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(54) **RESIN BOARD STRUCTURE AND METHOD FOR FABRICATING THE SAME**

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(52) **U.S. Cl.**

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(57) **ABSTRACT**

A resin board structure includes a first member including a first metal film and one thermoplastic resin layer or a stack which includes two or more thermoplastic resin layers, and a second member including a second metal film. The first and second metal films are bonded together, and at least a portion the first metal film and at least a portion of the second metal film overlap each other. The first and second metal films are metallurgically bonded at an interface between the first metal film and the second metal film. The first member includes a first junction resin covering portion defined by a portion of a thermoplastic resin layer and overlapping a portion at which the first metal film and the second metal film overlap each other, and the first junction resin covering portion includes an uneven surface to reduce or prevent slippage due to ultrasonic vibration.

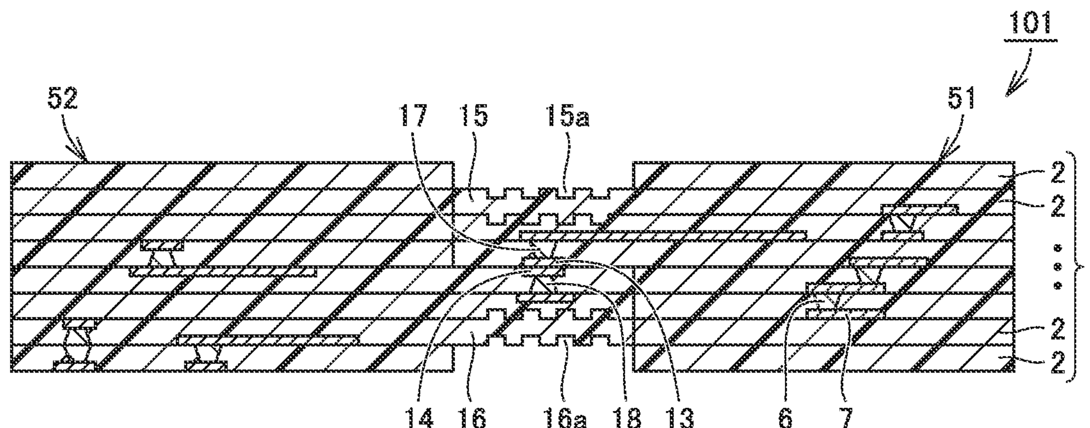


FIG.1

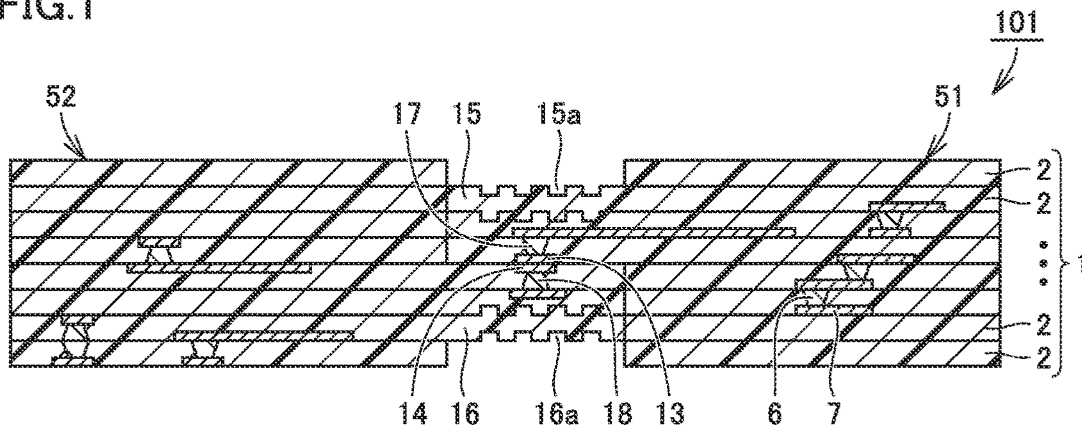


