

PROCESS FOR PRODUCING ELECTRICAL DIAGRAM OF LIQUID CRYSTAL POLYMER THIN FILM

BACKGROUND OF THE INVENTION

[0001] The present invention relates to the field of soft circuit boards and, more
5 particularly, to a process for producing an electrical diagram of a liquid crystal polymer
thin film.

[0002] In response to the trend of high frequency of electronic and communication
operations, the substrates of soft circuit boards are developed towards materials with low
dielectric constants, and the liquid crystal polymer (LCP) thin film is the first choice.
10 Conventional processes for producing electric diagrams of soft circuit boards have
several disadvantages. Firstly, a diagram shape is formed on a copper-clad LCP thin
film through use of a shield jig, and the shielding material is etched and stripped to form
an electrical diagram. A large quantity of etching solution is required during this
process. Secondly, a conductive paint is printed on the LCP thin film to form the
15 resultant electrical diagram. However, the medium (such as resin, auxiliary, etc.) of the
conductive paint reduces the electrical conductivity and affects the electrical
characteristics. Thus, it is an important issue to solve the above disadvantages in the
field.

BRIEF SUMMARY OF THE INVENTION

20 **[0003]** An objective of the present invention is to provide a process for producing an
electrical diagram of a liquid crystal polymer (LCP) thin film without using a medium.
Instead, a metal-molecule bonded layer is directly formed on the LCP thin layer to form
the electrical diagram for transmission and reception of electrical signals,
anti-electromagnetic disturbance, and electromagnetic shielding. Furthermore,
25 excellent electrical conductivity and excellent electrical characteristics can be obtained.

[0004] To achieve the above objective, a process for producing an electrical diagram of a liquid crystal polymer thin film according to the present invention comprises the following steps of: (a) preparing the LCP thin film from a liquid crystal polymer; (b) forming a shielding layer on a surface of the LCP thin film, and producing a
5 hollowed-out pattern on the shielding layer according to a pre-determined diagram shape; (c) blowing metal particles, formed of molten metal, by a pressurized gas using normal-temperature pressurized thermal spraying, wherein the metal particles pass through the hollowed-out pattern of the shielding layer, such that the metal particles are sprayed and secured to the surface of the LCP thin film to form a metal-molecule bonded
10 layer, and the metal-molecule bonded layer is suddenly cooled to form the electrical diagram; and (d) removing the shielding layer from the LCP thin film, and taking out the LCP thin film with the electrical diagram.

[0005] In an example, the shielding layer in step (b) is formed by a tape, printing, coating, or a shield jig.

15 **[0006]** In an example, in step (b), the surface of the LCP thin film is processed to form a coarse portion by passing a laser beam through the hollowed-out pattern, and the metal-molecule bonded layer is sprayed and secured on the coarse portion in step (c).

[0007] In an example, the metal-molecule bonded layer in step (c) is selected from the group consisting of zinc, copper, nickel, zinc-copper alloy, and copper-nickel alloy.

20 **[0008]** In an example, in step (c), a bonding force of the metal-molecule bonded layer bonded to the surface of the LCP thin layer is 9-11 kgf/cm², and the metal-molecule bonded layer has a porosity of 1-5%.

[0009] In an example, in step (d), the electrical diagram includes conductive wires of a width of not larger than 0.15mm for electrical conduction.

25 **[0010]** In an example, in step (d), the electrical diagram is used for anti-electromagnetic disturbance or electromagnetic shielding.

[0011] The present invention will become clearer in light of the following detailed description of illustrative embodiments of this invention described in connection with the drawings.

DESCRIPTION OF THE DRAWINGS

5 **[0012]** FIG. 1 is a cut-away perspective view of a liquid crystal polymer thin film with a shielding layer according to the present invention.

[0013] FIG. 2 is a cut-away perspective view illustrating formation of a hollowed-out pattern on the shielding layer according to a predetermined diagram shape.

10 **[0014]** FIG. 3 is a cut-away perspective view illustrating formation of a coarse portion on a surface of the liquid crystal polymer thin film along the hollowed-out pattern.

[0015] FIG. 4 is a cut-away perspective view illustrating formation of a metal-molecule bonded layer on the coarse portion of the liquid crystal polymer thin film.

15 **[0016]** FIG. 5 is a cut-away perspective view of the liquid crystal polymer thin film after removal of the shielding layer from the surface of the liquid crystal polymer thin film along the periphery of an electrical diagram.

DETAILED DESCRIPTION OF THE INVENTION

20 **[0017]** With reference to FIGS. 1-5, the present invention directly forms an electrical diagram 6 on a liquid crystal polymer (LCP) thin film 1 without any media. The process according to the present invention comprises preparing the LCP thin film 1 (see FIG. 1) from a liquid crystal polymer (step (a)).

