

EPOXY RESIN LAMINATE BOARD
AS A REINFORCING MATERIAL
FOR FLEXIBLE PRINTED WIRING BOARD

BACKGROUND OF THE INVENTION

This invention relates to an epoxy resin laminate board used as a reinforcing material for a flexible printed wiring board used in an electronic device, that is, a reinforcing material to be laminated on a flexible printed wiring board to improve the mountability on an electronic device and to achieve reliability of performance after having been mounted on an electronic device.

A reinforcing material for a flexible printed wiring board is used to impart rigidity to the flexible printed wiring board.

As a method of laminating such a reinforcing material on a flexible printed wiring board, there are the following methods.

In one method, a sheet material having a thickness of about 0.1 mm to 2 mm and having a reinforcing effect is blanked to a predetermined shape with a blanking die, and laminated on at least one side of a flexible printed wiring board with an adhesive. In another method, an adhesive is applied to or an adhesive sheet is laminated

on a sheet material before blanking the sheet material, and the sheet material is laminated on a flexible printed wiring board, and the laminate is blanked to a predetermined shape with a blanking die.

Heretofore, as reinforcing materials for flexible printed wiring boards, laminate boards for electrical insulation have been used which are obtained by impregnating a substrate with thermosetting resin to form a prepreg and drying and hot pressing the prepreg thus obtained.

As such laminate boards for electrical insulation, there are paper substrate/phenolic resin laminate boards, cotton cloth substrate/phenolic resin laminate boards, glass fabric substrate/epoxy resin laminate boards, glass mat substrate/unsaturated polyester resin laminate boards, etc. as described in JIS K 6912.

Among them, glass fabric substrate/epoxy resin laminate boards, which are superior in heat resistance, mechanical strength (rigidity) and warp properties, are most often used as reinforcing materials.

Basic properties required for reinforcing materials include heat resistance so high as to withstand solder reflow steps, mechanical strength (rigidity), and warp properties. Thickness accuracy, flame retardancy, etc. are also required.

In recent years, with increased performance and

reduced size of electronic devices in which are used flexible printed wiring boards, poor mounting of electronic parts and malfunction of electronic devices resulting from fall of powder from blanked surfaces of the reinforcing material have posed a problem.

Thus, blanking powder is usually removed by air blowing or rinsing reinforcing materials after blanking.

While it is possible to remove blanking powder, with a reinforcing material using glass fiber such as a glass cloth substrate/epoxy resin laminate board, it is difficult to remove beard-like glass fiber exposed on blanked surfaces. Thus, reinforcing materials that are less liable to powder fall from blanked surfaces are required.

If a film carrying an adhesive for bonding to a flexible printed wiring board is laminated on a reinforcing material and then the laminate is blanked, since the reinforcing material and the adhesive film are different in material and thus different in the optimum blanking conditions, it is difficult to know optimum blanking conditions for preventing powder fall.

Thus, improvements for preventing powder fall are required for reinforcing materials. But since laminate boards that have heretofore been used as reinforcing materials have been used for electrical insulation, they were insufficient particularly in suppressing powder fall

from blanked surfaces among the properties required for reinforcing materials.

In order to suppress powder fall from blanked surfaces, it may be possible to use heat-resistant thermoplastic resin sheets such as polyimide (PI), polyetherether ketone (PEEK) or polyphenylene sulfide (PPS). But they are insufficient from an economical viewpoint or in mechanical strength (rigidity).

On the other hand, when a reinforcing material is laminated on a flexible printed wiring board, an adhesive or an adhesive sheet is usually arranged only at a portion to be bonded between the flexible printed wiring board and the reinforcing material and they are bonded together by hot pressing. In this method, both the portion to be bonded to the wiring board and the portion not to be bonded are equally hot-pressed.

