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(54) **DEVICE AND METHOD FOR PRINTING FUNCTIONAL MATERIAL ON BIOCOMPATIBLE THIN-FILM**

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(52) **U.S. Cl.**

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USPC **156/240**; 156/381

(57) **ABSTRACT**

A device for printing a functional material on a biocompatible thin-film is provided, including: a feeder for feeding a thin-film sheet including the biocompatible thin-film and a first support into the printing device; a controller for loading makeup information for printing the functional material on the thin-film; a printing unit for printing the functional material corresponding to the makeup information on the thin-film based on a makeup signal from the controller; a feeder for feeding a second support into the device; a transfer unit for transferring a thin-film printed body, the thin-film on which the functional material is printed by the printing unit from the first support to the second support; and a delivery unit for delivering the transferred thin-film printed body to outside the device. This configuration enables people who lack sufficient makeup knowledge, techniques, or time to apply makeup easily, quickly, and safely.

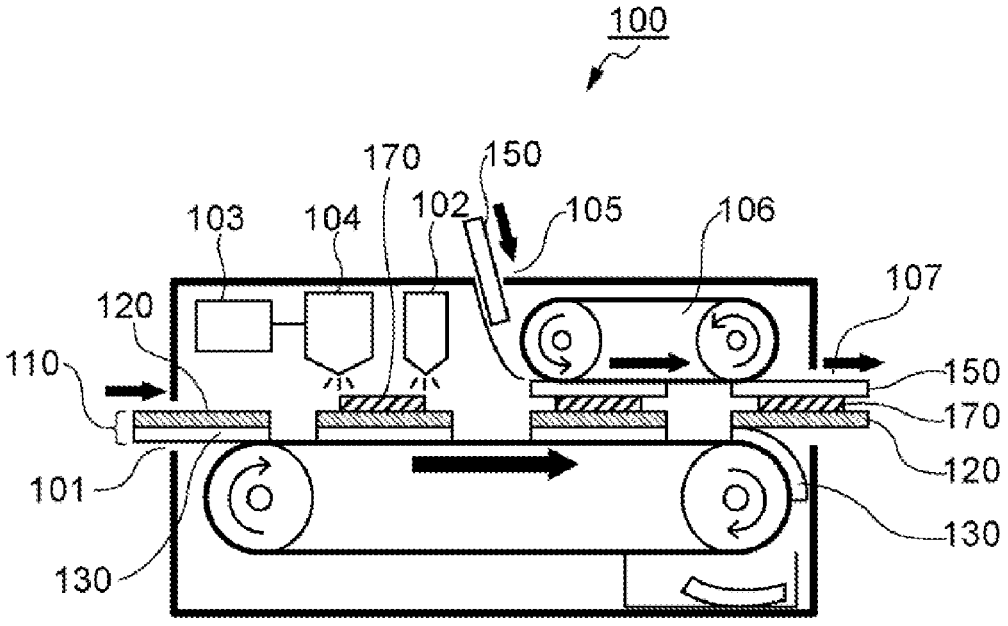


FIG. 1

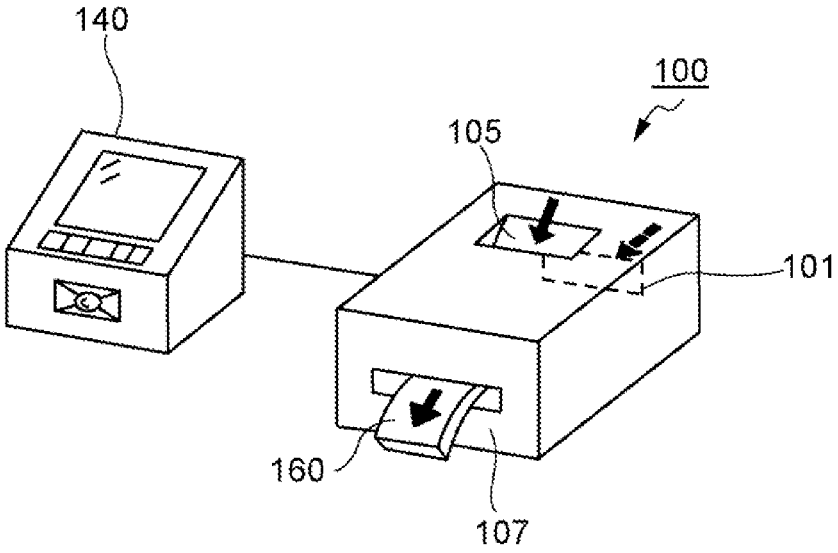

140
100
105
101
160
107

FIG. 2

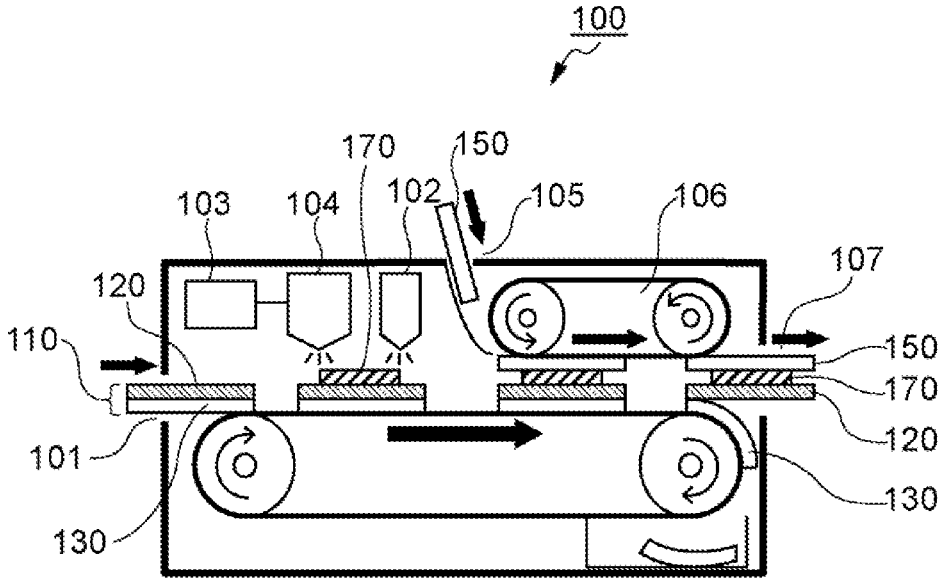

100
170
150
103
104
102
105
106
107
120
110
150
170
120
101
130
130

FIG. 3

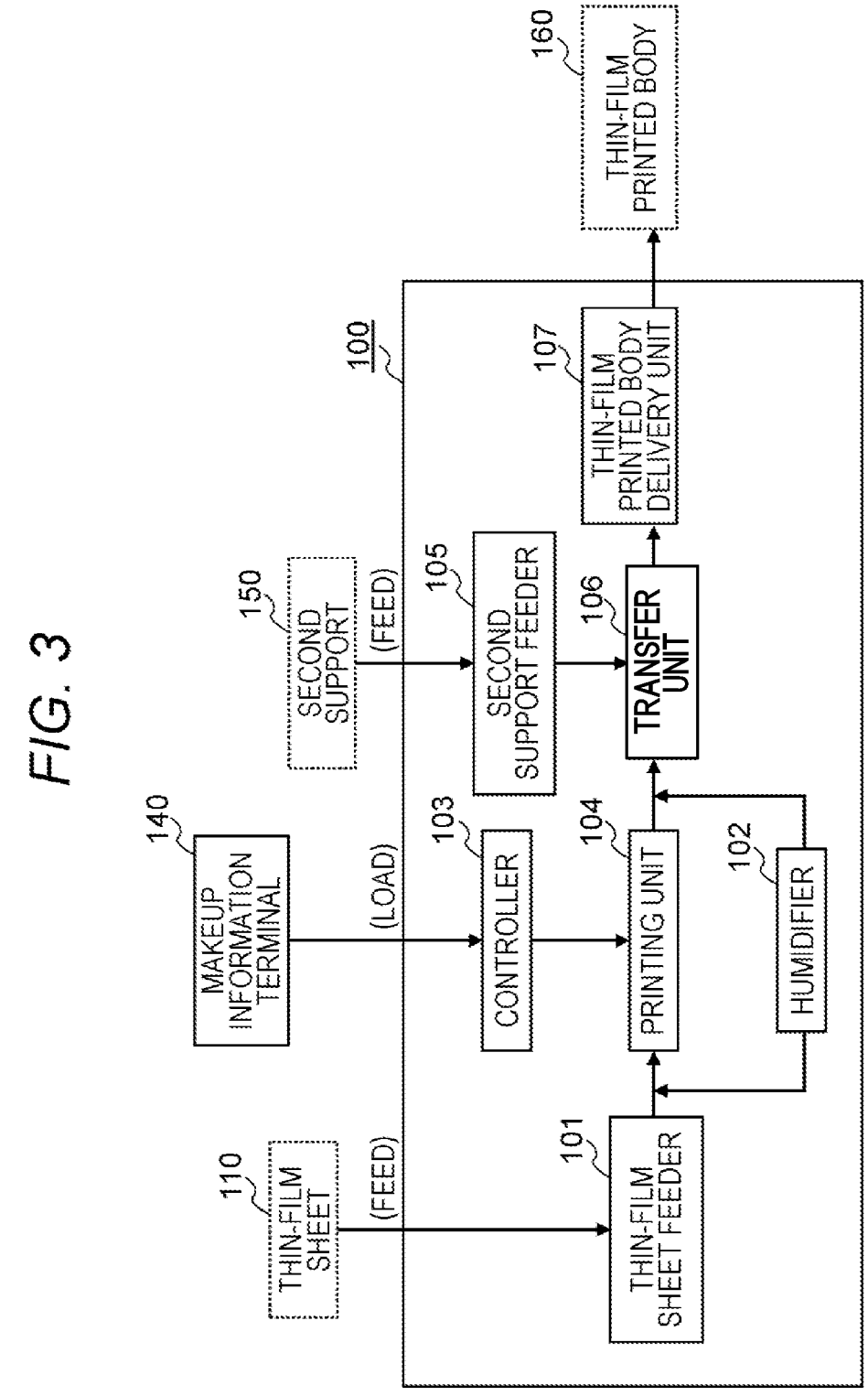

160
THIN-FILM PRINTED BODY
100
107
THIN-FILM PRINTED BODY DELIVERY UNIT
150
SECOND SUPPORT
(FEED)
105
SECOND SUPPORT FEEDER
106
TRANSFER UNIT
140
MAKEUP INFORMATION TERMINAL
(LOAD)
103
CONTROLLER
104
PRINTING UNIT
102
HUMIDIFIER
110
THIN-FILM SHEET
(FEED)
101
THIN-FILM SHEET FEEDER

