STAMP, HOLDING PORTION, TRANSFER METHOD, METHOD FOR MANUFACTURING ELECTRIC/ELECTRONIC APPLICATION PRODUCT, METHOD FOR MANUFACTURING DISPLAY, AND HOLDING METHOD FOR HOLDING ON STAMP

TECHNICAL FIELD

[0001] The present disclosure relates to a stamp for transferring, to another substrate, a fine structure like a semiconductor element formed or placed on a substrate, a holding portion of the stamp, a transfer method by the stamp, a method for manufacturing an electric/electronic application product using the transfer method, a method for manufacturing a display, and a holding method for holding on the stamp.

BACKGROUND ART

[0002] In recent years, along with the development of microfabrication of semiconductor elements, a fine structure transfer technology using a stamp is getting

attention as assembling means for an electric/electronic application product utilizing semiconductor elements. In particular, a development is becoming active for technologies of manufacturing displays, such as a signage, a TV, a medical, an in-vehicle, a Pad, a smartphone and a smartwatch, and LED displays for AR/VR, by transferring, at one time, a single, a plurality or a large number like several tens of thousands of mini LEDs (LEDs that have respective shorter sides which are greater than or equal to 100 μm to several 100 μm) or micro LEDs (with respective shorter sides which are smaller than or equal to 100 μm, and furthermore, smaller than or equal to 50 μm) using such a technology.

[0003] Such a stamp includes, for example, a convex holding portion 2 that utilizes a PDMS (polydimethylsiloxane) rubber. A fine structure is caused to stick to such a holding portion 2, and is transferred from a supply substrate to a receiving

substrate. Depending on various conditions, such as a pressurizing condition, the thickness of a substrate, a dot height, the area of the stamp and the misalignment of the height positions of micro LEDs, however, a fine structure may unintendedly stick to the portion of the stamp other than the holding portion 2. Moreover, micro LEDs that are present as contaminants in a process environment like a cleansing solution, and other foreign materials may also stick to the stamp that is being handled. When, in particular, a micro LED sticks, since the contact area with the stamp is relatively large, removal of such an LED by cleansing is difficult. When a pick-up is attempted using such a stamp to which the micro LED is sticking, there is a possibility such that the sticking micro LED may contact and damage a new micro LED. Moreover, when the stamp to which a foreign material is sticking is utilized, the foreign material may stick to a micro LED at a transfer originator, a

micro LED or a substrate at a transfer destination. This causes a failure. Hence, as illustrated in FIG. 1, by providing tiny protrusions 49 at portions other than the holding portion 2, a micro LED is prevented from unintendedly sticking (e.g., Patent Document 1).

CITATION LIST

PATENT LITERATURES

[0004] Patent Document 1: Japan Patent No. 6453437

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0005] Even if the surface of the stamp other than the holding portion 2 is formed as a rough surface, however, it is difficult to completely prevent a fine structure from unintendedly sticking to the portions other than the holding portion 2 of the stamp. Conversely, when the protrusions 49 are provided at the surface of the stamp

other than the holding portion 2, a sticking fine structure may fall from the stamp prior to the cleansing process for the stamp, and may contaminate a transfer path, etc.

[0006] Hence, an objective of the present disclosure is to provide a stamp which prevents a fine structure from sticking to a surface of the stamp other than a holding portion thereof, and which can suppress, from the stamp, a fall of a fine structure that is unintendedly sticking to such a surface, the holding portion for the stamp, a transfer method by such a stamp, a method for manufacturing an electric/electronic application product utilizing such a transfer method, a method for manufacturing a display, and a holding method for holding on the stamp.

SOLUTION TO PROBLEM

[0007] (X1) In order to accomplish the above objective, a stamp according to the present disclosure is a stamp which is for transferring a fine structure, and which includes:

a base portion formed on a substrate;

a holding portion which is formed on the base portion, and which includes a holding surface for holding the fine structure; and

a sticking suppressing portion which is formed around the holding portion on the base portion, and which includes a plurality of convexities each including a sticking suppressing surface with a lower height than a height of the holding surface,

in which the sticking suppressing portion is formed so as to have, when the fine structure sticks to the sticking suppressing portion, adhesive force that does not allow the fine structure to fall by force that

is smaller than or equal to an own weight of the fine structure.

[0008] (X2) Moreover, a stamp according to the present disclosure is a stamp which is for transferring a fine structure, and which includes:

a base portion formed on a substrate;

a holding portion which is formed on the base portion, and which includes a holding surface for holding the fine structure; and

a sticking suppressing portion which is formed around the holding portion on the base portion, and which includes a plurality of convexities each including a sticking suppressing surface with a lower height than a height of the holding surface,

in which an area B of the sticking suppressing surface is greater than or equal to 1/100 times as an area A of the holding surface.

[0009] (X3) In this case, it is preferable that the area B of the sticking suppressing surface should be smaller than or equal to 1/2 times as the area A of the holding surface.

[0010] (X4) Furthermore, a stamp according to the present disclosure is a stamp which is for transferring a fine structure, and which includes:

a base portion formed on a substrate;

a holding portion which is formed on the base portion, and which includes a holding surface for holding the fine structure; and

a sticking suppressing portion which is formed around the holding portion on the base portion, and which includes a plurality of convexities each including a sticking suppressing surface with a lower height than a height of the holding surface,

in which the sticking suppressing portion is formed in a shape in such a way that, when a plane in a

same shape as a shape of the holding surface and the sticking suppressing portion contact with each other at an arbitrary position, a total contact area T between the plane and the sticking suppressing surface becomes greater than or equal to 1/100 times as an area A of the holding surface.

[0011] (X5) In this case, it is preferable that the sticking suppressing portion should be formed in a shape in such a way that, when the plane in the same shape as the shape of the holding surface and the sticking suppressing portion contact with each other at the arbitrary position, the total contact area T between the plane and the sticking suppressing surface becomes smaller than or equal to 1/2 times as the area A of the holding surface.

[0012] (X6) Still further, a stamp according to the present disclosure is a stamp which is for transferring a fine structure, and which includes:

a base portion formed on a substrate;

a holding portion which is formed on the base portion, and which includes a holding surface for holding the fine structure; and

a sticking suppressing portion which is formed around the holding portion on the base portion, and which includes a plurality of convexities each including a sticking suppressing surface with a lower height than a height of the holding surface,

in which the sticking suppressing portion is formed in a shape in such a way that, when the fine structure and the sticking suppressing portion contact with each other at an arbitrary position, a total contact area T' with the sticking suppressing surface becomes at least greater than or equal to 1/100 times as an area A' of the fine structure.

