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(54) Title: DIGITALLY PRINTED HEAT TRANSFER LABEL

(57) Abstract: A heat transfer label assembly comprises a carrier, a release layer overlying a first side of the carrier, and a primer overlying the release layer such that the release layer is disposed between the carrier and the primer. The primer may comprise at least one polyacrylic acid polymer.

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DIGITALLY PRINTED HEAT TRANSFER LABEL

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. Provisional Application No. 61/197,090, filed October 23, 2008, which is incorporated by reference herein in its entirety.

TECHNICAL FIELD

This disclosure is directed generally to heat transfer labels and, more particularly, digitally printed heat transfer labels and methods of making such labels.

BACKGROUND

Digital printing is used widely in the field of printing, particularly for the preparation of prototypes, low quantity print runs, and for the customization of print media. In contrast to many other printing techniques, digital printing does not require the preparation of costly printing plates and therefore allows for rapid transitioning between designs.

Despite its advantages, it is believed that digital printing has not been used to make heat transfer labels. Heat transfer labels are labels that are printed in reverse onto a release carrier and transferred to a container using heat and pressure. The present inventors have discovered that there are unique challenges associated with the use of digital printing technology to print onto substrates with release layers. In particular, the heat associated with the digital printing process can cause premature softening of the release layer, which may result in defects in the print quality of the label and/or the decorated container. Thus, there remains a need for a heat transfer label and assembly suitable for use with digital printing.

SUMMARY

This disclosure is directed generally to a heat transfer label assembly that may be suitable for use with digital printing technology. The heat transfer label assembly includes a plurality of layers or components in a facing, contacting relationship with one another. In one example, the heat transfer label assembly includes a primer layer that comprises one or more materials that work in concert to assist with maintaining the stability of the heat transfer label assembly during the digital printing process. Other features and aspects of the invention will be apparent from the following description and the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

The description refers to the accompanying drawings in which like reference characters refer to like parts throughout the several views, and in which:

FIG. 1A is a schematic cross-sectional view of an exemplary heat transfer label assembly;

FIG. 1B is a schematic perspective view of a decorated container including, for example, the label of **FIG. 1A**; and

FIG. 2 is a schematic cross-sectional view of another exemplary heat transfer label assembly.

DESCRIPTION

Various aspects of the disclosure may be illustrated by referring to the figures, in which the relative widths of the various layers generally indicate the relative area of each layer in the structure. It will be understood that the relative thicknesses of the various layers may be altered or exaggerated for purposes of illustration, and that such thicknesses are not indicative of actual or relative thicknesses of actual structures. Further, although several different exemplary aspects, implementations, and embodiments are provided, numerous interrelationships between, combinations thereof, and modifications of the various inventions, aspects, implementations, and embodiments are contemplated hereby.

FIG. 1A depicts a schematic cross-sectional view of an exemplary heat transfer label structure or assembly **100**. The assembly **100** generally includes a plurality of layers including a carrier or substrate **102**, a release coating or layer **104**, a primer or primer layer **106**, an ink **108**, which may be digitally printed, and an adhesive (or adhesive coating or layer) **110**. Each layer **102**, **104**, **106**, **108**, **110** is in a substantially facing, contacting relationship with the respective adjacent layer(s). Layers **106**, **108**, **110**, and in some instances, at least a portion of layer **104**, generally define a label **112**. When the label **112** is joined to a container **114** (**FIG. 1B**), the adhesive **110** generally faces the exterior surface of the container **114**.

While one specific structure or assembly **100** is illustrated schematically in **FIG. 1**, it will be appreciated that each of the layers of the heat transfer label assembly **100** may vary for each packaging application. All layer names are provided for convenience of explanation and not limitation in any manner. Further, layers may be added or omitted as needed. By way of example, the adhesive **110** may be omitted in some embodiments where another means of securing the label **112** is provided. Other modifications are contemplated.