FIG.2

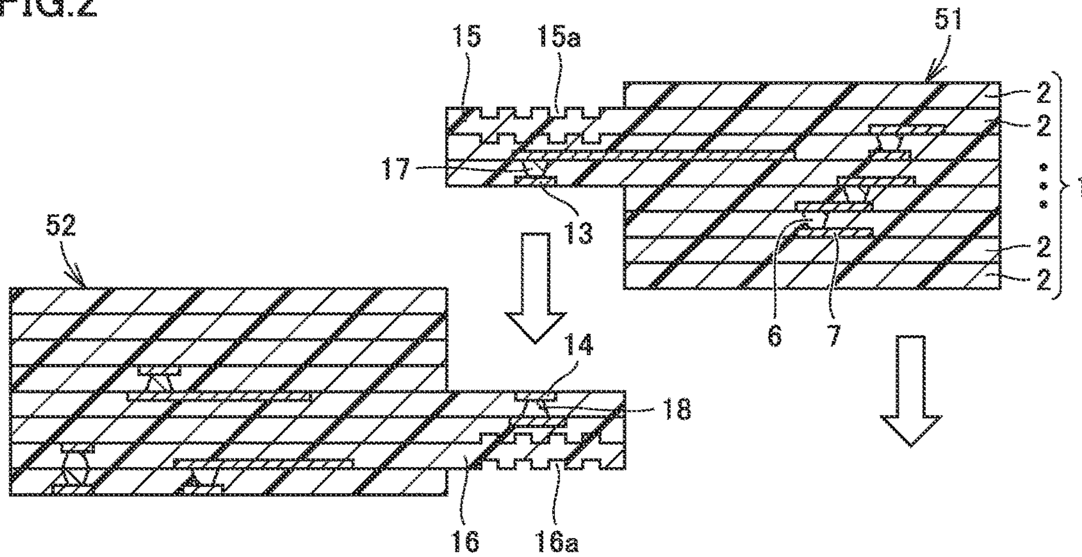


FIG.3

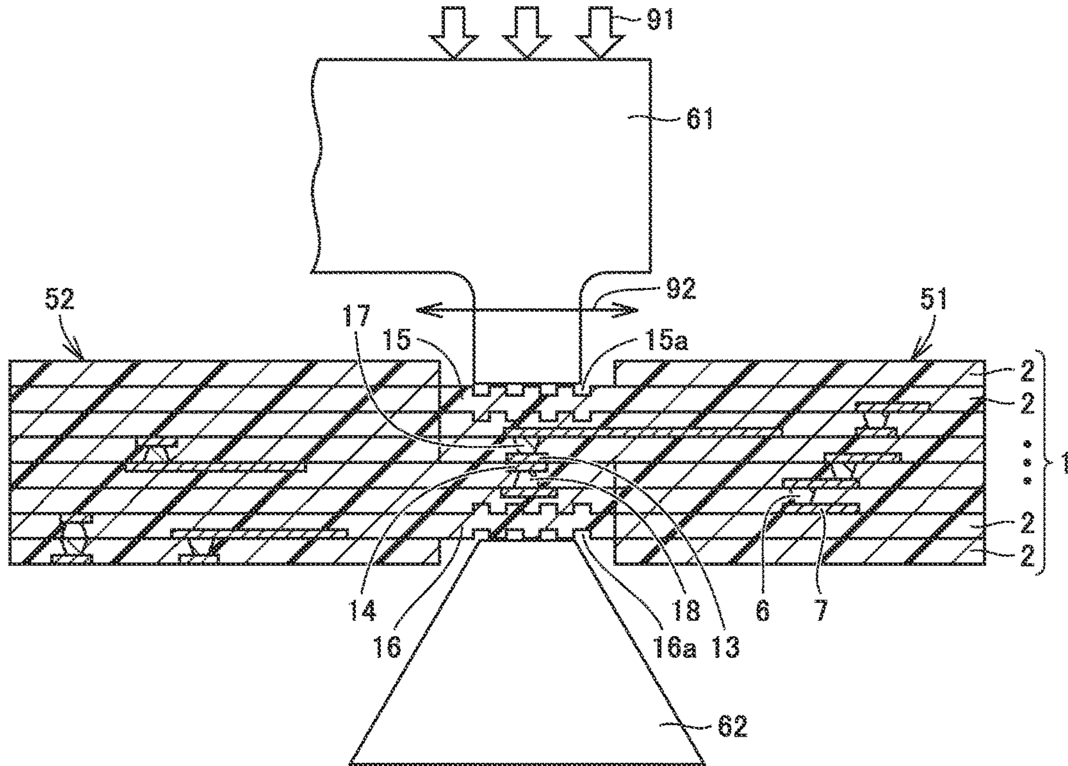


FIG.4

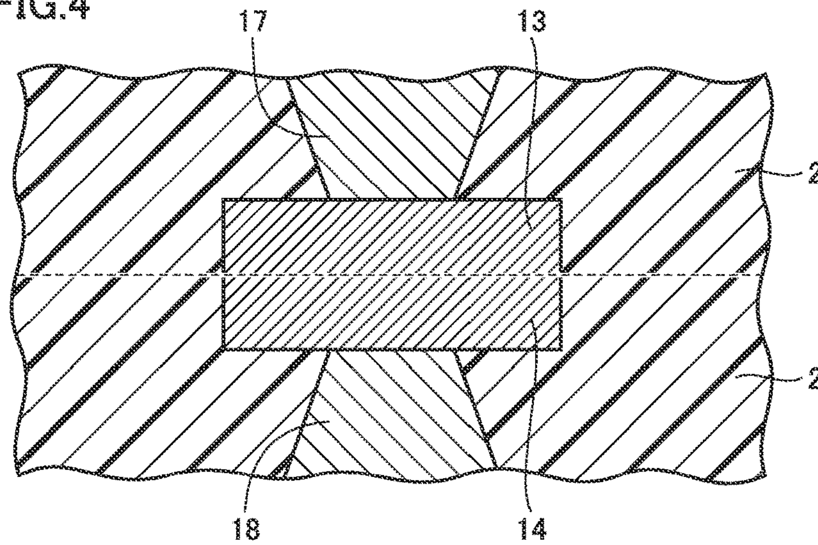


FIG.5

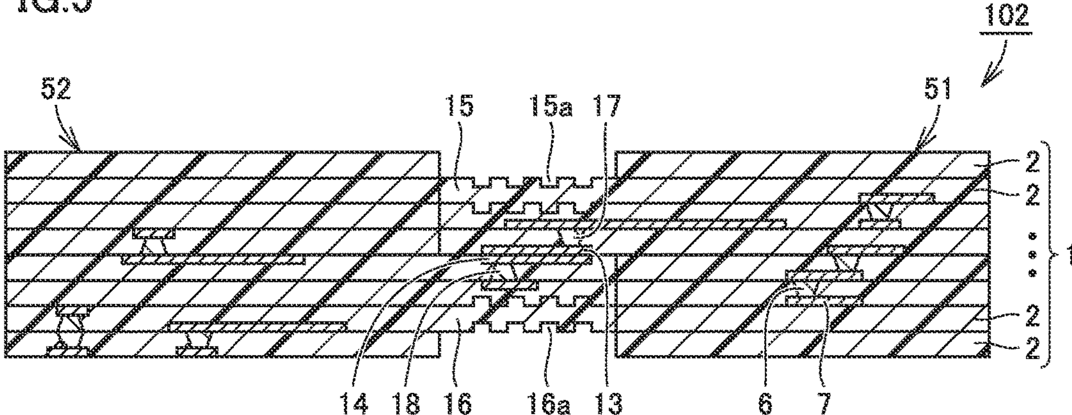


FIG.6

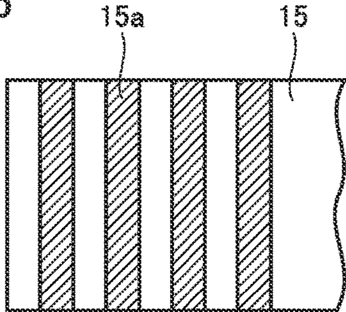


FIG.7

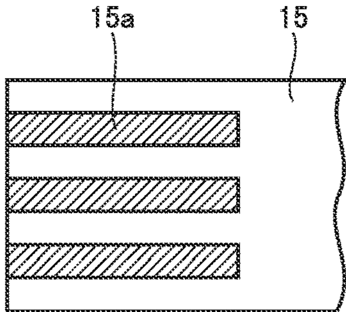


FIG.8

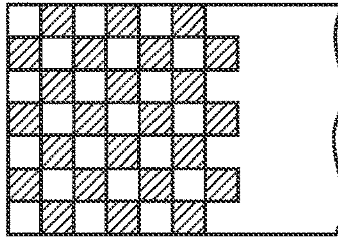


FIG.9

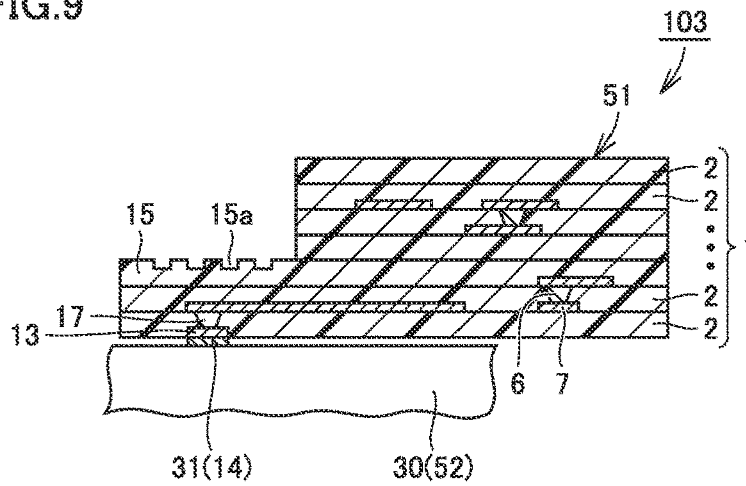


FIG.10

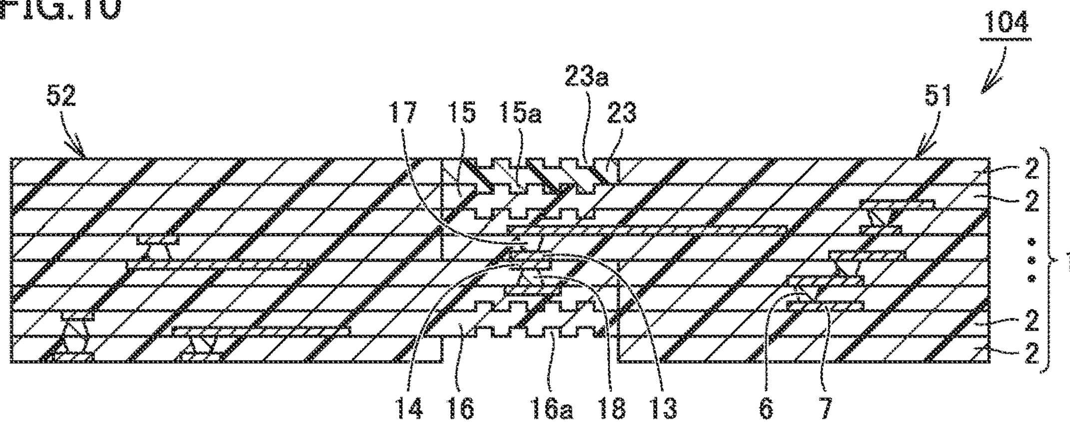


FIG.11

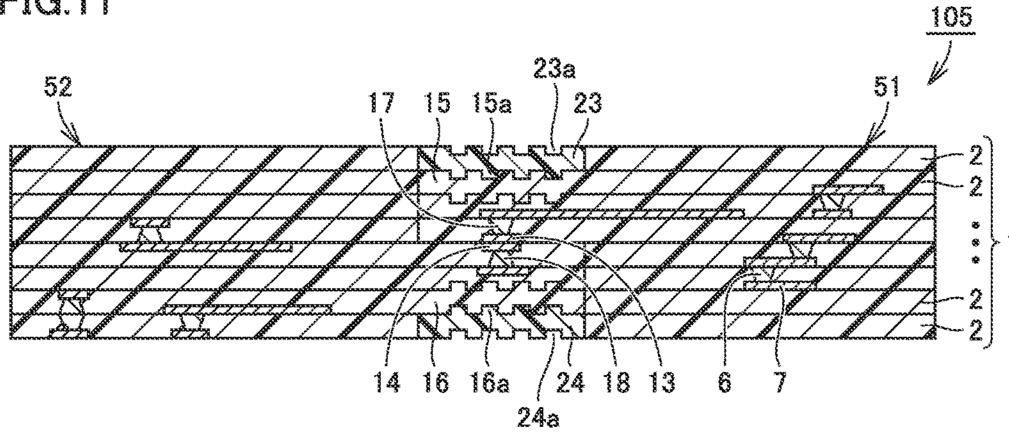


FIG.12

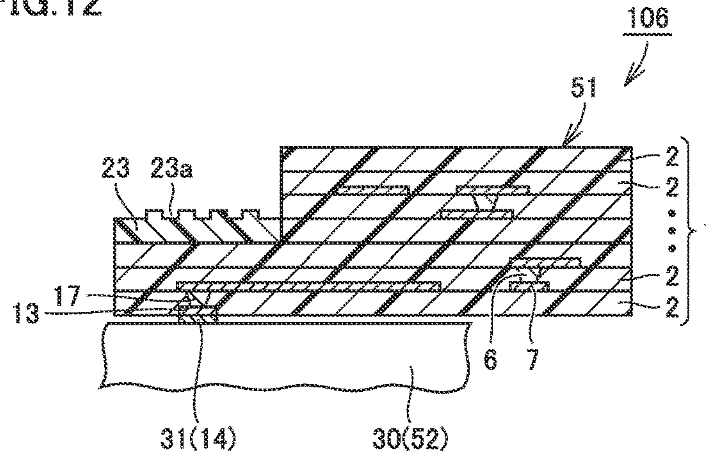
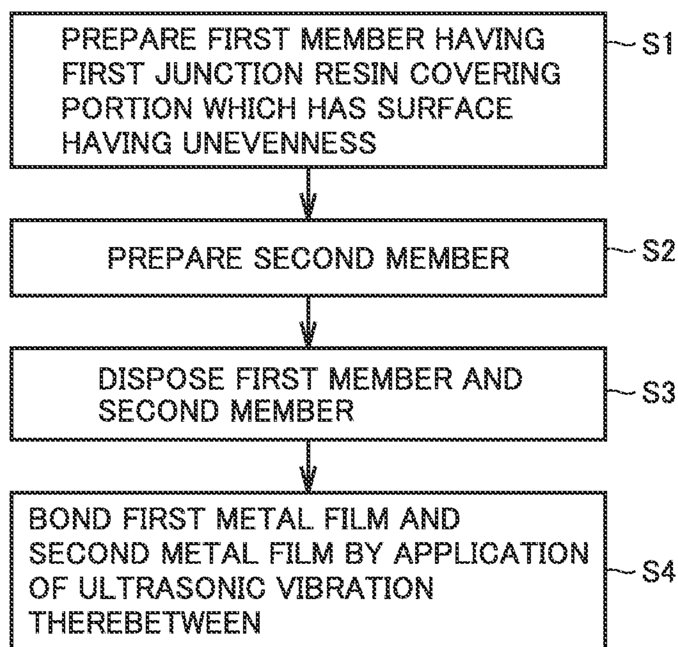