Thus, during hot pressing, the resin of the laminate board forming the reinforcing material will get into or be fused to the reinforcing material even at the portion where no adhesive or adhesive sheet is arranged, due to heat and pressure in hot pressing. As a result, even at the portion not to be bonded, the flexible printed wiring board and the reinforcing material will be pressed hard against each other. This worsens workability and produces defectives due to breakage of flexible printed wiring boards. Thus, it is conceivable to apply

a release agent beforehand by printing to the portion of the flexible printed wiring board where bonding is not necessary. But if the release agent adheres to a portion where bonding is necessary, poor bonding would result. Also, the number of steps will increase, thus increasing the processing cost.

An object of this invention is to provide a reinforcing material for a flexible printed wiring board which is a glass fiber substrate/epoxy resin laminate board which is superior from an economical viewpoint and in which powder fall from blanked surfaces is suppressed, and when superposed on and bonded by hot pressing to a flexible printed wiring board, it is possible to keep the portion not to be bonded to the flexible wiring board not pressed against the flexible printed wiring board.

SUMMARY OF THE INVENTION

According to this invention, there is provided an epoxy resin laminate board as a reinforcing material for a flexible printed wiring board characterized in that it is formed by impregnating a glass fiber substrate with an epoxy resin to prepare an epoxy resin prepreg, laminating electrically insulating films on both sides of the epoxy resin prepreg, and hot pressing them together.

Blanking powder during blanking tends to be

produced from the surface layer of a reinforcing material. The glass fiber substrate/epoxy resin laminate board for a reinforcing material of a flexible printed wiring board according to this invention is less liable to powder fall during blanking because electrically insulating films, which are less likely to develop powder fall during the blanking step, are provided on the surface layer. Also, the glass fiber substrate/epoxy resin laminate board according to this invention is superior in mechanical strength (rigidity), since the core material is a glass fiber substrate using an epoxy resin, which is superior in mechanical strength (rigidity), as a binder.

Also, with the glass fiber substrate/epoxy resin laminate board for a reinforcing material of a flexible printed wiring board according to this invention, since electrically insulating films are provided on both sides of a glass fiber substrate/epoxy resin laminate board, its portions which need not be bonded are never fused to flexible printed wiring board even when heated by hot pressing, so that it can be easily peeled off the flexible printed wiring board.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The glass fiber substrate used for the glass fiber substrate/epoxy resin laminate board for the reinforcing

material of a flexible printed wiring board according to this invention may be a woven fabric, a mat or a nonwoven fabric. But a nonwoven fabric is especially preferable to suppress powder fall because its glass fibers are individually dispersed.

As the electrical insulation film, polyimide (PI), polyetherether ketone (PEEK), polyetherimide (PEI), polyphenylene sulfide (PPS) or polyethylene naphthalate (PEN) film or the like may be used. In particular, a polyimide film is high in heat resistance (glass transition temperature) and thus has an advantage that it is less likely to be fused to the flexible printed wiring board when heated by hot pressing. Thus, at the portion of the reinforcing material that does not have to be bonded, the flexible wiring board and the reinforcing material are easy to peel, so that workability is superior and it is possible to prevent defects in the form of breakage. Also, since a polyimide film is superior in bonding properties to an epoxy resin and also superior in dimensional stability for heat, it is preferable in suppressing warp too.

As for the epoxy resin, an ordinarily used epoxy resin may be used, and though not particularly limited, it is preferable that the epoxy resin does not contain any inorganic fillers such as aluminum hydroxide, magnesium hydroxide, talc, silica or antimony trioxide for

the purpose of suppressing powder fall during blanking.

[Examples]

(Example 1)

A prepreg (A) was prepared by impregnating varnish having a solid content of 50% into a glass fabric (weight 145 g/m²) and drying so that the thickness after forming will be 125 micrometers. The varnish was obtained by mixing 100 parts by weight of aluminum hydroxide as an inorganic filler, 2 parts by weight of dicyandiamide as a curing agent, and 1 part by weight of imidazole as a curing promoter to 100 parts by weight of brominated bisphenol type A epoxy resin. Polyimide films (Apical AH made by Kaneka Corporation) having a thickness of 25 micrometers were laminated on both sides of the prepreg thus obtained and hot pressed for 120 minutes at a temperature of 160 °C and a pressure of 2.9 MPa to obtain a laminate having a thickness of 175 micrometers.

