immediately, and the non-specific amplification reactions caused by misannealing of the oligonucleotide primer that can occur until the heater reaches the reaction temperature can be avoided.

[0008]

On the other hand, when pre-heating the heater, the nucleic acid amplification reaction may start immediately after the microchip has come into contact with the heater. Consequently, the nucleic acid amplification reaction may proceed before the apparatus has started the analysis operation after the operation for mounting the microchip in the apparatus has been completed and the microchip has come into contact with the heater. If such a deviation occurs between the start time of the nucleic acid amplification reaction and the analysis start time, the reaction time cannot be strictly controlled, and accurate analysis results cannot be obtained.

[0009]

Embodiments of the present invention provide a nucleic acid analysis apparatus capable of controlling the timing of a reaction starting without requiring a complex configuration or control.

Solution to Problem

[0010]

According to a first aspect of the present invention, there is provided a nucleic acid analysis apparatus, comprising: a chip holding unit for holding a microchip; an upper unit and a lower unit; wherein the lower unit comprises a lower heater and the upper unit comprises a upper heater; wherein the upper unit and the lower unit are operable to receive the microchip, and wherein the upper unit and the lower unit are each connected by a hinge in a manner that enables them to be opened and closed; and wherein the chip holding unit is configured to change a position between a first holding position that holds the microchip in midair when the upper unit and the lower unit are in an open position and a second holding position that holds the microchip in contact with ~~an heating element~~ the lower heater and the upper heater when the upper unit and the lower unit are in a closed position.

The nucleic acid analysis apparatus includes an opening/closing structure configured from a hinge. The chip holding unit is connected by the hinge and moves between the first holding position and the second holding position in coordination with opening and closing of the opening/closing structure. Specifically, the chip holding unit moves to the first holding position in coordination with an opening operation of the opening/closing structure, and moves to the second holding position in coordination with a closing operation of the opening/closing structure.

In this nucleic acid analysis apparatus, by opening the opening/closing structure and then closing the opening/closing structure after the microchip has been held in a chip holding unit that is at a first position, the microchip held in the chip holding unit can be brought into contact with the heating unit for the first time. In other words, with this nucleic acid analysis apparatus, the microchip mounted in the chip holding unit during opening of the opening/closing structure can be prevented from coming into contact with the heating unit until the opening/closing structure is closed. Therefore, with this nucleic acid analysis apparatus, the timing of the start of the nucleic acid reaction can be precisely controlled by making the closing operation of the opening/closing structure and the start of heating the microchip match.

[0011]

According to an embodiment of the present invention, it is preferable for the nucleic acid analysis apparatus to have an insertion opening of the microchip in the chip holding unit. A shape of the insertion opening is a perpendicular cross-section shape of the microchip in an insertion direction, preferably. The chip holding unit includes a flexible member having a hook-shaped tip portion extending in the insertion direction of the microchip, preferably. In a state in which the microchip is inserted in the chip holding unit, the tip portion of the flexible member fits into a groove formed on a side peripheral portion of the microchip. In addition, in a state in which the microchip is inserted in the chip holding unit, the tip portion of the flexible member abuts only one face of the groove formed in a V shape, and urges the microchip in the insertion direction, preferably.

[0012]

The lower unit includes a light source, a lens, an optical filter, and a lower heater, and the upper unit includes an upper heater, a detection filter, a lens, and a detector. The light source is an LED array, and the detector is a PDIC array.

It is preferable for the nucleic acid analysis apparatus to include a sensor configured to detect opening and closing of the upper unit and the lower unit. In addition, a sensor configured to detect the inserted microchip is provided in the chip holding unit, preferably.

[0013]

According to a second aspect of the present invention, there is provided a method for mounting a microchip in a nucleic acid analysis apparatus, the method comprising: providing a chip holding unit for holding a microchip; providing an upper unit and a lower unit; providing a lower heater on the lower unit and an upper heater on the upper unit; receiving a microchip between the upper unit and the lower unit, wherein the upper unit and the lower unit are each connected by a hinge in a manner that enables them to be opened and closed; moving the chip holding unit to change a position between a first holding position that

holds the microchip in midair when the upper unit and the lower unit are in an open position, and a second holding position that holds the microchip in contact with ~~an heating element~~ the lower heater and the upper heater when the upper unit and the lower unit are in a closed position.