[0013] (X7) In this case, it is preferable that the sticking suppressing portion should be formed in a shape

in such a way that, when the fine structure and the sticking suppressing portion contact with each other at the arbitrary position, the total contact area T' with the sticking suppressing surface becomes smaller than or equal to 1/2 times as the area A' of the fine structure.

[0014] (X8) Yet still further, a stamp according to the present disclosure is a stamp which is for transferring a fine structure, and which includes:

a base portion formed on a substrate;

a holding portion which is formed on the base portion, and which includes a holding surface for holding the fine structure; and

a sticking suppressing portion which is formed around the holding portion on the base portion, and which includes a plurality of convexities each including a sticking suppressing surface with a lower height than a height of the holding surface,

in which a product of adhesive force of the material of the sticking suppressing surface by an area of the sticking suppressing surface is greater than or equal to 1/100 times as a product of adhesive force of the material of the holding surface by an area of the holding surface.

[0015] (X9) In this case, it is preferable that the product of the adhesive force of the material of the sticking suppressing surface by the area of the sticking suppressing surface should be smaller than or equal to 1/2 times as the product of the adhesive force of the material of the holding surface by the area of the holding surface.

[0016] (X10) Moreover, a stamp according to the present disclosure is a stamp which is for transferring a fine structure, and which includes:

a base portion formed on a substrate;

a holding portion which is formed on the base portion, and which includes a holding surface for holding the fine structure; and

a plurality of convexities which is formed on a side face connecting the base portion and the holding surface with each other, and each of which includes a sticking suppressing surface with a lower height than a height of the holding surface.

[0017] (X11) In this case, it is preferable that at least a part of the holding portion should be formed in a circular cylindrical shape, a polygonal columnar shape, a circular conical and trapezoidal shape, a polygonal pyramid and trapezoidal shape, or one of those shapes partially chamfered.

[0018] (X12) Furthermore, a transfer method according to the present disclosure can transfer a fine structure using the above-described stamp according to the present disclosure. A method for manufacturing an

electric/electronic application product according to the present disclosure includes a process of transferring the fine structure by the transfer method. A method for manufacturing a display according to the present disclosure includes the process of transferring the fine structure by the transfer method.

[0019] (X13) Still further, a holding portion according to the present disclosure is a holding portion which is a structural component of a stamp for transferring a fine structure, and which includes:

a holding surface for holding the fine structure;

a side face that extends toward an opposite surface to the holding surface; and

a plurality of convexities formed on the side face and each including a sticking suppressing surface.

[0020] (X14) A transfer method according to the present disclosure is a transfer method which is for transferring a fine structure by a stamp, and which includes:

a pick-up process to cause the fine structure to be held on a holding surface of the stamp; and

a releasing process to release the fine structure from the holding surface of the stamp,

in which the stamp includes:

a base portion formed on a substrate;

a holding portion which is formed on the base portion, and which includes the holding surface for holding the fine structure; and

a sticking suppressing portion which is formed around the holding portion on the base portion, and which includes a plurality of convexities each including a sticking suppressing surface with a lower height than a height of the holding surface, and

in which the sticking suppressing portion is formed so as to have, when the fine structure sticks to the sticking suppressing portion, adhesive force that does not allow the fine structure to fall by force that is smaller than or equal to an own weight of the fine structure.

[0021] (X15) In this case, it is preferable that such a method should further include a removing process capable of removing the fine structure from the sticking suppressing surface.

[0022] (X16) Moreover, a transfer method according to the present disclosure is a transfer method of a fine structure by a stamp that is picking up the fine structure subjected to transfer and also the fine structure not subjected to transfer,

in which the stamp includes:

a base portion formed on a substrate;

a holding portion which is formed on the base portion, and which includes a holding surface for holding the fine structure; and

a sticking suppressing portion which is formed around the holding portion on the base portion, and which includes a plurality of convexities each including a sticking suppressing surface with a lower height than a height of the holding surface,

in which the transfer method includes:

a pick-up process to cause the fine structure subjected to the transfer to be held on the holding portion; and

a transfer process to transfer the fine structure subjected to the transfer and held on the holding portion,

in which the fine structure not subjected to the transfer is held on the sticking suppressing portion in the pick-up process, and

in which adhesive force of the sticking suppressing portion is controlled in such a way that the fine structure not subjected to the transfer and held on the sticking suppressing portion is still being held on the sticking suppressing portion in the transfer process.

[0023] (X17) In this case, such a method may further include a removing process to remove the fine structure not subjected to transfer and still held on the sticking suppressing portion, in which the adhesive force of the sticking suppressing portion or removal force of the removing process is controlled in such a way that the fine structure not subjected to the transfer is removed by the removing process.

[0024] (X18) A method for manufacturing an electric/electronic application product according to the present disclosure includes the process of transferring a fine structure by the above-described transfer method according to the present disclosure. Moreover, a method

for manufacturing a display according to the present disclosure includes the process of transferring the fine structure by such a transfer method.

[0025] (X19) A holding method according to the present disclosure is a holding method for holding a fine structure not subjected to pickup on a stamp,

in which the stamp includes:

a base portion formed on a substrate;

a holding portion which is formed on the base portion, and which includes a holding surface for holding the fine structure; and

a sticking suppressing portion which is formed around the holding portion on the base portion, and which includes a plurality of convexities each including a sticking suppressing surface with a lower height than a height of the holding surface,

in which the holding method includes:

a pick-up process to cause the fine structure subjected to the pickup and placed on a supply substrate to be held on the holding surface of the stamp; and

a releasing process to cause the fine structure subjected to the pickup and held on the holding surface to be released from the holding surface and to be transferred to a receiving substrate, and

in which the fine structure not subjected to the pickup and detached from the supply substrate in the pick-up process is caused to stick to the sticking suppressing portion, the releasing process is carried out with the fine structure not subjected to the pickup being held on the stamp, and in a subsequent removing process, the fine structure not subjected to the pickup and held on the stamp is removed from the sticking suppressing surface.

ADVANTAGEOUS EFFECTS OF INVENTION

[0026] According to the stamp for transferring a fine structure, the holding portion for such a stamp, and the transfer method by such a stamp, when unintended sticking of a fine structure occurs, unintended fall thereof can be suppressed by the configuration of a sticking suppressing portion.

