lands.

Since soldering is required for mounting electronic components in the above-described printed circuit boards, a soldering resist layer is formed on the printed circuit board for prohibiting the solder from becoming deposited on those portions where soldering is not required.

The following method may be used as a method for producing the printed wiring board.

First, an insulating substrate 101 having copper foils 1102, 103 on both surfaces thereof as shown in Fig.1 is prepared. A through-hole 104, which is to become a connection hole, is formed at a pre-set position of the insulating substrate 101, comprised of the copper foil 102, insulating substrate 101 and the copper foil 103, layered together, as shown in Fig.2.

The copper foils 102, 103 on both sides of the insulating substrate 101 are then patterned for forming a first wiring circuit pattern 105 having a land 105a as a connecting portion at a pre-set position and a second wiring circuit pattern 106 having a land 106a as a connecting portion at a pre-set position, as shown in Fig.5. It should be noted that one of the opening ends of the through-hole 104 is opened on a mid portion of the land 105a of the first wiring circuit pattern 105, while the other opening end of the through-hole 104 is opened on a mid portion of the land 106a of the second wiring circuit pattern 106. Patterning is carried out by forming an etching resist on

the copper foil of the insulating substrate by the printing method or by the photographic method, removing unneeded portions of the copper foil by etching using an etchant, such as ferric chloride, for forming a pre-set circuit pattern, and by peeling the etching resist with e.g., a solution of sodium hydroxide for completing a circuit pattern having the exposed copper foil conductor.

A first soldering layer 107 as shown in Fig.4 is then layered for covering those portions of both surfaces of the insulating substrate 101 which are not in need of soldering except the lands 105a, 106a of the wiring circuit patterns 105, 106 and the through-holes 104.

Then, a number of symbol marks, such as service marks or letters for specifying the component mounting positions, are formed at pre-set positions. These symbol marks are generally formed by layering by printing.

Then, a screen 108 having an opening 108a in register with the position of forming the through-hole 104 is arrayed on the first wiring circuit pattern 105, as shown in Fig.5. An electrically conductive paste 109 is placed on the screen 108, and a squeegee 110 is moved thereon in a direction indicated by arrow M in Fig.5 for scraping the electrically conductive paste 109.

The electrically conductive paste 109 is then extruded into the inside of the through-hole 104 via the opening 108a for

performing screen printing. The electrically conductive paste 109 is layered on the land 105a of the first wiring circuit pattern 105 at the same time as it is charged into the through-hole 104. On the other hand, the electrically conductive paste 109 is also layered on the land 106a of the second wring circuit pattern 106.

The electrically conductive paste 109 charged into the inside of the through-hole 104 is then thermally cured for layering the electrically conductive paste 109 on the inner wall surface of the through-hole 104 and on portions of the lands 105a, 106a for completing the connecting hole for electrically interconnecting the lands 105a, 106a and also for electrically interconnecting the first and second wiring circuit patterns 105, 106 formed on the insulating substrate 101, as shown in Fig.6.

Then, a second solder resist layer 111 is formed for covering the electrically conductive paste 109 on the lands 105a, 106a and the first solder resist layer 107, in such a manner that the solder is not affixed to the electrically conductive paste 109 on the lands 105a, 106a, for completing the printed wiring board.

However, if the printed wiring board is produced by the above-described method, so-called bleeding tend to be incurred during screen printing carried out for charging the electrically conductive paste, thus leading to lowered productivity or reliability.

In the above-described production method, the screen printing for charging the electrically conductive paste 109 is carried out after forming the first and second wiring circuit patterns 105, 106, the first solder resist layer 107 on the first and second wiring circuit patterns 105, 106 and the symbol marks in this order. Thus the screen printing is carried out on a surface presenting irregularities due to the previous formation of the first solder resist layer and the symbol marks by printing. The result is that the screen can not adhere to the printing support during transcription thus leading to bleeding in which printing is performed on the portions other than the portions on which to print the electrically conductive paste thereby lowering productivity and reliability (insulating characteristics).

OBJECT AND SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a printed wiring board and a method for producing the same whereby bleeding in the screen printing performed for charging the electrically conductive paste is suppressed for improving productivity and reliability.