[0013a]

According to a third aspect of the present invention, there is provided an analysis apparatus, comprising: a reaction induction unit configured to induce a reaction in a reaction area by contacting a microchip in which the reaction area is formed; a chip holding unit for holding the microchip; an upper unit and a lower unit; wherein the lower unit comprises a lower heater and the upper unit comprises a upper heater; wherein the upper unit and the lower unit are operable to receive the microchip, and wherein the upper unit and the lower unit are each connected by a hinge in a manner that enables them to be opened and closed; and wherein the chip holding unit is configured to change a position between a first holding position that holds the microchip in midair when the upper unit and the lower unit are in an open position and a second holding position that holds the microchip in contact with ~~an heating element~~ the lower heater and the upper heater when the upper unit and the lower unit are in a closed position.

[0014]

In the present invention, the term "nucleic acid amplification reaction" includes a PCR (polymerase chain reaction) method that involves a temperature cycle, and a variety of isothermal amplification methods that do not involve a temperature cycle. Examples of the isothermal amplification methods include a LAMP (Loop-Mediated Isothermal Amplification) method, an SMAP (SMart Amplification Process) method, a NASBA (Nucleic Acid Sequence-Based Amplification) method, an ICAN (Isothermal and Chimeric primer-initiated Amplification of Nucleic acids) method (registered trademark), a TRC (transcription-reverse transcription concerted) method, a SDA (strand displacement amplification) method, a TMA (transcription-mediated amplification) method, a RCA (rolling circle amplification) method and the like. In addition, the term "nucleic acid amplification reaction" widely includes nucleic acid amplification reactions for amplifying nucleic acids at a varying temperatures or at a constant temperature. Further, the term "nucleic acid amplification reaction" also includes reactions involving quantification of amplified nucleic acid strands such as a real time PCR (RT-PCR) method and an RT-RAMP method.

Advantageous Effects of Invention

[0015]

Embodiments of the present invention provide a nucleic acid analysis apparatus capable of precisely controlling the timing of a reaction starting without requiring a complex configuration or control.

Brief Description of Drawings

[0016]

[FIG. 1] FIG. 1 is a diagram illustrating a configuration of a nucleic acid analysis apparatus 1a according to the present technology.

[FIG. 2] FIG. 2 is a diagram illustrating the nucleic acid analysis apparatus 1a in a state in which an upper unit 11 and a lower unit 12 are closed.

[FIG. 3] FIG. 3 is a diagram illustrating the nucleic acid analysis apparatus 1a in a state in which the upper unit 11 and the lower unit 12 are open.

[FIG. 4] FIG. 4 is a diagram illustrating a configuration of the upper unit 11 and the lower unit 12.

[FIG. 5] FIG. 5 is a diagram illustrating the nucleic acid analysis apparatus 1a and a microchip 2 in a state in which the upper unit 11 and the lower unit 12 are open.

[FIG. 6] FIG. 6 is a diagram illustrating a configuration of a chip holder 13.

[FIG. 7] FIG. 7 is a diagram illustrating a configuration of an insertion opening 134 of the chip holder 13.

[FIG. 8] FIG. 8 is a diagram illustrating a configuration of a lever 135 of the chip holder 13.

[FIG. 9] FIG. 9 is a diagram illustrating a misinsertion prevention function of the lever 135.

[FIG. 10] FIG. 10 is a diagram illustrating a positioning function of the lever 135.

[FIG. 11] FIG. 11 is a flowchart illustrating operation of the nucleic acid analysis apparatus 1a.

