[Patent Document 1] Japanese Unexamined Patent Publication No. 2010-114414

SUMMARY ~~OF THE INVENTION~~

TECHNICAL PROBLEM

[0004]

However, as a result of studies by the present inventor, it has been found that, in the surface treatment method for semiconductor substrates disclosed in Patent Document 1, there is room for improvement in terms of manufacturing stability.

SOLUTION TO PROBLEM

[0005]

As a result of further studies by the present inventor, the following findings have been obtained.

In a general structure at an edge portion of a semiconductor substrate, an angle formed with a top edge increases from 0 degrees to 90 degrees in a region of an upper bevel or a front shoulder from the top edge (approximately horizontal plane) to an end face (approximately vertical plane). That is, in the edge portion of the semiconductor substrate, an inclined surface having any angle of more than 0 degrees and 90 degrees or less is formed.

In a manufacturing process of the semiconductor substrate, in a case of subjecting a main surface having a pattern formation region in which a fine pattern is formed to a rinsing treatment with a rinsing solution such as water and an organic solvent, it has been found that the rinsing solution does not run out properly at the edge portion of the semiconductor substrate and there is a risk of wrapping around

the rinsing solution to a back surface along with the inclined surface.

[0006]

As a result of intensive studies based on such findings, it has been found that, by performing a surface treatment using a surface treatment agent composition which sets a receding contact angle of 2-propanol (hereinafter, also referred to as "IPA") and/or a receding contact angle of pure water to predetermined values on a bevel region formed on a periphery of the semiconductor substrate, liquid drainage characteristics of the rinsing solution in the bevel region can be controlled, and by adopting the IPA receding contact angle and/or the water receding contact angle as indexes, it is possible to stably evaluate the liquid drainage characteristics. Further, it has been found that, by setting the IPA receding contact angle and/or the water receding contact angle to a predetermined value or more, it is possible to suppress the rinsing solution from wrapping around to the back surface of the semiconductor substrate during the manufacturing process, and the present ~~invention~~ disclosure has been completed.

[0006a]

In an aspect of the present disclosure, there is provided a treatment method of treating a main surface of a semiconductor substrate that has, on the main surface of the substrate, a pattern formation region in which a pattern having a concave-convex structure with a pattern dimension of 30 nm or less is formed and a bevel region which is formed on a periphery of the pattern formation region, the method comprising:

a surface treatment step of bringing a surface treatment agent composition including a silylating agent into contact with the pattern

formation region and the bevel region on the main surface of the semiconductor substrate,

wherein an IPA receding contact angle obtained by the following procedure is 3° or more at a room temperature of 25°C, and/or

a water receding contact angle obtained by the following procedure is 40° or more at the room temperature of 25°C,

(procedure)

the surface treatment agent composition is brought into contact with a smooth surface of a silicon oxide substrate of which surface is composed of silicon oxide to perform a surface treatment, and

with respect to the surface-treated surface of the silicon oxide substrate in a state of being stood on a horizontal table, 3 μl of 2-propanol is dropped on the surface at the room temperature of 25°C and a value of a contact angle 60 seconds later after the dropping is measured and defined as the IPA receding contact angle (°), and

30 μl of pure water is dropped on the surface at the room temperature of 25°C, the pure water is sucked at a rate of 6 μl/sec, and a value of a contact angle while a droplet size is decreasing is measured and defined as the water receding contact angle (°).

[0006b]

In another aspect, there is provided a treatment method of treating a main surface of a semiconductor substrate that has, on the main surface of the substrate, a pattern formation region in which a pattern having a concave-convex structure with a pattern dimension of 30 nm or less is formed and a bevel region which is formed on a periphery of the pattern formation region, the method comprising:

a surface treatment step of bringing a surface treatment agent

composition including a silylating agent into contact with the pattern formation region and the bevel region on the main surface of the semiconductor substrate; and

an evaluation step of determining whether or not an IPA receding contact angle is 3° or more and/or a water receding contact angle is 40° or more on the main surface of the semiconductor substrate after the surface treatment step.