FIG. 4A

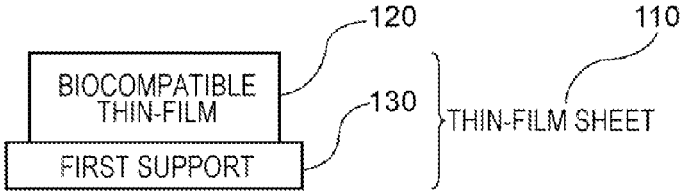


FIG. 4B

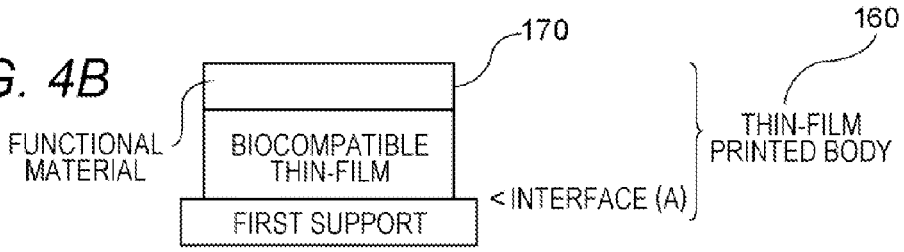


FIG. 4C

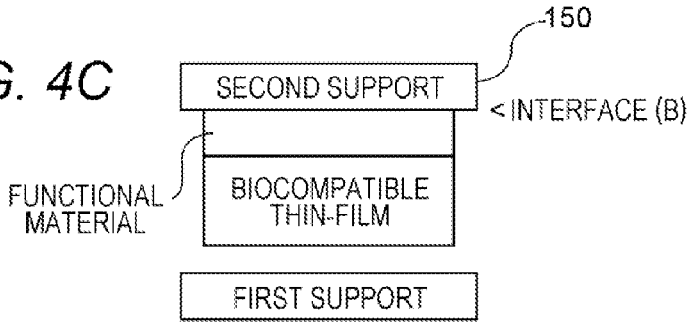


FIG. 4D

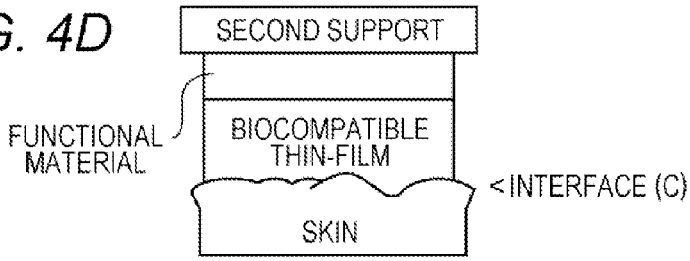
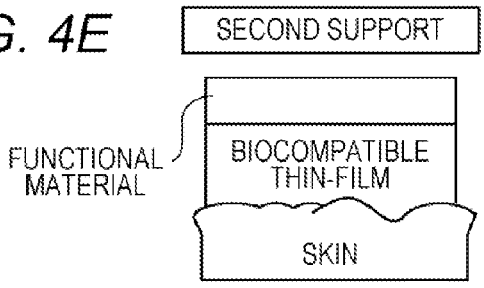


FIG. 4E



DEVICE AND METHOD FOR PRINTING FUNCTIONAL MATERIAL ON BIOCOMPATIBLE THIN-FILM

TECHNICAL FIELD

[0001] The present disclosure relates to a device and a method for printing a functional material used, for example, in cosmetic and medical fields on a biocompatible thin-film.

BACKGROUND ART

[0002] In recent years, methods for facial makeup (hereinafter simply referred to as "makeup") have diversified. This makes it difficult, particularly for people who do not have sufficient knowledge about makeup, to select appropriate makeup from countless options. This is because it takes an enormous amount of time and effort to actually try every makeup to determine and compare the makeup.

[0003] In view of the above, for example, PTL 1 and PTL 2 disclose techniques for generating and presenting a simulation image of a face when makeup is applied. Each of the techniques (hereinafter referred to as the "conventional technique") disclosed in these patent literatures acquires an image by photographing a face to which makeup is to be applied. The conventional technique generates a simulation image by superimposing onto the acquired image an image that shows a makeup condition when lipstick, blush (rouge), and the like are applied to the face. Each of these conventional techniques then displays the generated simulation image on a display device.

[0004] Based on the display image, a user can determine suitability of the makeup without actually applying the makeup for comparison and consideration, thereby allowing selection of appropriate makeup with less time and effort.

[0005] However, even when makeup suitable for oneself is proposed with such a simulation image, actually applying the makeup to oneself needs a specific cosmetic agent and a makeup set, and makeup techniques and makeup time of some extent or more.

[0006] Accordingly, some users may face difficulty in applying the proposed makeup to themselves or may have to take trouble to request a professional beautician or the like to apply the makeup.

[0007] The present disclosure therefore provides a device for printing a functional material based on makeup information, such as a cosmetic agent, on a biocompatible thin-film as an effective method for outputting a proposal result made by such a simulation device.

[0008] That is, the present disclosure provides a device and a method for printing a functional material on a biocompatible thin-film that allows simple application of makeup customized for an individual and the latest makeup to a human body by printing the functional material based on makeup information on the biocompatible thin-film, and by affixing the biocompatible thin-film on the human body.

CITATION LIST

Patent Literatures

[0009] PTL 1: Unexamined Japanese Patent Publication No. 2001-346627

[0010] PTL 2: Unexamined Japanese Patent Publication No. 2003-44837

SUMMARY

[0011] The present disclosure is directed to a device for printing a functional material on a biocompatible thin-film, the device including: a thin-film sheet feeder for feeding a thin-film sheet including the biocompatible thin-film and a first support into inside of the device for printing the functional material on the biocompatible thin-film; a controller for loading makeup information for printing the functional material on the biocompatible thin-film; a printing unit for printing the functional material corresponding to the makeup information on the biocompatible thin-film based on the makeup information from the controller; a second support feeder for feeding a second support into inside of the device for printing the functional material on the biocompatible thin-film; a transfer unit for transferring a thin-film printed body that is the biocompatible thin-film on which the functional material is printed by the printing unit from the first support to the second support; and a thin-film printed body delivery unit for delivering the thin-film printed body transferred to the second support to outside of the device for printing the functional material on the biocompatible thin-film.