CLAIMS

1. A nucleic acid analysis apparatus, comprising:

a chip holding unit for holding a microchip;

an upper unit and a lower unit;

wherein the lower unit comprises a lower heater and the upper unit comprises a upper heater;

wherein the upper unit and the lower unit are operable to receive the microchip, and wherein the upper unit and the lower unit are each connected by a hinge in a manner that enables them to be opened and closed; and

wherein the chip holding unit is configured to change a position between

a first holding position that holds the microchip in midair when the upper unit and the lower unit are in an open position, and

a second holding position that holds the microchip in contact with ~~an heating element~~ the lower heater and the upper heater when the upper unit and the lower unit are in a closed position .

2. The nucleic acid analysis apparatus according to claim 1, further comprising:

an opening/closing structure configured from the hinge,

wherein the chip holding unit is connected by the hinge and moves between the first holding position and the second holding position in coordination with opening and closing of the opening/closing structure.

3. The nucleic acid analysis apparatus according to claim 2, wherein the chip holding unit moves to the first holding position in coordination with an opening operation of the opening/closing structure, and moves to the second holding position in coordination with a closing operation of the opening/closing structure.

4. The nucleic acid analysis apparatus according to claim 3,

wherein an insertion opening of the microchip is included in the chip

holding unit, and

wherein a shape of the insertion opening is a perpendicular cross-section shape of the microchip in an insertion direction.

5. The nucleic acid analysis apparatus according to claim 4,

wherein the chip holding unit includes a flexible member having a hook-shaped tip portion extending in the insertion direction of the microchip, and

wherein, in a state in which the microchip is inserted in the chip holding unit, the tip portion of the flexible member fits into a groove formed on a side peripheral portion of the microchip.

6. The nucleic acid analysis apparatus according to claim 5, wherein, in a state in which the microchip is inserted in the chip holding unit, the tip portion of the flexible member abuts only one face of the groove formed in a V shape, and urges the microchip in the insertion direction.

7. The nucleic acid analysis apparatus according to claim 1, further comprising:

a sensor configured to detect opening and closing of the upper unit and the lower unit.

8. The nucleic acid analysis apparatus according to claim 7, wherein a sensor configured to detect the inserted microchip is provided in the chip holding unit.

9. The nucleic acid analysis apparatus according to claim 8,

wherein the lower unit includes a light source, a lens, and an optical filter, ~~and a lower heater,~~ and

wherein the upper unit includes ~~an upper heater,~~ a detection filter, a lens, and a detector.

10. The nucleic acid analysis apparatus according to claim 9, wherein the light

source is an LED array, and the detector is a PDIC array.

11. The nucleic acid analysis apparatus according to claim 10, further comprising:

a reading device of an identifier attached to the microchip.

12. A method for mounting a microchip in a nucleic acid analysis apparatus, the method comprising:

providing a chip holding unit for holding a microchip;

providing an upper unit and a lower unit;

providing a lower heater on the lower unit and an upper heater on the upper unit;

receiving a microchip between the upper unit and the lower unit, wherein the upper unit and the lower unit are each connected by a hinge in a manner that enables them to be opened and closed;

moving the chip holding unit to change a position between

a first holding position that holds the microchip in midair when the upper unit and the lower unit are in an open position, and

a second holding position that holds the microchip in contact with ~~an heating element~~ the lower heater and the upper heater when the upper unit and the lower unit are in a closed position.

~~14~~13. An analysis apparatus, comprising:

a reaction induction unit configured to induce a reaction in a reaction area by contacting a microchip in which the reaction area is formed;

a chip holding unit for holding the microchip;

an upper unit and a lower unit;

wherein the lower unit comprises a lower heater and the upper unit comprises a upper heater;

wherein the upper unit and the lower unit are operable to receive the microchip, and wherein the upper unit and the lower unit are each connected by a

hinge in a manner that enables them to be opened and closed; and

wherein the chip holding unit is configured to change a position between

a first holding position that holds the microchip in midair when the upper unit and the lower unit are in an open position, and

a second holding position that holds the microchip in contact with ~~an heating element~~ the lower heater and the upper heater when the upper unit and the lower unit are in a closed position.