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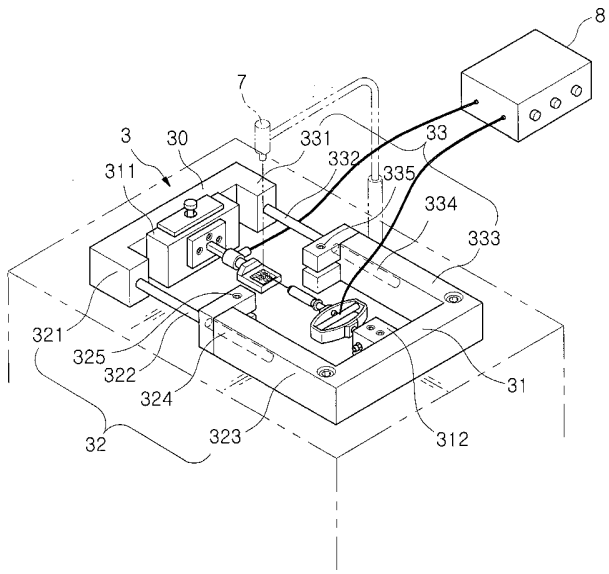
(54) **Title:** MICRO MATERIAL TESTER



(57) **Abstract:** Disclosed is a micro material tester for measuring physical properties of micro-sized materials used in a micro electro mechanical system. The micro material tester according to the present invention includes: a tensile test specimen including a testing piece, which is laterally provided and includes a measuring portion, and first and second pieces, which are provided on both sides of the testing piece; and a plate member which has flat upper and lower surfaces and has the tensile test specimen fixed on its upper surface by attaching the first piece to the plate member.

WO 2006/075810 A1

MICRO MATERIAL TESTER

FIELD OF THE INVENTION

The present invention relates to a micro material tester for measuring physical properties of micro-sized materials used in a micro electro mechanical system.

BACKGROUND OF THE INVENTION

In general, micro-sized materials used in a micro electro mechanical system mostly range in size from tens of nanometers to tens of micrometers. Accordingly, it is very difficult to observe and measure the micro-sized materials using conventional tools or equipment for measuring macro-sized materials.

In particular, the micro-sized materials used in the micro electro mechanical system are known to have physical properties different from the macro-sized materials. Conventionally, the physical properties of the micro-sized materials used in the micro electro mechanical system have been measured in an indirect method.

However, there is a problem in that the physical properties of the micro-sized materials used in the micro electro mechanical system are not very reliable when measured through the indirect method.

SUMMARY OF THE INVENTION

The present invention provides a micro material tester capable of measuring physical properties of micro-sized materials used in a micro electro mechanical system in a direct tensile test method.

In accordance with an aspect of the present invention, there is provided a micro material tester comprising: a main body 3 including first and second fixing parts 311, 312 which are provided on its both sides; a member fixing unit 4 which is provided between the first and second fixing parts 311, 312, and on which a test specimen member is fixed, the test specimen member including a tensile test specimen 1 consisting of a testing piece 11, which is laterally elongated and has a measuring portion 111, and first and second pieces 12, 13 provided on both sides of the testing piece 11, and a plate member 2 which has flat upper and lower surfaces and on the upper surface of which the tensile test specimen 1 is laterally fixed by attaching the first piece 12 to the plate member 2; tensile means 5 which is provided between an upper portion of the second piece 13 of the tensile test specimen 1 and the second fixing part 312 and elongates the tensile test specimen 1; tensile load measurement means 6 which is provided

between the member fixing unit 4 and the first fixing part 311 and measures tensile load when the tensile means 5 elongates the tensile test specimen 1; and measuring portion measurement means 7 which is provided over the member fixing unit 4 and measures the measuring portion 111 of the tensile test specimen 1.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

Fig. 1 is a perspective view showing a test specimen member in accordance with a first embodiment of the present invention;

Fig. 2 is a perspective view showing a test specimen member in accordance with a second embodiment of the present invention;

Fig. 3 is a perspective view showing a micro material tester in accordance with the present invention;

Fig. 4 is an enlarged view showing a main portion of the micro material tester shown in Fig. 3;

Fig. 5 is an exploded perspective view showing tensile means shown in Fig. 3;

Fig. 6 is an enlarged perspective view showing

tensile load measurement means shown in Fig. 3;

Fig. 7 is a cross-sectional view showing a member fixing unit shown in Fig. 3; and

Fig. 8 is a perspective view showing a member fixing unit in accordance with another embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Exemplary embodiments in accordance with the present invention will now be described in detail with reference to the accompanying drawings where like reference numerals denote like elements.

Fig. 1 is a perspective view showing a test specimen member in accordance with a first embodiment of the present invention. As shown in Fig. 1, a member fixing unit 4, tensile load measurement means 6, and tensile means 5, which constitute a tensile tester of the test specimen member, are illustrated.