[0012] Such a configuration enables, for example, people who do not have sufficient knowledge or techniques about makeup and people who cannot take time for makeup to apply makeup easily, quickly, and safely without assistance.

BRIEF DESCRIPTION OF DRAWINGS

[0013] FIG. **1** is a diagram illustrating an external appearance of a printing device according to a first exemplary embodiment of the present disclosure.

[0014] FIG. **2** is a diagram illustrating an internal structure of the printing device according to the first exemplary embodiment of the present disclosure.

[0015] FIG. **3** is a diagram illustrating a configuration of the printing device according to the first exemplary embodiment of the present disclosure.

[0016] FIG. **4**A is a diagram illustrating an operation of the printing device according to the first exemplary embodiment of the present disclosure.

[0017] FIG. **4**B is a diagram illustrating an operation of the printing device according to the first exemplary embodiment of the present disclosure.

[0018] FIG. **4**C is a diagram illustrating an operation of the printing device according to the first exemplary embodiment of the present disclosure.

[0019] FIG. **4**D is a diagram illustrating an operation of the printing device according to the first exemplary embodiment of the present disclosure.

[0020] FIG. **4**E is a diagram illustrating an operation of the printing device according to the first exemplary embodiment of the present disclosure.

DESCRIPTION OF EMBODIMENT

Findings Underlying the Present Disclosure

[0021] The present disclosure provides a printing device and a printing method for allowing simple application of makeup customized for an individual and the latest makeup to a human body by printing a functional material based on makeup information, such as a cosmetic agent, on a biocompatible thin-film medium, and by affixing the biocompatible thin-film medium on the human body.

[0022] This enables, for example, people who do not have sufficient knowledge or techniques about makeup and people who cannot take time for makeup to apply makeup easily, quickly, and safely.

[0023] However, the following problems may be considered in production of a thin-film printed body that is a biocompatible thin-film on which the functional material is printed.

[0024] First, since the thin-film itself is directly affixed on the human body, a biocompatible material that does not stimulate or damage the human body needs to be used. In addition, the thin-film is required to have an adhesive property such that the thin-film comes into intimate contact with skin even if an adhesive agent or the like is not laminated.

[0025] The thin-film printed body is required to have higher adhesive property of the biocompatible thin-film to the human body to allow good transfer to the skin, that is, to satisfy a relationship of "an adhesive force B<an adhesive force C" to be described later, whoever uses the thin-film printed body.

[0026] In order to reduce the makeup coming off due to sebum or the like and in order to allow the cosmetic agent to last long, preferably a thin-film side of the thin-film printed body is brought into intimate contact with a human body side.

[0027] Furthermore, since the biocompatible thin-film has a thickness of the order of nanometers, which is so thin that the user does not feel the thin-film is affixed on the skin, handling requires greatest care. For example, the thickness of the nanometer order causes the thin-film to dry easily. Once the thin-film dries, pliability of the thin-film decreases. Therefore, when the thin-film in a dry state absorbs moisture, for example, the pliability increases. However, since rigidity of the thin-film itself is low, it is very difficult to retain the thin-film in a plane state. There is another method of retaining the plane state of the thin-film by, for example, making the thin-film drift in a solution, which however imposes an inconvenience on affixation of the film.

[0028] Furthermore, since films to be affixed on skin have previously been thick, such as a sheet-shaped pack cosmetic agent and an adhesive plaster, it is possible to perform position adjustments on the skin as needed after affixation on the skin. However, for a thin-film that is so thin that the user does not feel the thin-film is affixed on the skin, it is difficult to manipulate the film after affixation on the skin.

[0029] Therefore, a printing device for producing a thin-film printed body is required to consider humidification for facilitating handling of the thin-film, and to consider secure transfer to the skin.

[0030] That is, in the present disclosure, in view of careful handling and good transfer of a cosmetic agent or the like required because a functional material, such as a cosmetic agent, is to be printed on a thin, delicate biocompatible thin-film medium, and in view of safety required because a thin-film printed body is to be affixed on a human body, a printing device has been created that allows printing of a functional material, such as a cosmetic agent, on a biocompatible thin-film.

[0031] An exemplary embodiment of the present disclosure will be described in detail below with reference to the drawings.

First Exemplary Embodiment

[0032] FIG. **1** is a diagram illustrating an external appearance of printing device **100** according to a first exemplary embodiment of the present disclosure. Printing device **100** is connected to makeup information terminal **140**, and can receive makeup information. Here, makeup information terminal **140** may include an input unit capable of receiving makeup information related to a user, a camera capable of photographing the user oneself, and the like. In addition, makeup information terminal **140** may be connected to a network to obtain makeup information from outside.

[0033] FIG. **2** is a diagram illustrating an internal structure of printing device **100** according to the first exemplary embodiment of the present disclosure. FIG. **2** schematically illustrates thin-film sheet **110** fed from thin-film sheet feeder **101** being delivered from thin-film printed body delivery unit **107** as thin-film printed body **160**.

[0034] With reference to FIG. **3**, a description will now be given of a configuration of printing device **100** according to the first exemplary embodiment of the present disclosure. FIG. **3** is a diagram illustrating the configuration of printing device **100** according to the first exemplary embodiment of the present disclosure.

[0035] Printing device **100** includes thin-film sheet feeder **101**, humidifier **102**, controller **103**, printing unit **104**, second support feeder **105**, transfer unit **106**, and thin-film printed body delivery unit **107**.

[0036] Thin-film sheet feeder **101** includes a roller and drive mechanism for feeding thin-film sheet **110** from outside of printing device **100** into inside of printing device **100**.

[0037] Here, thin-film sheet **110** is biocompatible thin-film **120** mounted on first support **130** in advance, thin-film **120** serving as a base for printing a functional material, such as a cosmetic agent. Thin-film sheet **110** is provided, for example, in a form of a seal or a roll.