Next, 100 sheets of this reinforcing material were blanked with a blanking dies. Then, after each of the blanked reinforcing materials was air-blown for ten seconds with an air gun under an air pressure of 6 kg/cm² per piece to remove blanking powder, the weights (A) of the test pieces were measured. The test pieces were then put in a plastic container and vibrated for five minutes with a vibrator. Next, after the test pieces were air-blown under the same conditions as above to remove

blanking powder, the weights (B) of the test pieces were measured.

The amount of powder that has fallen was determined using the following formula:

Amount of powder that fell (g) = weight A (g) - weight B (g)

The peelability between the flexible wiring board and the laminate board was determined in the following manner. The laminate board was put on the polyimide side of a flexible wiring board worked to a width of 1 cm (on which a circuit was formed by laminating a copper foil having a thickness of 35 micrometers on one side of a polyimide film having a thickness of 25 micrometers). The laminate was sandwiched between mirror-surfaced plates and hot pressed for 120 minutes at a temperature of 180 °C and a pressure of 2.9 MPa. The laminate was then tested with a Schopper tensile testing machine for breakage of the flexible printed wiring board when the wiring board was peeled off the laminate board at an angle of 90° (number of test pieces: 100).

[Formula 1]

$$\text{Rate of breakage} = \frac{\text{Number of broken pieces of flexible printed wiring board}}{100} \times 100$$

(Example 2)

Except that a glass nonwoven fabric (weight: 53 g/m²) was used instead of glass woven fabric used in

Example 1, and that a prepreg (B) was obtained by impregnating and drying so that the thickness after forming was 125 micrometers, a laminate board was formed in the same manner as in Example 1, and test was conducted in the same manner as in Example 1.

(Example 3)

Except that aluminum hydroxide as an inorganic filler was not added and that a prepreg (C) was obtained by impregnation and drying so that the thickness after molding was 125 micrometers, a laminate board was formed in the same manner as in Example 1, and test was conducted in the same manner as in Example 1.

(Comparative Example 1)

Impregnation and drying was carried out on the glass woven fabric used in Example 1 so that the thickness after molding was 175 micrometers. Release polypropylene films were arranged on both sides thereof, hot pressing was carried out in the same manner as in Example 1 to form a laminate board having a thickness of 175 micrometers, and test was conducted in the same manner as in Example 1.

The test results of Examples 1-3 and Comparative Example 1 are shown in Table 1.

TABLE 1

	Ex. 1	Ex. 2	Ex. 3	Comp. Ex. 1
Amount of powder that fell (mg)	44	28	31	92
Rate of breakage (%)	0	0	0	11

According to this invention, it is possible to suppress fall of powder from blanked surfaces due to blanking. By hot pressing with a flexible wiring board, it is possible to obtain a glass fiber substrate/exoxy resin laminate board for reinforcement of a flexible printed wiring board which is superior in peelability at portions where no bonding is necessary.

What is claimed is:

1. An epoxy resin laminate board as a reinforcing material for a flexible printed wiring board characterized in that it is formed by impregnating a glass fiber substrate with an epoxy resin to prepare an epoxy resin prepreg, laminating electrically insulating films on both sides of said epoxy resin prepreg, and hot pressing them together.

2. An epoxy resin laminate board as a reinforcing material for a flexible printed wiring board as claimed in claim 1 wherein said glass fiber substrate is a nonwoven glass fabric.

3. An epoxy resin laminate board as a reinforcing material for a flexible printed wiring board as claimed in claim 1 wherein said electrically insulating films are made of polyimide.