FIG.13



RESIN BOARD STRUCTURE AND METHOD FOR FABRICATING THE SAME

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of priority to Japanese Patent Application No. 2015-196723 filed on Oct. 2, 2015 and is a Continuation Application of PCT Application No. PCT/JP2016/077126 filed on Sep. 14, 2016. The entire contents of each application are hereby incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention relates to a resin board structure and a method for fabricating the same.

2. Description of the Related Art

[0003] Japanese Patent Laid-Open No. 2001-7511 discloses a technology of fusing metals together by application of ultrasonic vibration, as a method for bonding circuit boards together. According to Embodiment 1 of Japanese Patent Laid-Open No. 2001-7511, an object having a conductor pattern formed thereon by etching copper foil on the surface of a PET film and an object having a conductor pattern formed thereon by etching aluminum foil on the surface of a PET film are overlapped so that the copper foil conductor pattern and the aluminum foil conductor pattern are in contact, and the objects are sandwiched between an ultrasonic horn and an anvil and ultrasonic vibration is applied to the objects. According to Embodiment 2 of Japanese Patent Laid-Open No. 2001-7511, at least one of the ultrasonic horn and the anvil has an end face having multiple projections, and resin boards are fused together by ultrasonic vibration through holes created by plastic flow of metal.

[0004] Japanese Patent Laid-Open No. 2006-24590 discloses a method of use of an ultrasonic horn having a corrugated tip to bond terminals of flexible circuit boards by ultrasonic bonding.

[0005] If at least one of two circuit boards that are ultrasonically bonded together includes a thermoplastic resin layer, the method disclosed as Embodiment 1 in Japanese Patent Laid-Open No. 2001-7511 may cause the thermoplastic resin to slip during application of the ultrasonic vibration. This is due to the flexibility of the thermoplastic resin. If the ultrasonic vibration causes the slip, the ultrasonic vibration may not be applied to the circuit boards as intended and bonding failure may occur, or the circuit boards may be misaligned relative to each other.

[0006] For the method disclosed as Embodiment 2 in Japanese Patent Laid-Open No. 2001-7511, it is assumed that the holes are created in the metallic foil conductor pattern. Thus, the method can be employed to bond such circuit boards that have no problem for use even when holes are created in the conductor pattern. Moreover, at the alignment phase of the circuit boards with a jig for the ultrasonic bonding, a slip is caused by the ultrasonic vibration, unless the resin layer conforms the unevenness of the jig. This may cause bond failure to occur or the resin layer to be misaligned relative to the jig.

[0007] The method disclosed in Japanese Patent Laid-Open No. 2006-24590 may cause bond failure to occur or the resin layer to be misaligned due to a slip caused by the ultrasonic vibration, until the ultrasonic horn eats into the surface of the flexible circuit board at the initial phase.

SUMMARY OF THE INVENTION

[0008] Preferred embodiments of the present invention provide resin board structures and methods for fabricating the same which provide ultrasonic bonding while reducing or preventing slippage due to the ultrasonic vibration and reducing or preventing the occurrence of bonding failure or misalignment due to the slippage.

[0009] A resin board structure according to a preferred embodiment of the present invention includes a first member including a first metal film and one thermoplastic resin layer or a stack which includes two or more thermoplastic resin layers; and a second member including a second metal film, wherein the first metal film and the second metal film are bonded together, at least a portion of the first metal film and at least a portion of the second metal film overlap each other, the first metal film and the second metal film are metallurgically bonded at an interface between the first metal film and the second metal film, the first member includes a first junction resin covering portion which is a portion of a thermoplastic resin layer and overlaps a portion at which the first metal film and the second metal film are overlap each other, and the first junction resin covering portion includes an uneven surface including unevenness to reduce or prevent slippage due to ultrasonic vibration.

[0010] In a resin board structure according to a preferred embodiment of the present invention, the first junction resin covering portion includes the uneven surface to reduce or prevent slippage due to ultrasonic vibration, thus enabling the ultrasonic bonding while reducing or prevent slippage due to the ultrasonic vibration and reducing or preventing the occurrence of bond failure or misalignment due to the slippage. Thus, a resin board structure having a good bond is achieved.

[0011] The above and other elements, features, steps, characteristics and advantages of the present invention will become more apparent from the following detailed description of the preferred embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF DRAWINGS

[0012] FIG. **1** is a cross-sectional view of a resin board structure according to Preferred Embodiment 1 of the present invention.

[0013] FIG. **2** is an illustration of a way to assemble a first member and a second member in order to obtain the resin board structure according to Preferred Embodiment 1 of the present invention.

[0014] FIG. **3** is an illustration of a way of ultrasonic bonding in order to obtain the resin board structure according to Preferred Embodiment 1 of the present invention.

[0015] FIG. **4** is an enlarged cross-sectional view of a junction between a first metal film and a second metal film which are included in the resin board structure according to Preferred Embodiment 1 of the present invention.

[0016] FIG. **5** is a cross-sectional view of a resin board structure according to Preferred Embodiment 2 of the present invention.

[0017] FIG. **6** is a plan view of a first example of a metal film pattern at a junction.

[0018] FIG. **7** is a plan view of a second example of the metal film pattern at the junction.

[0019] FIG. **8** is a plan view of a third example of the metal film pattern at the junction.

[0020] FIG. **9** is a cross-sectional view of a resin board structure according to Preferred Embodiment 3 of the present invention.

[0021] FIG. **10** is a cross-sectional view of a resin board structure according to Preferred Embodiment 4 of the present invention.

[0022] FIG. **11** is a cross-sectional view of a resin board structure according to Preferred Embodiment 5 of the present invention.