The heat transfer label assembly **100** may be used in the conventional manner using heat and pressure to transfer the ink **108**, primer **106**, and adhesive coating **110** of the label **112** to a container **114** in the conventional manner. Specifically, according to one exemplary method, the assembly **100** may be brought into intimate contact with the surface of the container **114** with the adhesive **110** facing the container **114**. Heat and pressure may be applied to the assembly **100**. The heat softens the release coating **104** and allows the primer **106**, ink **108**, and adhesive **110** to separate from the carrier **102**, while the application of pressure transfers the primer **106**, ink **108**, and adhesive **110** to the container **114**. Additionally, at least some of the release coating **104** may transfer to the container **114**. Thus, the outermost layer of the transferred label **112** may comprise primer **108** and/or release coating **104**. The decorated container may then be subject to a flaming process, during which any release layer **104** material

transferred to the container is re-melted, thereby imparting a glossy finish to the label **112** on the container **114**.

A plurality of labels **112** may be indexed along the length of the carrier **102** so that a multitude of containers **114** can be decorated using an automated process. It will be noted that the figures illustrate only one of such labels **112**.

Various materials may be used to form each layer of the heat transfer label assembly **100**, and each layer may have various basis weights or coat weights, depending on the particular application.

The substrate or carrier **102** generally comprises a base material on which the remaining layers of the assembly are supported. Accordingly, some layers may be described as "overlying" or being "on" other layers. However, it will be appreciated that the assembly **100** may be inverted, such that the carrier **102** overlies the other layers. Accordingly, such terminology is provided merely for convenience of explanation and not limitation in any manner.

The carrier **102** may generally comprise a flexible material, for example, paper. The paper may include a clay coating on one or both sides. The paper may have a basis weight of from about 5 to about 75 lbs/ream (i.e., lbs/3000 sq. ft.), for example, about 10 to about 50 lbs/ream, for example, from about 20 to about 30 lbs/ream. However, other ranges and basis weights are contemplated. In other instances, the carrier **102** may comprise other materials, for example, a polymer film. Other suitable carriers may be used.

The release layer **104** generally comprises a substance that softens in response to heat. In one particular example, the release layer comprises a wax or a blend of waxes. Generally, the release layer **104** is formed from a material having a sufficiently low softening point so the transfer of the label **112** (i.e., the separation of the carrier **102** from the label **112**) can be initiated at a relatively low temperature ("release temperature" or "transfer temperature"), for example, from about 50°C to about 85°C, for example, from about 55°C to about 75°C, for example, from about 60°C to about 70°C. In one particular example, the release layer **104** comprises a blend of waxes having a softening temperature of about

65°C. However, the softening temperature of the release layer may vary for each application. Accordingly, other suitable materials may be used.

As with the various other layers of the assembly **100**, the release layer **104** may be present in any suitable amount needed to achieve the desired printing and/or transfer characteristics. In one example, the release layer **104** may have a basis weight of from about 2 to about 12 lbs/ream (on a dry basis), for example, from about 5 to about 9 lbs/ream. Other ranges and basis weights are contemplated. The release layer **104** may be deposited on or applied to the carrier **102** using any suitable technique, for example, using a Meyer rod or roll coater. Where the carrier **102** is a clay coated paper, the release layer **104** may be applied to the clay coated side of the paper if desired.

The primer **106** generally comprises a substance that prepares the surface of the release layer **104** for receiving ink **108**, which may be applied using digital printing or any other suitable technique. The selection of the primer determines the visual quality of the printing, i.e., the ink receptivity, ink adhesion, and rub resistance of the ink.

Where the ink **108** is to be printed using digital printing, the present inventors have found that the temperatures associated with typical digital printing processes (e.g., the blanket temperature, typically about 30-40°C) may exceed the softening temperature of the release layer **104**, which may cause the release layer **104** to soften and/or destabilize, thereby potentially causing various defects in the label **112**. Such defects may include a reduction in print quality due to the overall destabilization of the printing surface (e.g., the primer **106** on the softened release layer **104**), premature separation of the label **112** from the carrier **102**, and/or "stringing" of the release layer **104** (and possibly primer **106**), particularly along the peripheral edges or boundaries of the transferred label **112**. Accordingly, the primer **108** may be selected to assist with stabilizing the release layer **104**, for example, by having a chemical affinity for the release layer material **104** (e.g., wax), and/or by providing some degree of thermal insulation to reduce the amount of heat transferred from the blanket to the release layer **104**.