BRIEF DESCRIPTION OF DRAWINGS

[0027] FIG. 1 is a schematic cross-sectional view illustrating a conventional stamp;

FIG. 2 is a schematic cross-sectional view illustrating a stamp according to the present disclosure;

FIG. 3 is a schematic plan view illustrating the stamp according to the present disclosure;

FIG. 4 is a schematic plan view illustrating the stamp according to the present disclosure; and

FIG. 5 is a schematic cross-sectional view illustrating another stamp according to the present disclosure.

DESCRIPTION OF EMBODIMENTS

[0028] A description will be given below of a stamp 100 according to the present disclosure. As illustrated in FIG. 2 and FIG. 3, the stamp 100 according to the present disclosure is to transfer a fine structure 200, and includes a base portion 1 formed on a substrate 10, holding portions 2 each including a holding surface 21 to hold the fine structure 200, and a sticking suppressing portion 3 that includes a plurality of convexities 4 each including a sticking suppressing surface 41 that has a lower height than that of the holding surface 21.

[0029] The fine structure 200 herein means, in the broad sense, a fine object that is smaller than or equal to several mm. More specifically, an IC chip, one-

dimensional to three-dimensional packages on which ICs and LSIs are compositely mounted, an element that is an inorganic or organic semiconductor like a Light Emitting Diode (LED), and electric circuit elements, such as a resistor, a capacitor and a coil, are example fine structures 200 that are elements with a size which cannot be handled by a general chip bonder. In the case of, in particular, LEDs, needs for an element with a size that is smaller than or equal to several 100 μm are increasing. The present disclosure can be applied to, as appropriate, a structure that has at least partially a size in a μm-order.

[0030] When the fine structure 200 is an LED that is a so-called mini LED which is an LED having a shorter side from greater than or equal to 100 μm to several 100 μm, recent available LEDs have a height from 100 μm to 130 μm. In the case of a so-called micro LED that has a shorter side smaller than 100 μm, and furthermore,

smaller than 50 μm, a sapphire substrate layer is eliminated, and thus the thickness becomes 6 μm. In such a case, it is preferable that the unevenness in a surface of a stamp component 13 to which the fine structure 200 sticks should be within substantially several times as the thickness (the height) of the LED.

[0031] Furthermore, a fine object which is other than electric/electronic circuit elements and which cannot be directly grasped by vacuum suction can be transferred and then assembled using a fine structure transfer apparatus according to the present disclosure, thus involved in the fine structure 200 to be transferred according to the present disclosure.

[0032] The base portion 1 is formed on the substrate 10, and is a portion that becomes a base for the holding portion 2 and for the sticking suppressing portion 3 to be described below. The base portion 1 is not limited to any particular materials as far as such a material can be

a base for the holding portion 2 and for the sticking suppressing portion 3, but for example, resins, such as a silicone-based rubber and a PDMS (polydimethylsiloxane) rubber, are applicable.

[0033] When the base portion 1 is too thick, the fine structure 200 not subjected to the transfer is likely to contact the base portion 1 when the holding portion 2 is deformed. Moreover, when pressurized, the substrate 10 and the base portion 1 are likely to deform in a convex shape toward the opposite side to the pressurization direction, and from this point, the fine structure 200 not subjected to the transfer becomes likely to contact the base portion 1. Those become a cause of the unintended sticking of the fine structure 200. Hence, it is appropriate that the height of the base portion 1 is set to be smaller than or equal to three times as the height of the holding portion 2, preferably, smaller than

or equal to 1 time, more preferably, smaller than or equal to 1/2 times.

[0034] The substrate 10 is a portion that becomes a base for the base portion 1. The substrate 10 is not limited to any particular materials as far as such a material can be a base for the base portion 1, but for example, a fused silica glass substrate is applicable. It is preferable that the fused silica glass substrate should be synthetic fused silica glass. When the dimension of the fine structure 200 is small, and the height thereof becomes smaller than several 10 μm, the flatness of the base portion 1 that becomes the base for the holding portion 2 becomes more important. It is preferable that the variability in the flatness should be substantially within the height of the fine structure 200. In order to accomplish the flatness of the base portion 1 that is a silicone-based rubber film, the flatness of the fused silica glass substrate that is a

basal material thereof remarkably effects. Since the film thickness uniformity within a surface (Total Thickness Variation: TTV) that is smaller than or equal to substantially 1 μm can be accomplished in the case of the synthetic fused silica glass, application of the synthetic fused silica glass minimizes the variability in the film thickness throughout the whole stamp component. Moreover, the application of synthetic fused silica glass is advantageous since a thermal stability can be accomplished when the transfer action of the fine structure is repeated. That is, the synthetic fused silica glass substrate has a substantially 1/5 thermal expansion coefficient in comparison with those of other fused silica glass substrates, and thus thermal distortion during such an action can be made small. In particular, in the case of the stamp 100 that includes the holding portions 2, the positional displacement and flexure (distortion) of the holding surface 21 of the

holding portion 2 by thermal shrinkage can be reduced, enabling a precise transfer action. Note that the substrate 10 may be formed integrally with the base portion 1, etc. For example, the substrate 10, the holding portion 2 and the sticking suppressing portion 3 may be collectively molded by resin.

[0035] Moreover, it is preferable that the substrate should be a rigid substrate. Application of the rigid substrate can suppress a slack of the base portion between the holding portions in a pick-up process. Hence, in comparison with a case in which no rigid substrate is applied, the pressurization to the stamp in the pick-up process can be increased. According to the present disclosure, the term rigid substrate means a substrate that has no substantial change and distortion in the shape at the time of pressurization in the pick-up process, and specific examples are an inorganic substrate like the above-described fuses silica glass substrate,

and a metal substrate. Note that an organic substrate is also applicable as far as it is a rigid substrate, and even if an organic material applied for a flexible substrate is adopted, it becomes applicable as a rigid substrate by adjusting the thickness, etc., of the substrate. When a substrate is transparent to visible light, the fine structure can be easily observed through the stamp, facilitating an alignment, thus preferable.

[0036] The holding portion 2 is formed on the base portion 1, and includes the holding surface 21 to hold the fine structure 200. The number of the holding portions 2 on the base portion 1 may be one or multiple. When one such portion is placed on the base portion 1, one of the fine structures 200 placed densely on the supply substrate is selectively caused to stick to the holding surface 21 and to be picked up, and can be placed at an arbitrary position on the receiving substrate. This enables a repair such that the normal fine structure

200 is selectively transferred to the position of the defective fine structure 200. Conversely, when multiple such portions are placed on the base portion 1, the plurality of fine structures 200 corresponding to the respective positions of the holding portion 2 can be transferred at once.