According to the present invention, a printed wiring board in which a through-hole bored through an insulating substrate is formed at a mid portion of registering lands of wiring circuit patterns formed on both surfaces of the insulating substrate, and in which the wiring circuit patterns on the upper and lower

surfaces of the insulating substrate are electrically interconnected by an electrically conductive paste layered on the inner wall surface of the through-hole as far as portions of the lands, is disclosed. A single-layer solder resist layer is deposited on the upper and lower surfaces of the insulating substrate for covering the wiring circuit patterns as far as the electrically conductive paste on the lands.

According to the present invention, a method for producing a printed wiring board including the steps of forming a through-hole at a pre-set position in an insulating substrate having electrically conductive layers on both surfaces thereof, forming a pre-set wiring circuit pattern having a land on an electrically conductive layer formed on each surface of the insulating substrate, charging an electrically conductive paste in the through-hole for layering the electrically conductive paste on the inner wall surface of the through-hole as far as a portion of each land, curing the electrically conductive paste on drying and layering a single-layer solder resist layer for covering the wiring circuit pattern formed on each surface of the insulating substrate as far as the electrically conductive paste on the land.

The method may also include the step of forming a symbol mark after formation of the solder resist layer.

With the printed wiring board of the present invention, since the electrically conductive paste is charged into a

through-hole bored in the insulating substrate at a mid portion of the registering lands of the wiring circuit patterns formed on both surfaces of the insulating substrate, so that the paste is deposited on the inner wall surfaces as far as portions of the lands, and single-layer solder resist layers are formed on both surfaces of the insulating substrate for covering the wiring circuit patterns and the electrically conductive paste on the lands, thus simplifying the construction. In addition, the solder resist layer may be formed during the production by a one-step operation.

For producing the printed wiring board of the present invention, the electrically conductive paste is charged in the through-hole formed in the insulating substrate at a mid portion of registering lands of wiring circuit patterns formed on both surfaces of the insulating substrate, so that the electrically conductive paste is layered on the inner wall surface of the through-hole as far as portions of the lands. Then, single-layer solder resist layers are formed for covering the wiring circuit patterns as far as the electrically conductive paste on the lands. Thus the step of screen printing for charging the electrically conductive paste is performed before forming the solder resist layer. Thus the screen printing is performed on the planar surface free of irregularities, so that bleeding is scarcely produced.

If the above production method also includes the step of

forming symbol marks after the formation of the solder resist layer, the step of screen printing for charging the electrically conductive paste is carried out on the surface free of irregularities caused by formation of the symbol marks, so that bleeding is again scarcely produced.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig.1 is a schematic cross-sectional view showing the step of preparing an insulating substrate for producing a conventional printed wiring board.

Fig.2 is a schematic cross-sectional view showing the step of forming a through-hole for producing a conventional printed wiring board.

Fig.3 is a schematic cross-sectional view showing the step of forming first and second wiring circuit patterns for producing a conventional printed wiring board.

Fig.4 is a schematic cross-sectional view showing the step of forming a first solder resist layer for producing a conventional printed wiring board.

Fig.5 is a schematic cross-sectional view showing the step of performing screen printing for charging the electrically conductive paste for producing a conventional printed wiring board.

Fig.6 is a schematic cross-sectional view showing the step of forming a connection hole for producing a conventional printed wiring board.

Fig.7 is a schematic cross-sectional view showing the step of forming a second solder resist layer for producing a conventional printed wiring board.

Fig.8 is a schematic cross-sectional view showing a printed wiring board according to the present invention.

Fig.9 is a schematic cross-sectional view showing the step of providing an insulating substrate for producing a printed wiring board according to the present invention.

Fig.10 is a schematic cross-sectional view showing the step of forming a through-hole for producing a printed wiring board according to the present invention.

Fig.11 is a schematic cross-sectional view showing the step of forming first and second wiring circuit patterns for producing a printed wiring board according to the present invention.

Fig.12 is a schematic cross-sectional view showing the step of performing screen printing for charging the electrically conductive paste for producing a printed wiring board according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, a printed wiring board according to the present invention and the method for producing the same will be explained in detail.

