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Summary ~~of Invention~~

Technical Problem

[0018]

It is an object of the ~~present invention~~embodiments disclosed herein to provide a resin mold for nanoimprinting, which is free from transfer defects, has excellent releasability from a resin on which imprinting has been performed and has no defects due to imprinting. It is another object of the embodiments disclosed herein~~present invention~~ to provide a resin mold for nanoimprinting, which itself has release properties even if a release agent layer is not formed.

Solution to Problem

[0019]

The resin mold for nanoimprinting of the present ~~invention~~ disclosure, in a first aspect, is a resin mold for nanoimprinting, comprising a substrate and a resin layer having fine depressions and protrusions formed on the surface,

wherein the resin layer is formed from a copolymer of 1 to 49 parts by weight of a silicone-based macromonomer and/or a fluorine-based macromonomer and 99 to 51 parts by weight of at least one polymerizable monomer selected from the group consisting of a (meth)acrylic monomer, a styrene-based monomer, an epoxy-based monomer, an olefin-based

monomer and a polycarbonate-based resin-forming monomer,

the silicone-based macromonomer and/or the fluorine-based macromonomer has a molecular weight of 600 to 10000 and has, at an end of molecule, a reactive group copolymerizable with the polymerizable monomer, and when the reactive group is copolymerized with the polymerizable group, silicone-based units or fluorine-based units that constitute the macromonomer form side chains on a trunk polymer formed from the polymerizable monomer and the macromonomer.

[0020]

In this resin mold for nanoimprinting, the resin layer may be formed on one substrate selected from the group consisting of a resin substrate, a glass substrate, a silicon substrate, a sapphire substrate, a carbon substrate and a GaN substrate.

[0021]

When the thickness of the resin layer is designated by y and the height of the protrusion formed on the resin layer is designated by x in the resin mold for nanoimprinting ~~of the present invention~~as defined above, the resin layer preferably has a relationship represented by the following formula (I):

[0022]

$$y = nxx \qquad (I)$$

wherein n is a value ranging from 1 to 15.

[0023]

The resin mold for nanoimprinting ~~of the present invention is~~as defined above

formed by copolymerizing a macromonomer having a reactive polymerizable group at an end with another monomer. This macromonomer preferably has the reactive polymerizable group at one end, and the silicone units or the fluorine-containing units that constitute the macromonomer preferably form a chain structure.

[0024]

The resin that constitutes the resin mold for nanoimprinting ~~of the present invention~~as defined above has a weight-average molecular weight (Mw), as measured by gel permeation chromatography, of 50000 to 150000.

[0025]

In the present ~~invention~~disclosure, the pitch of repeating units of the surface shape formed on the resin layer is in the range of 10 to 50000 nm.

[0026]

On the surface of the resin layer that constitutes the resin mold for nanoimprinting ~~of the present invention~~as defined above, the side chains of the macromonomer are present so that the contact angle between the resin layer surface and pure water may become not less than 100 degrees.

[0027]

The light transmittance of the resin mold for nanoimprinting as defined above~~of the present invention~~ at 365 nm is usually not less than 75%.

[0028]

The resin mold for nanoimprinting ~~of the present invention~~as defined above can

be also arranged on a surface of a roller.

Advantageous Effects ~~of Invention~~

[0029]

In the resin mold for nanoimprinting of the present ~~invention~~disclosure, a specific macromonomer is used, so that parts having a release function are bonded in the form of branches to the main chain of the resin and are present in the vicinity of the surface. Therefore, bleedout of a release agent does not occur differently from a conventional resin mold, and falling-off of the parts having a release function can be inhibited.

[0030]

Moreover, by copolymerizing a silicone-based or fluorine-based mocromonomer having a number-average molecular weight (Mn) of 600 to 10000, a structure (side chain part) having a release function can be allowed to be present on the surface of the resin mold composed of such a copolymer, and good release properties are exhibited.

Brief Description of Drawings

[0031]

[Fig. 1] Fig. 1 is a sectional view showing an example of the resin mold for nanoimprinting of the present invention.

[Fig. 2] Fig. 2 is a group of sectional views showing an example of a method using the resin mold for nanoimprinting of the present

Claims

1. A resin mold for nanoimprinting, comprising a substrate and a resin layer formed on the substrate and having fine depressions and protrusions formed on a surface of the resin layer,

wherein the resin layer is formed from a copolymer of 1 to 49 parts by weight of a silicone-based macromonomer and/or a fluorine-based macromonomer and 99 to 51 parts by weight of at least one polymerizable monomer selected from the group consisting of a (meth)acrylic monomer, a styrene-based monomer, an epoxy-based monomer, an olefin-based monomer and a polycarbonate-based resin-forming monomer,

the silicone-based macromonomer and/or the fluorine-based macromonomer has a molecular weight of 600 to 10000 and has, at an end of molecule, a reactive group copolymerizable with the polymerizable monomer, and when the reactive group is copolymerized with the polymerizable group, silicone-based units or fluorine-based units that constitute the macromonomer form side chains on a trunk polymer formed from the polymerizable monomer and the macromonomer.

2. The resin mold for nanoimprinting as claimed in claim 1, wherein when the thickness of the resin layer is designated by y and the height of the protrusion formed on the resin layer is designated by x, the resin layer has a relationship represented by the following formula (I):

$$y = n \times x \qquad (I)$$