[0037] The holding portion 2 may be in any shape as far as the fine structure 200 can be held, and may be designed as appropriate in accordance with the shape and dimension of the fine structure 200 so as to optimally hold such a structure. For example, at least a part of the holding portion 2 may be in a columnar shape, such as a circular cylindrical shape or a polygonal columnar shape, a trapezoidal shape, such as a circular conical and trapezoidal shape or a polygonal pyramid and trapezoidal shape, one of those shapes but chamfered, or a combination of those shapes.

[0038] Moreover, when the pitch between the holding portions 2 is large, the fine structure 200 not subjected to the transfer is likely to contact the base portion 1 when the holding portion 2 deforms. This becomes a cause of an unintended sticking of the fine structure 200. Hence, it is preferable that the pair of the holding portions 2 should be separated from each other by at least greater than or equal to 1/2 times as the height of the holding portion 2, preferably, greater than or equal to 1 time, more preferably, greater than or equal to twice.

[0039] Furthermore, the fine structure 200 which is not subjected to the transfer and which unintendedly sticks to the convexity 4 of the sticking suppressing portion 3 disrupts the transfer of the fine structure 200 that is subjected to the transfer when the height of the holding portion 2 is low. Hence, it is preferable that the holding portion 2 should be formed in a height that is at

least greater than or equal to twice as the total of the height of the convexity 4 and the height of the fine structure 200, preferably, greater than or equal to three times, and more preferably, greater than or equal to 5 times.

[0040] The material of the holding portion 2 is not limited to any particular materials as far as the fine structure 200 can be held without any damage, but for example, resins, such as silicone-based rubber and a PDMS (polydimethylsiloxane) rubber, are applicable. Moreover, the holding portion 2 and the base portion 1 may be formed of different materials from each other, but may be formed integrally with each other of the same material.

[0041] The holding surface 21 is a surface provided at a side of the holding portion 2 opposite to the base portion 1, and is to hold the fine structure 200 by the adhesive force of such a surface. The holding surface 21 allows the fine structure 200 to directly contact

therewith, thereby holding the fine structure 200. The holding surface 21 may be formed in any shape as far as the fine structure 200 can be held, and may be designed as appropriate in accordance with the shape and dimension of the fine structure 200 so as to accomplish the optimal adhesive force. When, for example, a surface of the fine structure 200 at a side at which such a structure is held by the holding surface 21 (will be referred to as a held surface 201 below) is rectangular in a planar shape, the holding surface may be formed in a rectangular shape in accordance with the foregoing rectangular shape. Moreover, the holding surface 21 is not limited to a flat surface.

[0042] The sticking suppressing portion 3 is a region formed around the holding portion 2 on the base portion 1. Moreover, the sticking suppressing portion 3 includes the plurality of convexities 4 each including the sticking suppressing surface 41 with a lower height than

that of the holding surface 21. This suppresses a sticking of the fine structure 200 to the base portion 1. The material of the sticking suppressing portion 3 is not limited to any particular materials, but for example, resins, such as a silicone-based rubber and a PDMS (polydimethylsiloxane) rubber, are applicable. Furthermore, the sticking suppressing portion 3 and the base portion 1 may formed of different materials from each other, but those may be formed integrally with each other of the same material.

[0043] Such a stamp can be produced by, for example, imprinting disclosed in WO2021/132142. In this case, integral molding with the same material may be facilitated by preparing, in advance, a mold that has molding patterns for the base portion, the holding portions and the sticking suppressing portion, respectively. Needless to say, other molding schemes may be also applied. Moreover, by dividing the molding

procedure into multiple steps, the base portion, the holding portions and the sticking suppressing portion can be molded of the different materials.

Furthermore, by providing the different materials to the sticking suppressing surface and/or the holding surface, the difference in adhesive force between the sticking suppressing surface and the holding surface can be controlled.

[0044] The sticking suppressing surface 41 is not limited to any particular surfaces as far as a sticking of the fine structure 200 can be suppressed, and may be a plane or a curved surface. Moreover, in addition to those characteristics, such a surface may employ a multi-faceted structure with vertices. In this case, it is preferable that the vertex angle of a cross-sectional shape which passes through a plane perpendicular to the surface of the base portion (the surface of the substrate) should be greater than or equal to 150

degrees. It is not necessary that the entire sticking suppressing surface is a plane or a curved surface, and such a surface may partially include a plane or a curved surface, or may be a combination thereof. Moreover, a space by a recess may be provided at the center portion, etc., or further fine concavities and convexities may be provided. As described above, a surface that is substantially planar is appropriately applied as the sticking suppressing surface.

[0045] The sticking suppressing portion 3 is formed so as to have smaller adhesive force to the fine structure 200 than that of the holding surface 21 in order to suppress a sticking of the fine structure 200. For example, the sticking suppressing portion 3 includes the plurality of convexities 4 so as to have a smaller area to which the fine structure 200 sticks than that of the holding surface 21.

[0046] Regarding the shape of the sticking suppressing surface, it is preferable that the long-axis diameter as viewed in a direction perpendicular to the surface of the base portion (the surface of the substrate) should be smaller than or equal to twice as the short-axis diameter, more preferably, smaller than or equal to 1.5 times, and further preferably, 1 time. The designing within such a range facilitates the sticking suppressing portion to increase the density of the convexities while suppressing a sticking of the fine structure not subjected to the pickup. In this case, the short-axis diameter is defined as the smallest pitch when the contour of the sticking suppressing surface is held between two parallel lines in contact therewith, and the long-axis diameter is defined as a pitch measured in a direction perpendicular to the short-axis direction. Forming the shape of the sticking suppressing surface in a shape, such as a circle, an ellipse, or a polygon,

facilitates a control for a relation between the long-axis diameter and the short-axis diameter.

[0047] Regarding the shape of the connection portion (the basal portion of the convexity) between the convexity forming the sticking suppressing portion and the base portion, like the shape of the sticking suppressing surface, it is preferable that the long-axis diameter as viewed in the direction perpendicular to the surface of the base portion (the surface of the substrate) should be smaller than or equal to twice as the short-axis diameter, more preferably, smaller than or equal to 1.5 times, and further preferably, 1 time. The designing within such a range facilitates the sticking suppressing portion to increase the density of the convexities while suppressing a sticking of the fine structure not subjected to the pickup. In this case, the short-axis diameter is defined as the smallest pitch when the contour of the connection portion (the basal portion

of the convexity) between the convexity and the base portion is held between two parallel lines in contact therewith, and the long-axis diameter is defined as a pitch measured in a direction perpendicular to the short-axis diameter. Forming the shape of the connection portion (the basal portion of the convexity) between the convexity and the base portion in a shape, such as a circle, an ellipse, or a polygon, facilitates a control for a relation between the long-axis diameter and the short-axis diameter.