[0038] In such thin-film sheet **110**, an interface (A) between biocompatible thin-film **120** and first support **130** is retained by, for example, static electricity, chemical adsorption, and physical adsorption. A surface of first support **130** of thin-film sheet **110** has, for example, a hydrophilic group.

[0039] Thin-film sheet feeder **101** rolls and feeds thin-film sheet **110** into inside of printing device **100** while rotating a roller that comes in contact with only a first support part of thin-film sheet **110** to avoid damaging biocompatible thin-film **120** of thin-film sheet **110**.

[0040] Here, biocompatible thin-film **120** in thin-film sheet **110** is required to have a characteristic suitable for print of functional materials such as a cosmetic agent and a medical material, and for subsequent affixation on the human body. In other words, the thin-film itself is a biocompatible, safe material that does not have adverse health effects on the human body, such as a stimulus and a hazardous property.

[0041] Preferably, a surface of biocompatible thin-film **120** on a side on which functional material **170** is printed fixes functional material **170** or the like well, and does not allow a component of functional material **170** or the like to penetrate to a surface on an opposite side that is to be affixed onto the human body. This minimizes damage caused by the cosmetic agent or the like to the human body.

[0042] In addition, a surface of biocompatible thin-film **120** to be affixed on the human body has an adhesive property capable of coming into intimate contact with skin by itself without the need for another material, such as an adhesive agent. This makes it possible to prevent damage caused by the adhesive agent or the like to the human body, to eliminate a

process of adding an adhesive layer to biocompatible thin-film **120**, and to facilitate manufacturing of thin-film printed body **160**.

[0043] Since biocompatible thin-film **120** supports functional material **170**, such as a printed cosmetic agent, thin-film printed body **160** including biocompatible thin-film **120** and functional material **170** is adapted to be transferred to skin by being pressed against the skin.

[0044] As such a thin-film, for example, a nano thin-film or the like based on a nano sheet of a biocompatible polymer can be used.

[0045] Humidifier **102** has a mechanism for humidifying thin-film sheet **110**. Humidifier **102** can improve pliability of biocompatible thin-film **120** and lower an adhesive force of the interface (A) between first support **130** and thin-film **120** by, for example, spraying vapor or water-soluble liquid, or by putting thin-film sheet **110** in water or water-soluble liquid. Here, water (vapor) and water-soluble liquid are used because of safety for the human body and being non-stimulative to skin. Furthermore, it is also possible to use water (vapor) and water-soluble liquid with an intention of making the water more antiseptic or maintaining a wet condition of the thin-film for a long time by adding another component into the water-soluble liquid.

[0046] Humidifier **102** is, for example, humidifier **102** maintained at constant humidity, and humidifies biocompatible thin-film **120** by putting thin-film **120** in a constant humidity environment. Alternatively, humidifier **102** humidifies thin-film **120** by causing a base material containing water or water-soluble liquid to come into contact with biocompatible thin-film **120**.

[0047] Humidifier **102** may be provided before or after printing, or both before and after printing in printing unit **104**. However, it is possible to obtain an effect of the present exemplary embodiment even if humidifier **102** is not provided.

[0048] For example, at a time of printing functional materials that have poor compatibility with water or water-soluble liquid and are difficult to print when the above-described component exists (is easy to print and fix in a dry state), such as a cosmetic agent and a medical material, humidification is preferably performed by humidifier **102** after printing.

[0049] When thin-film printed body **160** is not transferred to skin immediately after production, it is necessary to maintain thin-film printed body **160** within printing device **100**. As described above, thin-film printed body **160** is easy to dry because of the thickness of the order of nanometer. Accordingly, when thin-film printed body **160** is not transferred to the skin immediately, humidifier **102** can be used for humidifying again the thin-film that has dried with lowered pliability just before thin-film printed body **160** is transferred to the skin. This allows a user to use, print, and transfer thin-film printed body **160** at any desired time without time constraints.

[0050] Controller **103** generates printing information about how functional material **170** or the like is to be printed on biocompatible thin-film **120**. Controller **103** includes a communication unit for communication with, for example, external makeup information terminal **140**, a signal processor, a storage unit, and the like. The generated printing information is sent to printing unit **104** as a printing signal (control signal for a printing operation of a head).

[0051] Makeup information terminal **140** with which controller **103** communicates provides makeup information that serves as a base for generating the printing information. The makeup information is, for example, information that shows details of makeup proposed for a user who wants to receive makeup assistance. The makeup information is provided, for example, as an application in makeup information terminal **140** or as cloud service from a server to which makeup information terminal **140** is connected.

[0052] Printing unit **104** has a head mechanism for printing functional material **170**, such as a cosmetic agent, on biocompatible thin-film **120** of thin-film sheet **110** based on the printing signal from controller **103**. Printing unit **104** employs a known printing method, for example, a bubble jet method and a thermal dye-sublimation method. The printing method is not limited as long as functional material **170**, such as a cosmetic agent, can be printed well on biocompatible thin-film **120**.

[0053] Second support feeder **105** includes a roller and drive unit for supplying second support **150** from outside of printing device **100** into inside of printing device **100**. Here, second support **150** is a support on which thin-film printed body **160** is transferred from first support **130**, and is provided in advance in a form of a seal or a roll. A surface of second support **150** may, for example, receive surface treatment for increasing hydrophilic properties, have an uneven pattern, or use a temperature-responsive polymer. A concentration of either positive or negative may be increased by applying an electric field or the like.

[0054] Transfer unit **106** transfers thin-film printed body **160** from first support **130** to second support **150** without damage to thin-film printed body **160**, thin-film printed body **160** having makeup information printed by printing unit **104** as functional material **170**. Transfer unit **106** includes, for example, a roller and a drive mechanism. At this time, transfer unit **106** transfers thin-film printed body **160** so that a surface of thin-film printed body **160** on which functional material **170** is printed comes into contact with second support **150**.