It will be appreciated that numerous primers (i.e., primer compositions) may be suitable for stabilizing the release layer **104**. In one example, the primer **108** may comprise a polyacrylic acid polymer, for example, a polyacrylic acid copolymer. In one particular example, the polyacrylic acid polymer may comprise an ethylene acrylic acid copolymer. The primer **108** also may include other polymeric components, for example, a polyethylene polymer, or any other suitable polymer. The primer **108** also may include one or more non-polymeric components, for example, silica, wax, and/or talc. Still other components may be included.

Thus, in one specific example, the primer **108** may comprise a blend of a polyacrylic acid polymer and optionally, one or more non-polymeric components, for example, silica, wax, and/or talc. In another specific example, the primer **108** may comprise a blend of a polyacrylic acid polymer, a polyethylene polymer, and optionally, one or more non-polymeric components, for example, silica, wax, and/or talc. In still another specific example, the primer **108** may comprise a blend of a polyacrylic acid polymer and a polyethylene polymer. However, numerous other primer compositions are contemplated.

Some examples of materials that may be suitable for use in the primer include DIGIPRIME 4500 primer (formerly referred to as "GPI X5 experimental primer") (Michelman, Inc., Cincinnati, Ohio) and DIGIPRIME 4501 (formerly referred to as "GPI X12 experimental primer") (Michelman, Inc., Cincinnati, Ohio), both of which are believed to comprise at least one polyacrylic acid polymer, for example, a polyacrylic acid copolymer, such as an ethylene acrylic acid copolymer. It is also believed that DIGIPRIME 4500 primer and/or DIGIPRIME 4501 primer may include one or more non-polymeric components, for example, silica, wax, and/or talc. Another material that may be suitable for use in the primer is ADCOTE 50C35 adhesive (Rohm & Hass, Philadelphia, Pennsylvania), which is believed to comprise a polyethylene polymer. While not wishing to be bound by theory, it is believed that the ADCOTE 50C35 adhesive may assist with adhering the ink **108** to the release layer **104**.

The amount of each component in the primer may vary for each application, depending on the particular digital printing application. By way example, in various exemplary primers including a polyacrylic acid polymer and a polyethylene polymer, the ratio of the polyacrylic acid polymer to the polyethylene polymer may be from about 1:1 to about 20:1, for example, from about 2:1 to about 15:1, for example, from about 3:1 to about 12:1, for example, from about 3:1 to about 7:1, for example, from about 4:1 to about 6:1. In some specific examples, the ratio may be about 4:1, about 4.5:1, about 5:1, about 5.5:1, about 6:1, about 6.5:1, about 7:1, about 7.5:1, about 8:1, about 8.5:1, about 9:1, about 9.5:1, about 10:1, about 10.5:1, about 11:1, about 11.5:1, about 12:1, or any other suitable ratio.

Likewise, for the specific example of an exemplary primer comprising a blend of DIGIPRIME 4501 primer and ADCOTE 50C35 adhesive, the ratio of DIGIPRIME 4501 primer solids (including the polyacrylic acid polymer) to ADCOTE 50C35 adhesive solids (including the polyethylene polymer) may be from about 1:1 to about 20:1, for example, from about 2:1 to about 15:1, for example, from about 3:1 to about 12:1, for example, from about 3:1 to about 7:1, for example, from about 4:1 to about 6:1. In some specific examples, the ratio of solids may be about 4:1, about 4.5:1, about 5:1, about 5.5:1, about 6:1, about 6.5:1, about 7:1, about 7.5:1, about 8:1, about 8.5:1, about 9:1, about 9.5:1, about 10:1, about 10.5:1, about 11:1, about 11.5:1, about 12:1, or any other suitable ratio.