[0018] In step (b), a shielding layer 2 is formed on a surface of the LCP thin film 1 (see FIG. 1). The shielding layer 2 can be formed by a tape, printing, coating, or a shield jig. Then, the shielding layer 2 is carved by a laser beam to form a hollowed-out pattern 3 (see FIG. 2) according to a pre-determined diagram shape. Furthermore, the

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laser beam passes through the hollowed-out pattern 3 to process the surface of the LCP thin film 1, forming a coarse portion 4 on the surface of the LCP thin film 1 (see FIG. 3).

[0019] In step (c), metal particles formed of molten metal is blown by a pressurized gas using normal-temperature pressurized thermal spraying to pass through the

5 hollowed-out pattern 3 of the shielding layer 2, such that the metal particles are sprayed and secured to the coarse portion 4 of the surface of the LCP thin film 1 to form a metal-molecule bonded layer 5 (see FIG. 4). The metal-molecule bonded layer 5 can be selected from the group consisting of zinc, copper, nickel, zinc-copper alloy, and cooper-nickel alloy. Furthermore, the metal-molecule bonded layer 5 is suddenly
10 cooled to form the electrical diagram 6.

[0020] In step (d), the shielding layer 2 is removed from the LCP thin film 1, and the LCP thin film 1 with the electrical diagram 6 is taken out (see FIG. 5).

[0021] In step (c) of the process according to the present invention, the spraying pressure used in the normal-temperature pressurized thermal spraying is 3-12 bars. The
15 fusion temperature of the thermal spraying machine can be adjusted according to the properties of the electrically conductive material. The working voltage and the working current of the thermal spraying machine are 20-50V and 185-295A, respectively. The metal melts by using an electric arc and is blown by the pressurized gas to form metal particles. Thus, the metal particles are sprayed and secured on the coarse portion
20 4 to form the metal-molecule bonded layer 5. The metal particles are suddenly cooled to the normal temperature (about 24-40°C). The bonding force of the metal-molecule bonded layer 5 bonded to the surface of the LCP thin layer 1 is 9-11 kgf/cm², and the metal-molecule bonded layer 5 has a porosity of 1-5%, thereby increasing the binding force and the fineness. When the LCP thin film 1 with the electrical diagram 6 is used
25 on a soft circuit board, the electrical diagram 6 includes conductive wires of a width of not larger than 0.15mm for electrical conduction, which can be used for electrical

conduction and which meets the high frequency demands of electronic and communication operations. Furthermore, the electrical diagram 6 can be used for anti-electromagnetic disturbance or electromagnetic shielding.

[0022] Although specific embodiments have been illustrated and described,

5 numerous modifications and variations are still possible without departing from the scope of the invention. The scope of the invention is limited by the accompanying claims.

CLAIMS

1. A process for producing an electrical diagram of a liquid crystal polymer (LCP) thin film, comprising the following steps of:

5 (a) preparing the LCP thin film from a liquid crystal polymer;

(b) forming a shielding layer on a surface of the LCP thin film, and producing a hollowed-out pattern on the shielding layer according to a pre-determined diagram shape;

(c) blowing metal particles, formed of molten metal, by a pressurized gas using normal-temperature pressurized thermal spraying, wherein the metal particles pass through the hollowed-out pattern of the shielding layer, such that the metal particles are sprayed and secured to the surface of the LCP thin film to form a metal-molecule bonded layer, and the metal-molecule bonded layer is suddenly cooled to form the electrical diagram; and

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(d) removing the shielding layer from the LCP thin film, and taking out the LCP thin film with the electrical diagram.

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2. The process for producing the electrical diagram of the liquid crystal polymer thin film as claimed in claim 1, wherein the shielding layer in step (b) is formed by a tape, printing, coating, or a shield jig.

20 3. The process for producing the electrical diagram of the liquid crystal polymer thin film as claimed in claim 1, wherein in step (b), the surface of the LCP thin film is processed to form a coarse portion by passing a laser beam through the hollowed-out pattern, and the metal-molecule bonded layer is sprayed and secured on the coarse portion in step (c).

25 4. The process for producing the electrical diagram of the liquid crystal polymer thin film as claimed in claim 1, wherein the metal-molecule bonded layer in

step (c) is selected from the group consisting of zinc, copper, nickel, zinc-copper alloy, and cooper-nickel alloy.

5. The process for producing the electrical diagram of the liquid crystal polymer thin film as claimed in claim 1, wherein in step (c), a bonding force of the
5 metal-molecule bonded layer bonded to the surface of the LCP thin layer is 9-11 kgf/cm², and wherein the metal-molecule bonded layer has a porosity of 1-5%.

6. The process for producing the electrical diagram of the liquid crystal polymer thin film as claimed in claim 1, wherein in step (d), the electrical diagram includes conductive wires of a width of not larger than 0.15mm for electrical
10 conduction.

7. The process for producing the electrical diagram of the liquid crystal polymer thin film as claimed in claim 1, wherein in step (d), the electrical diagram is used for anti-electromagnetic disturbance or electromagnetic shielding.

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