[0048] It is preferable that the height of the convexity should be smaller than or equal to 1.5 times as the long-axis diameter of the connection portion (the basal portion of the convexity) between the convexity and the base portion, and more preferably, smaller than or equal to 1.0 time. In order to secure a distance to the surface of the base portion and to suppress a sticking of the fine structure not subjected to the pickup, it is

preferable to be greater than or equal to 0.3 times, and more preferably, greater than or equal to 0.5 times.

[0049] In addition, it is preferable that the sticking suppressing portion 3 should not only suppress a sticking of the fine structure 200 but also suppress, as illustrated in FIG. 3, a fall of, from the stamp 100 to a transfer path, etc., the fine structure 200 due to the own weight, etc., sticking once to the sticking suppressing portion 3. In order to accomplish such an effect, it is preferable that the sticking suppressing portion 3 should be formed so as to have, when the fine structure 200 sticks to the sticking suppressing portion 3, adhesive force which does not allow the fine structure 200 to fall by force that is at least smaller than or equal to the own weight. Various kinds of designing schemes are conceivable for such a sticking suppressing portion 3 with the fine structure 200 to be transferred

taken into consideration. For example, designing may be made as follow.

[0050] (1) When an area A of the holding surface 21 is to be formed based on the weight of the fine structure 200 to be held, an area B of the sticking suppressing surface 41 may be designed using a ratio with the area A of the holding surface 21. The inventors of the present disclosure found that, in order to stably hold the fine structure 200, it is necessary that the adhesion energy of the surface of the holding portion should be greater than or equal to 100 times as the necessary adhesion energy for holding the fine structure 200. Hence, when the holding surface 21 and the sticking suppressing surface 41 are formed of the same material, in order to suppress a fall of, from the stamp 100, the fine structure 200 sticking once, it is appropriate that the area B of the sticking suppressing surface 41 should be formed so as to be greater than or equal to 1/100 times

as the area A of the holding surface 21, more preferably, greater than or equal to 1/50 times, and further preferably, greater than or equal to 1/30 times.

Moreover, in order to suppress the fine structure 200 to stick to the sticking suppressing portion 3, it is preferable that the area B of the sticking suppressing surface 41 should be formed so as to be smaller than or equal to 1/2 times as the area A of the holding surface 21, more preferably, smaller than or equal to 1/5 times, and further preferably, smaller than or equal to 1/10 times.

Note that when the sticking suppressing surface 41 is a curved surface, the area B thereof can be estimated by the following formula from the Hertz contact theory.

$$B = n\pi\,(3(1-\nu 2)/4E) \times (L/n)\times r)2/3,$$

where:

n is the number of convexities 4 in contact with the fine structure 200;

r is the curvature radius of the convexity 4;

E is the Young's modulus of the convexity 4;

ν is the Poisson's ratio of convexity 4; and

L is the load of the fine structure 200.

[0051] (2) Moreover, the shape of the holding surface 21 can be designed based on the shape of the fine structure 200 to be held since generally formed in accordance therewith. For example, the sticking suppressing portion 3 may be designed in accordance with a ratio between a total contact area T of a plane 300 with the sticking suppressing surface 41 and an area A of the holding surface 21 providing that, as illustrated in FIG. 4, the virtual plane 300 in the same shape as that of the holding surface 21 contacts the sticking suppressing portion 3 at an arbitrary position. In order to suppress a fall of, from the stamp 100, the fine

structure 200 sticking once, it is preferable that the sticking suppressing portion 3 should be formed in a shape such that the total contact area T becomes greater than or equal to 1/100 times as the area A of the holding surface 21, more preferably, greater than or equal to 1/50 times, and further preferably, greater than or equal to 1/30 times. Moreover, in order to suppress the fine structure 200 to stick to the sticking suppressing portion 3, it is preferable that the sticking suppressing portion 3 should be formed in a shape such that the total contact area T becomes smaller than or equal to 1/2 times as the area A of the holding surface 21, more preferably, smaller than or equal to 1/5 times, and further preferably, smaller than or equal to 1/10 times. Such a total contact area T may be adjusted by adjusting the number and arrangement of the convexities 4 of the sticking suppressing portion 3, and the shape and area of the sticking suppressing surface 41. By adjusting the

number and arrangement of the convexities in the sticking suppressing portion in such a way that greater than or equal to four, more preferably, greater than or equal to five convexities become in contact with the above-described plane, the holding of the fine structure not subjected to the pickup and sticking unintendedly is facilitated. As for the upper limit of such a number, when it is 10 or so, the sticking suppression action and the holding action can be well balanced.

[0052] (3) Furthermore, the designing may be made based on an area A' of the held surface 201 of the fine structure 200. The sticking suppressing portion 3 may be designed in accordance with a ratio between a total contact area T' of the held surface 201 with the sticking suppressing surface 41 and the area A' of the fine structure 200 providing that, as illustrated in FIG. 3, the fine structure 200 contacts the sticking suppressing portion 3 at an arbitrary position. For example, in

order to suppress a fall of, from the stamp 100, the fine structure 200 sticking once, it is preferable that the sticking suppressing portion 3 should be formed in a shape such that the total contact area T' becomes greater than or equal to 1/100 times as the area A' of the fine structure 200, more preferably, greater than or equal to 1/50 times, and further preferably, greater than or equal to 1/30 times. Moreover, in order to suppress the fine structure 200 to stick to the sticking suppressing portion 3, it is preferable that the sticking suppressing portion 3 should be formed in a shape such that the total contact area T' becomes smaller than or equal to 1/2 times as the area A' of the fine structure 200, more preferably, smaller than or equal to 1/5 times, and further preferably, smaller than or equal to 1/10 times. Such a total contact area T' may be adjusted by adjusting the number and arrangement of the convexities 4 of the

sticking suppressing portion 3, and the shape and area of the sticking suppressing surface 41.

[0053] (4) Still further, the sticking suppressing surface 41 and the holding surface 21 may be formed of different materials from each other. In such a case, designing may be made in accordance with a ratio between a product of, by the individual contact area, the individual adhesive force of the material of the holding surface 21, and that of the sticking suppressing surface 41. More specifically, when it is defined that respective adhesive forces of the material of the holding surface 21 and that of the sticking suppressing surface 41 are PA and PB, in order to suppress the fine structure 200 sticking once to fall from the stamp 100, a shape may be designed in such a way that PA × A becomes greater than or equal to 1/100 times as PB × B, more preferably, greater than or equal to 1/50 times, and further preferably, greater than or equal to 1/30 times.