As illustrated in the Examples, the present inventors have discovered that a primer including one or more polyacrylic acid polymers and, optionally, one or more non-polymeric components (e.g., example, silica, wax, and/or talc), provides the desired level of printing quality and temperature resistance for digital printing applications. The present inventors have also discovered that the addition of an additional polymeric component, for example, a polyethylene polymer, may enhance the quality of the label even further. However, it will be appreciated that numerous other suitable primers or primer compositions may be used.

The primer **106** may be present in the heat transfer label assembly in any suitable amount. For example, the primer may have a coat weight (dry) of from about 0.25 to about 2 lb/ream, for example, from about 0.5 to about 1 lb/ream. The primer **106** may be deposited on the release layer **104** using any suitable technique, for example, by flexographic or gravure printing. If needed or desired, the release layer **104** on the carrier **102** (e.g., a wax coated paper) may be subject to a corona treatment process to prepare the surface of the release layer **104** for receiving the primer. In one example, the corona treatment may be conducted at about 0.8 kW. However, other treatments are contemplated. After the primer **108** is applied, the partially constructed heat transfer label assembly may be dried.

The adhesive coating **110** generally comprises a material that is capable of adhering the ink to the container **114**. Accordingly, the type of adhesive used may vary depending on the type of container being used. For example, when the container is polyethylene, one suitable adhesive may be a polyamide adhesive. Alternatively, when the container is glass, one suitable adhesive may be a polyester adhesive. Numerous other possibilities are contemplated. Additionally, as stated previously, in some embodiments the adhesive **110** may be omitted.

Likewise, the amount of adhesive may vary for each application. The adhesive may generally be applied in an amount of from about 0.5 to about 3 lbs/ream (dry), for example, from about 1 to about 1.5 lb/ream. As shown in **FIG. 1A**, the adhesive coating **110** may extend beyond the peripheral margin of the ink **108** to facilitate adhesion to the container **114**. The adhesive may be applied to the ink using any suitable process, for example, by flexographic or gravure printing.

FIG. 2 schematically illustrates an exemplary variation of the heat transfer label structure **100** of **FIG. 1**. The heat transfer label assembly **200** of **FIG. 2** includes features that are similar to the assembly **100** shown in **FIG. 1**, except for variations noted and variations that will be understood by those of skill in the art. For simplicity, the reference numerals of similar features are preceded in the figures with a "**2**" instead of a "**1**".

In this example, the carrier (e.g., paper) **202** may be coated with a curable hold-out coating **216**, for example, an electron beam crosslinkable polymer. One

such coated paper is commercially available from Coating Excellence, International (Wrightstown, Wisconsin) under the reference name "35# C1S/2# EB Coating".

A release coating **204** may overlie the hold-out coating **216**. One example of a release coating that may be suitable is commercially available from Michelman, Inc. (Cincinnati, Ohio) under the trade name ML 162. However, numerous other release coatings are contemplated. The ink **208** then may be applied digitally to the primer **206**. The adhesive coating may **210** be omitted in some embodiments, as stated above.

The present disclosure may be understood further in view of the following examples, which are not intended to be limiting in any manner.

EXAMPLE 1

A heat transfer label assembly was prepared using digital printing. The ink was printed directly onto the wax side of a wax-coated paper. The wax somewhat softened during the printing process, presumably because the softening point of the wax (about 57°C) was slightly lower than the temperature of the ink applied (about 30-40°C). The premature softening of the wax rendered the label unsuitable for further use and evaluation.

EXAMPLE 2

A heat transfer label assembly was prepared using digital printing and a commercially available primer. First, paper having a basis weight of about 30 lb/ream coated with about 6 lb/ream wax (coat weight varied from about 4-9 lb/ream) was coated on the wax side with about 1 lb/ream of DIGIPRIME 4450 primer (Michelman, Inc., Cincinnati, Ohio). The primer was dried at a temperature of about 38°C at a line speed of about 50 ft/min. Next, an HP 4450 digital printer was used to apply a printed design over the primer.