Fig.8 shows a printed wiring board of the present embodiment having an insulating substrate 1 on one surface of which a first wiring circuit pattern 2 having a land 2a as a connecting

portion is formed and on the other surface of which a second wiring circuit pattern 3 having a land 3a as a connecting portion is formed. The first and second wiring circuit patterns are formed by copper foils.

There is formed a connection hole 4 bored through the insulating substrate 1 at mid portions of lands 2a, 3a of first and second wiring circuit patterns 2, 3 on both surfaces of the insulating substrate 1. An electrically conductive paste 5 formed of copper or silver paste is layered on the inner wall surface of the through-hole and on portions of the lands 2a, 3a for electrically interconnecting the first and second wiring circuit patterns 2, 3.

The insulating substrate 1 may be formed of materials such as an insulator, such as paper or glass cloth, coated or impregnated with phenol resin, polyester resin or epoxy resin or a composite insulating material.

With the present printed wiring board, a single-layer solder resist layer 6 is deposited for overlying an area from the first wiring circuit pattern 2 on the insulating substrate 1 as far as the electrically conductive paste 5 on the land 2a of the first wiring circuit pattern 2, while a single-layer solder resist layer 7 is deposited for overlying an area from the second wiring circuit pattern 3 as far as the electrically conductive paste 5 on the land 3a of the second wiring circuit pattern 3. It should be noted that the solder resist layers 6,

7 are formed only at the area where solder deposition is not needed during soldering, that is an area excluding the electrically conductive paste 5 on the lands 2a, 3a and the lands 2a, 3a.

That is, with the printed wiring board of the present embodiment, the electrically conductive paste 5 is charged into a through-hole bored through the insulating substrate 1 at a mid portion of the lands 2a, 3a of the first and second wiring circuit patterns 2, 3 formed on both sides of the insulating substrate 1 so that the paste 5 will be deposited on both the inner wall surfaces of the through-hole and portions of the lands 2a, 3a for completing the connection hole 4. The single-layer solder resist layers 6, 7 are formed on both surfaces of the insulating substrate 1 for overlying an area from the first and second wiring circuit patterns 2, 3 as far as the electrically conductive paste 5 on the lands 2a, 3a. Thus the structure is simplified, while the solder resist layers 6, 7 may be formed in one step, thus facilitating the production and improving the productivity.

First, an insulating substrate 1 having copper foils 8, 9 on both surfaces thereof as shown in Fig.9 is prepared. A through-hole 110 which is to become a connection hole is formed at a pre-set position of the insulating substrate 1, comprised of the copper foil 8, insulating substrate 1 and the copper foil 9, layered together, as shown in Fig.2.

The copper foils 8, 9 on both sides of the insulating substrate 1 are then patterned for forming a first wiring circuit pattern 2 having a land 2a as a connecting portion at a pre-set position and a second wiring circuit pattern 3 having a land 3a as a connecting portion at a pre-set position, as shown in Fig.3. It should be noted that one 10a of opening ends of the through-hole 10 is opened on a mid portion of the land 2a of the first wiring circuit pattern 2, while the other opening end 10b of the through-hole 10 is opened on a mid portion of the land 3a of the second wiring circuit pattern 3. Patterning is carried out by forming an etching resist on the copper foil of the insulating substrate by the printing method or by the photographic method, removing the unneeded portions of the copper foil by etching using an etchant such as ferric chloride for forming a pre-set circuit pattern, and by peeling the etching resist with e.g., a solution of sodium hydroxide for completing a circuit pattern having the exposed copper foil conductor.

Then, a screen 11 having an opening 11a in register with the position of forming the through-hole 10 is arrayed on the first wiring circuit pattern 2, as shown in Fig.12. An electrically conductive paste 5 is arranged on the screen 11, and a squeegee 12 is moved thereon in a direction indicated by arrow M in Fig.12 for scraping the electrically conductive paste 5.

The electrically conductive paste 5 is then extruded into the inside of the through-hole 10 via the opening 11a for

effecting screen printing. The electrically conductive paste 5 is layered on the land 2a of the first wiring circuit pattern 2 at the same time as it is charged into the through-hole 10. On the other hand, the electrically conductive paste 5 is also layered on the land 36a of the second wring circuit pattern 3.