Moreover, in order to suppress the fine structure 200 to stick to the sticking suppressing portion 3, a shape may be designed in such a way that PA × A becomes smaller than or equal to 1/2 times as PB × B, more preferably, smaller than or equal to 1/5 times, and further preferably, smaller than or equal to 1/10 times.

[0054] Note that the above-described respective adhesive forces of the material of the holding surface 21 and that of the sticking suppressing surface 41 are measured as follows.

First of all, a sample is formed in an aluminum petri dish in such a way that the thickness of the material of the holding surface 21 or of the sticking suppressing surface 41 becomes 1 mm. At this time, the sample is formed in such a way that the surface thereof becomes substantially horizontal. Moreover, since the surface texture of the sample affects the adhesive force, a smooth condition should be maintained without an air

bubble being left and large concavities and convexities and further inclination being present. Furthermore, not only within a measurement time but also a normal time, dusts are prevented from sticking to the surface (the adhesion surface) of the sample, the adhesion surface is prevented from being touched, and foreign materials are prevented from sticking thereto.

Next, under an environment at 23 ℃ and 50 %RH (relative humidity), a double-sided adhesive tape (available from Nitto Denko Corporation, the product name: general-purpose double-sided tape No. 501F) is pasted on the back surface of the aluminum petri dish, and is firmly fastened to a pressurization mount that is the sample stage of a compact desktop tester EZ-SX available from SHIMADZU Corporation. An SUS probe in a rectangular columnar shape and in a size 1 mm by 1 mm attached to the tester is caused to depress from the upper side toward the bottom side so as to be

perpendicular to the surface (the adhesion surface) of the sample. Such a depression applies 1 MPa of contact load for 15 seconds after the probe is caused to contact the adhesion surface at a rate of 0.05 mm/s.

Subsequently, contrary to the depression, the probe is moved from the bottom side toward the upper side at a rate of 200 mm/min so as to be perpendicular to the surface (the adhesion surface) of the sample, and necessary force for the probe to be removed from the surface of the sample is measured. The maximum measured value is taken as the adhesive force. The measurement is carried out by five times for each sample, and the average value of the adhesive forces in the respective measurements is taken as the adhesive force according to the present disclosure.

Note that the fact that the surface texture of the probe in such a measurement affects the adhesive force is not ignorable. Hence, SUS304 is taken as the

material, and the surface roughness is set to be 250 to 500 nm or so in a root-mean-square roughness (Rq).

[0055] A plurality of convexities 5 each including a sticking suppressing surface 51 may be formed on a side face 25 that connects the base portion 1 and the holding surface 21 with each other. In this case, the convexity 5 is formed in such a way that the height of the sticking suppressing surface 51 is lower than the height of the holding surface 21. This suppresses, when the fine structure 200 is to be held on the holding surface 21, the fine structure 200 to stick falsely to the side face 25 of the holding portion 2. When the side face of the holding portion is not inclined (is perpendicular) relative to the surface of the base portion (the surface of the substrate), the holding portion may be deformed by the pressurization at the time of pick-up process, and the side face may contact the fine structure not subjected to the pickup. However, by providing, on the

side face, the convexity that forms the sticking suppressing portion, a pickup of the undesired fine structure can be suppressed. Moreover, as illustrated in FIG. 5, when the side face is inclined (the inclination angle is smaller than 90 degrees, preferably, 40 degrees to 70 degrees) relative to the surface of the base portion (the surface of the substrate), in comparison with a case in which there is no inclination, the deformation of the holding portion by the pressurization is not likely to occur, but the distance between the fine structure not subjected to the pickup and the side face becomes short. Hence, the convexity that forms the sticking suppressing portion provided at the side face acts effectively.

[0056] Next, a transfer method according to the present disclosure will be described. The transfer method according to the present disclosure is to transfer the fine structure 200 by the stamp, and mainly includes the

pick-up process and a releasing process. As for the stamp, the above-described stamp 100 according to the present disclosure is applicable. For example, the stamp is applicable which includes the base portion 1 formed on the substrate 10, the holding portion 2 formed on the base portion 1 and including the holding surface 21 to hold the fine structure 200, and the sticking suppressing portion 3 formed around the holding portion 2 on the base portion 1, and including the plurality of convexities 4 each including the sticking suppressing surface 41 with a height lower than that of the holding surface 21, and in which the sticking suppressing portion 3 has, when the fine structure 200 sticks to the sticking suppressing portion 3, adhesive force that does not allow the fine structure 200 to fall by force smaller than or equal to the own weight.

[0057] The pick-up process is to cause the fine structure 200 to contact the holding surface 21 of the

stamp so as to be held thereon. For example, the holding surface 21 of the stamp is caused to contact the one or plurality of fine structures 200 placed in a large amount on the supply substrate, and is pressurized so as to cause the fine structure 200 to stick to the holding surface 21. Next, when the stamp is moved apart from the supply substrate, the fine structures 200 are picked up on the holding surface 21 of the stamp and are held thereon.

[0058] The releasing process is to release the fine structure 200 from the holding surface 21 of the stamp. The releasing process may be carried out in any schemes as far as the fine structure 200 can be released from the holding surface 21 of the stamp. For example, a film that has greater adhesive force than the adhesive force of the holding surface 21 of the stamp is formed on the receiving substrate. Next, the fine structure 200 held on the holding surface 21 of the stamp by the pick-up

process is depressed on the receiving substrate. Subsequently, the stamp and the receiving substrate are moved apart from each other, and thus the fine structure 200 held on the holding surface 21 of the stamp can be released therefrom.

[0059] Moreover, it is preferable that such a method should include a removing process capable of removing the fine structure 200 from the sticking suppressing surface 41. The removing process may be carried out in any schemes as far as the fine structure 200 can be removed from the sticking suppressing surface 41, but for example, wet cleansing and dry cleansing may be adopted and carried out. Example wet cleansing is a scheme of soaking the stamp in an isopropanol bath, and of applying ultrasound. Moreover, example dry cleansing is supercritical CO_2 cleansing.

Thus, the fine structure 200 sticking to the sticking suppressing surface 41 can be removed therefrom.

