It is preferable that the porous base member have a portion that does not come into contact with the piezo element.

~~It is preferable that a plurality of electrodes be provided and that a reactant that reacts with a target be provided on the porous base member that is provided so as to correspond to each of the electrodes.~~

~~In the surface acoustic wave sensor of the aspect of the invention, it is preferable that a plurality of electrodes be provided and that a separate reactant that reacts with a target be provided on the porous base member that is provided so as to correspond to each of the electrodes.~~

[0010]

In the surface acoustic wave sensor of the aspect of the invention, it is preferable that two electrodes be provided and that the porous base member come into contact with the piezo element with a thin film interposed therebetween, be connected to the porous base member, and have a portion that comes into contact with each electrode is formed of a hydrophobic base member.

In the surface acoustic wave sensor of the aspect of the invention, it is preferable that the piezo element include: a first portion having a region that is not electrically connected to the electrode; and a second portion having a thin film that is electrically connected to the electrode.

In the surface acoustic wave sensor of the aspect of the invention, it is preferable that the porous base member include a first region and a second region, that the first region and the second region be alternately formed in a propagation direction of the surface acoustic wave, and that the infiltration rate in the first region be greater than the infiltration rate in the second region.

In the surface acoustic wave sensor of the aspect of the invention, it is preferable

~~from the phase-amplitude detecting circuit 23, the PC 24 determines the amount and kind of an antibody on the surface and a specifically reacted antigen in a solution and displays the determination result.~~

[0023]

Here, the phase variation and the attenuation of amplitude of the SAW will be described.

The SAW is an acoustic wave that concentrates in the vicinity of the surface of the piezoelectric element substrate 10 (the position close to the surface) and propagates.

When a substance adsorbs onto the top surface of the piezoelectric element substrate 10, the mass per unit volume and the degree of viscosity of the top surface thereof vary.

As a result, the propagation velocity and the amplitude of the SAW vary.

For this reason, the propagation time of the SAW varies and the attenuation of amplitude varies.

In the first embodiment, an antigen that is contained in a solution is measured utilizing the variation in phase and variation in attenuation of amplitude.

Specifically, at first, a measurer of the SAW sensor 1 drops a solvent that does not contain an antigen on the region S shown in FIG. 2 and thereby makes the top of the reaction-region thin film 12 wet with the solvent, and measures the phase variation which is associated with the propagation time of the SAW (blank test).

Next, the measurer of the SAW sensor 1 replaces the SAW sensor 1 with another sample (SAW sensor 1), drops the solution of the sample containing an antigen on the region S shown in FIG. 2, and measures the phase variation which is associated with the propagation time thereof.

A difference between the phase variation corresponding to the solvent and the

phase variation corresponding to the solution is a variation in phase which is caused by an antigen antibody complex that is generated in the reaction-region thin film 12 due to an antigen-antibody reaction.

The PC 24 has stored the phase variation of the blank test in memory, calculates the difference between the phase variation and the phase variation obtained by dropping of a solution, and thereby calculates the variation in phase.

~~The PC 24 identifies an antigen contained in solution based on the variation in phase.~~

~~Similarly, attenuation of amplitude identifies an antigen contained in solution based on the variation in attenuation of amplitude.~~

In other cases, if the phase variation of the SAW in the solvent to be used is determined in advance, the measurer does not need to measure the phase variation of the SAW in the solvent.

Furthermore, even in the case where the propagation time of the SAW in the solvent to be used is not determined in advance, the phase and the amplitude which are immediately after dropping of solution containing an antigen are used as a reference, the amount of and the kind of antigen in solution is determined as a result of obtaining the difference between subsequent changes based thereon, and the determination result may be displayed.

[0024]

As described above, the SAW sensor of first embodiment includes: a piezoelectric element substrate (the piezoelectric element substrate 10) that propagates a surface acoustic wave; electrodes that carry out conversion of an electrical signal and a surface acoustic wave (the IDT 11-1 that carries out conversion of an electrical signal into a surface acoustic wave and the IDT 11-2 that carries out conversion of a surface

Based on a detection signal input from the sensor 101 and the burst signal input from the burst circuit 22, the phase-amplitude detecting circuit 23 calculates a phase variation and an amplitude change which are associated with a propagation time that is a time required for propagation of the SAW on the piezoelectric element substrate 110.