[0023] FIG. **12** is a cross-sectional view of a resin board structure according to Preferred Embodiment 6 of the present invention

[0024] FIG. **13** is a flowchart of a method for fabricating the resin board structure according to Preferred Embodiment 7 of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0025] The dimensions shown in the drawings are not strictly to scale, and may be exaggerated for convenience of illustration. In the following description, reference made to the idea of above/top or below/bottom means above/top or below/bottom relative to the orientation shown in the drawings, rather than absolute above/top or below/bottom.

Preferred Embodiment 1

[0026] Referring to FIGS. **1** through **4**, a resin board structure according to Preferred Embodiment 1 of the present invention is described. FIG. **1** shows a cross-sectional view of a resin board structure **101** according to the present preferred embodiment.

[0027] Resin board structure **101** includes a first member **51** including a first metal film **13** and one thermoplastic resin layer or a stack **1** which includes two or more thermoplastic resin layers **2**; and a second member **52** including a second metal film **14**. First metal film **13** and second metal film **14** are bonded together, at least a portion of first metal film **13** and at least a portion of second metal film **14** overlap each other. First metal film **13** and second metal film **14** are metallurgically bonded at an interface between first metal film **13** and second metal film **14**. First member **51** includes a first junction resin covering portion **15** which is a portion of thermoplastic resin layer **2** and overlaps a portion at which first metal film **13** and second metal film **14** overlap each other. First junction resin covering portion **15** includes a surface including unevenness **15*a*** to reduce or prevent slippage due to ultrasonic vibration.

[0028] First metal film **13** and second metal film **14** are metallurgically bonded by ultrasonically bonding separate films, i.e., first metal film **13** and second metal film **14**. For the ultrasonic bonding, an oxide, dust, etc. present on the interface is removed by the ultrasonic vibration before bonding, which brings crystal grains of metal close to each other to interatomic distance. A strong force of attraction is thus exerted between first metal film **13** and second metal film **14**, and the metallurgical bond is created therebetween. Resin board structure **101** includes portions that are metallurgically bonded in such a manner.

[0029] Resin board structure **101** is obtained by bonding, as shown in FIG. **2**, first member **51** and second member **52** which are prepared separately. As shown in FIG. **2**, first junction resin covering portion **15** of first member **51** and a second junction resin covering portion **16** of second member **52** overlap each other. As shown in FIG. **3**, the overlapping portion of first member **51** and second member **52** is placed on the top surface of an anvil **62** and pressurized by an ultrasonic horn **61** from the top in the direction of arrows **91**. Ultrasonic horn **61** and anvil **62** are included in an ultrasonic bonding apparatus. While ultrasonic horn **61** including a flat bottom surface and anvil **62** including the flat top surface are shown herein, these surfaces may have microscopic unevenness to increase the frictional forces. Ultrasonic horn **61** is caused to ultrasonically vibrate as indicated by an arrow **92**, while pressurizing the overlapping portion in the direction of arrows **91** in FIG. **3**. As a result of the ultrasonic bonding, metallurgical bonding is provided between first metal film **13** and second metal film **14** as shown in the enlarged view in FIG. **4**. At the same time, thermoplastic resin layers **2** around first metal film **13** and second metal film **14** are also welded together due to heating of the interface caused by the ultrasonic vibration. The position of the interface is schematically indicated by the dashed line shown in FIG. **4**.

[0030] One example of a preferred embodiment of the present invention has been described above. However, the shapes of first member **51** and second member **52** are not limited thereto.

[0031] In the present preferred embodiment, the surface of first junction resin covering portion **15** preferably includes unevenness **15*a*** to reduce or prevent slippage due to the ultrasonic vibration, thus reducing or preventing slippage of first member **51** due to the ultrasonic vibration. As a result, the ultrasonic bonding is performed, while reducing or preventing bond failure or misalignment. This achieves resin board structure **101** that has a good bond.

[0032] Preferably, first junction resin covering portion **15** is thinner than any other portions of first member **51**. First junction resin covering portion **15** being thin as described above facilitates providing the ultrasonic vibration to the bonding interface.

Preferred Embodiment 2

[0033] Resin board structure **101** described in Preferred Embodiment 1 includes interlayer connection conductors which similarly extend from above and below first metal film **13** and second metal film **14** and are connected at the junction between these conductor films. However, preferred embodiments of the present invention are not limited to such arrangement.

[0034] Referring to FIG. **5**, a resin board structure **102** according to Preferred Embodiment 2 of the present invention is described.

[0035] In resin board structure **102**, a first interlayer connection conductor **17** extending from within first member **51** is connected to first metal film **13**, and a second interlayer connection conductor **18** extending from within second member **52** is connected to second metal film **14**. Second interlayer connection conductor **18**, extending from within second member **52**, is connected to second metal film **14** at a different location from first interlayer connection conduc-

tor **17** as viewed in a direction perpendicular or substantially perpendicular to second metal film **14**.

[0036] Even when first metal film **13** and second metal film **14** are bonded together, including the interlayer connection conductors disposed at different locations therein as described in the present preferred embodiment, slippage due to the ultrasonic vibration is likely to occur if no countermeasure is provided to reduce or prevent it. However, the present preferred embodiment includes first junction resin covering portion **15** which includes the surface including unevenness **15***a* to reduce or prevent slippage due to the ultrasonic vibration. Thus, the present preferred embodiment reduces or prevents the occurrence of bond failure or misalignment that is due to the slip caused by the ultrasonic vibration, and provides significant benefits therefrom.

[0037] It is not necessary that the thermoplastic resin layers are welded together around a location at which the metal films are metallurgically bonded by the ultrasonic bonding. However, as described in Preferred Embodiments 1 and 2, preferably, the thermoplastic resin layers are in contact and fused together (see FIG. **4**). In other words, preferably, second member **52** includes one thermoplastic resin layer **2** or a stack which includes two or more thermoplastic resin layers **2**, and first member **51** and second member **52** are welded together at the contact portion between thermoplastic resin layers **2**. Bonding the thermoplastic resin layers in addition to bonding the metal films provides a solid, stable structure. The configuration in which the thermoplastic resin layers are additionally bonded is able to be achieved by adjusting the conditions of the ultrasonic vibration for the ultrasonic bonding. In particular, the configuration in which the thermoplastic resin layers are bonded together as well as the metal films being bonded together is able to be readily achieved, for example, by increasing a surface, which comes into contact with the object to be bonded, of the ultrasonic horn to be greater than the size of the metal film, as viewed from bottom, and increasing a surface, which comes into contact with the object to be bonded, of the anvil to be greater than the size of the metal film, as viewed from above.