The screen printing for charging the electrically conductive paste 5 is carried out on a planar surface which is free from irregularities and on which only the first and second wiring circuit patterns 2, 3 are formed and the solder resist layer is not formed. Thus the bleeding is less likely to occur during screen printing.

The electrically conductive paste 5, charged into the through-hole 10, is thermally cured so that the paste is layered on the inner wall surface of the through-hole 10 as far as parts of the lands 2a, 3a for forming a connecting hole for electrically connecting the lands 2a, 3a to each other and for electrically interconnection the first and second wiring circuit patterns 2, 3 formed on both surfaces of the insulating substrate 1.

Finally, for prohibiting deposition of the solder on the wiring circuit pattern of the first wiring circuit pattern 2 on the insulating substrate 1 and also for prohibiting deposition of the solder on the electrically conductive paste 5 on the land 2a of the first wiring circuit pattern 2, the single-layer resist layer 6 is deposited for covering the area extending from the

first wiring circuit pattern 2 as far as the electrically conductive paste 5 on the land 2a of the first wiring circuit pattern 2. Similarly, for prohibiting deposition of the solder on the wiring circuit pattern of the second wiring circuit pattern 3 on the insulating substrate 1 and also for prohibiting deposition of the solder on the electrically conductive paste 5 on the land 3a of the second wiring circuit pattern 3, the single-layer resist layer 7 is deposited for covering the area extending from the second wiring circuit pattern 3 as far as the electrically conductive paste 5 on the land 3a of the second wiring circuit pattern 3, for completing the printed wiring board of the present embodiment, as shown in Fig.8.

If the printed wiring board of the instant embodiment is prepared as described above, the screen printing for charging the electrically conductive paste 5 is carried out before forming the solder resist layers 6, 7. Since the screen printing may be performed in this manner on a planar surface free of irregularities, the so-called bleeding is less likely to occur, thus improving productivity and reliability.

In addition, with the above-described method for producing the printed wiring board, since the solder resist layers 6, 7 covering the electrically conductive paste 5 on the lands 2a, 3a and those portions of the lands 2a, 3a where deposition of the solder is not required may be formed in one step instead of in two steps as required in the conventional practice, thus

simplifying the production process and improving the productivity.

Although the description of the present invention has been made with reference to a printed wiring board not having symbol marks and the method for producing the same, the present invention may naturally be applied to a printed wiring board having the symbol mark. In such case, it suffices to form symbol marks after formation of the solder resist layer.

WHAT IS CLAIMED IS:

1. A printed wiring board in which a through-hole bored through an insulating substrate is formed at a mid portion of registering lands of wiring circuit patterns formed on both surfaces of the insulating substrate, and in which the wiring circuit patterns on the upper and lower surfaces of the insulating substrate are electrically interconnected by an electrically conductive paste layered on the inner wall surface of the through-hole as far as portions of the lands, wherein the improvement resides in that

single-layer solder resist layers are deposited on said upper and lower surfaces of the insulating substrate for covering the wiring circuit patterns as far as the electrically conductive paste on the lands.

2. A method for producing a printed wiring board comprising the steps of:

forming a through-hole at a pre-set position in an insulating substrate having electrically conductive layers on both surfaces thereof;

forming a pre-set wiring circuit pattern having a land on an electrically conductive layer formed on each surface of the insulating substrate;

charging an electrically conductive paste in said through-hole for layering said electrically conductive paste on the inner wall surface of the through-hole as far as a portion of each land;

curing said electrically conductive paste on drying; and

layering a single-layer solder resist layer for covering the wiring circuit pattern formed on each surface of said insulating substrate as far as the electrically conductive paste on said land.

3. The method as claimed in claim 2 further comprising the step of forming a symbol mark after formation of the solder resist layer.

4. The method as claimed in claim 2 wherein an electrically conductive paste is charged into a through-hole by screen printing for depositing the electrically conductive paste on an area extending from the inner wall surface of the through-hole as far as portions of the lands.