Specifically, the phase-amplitude detecting circuit 23 detects a phase variation and attenuation of amplitude which is associated with a required time (referred to as a delay time) between the inputting of the burst signal and the inputting of the detection signal.

The phase-amplitude detecting circuit 23 outputs a phase variation and an amplitude change, which is due to the detected delay time, to the PC 24.

~~Based on the phase variation and the amplitude change which are input from the phase-amplitude detecting circuit 23, the PC 24 determines the amount and kind of antibody on the surface and a specifically reacted antigen in a solution and displays the determination result.~~

[0050]

Here, the phase variation and the amplitude change of the SAW will be described.

The SAW is an acoustic wave that concentrates in the vicinity of the surface of the piezoelectric element substrate 110 (the position close to the surface) and propagates.

When a substance is absorbed onto the top surface of the piezoelectric element substrate 110, the mass per unit volume and the degree of viscosity of the top surface thereof vary.

As a result, the propagation velocity and amplitude of the SAW vary.

For this reason, the phase variation and the amplitude change which are associated with the delay time of the SAW vary.

CLAIMS

1. A surface acoustic wave sensor comprising:

a piezo element that propagates a surface acoustic wave;

an electrode that carries out conversion of an electrical signal and a surface acoustic wave; and

a porous base member which is disposed at a propagation path of the surface acoustic wave, is disposed above a detection region of the piezo element into which liquid serving as an analyte is introduced, and into which liquid infiltrates, the liquid having a portion that comes into contact with the detection region which is due to the liquid infiltration by a capillary phenomenon.

2. The surface acoustic wave sensor according to claim 1, further comprising a sealing structure that prevents the electrode from coming into contact with liquid.

3. The surface acoustic wave sensor according to claim 2, wherein

the porous base member has a portion that does not overlap the detection region in a plan view.

4. The surface acoustic wave sensor according to any one of claims 1 to 3, wherein

two electrodes are provided, and the detection region has a short-circuiting reaction region that is electrically connected to one of the two electrodes and an open reaction region that is not electrically connected to the other of the two electrodes.

5. The surface acoustic wave sensor according to any one of claims 1 to 3 and 4,

wherein

the porous base member allows liquid to infiltrate thereinto due to a capillary phenomenon in a propagation direction of the surface acoustic wave.

6. The surface acoustic wave sensor according to any one of claims 1 to 3, 4, and 5, wherein

separate reactants which react with a target are formed and dispersed in directions in which the solution infiltrates into the porous base member.

7. The surface acoustic wave sensor according to any one of claims 1 to 3 and 4 to 6, wherein

the porous base member includes at least one of a reaction layer including a substance that reacts with a target and a filter layer that removes other than a target.

8. The surface acoustic wave sensor according to any one of claims 1 to 3 and 4 to 7, wherein

the porous base member has a portion that does not come into contact with the piezo element.

9. The surface acoustic wave sensor according to any one of claims 1 to 3 and 4 to 8, wherein

a plurality of electrodes are provided, and a reactant that reacts with a target is provided on the porous base member that is provided so as to correspond to each of the electrodes.

10. The surface acoustic wave sensor according to any one of claims 1 to 3 and 4 to 9, wherein

a plurality of electrodes are provided, and a separate reactant that reacts with a target is provided on the porous base member that is provided so as to correspond to each of the electrodes.

11. The surface acoustic wave sensor according to any one of claims 1 to 3 and 4 to 10, wherein

two electrodes are provided, and the porous base member comes into contact with the piezo element with a thin film interposed therebetween, is connected to the porous base member, and has a portion that comes into contact with each electrode is formed of a hydrophobic base member.

12. The surface acoustic wave sensor according to claim 10, wherein

the piezo element includes:

a first portion having a region that is not electrically connected to the electrode; and

a second portion having a thin film that is electrically connected to the electrode.

13. The surface acoustic wave sensor according to any one of claims 1 to 3 and 4 to 12, wherein

the porous base member includes a first region and a second region,

the first region and the second region are alternately formed in a propagation direction of the surface acoustic wave, and

an infiltration rate in the first region is greater than an infiltration rate in the

second region.

14. The surface acoustic wave sensor according to claim 13, wherein in the porous base member, lengths in the propagation direction of the surface acoustic wave in a plurality of the first regions are different from each other.