[0006c]

In another aspect, there is provided a surface treatment agent composition used for treating a main surface of a semiconductor substrate that has, on the main surface of the substrate, a pattern formation region in which a pattern having a concave-convex structure with a pattern dimension of 30 nm or less is formed and a bevel region which is formed on a periphery of the pattern formation region, the surface treatment agent composition comprising:

a silylating agent,

wherein an IPA receding contact angle obtained by the following procedure is 3° or more at a room temperature of 25°C, and/or

a water receding contact angle obtained by the following procedure is 40° or more at the room temperature of 25°C,

(procedure)

the surface treatment agent composition is brought into contact with a smooth surface of a silicon oxide substrate of which surface is composed of silicon oxide to perform a surface treatment, and

with respect to the surface-treated surface of the silicon oxide substrate in a state of being stood on a horizontal table, 3 µl of 2-propanol is dropped on the surface at the room temperature of 25°C

and a value of a contact angle 60 seconds later after the dropping is measured and defined as the IPA receding contact angle (°), and

30 μl of pure water is dropped on the surface at the room temperature of 25°C, the pure water is sucked at a rate of 6 μl/sec, and a value of a contact angle while a droplet size is decreasing is measured and defined as the water receding contact angle (°).

[0007]

According to the present disclosure~~invention~~, there is provided a treatment method of treating a main surface of a semiconductor substrate that has, on the main surface of the substrate, a pattern formation region in which a pattern having a concave-convex structure with a pattern dimension of 30 nm or less is formed and a bevel region which is formed on a periphery of the pattern formation region, the method including a surface treatment step of bringing a surface treatment agent composition including a silylating agent into contact with the pattern formation region and the bevel region on the main

surface of the semiconductor substrate, in which an IPA receding contact angle is 3° or more at a room temperature of 25°C and/or a water receding contact angle is 40° or more at the room temperature of 25°C, which are obtained by the following procedure.

(Procedure)

A smooth surface of a silicon oxide substrate composed of silicon oxide is brought into contact with the surface treatment agent composition to perform a surface treatment. With respect to the surface-treated surface of the silicon oxide substrate in a state of being stood on a horizontal table, 3 µl of 2-propanol is dropped on the surface at the room temperature of 25°C and a value of a contact angle 60 seconds later after the dropping is measured and defined as the IPA receding contact angle (°). In addition, with respect to the surface-treated surface of the silicon oxide substrate in a state of being stood on a horizontal table, 30 µl of pure water is dropped on the surface at the room temperature of 25°C, the pure water is sucked at a rate of 6 µl/sec, and a value of a contact angle while a droplet size is decreasing is measured and defined as the water receding contact angle (°).

[0008]

In addition, according to the present ~~invention~~disclosure, there is provided a surface treatment agent composition used for treating a main surface of a semiconductor substrate that has, on the main surface of the substrate, a pattern formation region in which a pattern having a concave-convex structure with a pattern dimension of 30 nm or less is formed and a bevel region which is formed on a periphery of the pattern formation region, the surface treatment agent composition

including a silylating agent, in which an IPA receding contact angle is 3° or more at a room temperature of 25°C and/or a water receding contact angle is 40° or more at the room temperature of 25°C, which are obtained by the above-described procedure.

ADVANTAGEOUS EFFECTS OF THE ~~INVENTION~~DISCLOSURE

[0009]

According to the present ~~invention~~disclosure, a surface treatment method for semiconductor substrates, which is excellent in manufacturing stability, and a surface treatment agent composition used therein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Fig. 1 is a top view schematically showing a configuration of a semiconductor substrate.

Fig. 2 is a cross-sectional view schematically showing a configuration of a semiconductor substrate.

Fig. 3A to 3C are process cross-sectional views schematically showing a manufacturing process of the semiconductor substrate.

DESCRIPTION OF EMBODIMENTS

[0011]

Hereinafter, embodiments of the present invention will be described with reference to the drawings. In all drawings, the same components are designated by the same reference numerals, and description thereof will not be repeated. In addition, the drawings are schematic views and do not match the actual dimensional ratio.