[0055] Thin-film printed body delivery unit **107** delivers thin-film printed body **160** produced in transfer unit **106** to outside of printing device **100** as needed. Thin-film printed body delivery unit **107** includes a roller and a drive unit. For example, thin-film printed body delivery unit **107** may be configured to deliver sheet-shaped thin-film printed body **160** in response to a user request to allow the user to affix thin-film printed body **160** by oneself. Alternatively, thin-film printed body delivery unit **107** may have a mechanism in which thin-film printed body delivery unit **107** itself is detachable and thin-film printed body **160** can be transferred directly from thin-film printed body delivery unit **107** to skin by pressing thin-film printed body **160** against a face of a person.

[0056] In addition, printing device **100** may include a cutting unit (not illustrated) before thin-film printed body delivery unit **107**, the cutting unit being for cutting biocompatible thin-film **120** or thin-film printed body **160** into a desired shape. For example, it is possible to assist simpler makeup by processing thin-film printed body **160** for local makeup, such as rouge and eye shadow, into a shape convenient for transfer to a makeup position.

[0057] Furthermore, printing unit **104** may also include a tank (not illustrated) for supplying functional material **170** to be printed on biocompatible thin-film **120**. For example, when an ink-jet printing unit is employed, the tank can retain and supply a liquid functional material. Similarly, printing unit **104** may also include a ribbon (not illustrated) for retaining functional material **170** to be transferred to biocompatible

thin-film **120**. For example, when a thermal transfer printing unit is employed, the ribbon can retain and supply a powdered functional material.

[0058] With the foregoing configuration, when thin-film printed body **160** generated according to the present exemplary embodiment is affixed on a human body, a cosmetic agent printed based on the makeup information is easily affixed on skin to produce a visual effect as if makeup has been applied. This enables people who do not have sufficient knowledge or techniques about makeup and people who cannot take time for makeup to apply makeup easily, quickly, and safely.

[0059] Next, operations of printing device **100** according to the first exemplary embodiment of the present disclosure will be described with reference to FIG. **3** and FIG. **4**A to FIG. **4**E.

[0060] FIG. **4**A to FIG. **4**E are diagrams each illustrating the operation of printing device **100** according to the first exemplary embodiment of the present disclosure.

[0061] First, thin-film sheet feeder **101** supplies thin-film sheet **110** from outside of printing device **100** to inside of printing device **100**.

[0062] Next, thin-film sheet **110** including biocompatible thin-film **120** and first support **130** is sent to printing unit **104**.

[0063] Here, printing unit **104** prints functional material **170** corresponding to makeup information from outside on biocompatible thin-film **120** in accordance with printing information generated by controller **103**.

[0064] At this time, controller **103** communicates with, for example, makeup information terminal **140** that is outside of printing device **100** to obtain the makeup information. Controller **103** generates the printing information about what printing is to be made on biocompatible thin-film **120** in order to apply the makeup, and transmits the printing information to printing unit **104** as a control signal.

[0065] Based on the control signal, printing unit **104** drives a head to print functional material **170** on biocompatible thin-film **120**.

[0066] As a result, thin-film printed body **160** is formed with functional material **170** laminated on biocompatible thin-film **120**.

[0067] As functional material **170**, it is possible to select not only a cosmetic agent for female makeup but also every material that can perform functions required in medical or other fields.

[0068] In addition, preferably a thickness of biocompatible thin-film **120** is between 10 nm and 10,000 nm inclusive (between 10 nm and 10 μm inclusive). Particularly, a thickness of between 10 nm and 500 nm inclusive is more preferable. This is because a test result shows that the adhesive property to skin is good when the thickness is 500 nm or less.

[0069] Furthermore, it is possible to use an arbitrary material as a material for biocompatible thin-film **120** with no particular limitation. Examples of the materials for the thin-film include polyesters represented by polyglycolic acid, polylactic acid, polycaprolactone, polyethylene succinate, and polyethylene terephthalate, or copolymers thereof; polyethers represented by polyethylene glycol and polypropylene glycol; polyamides represented by nylon, polyglutamic acid, and polyaspartic acid, or salts thereof; polysaccharides represented by pullulan, cellulose, starch, chitin, chitosan, alginic acid, hyaluronic acid, and cornstarch, or salts thereof; silicones represented by acrylic silicone and trimethylsiloxysilicate; acrylic acids represented by alkyl acrylate, silicone acrylate, and amide acrylate, or copolymers thereof; polyvinyl alcohol; polyurethane; polycarbonate; polyacid anhydride; polyethylene; and polypropylene.

[0070] Here, the makeup information means information for printing a material that supports some functional components such as components for wide variety of uses including cosmetic and medical uses on biocompatible thin-film **120** to be affixed on skin. The present exemplary embodiment only discloses makeup as an example.

[0071] For example, when the cosmetic use is considered, the makeup information is information for makeup of part or all of a face, and means wide-ranging makeup from makeup for concealing part of spots to full makeup of the entire face. However, when uses in other fields, for example, a medical use and the like are considered, a functional material used for a region other than a face can also be used.

[0072] Furthermore, the makeup information may be provided by analyzing makeup optimized for an individual user, and may be provided as information for applying the latest makeup or makeup for a specific celebrity as an application installed in makeup information terminal **140** or as cloud service from a server via a network.

[0073] In addition, when the medical use is considered, a use for concealing a scar, such as a bruise or a burn, and a use for printing a medicinal ingredient to be used on an affected part like an adhesive plaster can be considered.

[0074] That is, use functions widely needed can be suitably added by causing a functional component needed for each use to be supported regardless of a use field.