15. The surface acoustic wave sensor according to claim 13 or claim 14, wherein in the porous base member, lengths in the propagation direction of the surface acoustic wave in a plurality of the second regions are different from each other.

It is preferable that the porous base member have a portion that does not come into contact with the piezo element.

It is preferable that a plurality of electrodes be provided and that reactants that react with each target be provided on the porous base member.

In the surface acoustic wave sensor of the aspect of the invention, it is preferable that a plurality of electrodes be provided and that reactants that react with each target be provided on each porous base member.

[0010]

In the surface acoustic wave sensor of the aspect of the invention, it is preferable that two electrodes be provided and that the porous base member come into contact with the piezo element with a thin film interposed therebetween, be connected to the porous base member, and have a portion that comes into contact with each electrode is formed of a hydrophobic base member.

In the surface acoustic wave sensor of the aspect of the invention, it is preferable that the piezo element include: a first portion having a region that is not electrically connected to the electrode; and a second portion having a thin film that is electrically connected to the electrode.

In the surface acoustic wave sensor of the aspect of the invention, it is preferable that the porous base member include a first region and a second region, that the first region and the second region be alternately formed in a propagation direction of the surface acoustic wave, and that the infiltration rate in the first region be greater than the infiltration rate in the second region.

In the surface acoustic wave sensor of the aspect of the invention, it is preferable

from the phase-amplitude detecting circuit 23, the PC 24 determines the amount of an antigen in a solution that were specifically-reacted with an antibody on the surface and displays the determination result.

[0023]

Here, the phase variation and the attenuation of amplitude of the SAW will be described.

The SAW is an acoustic wave that concentrates in the vicinity of the surface of the piezoelectric element substrate 10 (the position close to the surface) and propagates.

When a substance adsorbs onto the top surface of the piezoelectric element substrate 10, the mass per unit volume and the degree of viscosity of the top surface thereof vary.

As a result, the propagation velocity and the amplitude of the SAW vary.

For this reason, the propagation time of the SAW varies and the attenuation of amplitude varies.

In the first embodiment, an antigen that is contained in a solution is measured utilizing the variation in phase and variation in attenuation of amplitude.

Specifically, at first, a measurer of the SAW sensor 1 drops a solvent that does not contain an antigen on the region S shown in FIG. 2 and thereby makes the top of the reaction-region thin film 12 wet with the solvent, and measures the phase variation which is associated with the propagation time of the SAW (blank test).

Next, the measurer of the SAW sensor 1 replaces the SAW sensor 1 with another sample (SAW sensor 1), drops the solution of the sample containing an antigen on the region S shown in FIG. 2, and measures the phase variation which is associated with the propagation time thereof.

A difference between the phase variation corresponding to the solvent and the

phase variation corresponding to the solution is a variation in phase which is caused by an antigen antibody complex that is generated in the reaction-region thin film 12 due to an antigen-antibody reaction.

The PC 24 has stored the phase variation of the blank test in memory, calculates the difference between the phase variation and the phase variation obtained by dropping of a solution, and thereby calculates the variation in phase.

The PC 24 determinds the amount of an antigen contained in solution based on the variation in phase.

Similar to attenuation of amplitude, the PC 24 determinds the amount of an antigen contained in solution based on the variation in attenuation of amplitude.

In other cases, if the phase variation of the SAW in the solvent to be used is determined in advance, the measurer does not need to measure the phase variation of the SAW in the solvent.

Furthermore, even in the case where the propagation time of the SAW in the solvent to be used is not determined in advance, the phase and the amplitude which are immediately after dropping of solution containing an antigen are used as a reference, the amount of and the kind of antigen in solution is determined as a result of obtaining the difference between subsequent changes based thereon, and the determination result may be displayed.

[0024]

As described above, the SAW sensor of first embodiment includes: a piezoelectric element substrate (the piezoelectric element substrate 10) that propagates a surface acoustic wave; electrodes that carry out conversion of an electrical signal and a surface acoustic wave (the IDT 11-1 that carries out conversion of an electrical signal into a surface acoustic wave and the IDT 11-2 that carries out conversion of a surface

Based on a detection signal input from the sensor 101 and the burst signal input from the burst circuit 22, the phase-amplitude detecting circuit 23 calculates a phase variation and an amplitude change which are associated with a propagation time that is a time required for propagation of the SAW on the piezoelectric element substrate 110.

