[0005] In addition, an insulating layer used in a circuit board sometimes contains an inorganic filler such as silica in order to achieve properties such as a low thermal expansion coefficient and a low dielectric loss tangent, but in these cases, it is even more difficult to achieve a fine wiring.

[0006] Embodiments of the present invention provide a novel method for producing a circuit board that enables to form a conductor circuit in a fine pattern even when the insulating layer contains an inorganic filler.

MEANS FOR SOLVING PROBLEM

[0007] In order to solve the problems described above, the inventors of the present invention carried out an extensive investigation, and as a result, it was found that these problems could be solved by a method for producing a circuit board having the configuration described below, thereby resulting in completion of the present invention.

[0008] That is, the present invention includes the following contents.

According to a first aspect of the present invention, there is provided a method for producing a circuit board, the method including the following steps (X), (Y) and (Z):

(X) forming a first conductor circuit on a metal layer of a substrate with the metal layer attached thereto;

(Y) forming a resin composition layer by using a resin composition so as to embed the first conductor circuit formed on the metal layer, and then curing the resin composition layer to form an insulating layer; and

(Z) removing the substrate with the metal layer attached thereto to form a circuit board having a first main surface in which the first conductor circuit is exposed, wherein

the resin composition includes an epoxy resin, a curing agent and an inorganic filler.

In an embodiment of the above aspect, a content of the inorganic filler in the resin composition is in a range of 20% or more by mass to 75% or less by mass when nonvolatile components in the resin composition are defined as 100% by mass.

In an embodiment of the above aspect, an average particle diameter of the inorganic filler is 0.6 μm or less.

In an embodiment of the above aspect, the inorganic filler is silica.

In an embodiment of the above aspect, a minimum melt viscosity of the resin composition is 5,000 poise or less.

In an embodiment of the above aspect, a thickness of the metal layer is less than 0.5 μm.

In an embodiment of the above aspect, an arithmetic mean roughness Ra of a surface of the metal layer is 200 nm or less, and TTV, which is a difference between a maximum value and a minimum value of a height of the surface of the metal layer measured in a thickness direction of the substrate with the metal layer attached thereto, is 50 μm or less.

In an embodiment of the above aspect, in the substrate with the metal layer attached thereto, the substrate is selected from a metal substrate whose composition is different from that of the metal layer, an inorganic substrate, and an organic substrate.

In an embodiment of the above aspect, the step (Z) is carried out by removing the metal layer after removing the substrate.

In an embodiment of the above aspect, the step (X) includes

(X-1) forming a photoresist on the metal layer, and then irradiating the photoresist with light and developing the photoresist to expose the metal layer corresponding to a circuit pattern of the first conductor circuit to be formed, and

(X-2) forming a conductive layer on the exposed metal layer to form the first conductor circuit.

In an embodiment of the above aspect, the first conductor circuit includes a trench type conductor circuit.

In an embodiment of the above aspect, the step (Y) includes laminating a resin sheet that includes a support film and a resin composition layer formed on the support film onto the substrate such that the resin composition layer is in contact with the first conductor circuit.

An embodiment of the above aspect includes the following steps, after the step (Y):

(i) forming a second conductor circuit on a surface of the insulating layer; and

(ii) forming a resin composition layer so as to embed the second conductor circuit, and then curing the resin composition layer to form an insulating layer.

In an embodiment of the above aspect, the circuit board is for a semiconductor package.

According to a second aspect of the present invention, there is provided a circuit board having a first main surface and a second main surface, the circuit board including:

a trench type conductor circuit in the first main surface, wherein

a minimum line/space ratio (L/S) of the trench type conductor circuit is 2/2 μm or less,

in a cross section in a direction Y that is perpendicular to the first main surface and also

perpendicular to a direction of extension of the trench type conductor circuit, an angle difference between a straight line direction y1 defined by a side wall of the trench type conductor circuit and the direction Y is 20° or lees, and

an insulating layer defining the first main surface together with the trench type conductor circuit includes a cured product of a resin composition comprising an epoxy resin, a curing agent and an inorganic filler.

In an embodiment of the above aspect, the trench type conductor circuit has an inverse tapered shape in which a width thereof increases from the first main surface toward a depth direction of the circuit board.

In an embodiment of the above aspect, a ratio of a thickness T to a width W of the trench type conductor circuit (T/W) in the cross section in the direction Y perpendicular to the first main surface and also perpendicular to the direction of extension of the trench type conductor circuit is 1.5 or more.

In an embodiment of the above aspect, in the cross section in the direction Y perpendicular to the first main surface and also perpendicular to the direction of extension of the trench type conductor circuit, an exposed surface of the trench type conductor circuit is dented by 0.05W or more from an exposed surface of the insulating layer defining the first main surface together with the trench type conductor circuit.

In an embodiment of the above aspect, the circuit board has a multilayered structure having two or more circuit layers.

According to a third aspect of the present invention, there is provided a semiconductor package including:

the above circuit board ; and

a semiconductor chip formed on the first main surface so as to be electrically connected to the trench type conductor circuit of the circuit board.

In an embodiment of the above aspect, the semiconductor package is a Fan-Out type package.

EFFECT OF THE INVENTION

[0009] According to embodiments of the present invention, it is possible to provide a novel method for producing a circuit board that enables to form a conductor circuit in a fine pattern even when the insulating layer contains an inorganic filler.

BRIEF DESCRIPTION OF DRAWINGS

[0010] FIG. 1 is a schematic drawing (1) to illustrate the method for producing a circuit board in an embodiment of the present invention (hereinafter simply referred to as "production method of circuit board").

FIG. 2 is a schematic drawing (2) to illustrate the production method of circuit board.

FIG. 3 is a schematic drawing (3) to illustrate the production method of circuit board.

FIG. 4 is a schematic drawing (4) to illustrate the production method of circuit board.

FIG. 5 is a schematic drawing (5) to illustrate the production method of circuit board.

FIG. 6 is a schematic drawing (6) to illustrate the production method of circuit board.

FIG. 7 is a schematic drawing (7) to illustrate the production method of circuit board.