The completed structure then was applied to a polyethylene terephthalate container in the conventional manner under heat and pressure (preheater temp about 90°C, platen temperature about 190°C +/- 25°C). The results were

acceptable and comparable to conventional heat transfer labels (e.g., printed using gravure printing or other conventional printing techniques). However, some "stringing" was observed as the wax-coated paper was separated from the label.

EXAMPLE 3

A heat transfer label assembly was prepared using digital printing and a primer including a polyacrylic acid polymer. Specifically, DIGIPRIME 4500 primer (Michelman, Inc., Cincinnati, Ohio) (previously termed "GPI X5" by Michelman, Inc. as an experimental primer) was applied to a wax-coated paper (same as used in Example 2) in an amount of about 1 to 1.5 lb/ream (dry). As stated previously, it is believed that DIGIPRIME 4500 primer may include at least one polyacrylic acid polymer and possibly one or more non-polymeric additives, for example, silica, wax, and/or talc. It is also believed that DIGIPRIME 4500 primer has a lower tensile strength than the DIGIPRIME 4450 primer.

The completed structure then was applied to a polyethylene terephthalate container in the conventional manner under heat and pressure as described in Example 2. The label was successfully applied without stringing. Thus, digital printing was used to prepare a heat transfer label successfully. While not wishing to be bound by theory, it is believed that the primer reduced heat transfer from the digitally applied ink to the wax-coated paper and assisted with reducing the stringing of the label when the remainder of the structure was removed.

EXAMPLE 4

Various primer compositions were used to prepare heat transfer label assemblies and evaluated as described in Example 3. The primer compositions included DIGIPRIME 4501 primer (about 21.5% solids, as provided) (Michelman, Inc., Cincinnati, Ohio) (previously termed "GPI X12" by Michelman, Inc. as an experimental primer) and, in some examples, ADCOTE 50C35 adhesive (about 34.0% solids, as provided) (Rohm & Hass, Philadelphia, Pennsylvania). The results are set forth in **Table 1**, in which the solids ratio refers to the ratio of DIGIPRIME 4501 primer solids to ADCOTE 50C35 adhesive solids, and in which

all values are approximate. It will be noted that although some blocking was observed with Sample 4, it is contemplated that this may be addressed using anti-blocking agents or otherwise.

Table 1.

Sample	Primer composition	Solids ratio	Results
1	100% DIGIPRIME 4501 primer	1:0	Limited print length before print distorted
2	92.2% DIGIPRIME 4501 primer 4.8% ADCOTE 50C35 adhesive 3.0% water	12:1	Results similar to Sample 1 with some improvement
3	85.4% DIGIPRIME 4501 primer 9.0% ADCOTE 50C35 adhesive 5.6% water	6:1	Significantly better print quality than Samples 1 and 2
4	79.6% DIGIPRIME 4501 primer 12.6% ADCOTE 50C35 adhesive 7.8% water	4:1	Results similar to Sample 3, with some blocking of roll observed

Although certain embodiments of this invention have been described with a certain degree of particularity, those skilled in the art could make numerous alterations without departing from the spirit or scope of this invention. Any directional references (e.g., upper, lower, upward, downward, left, right, leftward, rightward, top, bottom, above, below, vertical, horizontal, clockwise, and counterclockwise) are used only for identification purposes to aid the reader's understanding of various embodiments, and do not create limitations, particularly as to the position, orientation, or use of the invention unless specifically set forth in the claims. Joinder references (e.g., joined, attached, coupled, connected, and the like) are to be construed broadly and may include intermediate members between a connection of elements and relative movement between elements. As such, joinder references do not necessarily imply that two elements are connected directly and in fixed relation to each other.

It will be recognized by those skilled in the art, that various elements discussed with reference to the various embodiments may be interchanged to create entirely new embodiments coming within the scope of the present

invention. It is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative only and not limiting. Changes in detail or structure may be made without departing from the spirit of the invention. The detailed description set forth herein is not intended nor is to be construed to limit the present invention or otherwise to exclude any such other embodiments, adaptations, variations, modifications, and equivalent arrangements of the present invention.