[0038] Second member **52** need not include one thermoplastic resin layer **2** or the stack which includes two or more thermoplastic resin layers **2**. Second member **52** may be a member other than the resin multilayer board. Second member **52** may be a member which includes no thermoplastic resin layer. In other words, only first member **51** may be a member which includes the thermoplastic resin layer.

[0039] Preferably, in the configuration in which second member **52** includes one thermoplastic resin layer **2** or the stack which includes two or more thermoplastic resin layers **2**, and first member **51** and second member **52** are welded together at the contact portion between thermoplastic resin layers **2**, second member **52** further includes the following configuration. In this case, preferably, second member **52** includes second junction resin covering portion **16** which is a portion of thermoplastic resin layer **2** and overlaps at least a portion of first metal film **13** and at least a portion of second metal film **14**, and second junction resin covering portion **16** includes a surface having an unevenness **16***a* to reduce or prevent slippage due to the ultrasonic vibration. The examples shown in FIGS. **1** and **5** already include this configuration. Second junction resin covering portion **16** whose surface includes unevenness **16***a* enables the application of the ultrasonic vibration, while holding, from the second junction resin covering portion **16** side as well as from the first junction resin covering portion **15** side, first member **51** and second member **52** from slipping, thus more reliably reducing or preventing the slippage due to the ultrasonic vibration. As a result, good ultrasonic bonding is provided, while reducing or preventing the occurrence of bond failure or misalignment.

[0040] While unevenness **15***a*, **16***a* has been described above with reference to the cross-sectional views, the patterns of unevenness **15***a* and unevenness **16***a* as viewed from above and below are to be described.

[0041] FIG. **6** shows an example of first junction resin covering portion **15** as viewed from above. For convenience of illustration, the lower portions of unevenness **15***a* are shown hatched in FIG. **6**. Non-hatched blank portions are higher than the hatched portions. In the example shown herein, unevenness **15***a* is preferably structured as a striped pattern which is a repeating pattern of straight grooves extending in a direction perpendicular or substantially perpendicular to the longitudinal direction (the left to right direction in FIG. **6**) of first junction resin covering portion **15**. The direction of the striped pattern is provided merely by way of example, and preferred embodiments of the present invention are not limited thereto. Unevenness **15***a* may preferably be structured as a striped pattern which is a repeating pattern of straight grooves extending in a direction parallel or substantially parallel to the longitudinal direction (the left to right direction in FIG. **7**) of first junction resin covering portion **15**, as shown in FIG. **7**, for example.

[0042] Unevenness **15***a* is not limited to striped patterns. Unevenness **15***a* may preferably be structured as a checkered pattern, as shown in FIG. **8** for example. The lower portions of unevenness **15***a* are also shown hatched in FIG. **8**.

[0043] Those described with reference to FIGS. **6** through **8** apply also to unevenness **16***a* in second junction resin covering portion **16**. The patterns of unevenness **15***a*, **16***a* are not limited to the striped pattern or the checkered pattern, and may be any other suitable patterns or random patterns.

Preferred Embodiment 3

[0044] Referring to FIG. **9**, a resin board structure according to Preferred Embodiment 3 of the present invention is described. FIG. **9** shows a cross-sectional view of a resin board structure **103** according to the present preferred embodiment.

[0045] Resin board structure **103** includes first member **51** including first metal film **13** and one thermoplastic resin layer **2** or stack **1** which includes two or more thermoplastic resin layers **2**, and second member **52** including second metal film **14**. Second member **52** is a motherboard **30**. Motherboard **30** may not include a stack of thermoplastic resin layers. Motherboard **30** may preferably be a printed circuit board, for example. First metal film **13** and second metal film **14** are bonded together, at least a portion of first metal film **13** and at least a portion of second metal film **14** overlap each other. First metal film **13** and second metal film **14** are metallurgically bonded at an interface between first metal film **13** and second metal film **14**. Second metal film **14** is a pad electrode **31** on the surface of motherboard **30**. First member **51** includes first junction resin covering portion **15** which is a portion of thermoplastic resin layer **2** and overlaps a portion at which first metal film **13** and second metal film **14** overlap each other. First junction resin cov-

ering portion **15** includes a surface including unevenness **15***a* to reduce or prevent a slip due to ultrasonic vibration.

[0046] In the present preferred embodiment, as with Preferred Embodiment 1, ultrasonic bonding is able to be provided, while reducing or preventing slippage due to the ultrasonic vibration and reducing or preventing the occurrence of bond failure or misalignment due to the slippage, thus providing resin board structure **103** having a good bond. As described in the present preferred embodiment, the connection between the stack which includes the thermoplastic resin layers and the motherboard which is not such a stack also benefits from the present invention, due to the surface of first junction resin covering portion **15** having unevenness **15***a* to reduce or prevent slippage due to the ultrasonic vibration.

Preferred Embodiment 4

[0047] Referring to FIG. **10**, a resin board structure according to Preferred Embodiment 4 of the present invention is described. FIG. **10** shows a cross-sectional view of a resin board structure **104** according to the present preferred embodiment.

[0048] Resin board structure **104** is similar to resin board structure **101** according to Preferred Embodiment 1, except for the following structure.

[0049] In resin board structure **104**, a first protective film **23** is provided over the surface of first junction resin covering portion **15**, and first protective film **23** includes a surface including unevenness **23***a* to reduce or prevent slippage due to ultrasonic vibration. First protective film **23** may preferably be, for example, a resist film. First protective film **23** may also be, for example, a resin film, such as a coverlay film.

[0050] In the present preferred embodiment, first junction resin covering portion **15** is protected by first protective film **23**. Since unevenness **23***a* is provided in the surface of first protective film **23**, even after first protective film **23** is provided over first junction resin covering portion **15**, unevenness **23***a* enables ultrasonic bonding to be provided, while reducing or preventing slippage due to the ultrasonic vibration and reducing or preventing the occurrence of bond failure or misalignment due to the slippage. As a result, resin board structure **104** having a good bond is achieved.

[0051] In particular, when first junction resin covering portion **15** is thinner than any other portions, significant reinforcing benefits are obtained by providing such a protective film, thus increasing reliability.