[0060] As described above, when the fine structure not subjected to the pickup sticks to the sticking suppressing surface, a contamination of a system environment like a transfer path due to the fine structure that continuously sticks to the sticking suppressing surface up to the removing process can be suppressed. Since micro LEDs and mini LEDs are quite small in size, and even if those fall to the transfer path, etc., it is difficult to confirm such a fall. When those unintendedly stick to or are trapped in components, such as the other stamp, the supply board, and the receiving substrate and an apparatus, a further defect may occur. Hence, it is preferable that all of the fine structures which unintendedly fall from the supply substrate should be controlled. Conversely, even if all of the fallen fine structures are not controlled but some of those are still controlled, a contamination of the system environment can be suppressed.

As described above, by causing the fine structure fallen from the supply substrate and not subjected to the pickup to be still held by the stamp up to the removing process, the collection thereof can be collectively carried out in the removing process, thus efficient. Accordingly, a possible risk and a time necessary for analyzing such a risk can be both reduced.

Note that the pick-up process and the removing process may be repeated by multiple times and other processes may be carried out prior to the removing process.

[0061] Moreover, another transfer method according to the present disclosure is a transfer method of the fine structure 200 by the stamp which is picking up the fine structure 200 subjected to the transfer and also the fine structure 200 not subjected to the transfer, and mainly includes the pick-up process and a transfer process. As for the stamp, the above-described stamp 100 according to

the present disclosure is applicable. For example, the stamp is applicable which includes the base portion 1 formed on the substrate 10, the holding portion 2 formed on the base portion 1 and including the holding surface 21 to hold the fine structure 200, and the sticking suppressing portion 3 formed around the holding portion 2 on the base portion 1, and including the plurality of convexities 4 each including the sticking suppressing surface 41 with a height lower than that of the holding surface 21.

[0062] The pick-up process is to cause the fine structure 200 subjected to the transfer to be held on the holding portion 2. For example, the holding surface 21 of the stamp is caused to contact the one or plurality of fine structures 200 placed in a large amount on the supply substrate, and is pressurized so as to cause the fine structure 200 to stick to the holding surface 21. Next, when the stamp is moved apart from the supply

substrate, the fine structures 200 are picked up on the holding surface 21 of the stamp and are held thereon.

[0063] The transfer process is to transfer the fine structure 200 held on the holding portion 2 and subjected to transfer. For example, this is a process until the fine structure 200 held on the holding portion 2 is transferred from the supply substrate to the receiving substrate, and such a fine structure 200 is mounted on the receiving substrate after the fine structure 200 is picked up from the supply substrate.

[0064] The adhesive force of the sticking suppressing portion 3 is controlled in such a way that, when the fine structure 200 not subjected to the transfer is held on the sticking suppressing portion 3 in the pick-up process, the fine structure 200 held on the sticking suppressing portion 3 and not subjected to the transfer is still being held on the sticking suppressing portion 3 in the transfer process. As for the control on the

adhesive force, for example, the adhesive force of the sticking suppressing surface may be adjusted, and like the above-described stamp 100 according to the present disclosure, the number of convexities 4 of the sticking suppressing portion 3, and the shape and area of the sticking suppressing surface 41 may be adjusted.

[0065] Moreover, the method may further include a removing process to remove the fine structure 200 still held on the sticking suppressing portion 3 and not subjected to the transfer. In this case, the adhesive force of the sticking suppressing portion 3 or the removal force of the removing process is controlled in such a way that the fine structure 200 not subjected to the transfer can be removed by the removing process. The removing process may be carried out in any schemes as far as the fine structure 200 can be removed from the sticking suppressing surface 41, but for example, wet

cleansing and dry cleansing may be adopted and carried out.

[0066] The above-described transfer method according to the present disclosure can be applied to a manufacturing method of an electric/electronic application product which includes a process to transfer the fine structure by such a transfer method. Moreover, the above-described transfer method according to the present disclosure can be applied to a manufacturing method of a display which includes a process to transfer the fine structure by such a transfer method.

[0067] Structural factors in the above-described various embodiments may be subdivided, and each of the subdivided structural factors alone or the combination thereof may be applied to (X1) to (X18). Moreover, the subdivided structural factor and the combination thereof may function as an invention that accomplishes each function and mechanism. In this case, it is obvious that

the other structural factors substantially not contribute to the accomplishment of such function and mechanism may be eliminated. Representative examples are the structural components, such as the substrate, the base portion, the holding portion, the sticking suppressing portion, the convexity that forms the sticking suppressing portion, the holding surface, the sticking suppressing surface, and the side face, and further, the material, shape, size, placement, and relation thereof.

REFERENCE SIGNS LIST

[0068]

1	Base portion
2	Holding portion
3	Sticking suppressing portion
4	Convexity
5	Convexity
10	Substrate
21	Holding surface

25	Side face
41	Sticking suppressing surface
51	Sticking suppressing surface
100	Stamp
200	Fine structure
300	Plane

CLAIMS

1. A stamp for transferring a fine structure, the stamp comprising:

a base portion formed on a substrate;

a holding portion which is formed on the base portion, and which comprises a holding surface for holding the fine structure; and

a sticking suppressing portion which is formed around the holding portion on the base portion, and which comprises a plurality of convexities each comprising a sticking suppressing surface with a lower height than a height of the holding surface,

wherein the sticking suppressing portion is formed so as to have, when the fine structure sticks to the sticking suppressing portion, adhesive force that does not allow the fine structure to fall by force that is

smaller than or equal to an own weight of the fine structure.

2. A stamp for transferring a fine structure, the stamp comprising:

a base portion formed on a substrate;

a holding portion which is formed on the base portion, and which comprises a holding surface for holding the fine structure; and

a sticking suppressing portion which is formed around the holding portion on the base portion, and which comprises a plurality of convexities each comprising a sticking suppressing surface with a lower height than a height of the holding surface,

wherein an area B of the sticking suppressing surface is greater than or equal to 1/100 times as an area A of the holding surface.

3. The stamp according to claim 2, wherein the area B of the sticking suppressing surface is smaller than or equal to 1/2 times as the area A of the holding surface.

4. A stamp for transferring a fine structure, the stamp comprising:

a base portion formed on a substrate;

a holding portion which is formed on the base portion, and which comprises a holding surface for holding the fine structure; and

a sticking suppressing portion which is formed around the holding portion on the base portion, and which comprises a plurality of convexities each comprising a sticking suppressing surface with a lower height than a height of the holding surface,

wherein the sticking suppressing portion is formed in a shape in such a way that, when a plane in a same shape as a shape of the holding surface and the sticking

suppressing portion contact with each other at an arbitrary position, a total contact area T between the plane and the sticking suppressing surface becomes greater than or equal to 1/100 times as an area A of the holding surface.