[0075] In addition, it is possible to freely design and print by oneself a seal for cheering sports, a seal to be affixed on a face in an amusement park, and the like.

[0076] Furthermore, with makeup information terminal **140**, it is also possible to analyze a user's individual beauty information from image information obtained by photographing the user's face, and to customize printing of a cosmetic agent. For example, it is also possible to have a skin-color correction function for matching a color with the user's skin color.

[0077] It is also possible to load individual face information to print an active ingredient (for example, a moisturizer, a sunscreen, a skin-whitening agent) only on a necessary place.

[0078] In addition, extraction of a characteristic point of the user's face makes it possible to print a positioning symbol or the like that assists the user in affixing the film simultaneously with a cosmetic agent, thereby assisting simpler makeup.

[0079] In printing unit **104**, thin-film sheet **110** on which functional material **170** is printed is humidified by humidifier **102** before being sent to transfer unit **106**. Such humidification improves softness of biocompatible thin-film **120**, and lowers an adhesive force of an interface (A) between first support **130** and biocompatible thin-film **120**.

[0080] Humidifier **102** facilitates and ensures transferring of thin-film printed body **160** from first support **130** to second support **150** in subsequent transfer unit **106**.

[0081] Then, humidified thin-film sheet **110** on which functional material **170** is printed is sent to transfer unit **106**. Here, thin-film printed body **160** with functional material **170** printed on biocompatible thin-film **120** is transferred to second support **150** supplied from outside of printing device **100** in advance by second support feeder **105** such that only a thin-film printed body **160** part comes into contact.

[0082] Operations of transferring will be described with reference to FIG. **4**A to FIG. **4**E.

[0083] In transfer unit **106**, second support **150** is brought into intimate contact with a functional material **170** side of thin-film printed body **160** on first support **130**.

[0084] Here, an adhesive force A and an adhesive force B are set to satisfy a relationship of A<B in advance, the adhesive force A being at an interface (A) between first support **130** and biocompatible thin-film **120**, the adhesive force B being at an interface (B) between a surface of biocompatible thin-film **120** on which makeup information is printed and second support **150**. Accordingly, thin-film printed body **160** separates from first support **130** on a biocompatible thin-film **120** side, and comes into intimate contact with second support **150** on a functional material **170** side. As a result, thin-film printed body **160** is transferred well from first support **130** to second support **150**.

[0085] Then, thin-film printed body **160**, while being supported by second support **150**, is delivered to outside of printing device **100** by thin-film printed body delivery unit **107**.

[0086] Here, an adhesive force B and an adhesive force C are set to satisfy a relationship of B<C in advance, the adhesive force B being at an interface (B) between second support **150** and thin-film **120** on which makeup information is printed, the adhesive force C being at an interface (C) between a human body (skin) and biocompatible thin-film **120**. Accordingly, thin-film printed body **160** separates from second support **150** on a functional material **170** side, and comes into intimate contact with the skin on a biocompatible thin-film **120** side. As a result, thin-film printed body **160** is transferred well from second support **150** to the skin. A magnitude relationship of the adhesive forces can be evaluated by a quantitative evaluation using devices, such as a rheometer and a bondtester, and by visually determining a proportion of thin-film printed body **160** being transferred when thin-film printed body **160** is affixed on a base material or the skin.

[0087] In this way, thin-film printed body **160** that is biocompatible thin-film **120** on which functional material **170** is printed is transferred to the skin, and the makeup is completed.

[0088] Thin-film printed body delivery unit **107** not only delivers thin-film printed body **160** of a single sheet, but also may be configured as a detachable module that is a transfer device for enabling direct transfer from the module to the skin.

[0089] Finally, a method of printing a functional material on a biocompatible thin-film with the aforementioned device will be described.

[0090] This method includes:

[0091] (1) a thin-film sheet feeding step of feeding a thin-film sheet including a biocompatible thin-film and a first support into inside of a device for printing a functional material on the biocompatible thin-film,

[0092] (2) a step of loading makeup information for printing the functional material on the biocompatible thin-film,

[0093] (3) a printing step of printing a functional material corresponding to the makeup information on the biocompatible thin-film based on the makeup information from a controller,

[0094] (4) a second support feeding step of feeding a second support into inside of the device for printing the functional material on the biocompatible thin-film,

[0095] (5) a transfer step of transferring a thin-film printed body that is the biocompatible thin-film on which the functional material is printed by a printing unit from the first support to the second support, and

[0096] (6) a thin-film printed body delivery step of delivering the thin-film printed body transferred to the second support to outside of the device for printing the functional material on the biocompatible thin-film.

[0097] Here, a humidification step of humidifying the thin-film sheet may be added before or after the printing step of (3). Furthermore, the aforementioned method may include a cutting step of cutting biocompatible thin-film **120** on which functional material **170** is printed into a desired shape before the thin-film printed body delivery step of (6).

[0098] It will be appreciated from the foregoing description that the configuration of printing device **100** of the present exemplary embodiment makes it possible to easily obtain thin-film printed body **160** for assisting makeup.

[0099] The present exemplary embodiment eliminates a concern about an influence of a printing agent on a living body because a printing surface of functional material **170** of thin-film printed body **160** is always on an opposite side of a surface on a side that is to be transferred to skin. That is, since only a biocompatible thin-film side is transferred to the human body, a user having skin weak to functional material **170**, such as a cosmetic agent, can also apply makeup easily and freely without limitation to a cosmetic agent or the like. When low-load thin-film printed body **160** is transferred onto a bruise until a complete cure of the bruise that remains after treatment, thin-film printed body **160** will become an item for a user who worries the bruise by treatment to live daily life with a rich spirit.