Preferred Embodiment 5

[0052] Referring to FIG. **11**, a resin board structure according to Preferred Embodiment 5 of the present invention is described. FIG. **11** shows a cross-sectional view of a resin board structure **105** according to the present preferred embodiment.

[0053] Resin board structure **105** is similar to resin board structure **104** according to Preferred Embodiment 4, except for the following structure.

[0054] First protective film **23** is provided over the surface of first junction resin covering portion **15**, first protective film **23** includes a surface including unevenness **23***a* to reduce or prevent slippage due to the ultrasonic vibration, a second protective film **24** is provided over the surface of second junction resin covering portion **16**, and second protective film **24** includes a surface including unevenness **24***a* to reduce or prevent slippage due to the ultrasonic vibration.

[0055] In the present preferred embodiment, since second protective film **24**, as well as first protective film **23**, is provided, the junction is protected from the second junction resin covering portion **16** side, as well as from the first junction resin covering portion **15** side. Since the surface of first protective film **23** includes unevenness **23***a* and the surface of second protective film **24** includes unevenness **24***a*, the ultrasonic bonding is provided, while reducing or preventing, by both unevenness **23***a*, **24***a*, slippage due to the ultrasonic vibration and the occurrence of bond failure or misalignment due to the slippage, thus achieving resin board structure **105** including a good bond.

Preferred Embodiment 6

[0056] Referring to FIG. **12**, a resin board structure according to Preferred Embodiment 6 of the present invention is described. FIG. **12** shows a cross-sectional view of a resin board structure **106** according to the present preferred embodiment.

[0057] In resin board structure **106**, second member **52** is motherboard **30**. Resin board structure **106** includes first member **51** including first metal film **13** and one thermoplastic resin layer **2** or stack **1** which includes two or more thermoplastic resin layers **2**; and second member **52** including second metal film **14**. First metal film **13** and second metal film **14** are bonded together, at least a portion of first metal film **13** and at least a portion of second metal film **14** overlap each other. First metal film **13** and second metal film **14** are metallurgically bonded at an interface between at least a portion of first metal film **13** and at least a portion of second metal film **14**. First member **51** includes a first junction resin covering portion which is a portion of thermoplastic resin layer **2** and overlaps the at least a portion of first metal film **13** and the at least a portion of second metal film **14**. First protective film **23** is provided over the surface of the first junction resin covering portion and first protective film **23** includes a surface including unevenness **23***a* to reduce or prevent slippage due to ultrasonic vibration.

[0058] As described in the present preferred embodiment, the configuration, in which second member **52** is motherboard **30**, first protective film **23** is provided over the surface of the first junction resin covering portion, and the surface of first protective film **23** includes unevenness **23***a*, enables the ultrasonic bonding to be provided, while reducing or preventing, by unevenness **23***a*, the occurrence of slippage due to the ultrasonic vibration. As a result, resin board structure **106** including a good bond is achieved.

Preferred Embodiment 7

[0059] Referring to FIGS. **13** and **1** through **3**, a method for fabricating the resin board structure according to Preferred Embodiment 7 of the present invention is described. FIG. **13** shows a flowchart of the method for fabricating the resin board structure according to the present preferred embodiment.

[0060] The method for fabricating the resin board structure according to the present preferred embodiment includes step S1 of preparing first member **51** including first metal film **13** and one thermoplastic resin layer **2** or stack **1** which includes two or more thermoplastic resin layers **2**, first

member **51** including first junction resin covering portion **15** which is a portion of a thermoplastic resin layer and overlaps first metal film **13**, first junction resin covering portion **15** including a surface including unevenness **15***a*; step S2 of preparing second member **52** including second metal film **14**; step S3 (see FIG. **2**) of disposing first member **51** and second member **52**, at least a portion of first metal film **13** and at least a portion of second metal film **14** being in contact with each other and overlapping each other; and step S4 (see FIG. **3**) of bonding first metal film **13** and second metal film together by application of relative ultrasonic vibration between first metal film **13** and second metal film **14**. This provides resin board structure **101** as shown in FIG. **1**.

[0061] In the present preferred embodiment, first junction resin covering portion **15** of first member **51** includes the surface including unevenness **15***a*. Thus, in step S4, the ultrasonic bonding is provided, while reducing or preventing slippage due to the ultrasonic vibration and reducing or preventing the occurrence of bond failure or misalignment due to the slippage.

[0062] Note that in the method for fabricating the resin board structure according to the present preferred embodiment, preferably, first junction resin covering portion **15** is thinner than any other portions of first member **51**. First junction resin covering portion **15** being thin as such facilitates providing the ultrasonic vibration to the bonding interface in step S**4**.

[0063] In the method for fabricating the resin board structure according to the present preferred embodiment, preferably, second member **52** includes one thermoplastic resin layer **2** or stack **1** which includes two or more thermoplastic resin layers **2**, and bonding step S4 bonds first member **51** and second member **52** together by welding at a contact portion between thermoplastic resin layers **2**. A solid, stable structure is obtained by bonding thermoplastic resin layers together by welding as such, in addition to bonding the metal films together.

[0064] While second member **52** shown in FIGS. **1** through **3** is also a stack of the thermoplastic resin layers, the type of second member **52** is not limited thereto to perform the method for fabricating the resin board structure. In the method for fabricating the resin board structure according to the present preferred embodiment, second member **52** may be motherboard **30**, as illustrated in FIGS. **9** and **12**.

Preferred Embodiment 8

[0065] A method for fabricating a resin board structure according to Preferred Embodiment 8 of the present invention is to be described.

[0066] The method for fabricating the resin board structure according to the present preferred embodiment includes preparing a first member including a first metal film and one thermoplastic resin layer or a stack which includes two or more thermoplastic resin layers, the first member including a first junction resin covering portion which is a portion of a thermoplastic resin layer and overlaps the first metal film; preparing a second member which includes a second metal film; disposing the first member and the second member, at least a portion of the first metal film and at least a portion of the second metal film being in contact with each other and overlapping each other; and bonding the first metal film and the second metal film together by application of relative ultrasonic vibration between the first metal film and the second metal film, wherein the first member includes a first protective film covering a surface of the first junction resin covering portion, the first protective film including a surface including unevenness.