Specifically, the phase-amplitude detecting circuit 23 detects a phase variation and attenuation of amplitude which is associated with a required time (referred to as a delay time) between the inputting of the burst signal and the inputting of the detection signal.

The phase-amplitude detecting circuit 23 outputs a phase variation and an amplitude change, which is due to the detected delay time, to the PC 24.

Based on the phase variation and the amplitude change which are input from the phase-amplitude detecting circuit 23, the PC 24 determines the amount of an antigen in a solution that were specifically-reacted with an antibody on the surface and displays the determination result.

[0050]

Here, the phase variation and the amplitude change of the SAW will be described.

The SAW is an acoustic wave that concentrates in the vicinity of the surface of the piezoelectric element substrate 110 (the position close to the surface) and propagates.

When a substance is absorbed onto the top surface of the piezoelectric element substrate 110, the mass per unit volume and the degree of viscosity of the top surface thereof vary.

As a result, the propagation velocity and amplitude of the SAW vary.

For this reason, the phase variation and the amplitude change which are associated with the delay time of the SAW vary.

**CLAIMS**

1. A surface acoustic wave sensor comprising:

a piezo element that propagates a surface acoustic wave;

an electrode that carries out conversion of an electrical signal and a surface acoustic wave; and

a porous base member which is disposed at a propagation path of the surface acoustic wave, is disposed above a detection region of the piezo element into which liquid serving as an analyte is introduced, and into which liquid infiltrates, the liquid having a portion that comes into contact with the detection region which is due to the liquid infiltration by a capillary action.

2. The surface acoustic wave sensor according to claim 1, further comprising a sealing structure that prevents the electrode from coming into contact with liquid.

3. The surface acoustic wave sensor according to claim 2, wherein

the porous base member has a portion that does not overlap the detection region in a plan view.

4. The surface acoustic wave sensor according to any one of claims 1 to 3, wherein

two electrodes are provided, and the detection region has a short-circuiting reaction region that is electrically connected to one of the two electrodes and an open reaction region that is not electrically connected to the other of the two electrodes.

5. The surface acoustic wave sensor according to any one of claims 1 to 4, wherein

the porous base member allows liquid to infiltrate thereinto due to a capillary

action in a propagation direction of the surface acoustic wave.

6. The surface acoustic wave sensor according to any one of claims 1 to 5, wherein separate reactants which react with a target are formed and dispersed in directions in which the solution infiltrates into the porous base member.

7. The surface acoustic wave sensor according to any one of claims 1 to 6, wherein the porous base member includes at least one of a reaction layer including a substance that reacts with a target and a filter layer that removes other than a target.

8. The surface acoustic wave sensor according to any one of claims 1 to 7, wherein the porous base member has a portion that does not come into contact with the piezo element.

9. The surface acoustic wave sensor according to any one of claims 1 to 8, wherein a plurality of electrodes are provided, and reactants that react with each target are provided on the porous base member.

10. The surface acoustic wave sensor according to any one of claims 1 to 9, wherein a plurality of electrodes are provided, and reactants that react with each target are provided on each porous base member.

11. The surface acoustic wave sensor according to any one of claims 1 to 10, wherein

two electrodes are provided, and the porous base member comes into contact

with the piezo element with a thin film interposed therebetween, is connected to the porous base member, and has a portion that comes into contact with each electrode is formed of a hydrophobic base member.

12. The surface acoustic wave sensor according to claim 10, wherein

the piezo element includes:

a first portion having a region that is not electrically connected to the electrode; and

a second portion having a thin film that is electrically connected to the electrode.

13. The surface acoustic wave sensor according to any one of claims 1 to 12, wherein

the porous base member includes a first region and a second region,

the first region and the second region are alternately formed in a propagation direction of the surface acoustic wave, and

an infiltration rate in the first region is greater than an infiltration rate in the second region.

14. The surface acoustic wave sensor according to claim 13, wherein

in the porous base member, lengths in the propagation direction of the surface acoustic wave in a plurality of the first regions are different from each other.

15. The surface acoustic wave sensor according to claim 13 or claim 14, wherein

in the porous base member, lengths in the propagation direction of the surface acoustic wave in a plurality of the second regions are different from each other.