5. The stamp according to claim 4, wherein the sticking suppressing portion is formed in a shape in such a way that, when the plane in the same shape as the shape of the holding surface and the sticking suppressing portion contact with each other at the arbitrary position, the total contact area T between the plane and the sticking suppressing surface becomes smaller than or equal to 1/2 times as the area A of the holding surface.

6. A stamp for transferring a fine structure, the stamp comprising:

a base portion formed on a substrate;

a holding portion which is formed on the base portion, and which comprises a holding surface for holding the fine structure; and

a sticking suppressing portion which is formed around the holding portion on the base portion, and which comprises a plurality of convexities each comprising a sticking suppressing surface with a lower height than a height of the holding surface,

wherein the sticking suppressing portion is formed in a shape in such a way that, when the fine structure and the sticking suppressing portion contact with each other at an arbitrary position, a total contact area T' with the sticking suppressing surface becomes greater than or equal to 1/100 times as an area A' of the fine structure.

7. The stamp according to claim 6, wherein the sticking suppressing portion is formed in a shape in such

a way that, when the fine structure and the sticking suppressing portion contact with each other at the arbitrary position, the total contact area T' with the sticking suppressing surface becomes smaller than or equal to 1/2 times as the area A' of the fine structure.

8. A stamp for transferring a fine structure, the stamp comprising:

a base portion formed on a substrate;

a holding portion which is formed on the base portion, and which comprises a holding surface for holding the fine structure; and

a sticking suppressing portion which is formed around the holding portion on the base portion, and which comprises a plurality of convexities each comprising a sticking suppressing surface with a lower height than a height of the holding surface,

wherein a product of adhesive force of the sticking suppressing surface by an area of the sticking suppressing surface is greater than or equal to 1/100 times as a product of adhesive force of the holding surface by an area of the holding surface.

9. The stamp according to claim 8, wherein the product of the adhesive force of the sticking suppressing surface by the area of the sticking suppressing surface is smaller than or equal to 1/2 times as the product of the adhesive force of the holding surface by the area of the holding surface.

10. A stamp for transferring a fine structure, the stamp comprising:

a base portion formed on a substrate;

a holding portion which is formed on the base portion, and which comprises a holding surface for holding the fine structure; and

a plurality of convexities which is formed on a side face connecting the base portion and the holding surface with each other, and each of which comprises a sticking suppressing surface with a lower height than a height of the holding surface.

11. The stamp according to claim 9, wherein at least a part of the holding portion is formed in a circular cylindrical shape, a polygonal columnar shape, a circular conical and trapezoidal shape, a polygonal pyramid and trapezoidal shape, or one of those shapes partially chamfered.

12. A holding portion that is a structural component of a stamp for transferring a fine structure, the holding portion comprising:

a holding surface for holding the fine structure;

a side face that extends toward an opposite surface to the holding surface; and

a plurality of convexities formed on the side face and each comprising a sticking suppressing surface.

13. A transfer method for transferring a fine structure by a stamp, the transfer method comprising:

a pick-up process to cause the fine structure to be held on a holding surface of the stamp; and

a releasing process to release the fine structure from the holding surface of the stamp,

wherein the stamp comprises:

a base portion formed on a substrate;

a holding portion which is formed on the base portion, and which comprises the holding surface for holding the fine structure; and

a sticking suppressing portion which is formed around the holding portion on the base portion, and which comprises a plurality of convexities each comprising a sticking suppressing surface with a lower height than a height of the holding surface, and

wherein the sticking suppressing portion is formed so as to have, when the fine structure sticks to the sticking suppressing portion, adhesive force that does not allow the fine structure to fall by force that is smaller than or equal to an own weight of the fine structure.

14. The transfer method according to claim 13, further comprising a removing process capable of removing the fine structure from the sticking suppressing surface.

15. A transfer method of a fine structure by a stamp that is picking up the fine structure subjected to transfer and also the fine structure not subjected to transfer,

wherein the stamp comprises:

a base portion formed on a substrate;

a holding portion which is formed on the base portion, and which comprises a holding surface for holding the fine structure; and

a sticking suppressing portion which is formed around the holding portion on the base portion, and which comprises a plurality of convexities each comprising a sticking suppressing surface with a lower height than a height of the holding surface,

wherein the transfer method comprises:

a pick-up process to cause the fine structure subjected to the transfer to be held on the holding portion; and

a transfer process to transfer the fine structure subjected to the transfer and held on the holding portion,

wherein the fine structure not subjected to the transfer is held on the sticking suppressing portion in the pick-up process, and

wherein adhesive force of the sticking suppressing portion is controlled in such a way that the fine structure not subjected to the transfer and still held on the sticking suppressing portion is still being held on the sticking suppressing portion in the transfer process.

16. The transfer method according to claim 15, further comprising a removing process to remove the fine structure not subjected to transfer and held on the

sticking suppressing portion, wherein the adhesive force of the sticking suppressing portion or removal force of the removing process is controlled in such a way that the fine structure not subjected to the transfer is removed by the removing process.

17. A transfer method for transferring the fine structure by the stamp according to any one of claims 1 to 11.

18. A method for manufacturing an electric/electronic application product, the method comprising a process to transfer the fine structure by the transfer method according to claim 17.

19. A method for manufacturing an electric/electronic application product, the method comprising a process to transfer the fine structure by

the transfer method according to any one of claims 13 to 16.

20. A method for manufacturing a display, the method comprising a process to transfer the fine structure by the transfer method according to claim 17.

21. A method for manufacturing a display, the method comprising a process to transfer the fine structure by the transfer method according to any one of claims 13 to 16.

22. A holding method for holding a fine structure not subjected to pickup on a stamp,

wherein the stamp comprises:

a base portion formed on a substrate;

a holding portion which is formed on the base portion, and which comprises a holding surface for holding the fine structure; and

a sticking suppressing portion which is formed around the holding portion on the base portion, and which comprises a plurality of convexities each comprising a sticking suppressing surface with a lower height than a height of the holding surface,

wherein the holding method comprises:

a pick-up process to cause the fine structure subjected to the pickup and placed on a supply substrate to be held on the holding surface of the stamp; and

a releasing process to cause the fine structure subjected to the pickup and held on the holding surface to be released from the holding surface and to be transferred to a receiving substrate, and

wherein the fine structure not subjected to the pickup and detached from the supply substrate in the

pick-up process is caused to stick to the sticking suppressing portion, the releasing process is carried out with the fine structure not subjected to the pickup being held on the stamp, and in a subsequent removing process, the fine structure not subjected to the pickup and held on the stamp is removed from the sticking suppressing surface.