[0100] Furthermore, since thin-film sheet **110** is humidified before or after printing of functional material **170**, thin-film printed body **160** can be peeled off from first support **130** with a small force during transferring from first support **130** to second support **150**. Therefore, it is possible to perform transferring in transfer unit **106** securely and safely, thereby allowing printing on a thin, delicate thin-film and secure handling until transfer to the skin.

[0101] It is needless to say that the present disclosure is not limited to the aforementioned exemplary embodiment and that various modifications may be made appropriately within the intended scope of the present disclosure.

[0102] The configuration of the present disclosure makes it possible to easily apply makeup customized for an individual or the latest makeup to a human body by printing a functional material based on makeup information, such as a cosmetic agent, on a biocompatible thin-film medium, and by transferring the thin-film medium to the human body.

[0103] This enables people who do not have sufficient knowledge or techniques about makeup and people who cannot take time for makeup to apply beautiful, safe makeup easily and quickly without assistance.

1. A device for printing a functional material on a biocompatible thin-film, the device comprising:

a thin-film sheet feeder configured to feed a thin-film sheet including the biocompatible thin-film and a first support into inside of the device for printing the functional material on the biocompatible thin-film;

a controller configured to load makeup information for printing the functional material on the biocompatible thin-film;

a printing unit configured to print the functional material corresponding to the makeup information on the biocompatible thin-film based on the makeup information from the controller;

a second support feeder configured to feed a second support into inside of the device for printing the functional material on the biocompatible thin-film;

a transfer unit configured to transfer a thin-film printed body that is the biocompatible thin-film on which the functional material is printed by the printing unit from the first support to the second support; and

a thin-film printed body delivery unit configured to deliver the thin-film printed body transferred to the second support to outside of the device for printing the functional material on the biocompatible thin-film.

2. The device for printing a functional material on a biocompatible thin-film according to claim **1**, wherein the thin-film sheet feeder feeds the thin-film sheet into inside of the device by rotating a roller that comes into contact with only the first support.

3. The device for printing a functional material on a biocompatible thin-film according to claim **1**, further comprising:

a humidifier configured to humidify the thin-film sheet.

4. The device for printing a functional material on a biocompatible thin-film according to claim **3**, wherein the humidifier sprays one of vapor and water-soluble liquid to humidify the thin-film sheet.

5. The device for printing a functional material on a biocompatible thin-film according to claim **3**, wherein the humidifier humidifies the thin-film sheet by putting the thin-film sheet in one of water and water-soluble liquid.

6. The device for printing a functional material on a biocompatible thin-film according to claim **3**, wherein the humidifier is provided downstream of the printing unit.

7. The device for printing a functional material on a biocompatible thin-film according to claim **1**, wherein the printing unit prints the functional material on part of the biocompatible thin-film based on user information.

8. The device for printing a functional material on a biocompatible thin-film according to claim **7**, wherein the printing unit prints a symbol for simplifying transfer on part of the biocompatible thin-film.

9. The device for printing a functional material on a biocompatible thin-film according to claim **1**, wherein the transfer unit transfers the thin-film printed body such that a surface of the thin-film printed body on which the functional material is printed comes into contact with the second support.

10. The device for printing a functional material on a biocompatible thin-film according to claim **1**, wherein, in the transfer unit, an adhesive force A and an adhesive force B satisfy a relationship of $A<B$, the adhesive force A being at an interface between the first support and the thin-film, the adhesive force B being at an interface between the thin-film surface on which the makeup information is printed and the second support.

11. The device for printing a functional material on a biocompatible thin-film according to claim **1**, wherein, in the transfer unit, an adhesive force B and an adhesive force C satisfy a relationship of $B<C$, the adhesive force B being at an interface between the thin-film surface on which the makeup information is printed and the second support, the adhesive force C being at an interface between the thin-film and skin to which the thin-film printed body is transferred.

12. The device for printing a functional material on a biocompatible thin-film according to claim **1**, further comprising:

a cutting unit configured to cut one of the thin-film and the thin-film printed body into a desired shape.

13. The device for printing a functional material on a biocompatible thin-film according to claim **1**, wherein the makeup information includes a skin-color correction function optimized for a skin color of each user.

14. The device for printing a functional material on a biocompatible thin-film according to claim **1**, further comprising:

a tank for supplying the functional material to be printed on the biocompatible thin-film.

15. The device for printing a functional material on a biocompatible thin-film according to claim **1**, further comprising:

a ribbon for retaining the functional material to be transferred to the biocompatible thin-film.

16. A method of printing a functional material on a biocompatible thin-film, the method comprising:

a thin-film sheet feeding step of feeding a thin-film sheet including the biocompatible thin-film and a first support into inside of a device for printing the functional material on the biocompatible thin-film;

a step of loading makeup information for printing the functional material on the biocompatible thin-film;

a printing step of printing the functional material corresponding to the makeup information on the biocompatible thin-film based on the makeup information from a controller;

a second support feeding step of feeding a second support into inside of the device for printing the functional material on the biocompatible thin-film;

a transfer step of transferring a thin-film printed body that is the biocompatible thin-film on which the functional material is printed by a printing unit from the first support to the second support; and

a thin-film printed body delivery step of delivering the thin-film printed body transferred to the second support to outside of the device for printing the functional material on the biocompatible thin-film.

17. The device for printing a functional material on a biocompatible thin-film according to claim **2**, further comprising:

a humidifier configured to humidify the thin-film sheet.

18. The device for printing a functional material on a biocompatible thin-film according to claim **17**, wherein the humidifier sprays one of vapor and water-soluble liquid to humidify the thin-film sheet.

19. The device for printing a functional material on a biocompatible thin-film according to claim **17**, wherein the humidifier humidifies the thin-film sheet by putting the thin-film sheet in one of water and water-soluble liquid.

20. The device for printing a functional material on a biocompatible thin-film according to claim **17**, wherein the humidifier is provided downstream of the printing unit.

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