opposite to said first surface, and connection terminals of said circuit, formed on said first surface, said



IC chip further having a protection layer formed on at least a part of said second surface;

mounting a magnetic head slider with at least one thin-film magnetic head element and said IC chip on a suspension, said IC chip being mounted on said suspension by ultrasonic bonding using Au or Cu bumps.

21. The method as claimed in claim 20, wherein said IC chip is fabricated, from a wafer with one surface and the other surface opposite to said one surface, by forming semiconductor integrated circuits and connection electrodes for the IC chips in said wafer from said one surface, by polishing said the other surface to decrease a thickness of said wafer, by forming a protection layer on at least a part of said the other surface of said wafer, and by cutting said wafer to have separated individual IC chips.

22. The method as claimed in claim 20, wherein said protection layer is made of a metal material.

23. The method as claimed in claim 20, wherein said protection layer is made of a resin material.

24. The method as claimed in claim 20, wherein said protection layer is a layer for coating the whole of said



second surface.

25. The method as claimed in claim 20, wherein said protection layer is a layer for coating only a part of said second surface.

26. The method as claimed in claim 20, wherein said protection layer is a layer for providing at least one component on said second surface.