[0067] In the present preferred embodiment, the unevenness is provided in the surface of the first protective film covering the surface of the first junction resin covering portion in the first member. Thus, the ultrasonic bonding is provided, while reducing or preventing slippage due to the ultrasonic vibration and reducing or preventing the occurrence of bond failure or misalignment due to the slippage (see FIG. **12**). The "unevenness," as used herein, reduces or prevents the slippage due to the ultrasonic vibration.

[0068] Note that two or more of the above preferred embodiments may be combined as appropriate.

[0069] Also note that the above preferred embodiments presently disclosed are illustrative in all aspects and do not limit the present invention.

[0070] The scope of the present invention is indicated by the appended claimed, rather than by the above description, and encompass all changes that come within the meaning and range of equivalency of the appended claims.

[0071] While preferred embodiments of the present invention have been described above, it is to be understood that variations and modifications will be apparent to those skilled in the art without departing from the scope and spirit of the present invention. The scope of the present invention, therefore, is to be determined solely by the following claims.

What is claimed is:

1. A resin board structure comprising:

a first member including a first metal film and one thermoplastic resin layer or a stack which includes two or more thermoplastic resin layers; and

a second member including a second metal film; wherein

the first metal film and the second metal film are bonded together, at least a portion of the first metal film and at least a portion of the second metal film overlap each other, the first metal film and the second metal film being metallurgically bonded at an interface between the first metal film and the second metal film;

the first member includes a first junction resin covering portion including a portion of a thermoplastic resin layer and overlapping a portion at which the first metal film and the second metal film overlap each other; and

the first junction resin covering portion includes an uneven surface including unevenness to reduce or prevent slippage due to ultrasonic vibration.

2. The resin board structure according to claim **1**, wherein the first junction resin covering portion is thinner than any other portions of the first member.

3. The resin board structure according to claim **1**, wherein

the second member includes one thermoplastic resin layer or a stack which includes two or more thermoplastic resin layers; and

the first member and the second member are welded together at a contact portion between thermoplastic resin layers.

4. The resin board structure according to claim **3**, wherein

the second member includes a second junction resin covering portion defined by a portion of a thermoplastic resin layer and overlapping a portion at which the first metal film and the second metal film overlap each other; and

the second junction resin covering portion includes an uneven surface including unevenness to reduce or prevent slippage due to ultrasonic vibration.

5. The resin board structure according to claim **1**, wherein the second member is a motherboard.

6. The resin board structure according to claim **1**, further comprising a first protective film provided over a surface of the first junction resin covering portion, the first protective film including an uneven surface including unevenness to reduce or prevent slippage due to ultrasonic vibration.

7. The resin board structure according to claim **4**, further comprising:

a first protective film provided over a surface of the first junction resin covering portion, the first protective film including an uneven surface including unevenness to reduce or prevent slippage due to ultrasonic vibration; and

a second protective film provided over a surface of the second junction resin covering portion, the second protective film including an uneven surface including unevenness to reduce or prevent slippage due to ultrasonic vibration.

8. A resin board structure comprising:

a first member including a first metal film and including one thermoplastic resin layer or a stack which includes two or more thermoplastic resin layers; and

a second member including a second metal film; wherein

the first metal film and the second metal film are bonded together, at least a portion of the first metal film and at least a portion of the second metal film overlap each other, the first metal film and the second metal film being metallurgically bonded at an interface between the first metal film and the second metal film;

the first member includes a first junction resin covering portion defined by a portion of a thermoplastic resin layer and overlapping a portion at which the first metal film and the second metal film overlap each other; and

a first protective film is provided over a surface of the first junction resin covering portion, the first protective film including an uneven surface including unevenness to reduce or prevent slippage due to ultrasonic vibration.

9. The resin board structure according to claim **8**, wherein the second member is a motherboard.

10. The resin board structure according to claim **8**, wherein

the second member includes a second junction resin covering portion including a portion of a thermoplastic resin layer and overlapping a portion at which the first metal film and the second metal film overlap each other; and

a second protective film is provided over a surface of the second junction resin covering portion, the second protective film including an uneven surface including unevenness to reduce or prevent slippage due to ultrasonic vibration.

11. The resin board structure according to claim **8**, wherein the first junction resin covering portion is thinner than any other portions of the first member.

12. A method for fabricating a resin board structure, the method comprising:

preparing a first member including a first metal film and one thermoplastic resin layer or a stack which includes two or more thermoplastic resin layers, the first member including a first junction resin covering portion defined by a portion of a thermoplastic resin layer and overlapping the first metal film, the first junction resin covering portion including an uneven surface including unevenness to reduce or prevent slippage due to ultrasonic vibration;

preparing a second member including a second metal film;

disposing the first member and the second member such that at least a portion of the first metal film and at least a portion of the second metal film are in contact with each other and overlap each other; and

bonding the first metal film and the second metal film together by application of relative ultrasonic vibration between the first metal film and the second metal film.

13. The method according to claim **12**, wherein the first junction resin covering portion is thinner than any other portions of the first member.

14. The method according to claim **12**, wherein

the second member includes one thermoplastic resin layer or a stack which includes two or more thermoplastic resin layers; and

bonding the first metal film and the second metal film together bonds the first member and the second member together by welding at a contact portion between thermoplastic resin layers.

15. The method according to claim **12**, wherein the second member is a motherboard.

16. A method for fabricating a resin board structure, the method comprising:

preparing a first member including a first metal film and including one thermoplastic resin layer or a stack which includes two or more thermoplastic resin layers, the first member including a first junction resin covering portion defined by a portion of a thermoplastic resin layer and overlapping the first metal film;

preparing a second member having a second metal film;

disposing the first member and the second member such that at least a portion of the first metal film and at least a portion of the second metal film are in contact with each other and overlap each other; and

bonding the first metal film and the second metal film together by application of relative ultrasonic vibration between the first metal film and the second metal film; wherein

the first member includes a first protective film covering a surface of the first junction resin covering portion, the first protective film including an uneven surface including unevenness to reduce or prevent slippage due to ultrasonic vibration.

17. The method according to claim **16**, wherein the first junction resin covering portion is thinner than any other portions of the first member.

18. The method according to claim **16**, wherein the second member is prepared to further include one thermoplastic resin layer or a stack which includes two or more thermoplastic resin layers, a second junction resin covering portion including a portion of a thermoplastic resin layer and overlapping the second metal film, and a second protective film covering a surface of the second junction resin covering portion, the second protective film including an uneven surface to reduce or prevent slippage due to ultrasonic vibration.

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