Accordingly, it will be readily understood by those persons skilled in the art that, in view of the above detailed description of the invention, the present invention is susceptible of broad utility and application. Many adaptations of the present invention other than those herein described, as well as many variations, modifications, and equivalent arrangements will be apparent from or reasonably suggested by the present invention and the above detailed description thereof, without departing from the substance or scope of the present invention.

While the present invention is described herein in detail in relation to specific examples or aspects, it is to be understood that this detailed description is only illustrative and exemplary of the present invention and is made merely for purposes of providing a full and enabling disclosure of the present invention and to set forth the best mode of practicing the invention known to the inventors at the time the invention was made. The detailed description set forth herein is not intended nor is to be construed to limit the present invention or otherwise to exclude any such other embodiments, adaptations, variations, modifications, and equivalent arrangements of the present invention.

What is claimed is:

1. A heat transfer label assembly comprising:

a carrier;

a release layer overlying a first side of the carrier; and

a primer overlying the release layer such that the release layer is disposed between the carrier and the primer, the primer comprising a polyacrylic acid polymer.

2. The heat transfer label assembly of claim 1, wherein the polyacrylic acid polymer comprises a polyacrylic acid copolymer.

3. The heat transfer label assembly of claim 2, wherein the polyacrylic acid copolymer comprises an ethylene acrylic acid copolymer.

4. The heat transfer label assembly of claim 1, wherein the primer further comprises at least one of silica, wax, and talc.

5. The heat transfer label assembly of claim 1, wherein the primer further comprises a polyethylene polymer.

6. The heat transfer label assembly of claim 5, wherein the ratio of the polyacrylic acid polymer to the polyethylene polymer is from about 3:1 to about 7:1.

7. The heat transfer label assembly of claim 5, wherein the ratio of the polyacrylic acid polymer to the polyethylene polymer is from about 4:1 to about 6:1.

8. The heat transfer label assembly of claim 1, wherein the release layer softens upon sufficient exposure to heat.

9. The heat transfer label assembly of claim 1, wherein the release layer comprises a wax.

10. The heat transfer label assembly of any of claims 1 to 9, wherein the label further includes an ink overlying the primer, such that the primer is disposed between the release layer and the ink.

11. The heat transfer label assembly of claim 10, wherein the ink is digitally printed onto the primer.

12. The heat transfer label assembly of claim 10, wherein the label further includes an adhesive overlying the ink, such that the ink is disposed between the primer and the adhesive.

13. A method of making a heat transfer label assembly, comprising:

applying a release layer to a carrier;

applying a primer to the release layer, the primer comprising a polyacrylic acid polymer; and

digitally printing an ink onto the primer.

14. The method of claim 13, wherein the polyacrylic acid polymer comprises a polyacrylic acid copolymer.

15. The method of claim 14, wherein the polyacrylic acid copolymer comprises an ethylene acrylic acid copolymer.

16. The method of claim 13, wherein the primer further comprises at least one of silica, wax, and talc.

17. The method of claim 13, wherein the primer further comprises a polyethylene polymer.

18. The method of claim 17, wherein the ratio of the polyacrylic acid polymer to the polyethylene polymer is from about 3:1 to about 7:1.

19. The method of claim 17, wherein the ratio of the polyacrylic acid polymer to the polyethylene polymer is from about 4:1 to about 6:1.

20. The method of any of claims 13 to 19, further comprising applying an adhesive to the digitally printed ink.

21. A method of decorating a container, comprising:

bringing a heat transfer label assembly into contact with a container, the heat transfer label assembly including

a carrier,

a release layer on a first side of the carrier,

a primer disposed on the release layer,

a digitally printed ink deposited on the primer, the heat transfer label assembly being positioned so that the ink is facing the container;

applying heat to the heat transfer label assembly in contact with the container, thereby softening the release layer; and

separating the carrier and, optionally, at least a portion of the release layer from the container, such that the ink is deposited on the container with the ink being disposed between the container and the primer.

22. The method of claim 21, wherein the primer comprises a polyacrylic acid polymer.

23. The method of claim 22, wherein the primer further comprises at least one of silica, wax, and talc.

24. The method of claim 22, wherein the polyacrylic acid polymer comprises a polyacrylic acid copolymer.

25. The method of claim 24, wherein the polyacrylic acid copolymer comprises an ethylene acrylic acid copolymer.

26. The method of claim 22, wherein the primer further comprises a polyethylene polymer.

27. The method of claim 26, wherein the ratio of the polyacrylic acid polymer to the polyethylene polymer is from about 3:1 to about 7:1.

28. The method of claim 26, wherein the ratio of the polyacrylic acid polymer to the polyethylene polymer is from about 4:1 to about 6:1.

29. The method of any of claims 21 to 28, wherein

the heat transfer label assembly further includes an adhesive on the ink, and

the method further comprises adhering the ink to the container with the adhesive.

30. A primer for digitally printing an ink onto a release layer, the primer comprising at least one of a polyacrylic acid polymer and a polyethylene polymer.

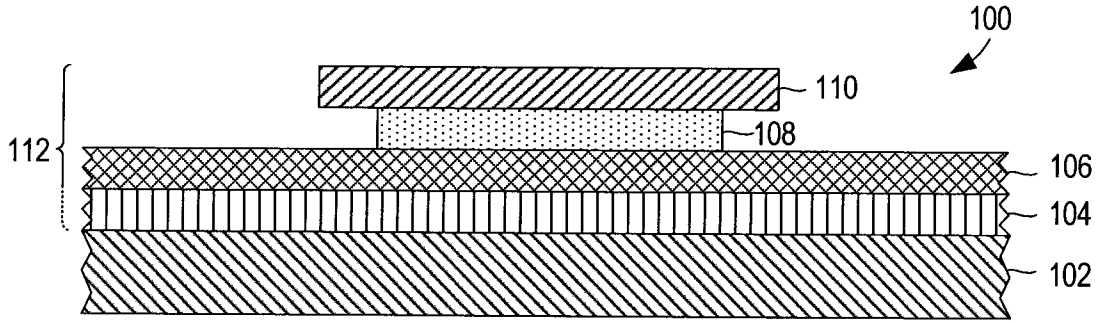

FIG. 1A

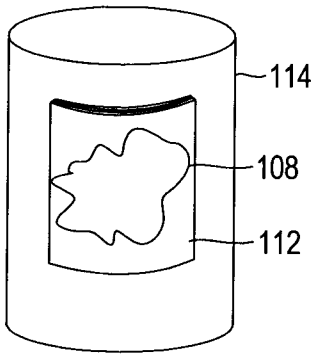

FIG. 1B

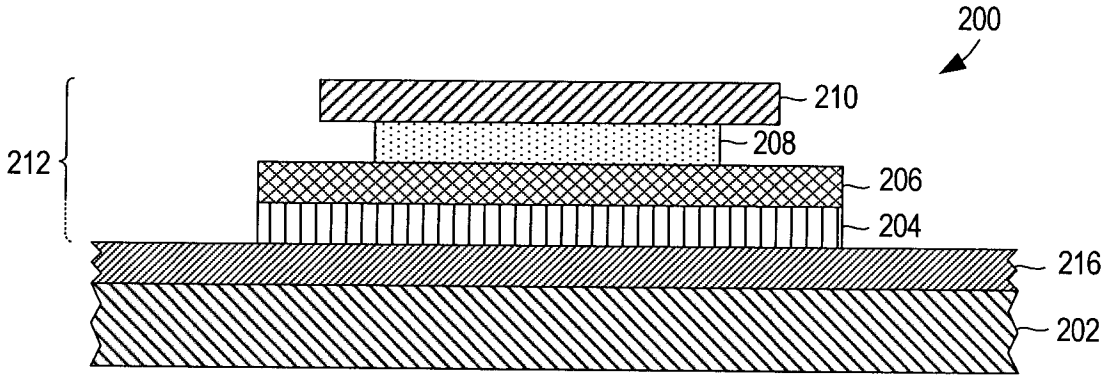

FIG. 2