The test specimen member used in testing physical properties of a micro-sized material according to the present invention (hereinafter referred to as "test specimen member") includes a tensile test specimen 1 including a testing piece 11, which is elongated laterally and includes a measuring portion 111, and a first piece 12 and a second piece 13, which are provided

on both sides of the testing piece 11, and a plate member 2 which has flat upper and lower surfaces and has at least one tensile test specimen 1 fixed on the upper surface.

The tensile test specimen 1 is configured such that the first piece 12 is fixed by an adhesive to the upper surface of the plate member 2 while the testing piece 11 and the second piece 13 are not fixed to the upper surface of the plate member 2. That is, the tensile test specimen 1 is fixed to the plate member 2 in such a manner that one end of the tensile test specimen 1 is fixed and the other end is not fixed to be elongated by tensile load.

In addition, the testing piece 11 includes a measuring portion 111 which is formed to have a predetermined size by two grooves or line markers (not shown) at its central portion. The displacement of the measuring portion 111 can be measured by measuring portion measurement means (not shown).

Meanwhile, the plate member 2 may further include a test plate member 21 made of a magnetic material on its lower side. Accordingly, the plate member 2 including the test plate member 21 is detachable to an upper surface of the member fixing unit 4 made of a magnetic material.

The plate member 2 may be configured in a rectangular shape so that it can be securely fixed to the upper surface of the member fixing unit 4.

In addition, a plurality of tensile test specimens 1 may be provided in a plurality of parallel rows on the upper surface of the plate member 2 so that the tensile test specimens 1 can be consecutively tested.

Accordingly, the test specimen thus configured is fixed to the upper surface of the member fixing unit 4 to perform a tensile test. At this time, the plate member 2 with the tensile test specimen provided thereon is fixed to the upper surface of the member fixing unit 4 using an adhesive or a magnet.

That is, to perform the tensile test, the test specimen member is first placed on the upper surface of the member fixing unit 4, one end of the member fixing unit 4 is then fixed to the tensile load measurement means 6, and one end of the tensile test specimen 1 attached to the plate member 2 is in turn elongated.

That is, the first piece 12 is fixed on the upper surface of the plate member 2, and one end of the tensile means 5 is fixed on an upper surface of the second piece 13 to apply tensile load. When the tensile load is applied to the tensile means 5, the testing piece 11 placed between the first and second pieces 12,

13 is elongated towards the second piece 13 to thereby perform a tensile test.

Fig. 2 is a schematic perspective view showing a test specimen member in accordance with a second embodiment of the present invention.

The test specimen member according to the second embodiment includes a plurality of tensile test specimens 1 and a plate member 2. The plurality of tensile test specimens 1 each having first and second pieces 12, 13 are provided on an upper surface of the plate member 2 in parallel rows in such a manner that the locations of the first and second pieces 12, 13 are alternately reversed, the first piece 12 being smaller in size than the second piece 13.

Accordingly, in the second embodiment, a plurality of tensile test specimen 1 are subjected to the tensile test while moving the plate member 2 back and forth. Next, after rotating the plate member 2 180 degree, a plurality of tensile test specimen 1 are again subjected to the tensile test while moving the plate member 2 back and forth.

Fig. 3 is a perspective view of a micro material tester in accordance with the present invention. Fig. 4 is an enlarged view of a main part of a micro material tester in accordance with the present invention.

The micro material tester comprises a main body 3 including a first fixing part 311 for finely adjusting the height of tensile load measurement means 6 and a second fixing part 312 for adjusting angular displacement to keep tensile means 5 level, a member fixing unit 4 which is provided between the first and second fixing parts 311, 312 and on which the above-mentioned test specimen member is fixed, the tensile means 5 which is provided between the member fixing unit 4 and the second fixing part 312 and elongates the tensile test specimen 1 constituting the test specimen member, tensile load measurement means 6 which is provided between the member fixing unit 4 and the first fixing part 311 and measures tensile load when the tensile test specimen 1 is elongated, and measuring portion measurement means 7 for measuring the measuring portion 111 of the tensile test specimen 1.

The micro material tester further comprises control means 8 which controls power applied to the tensile means 5 using an external signal, receives measurement data of the tensile load from the tensile load measurement means 6 in real time, and receives measurement data of the measuring portion 111 from the measurement unit measurement means 7 in real time.

Meanwhile, the main body 3 includes an upper-end

part 30 to which the first fixing part is fixed, a lower-end part 31 to which the second fixing part is fixed, and left-end and right-end parts 32 and 33 which interconnect the upper-end and lower-end parts 30, 31.

The left-end and right-end parts 32 and 33 include first parts 321, 331 including inserting shafts 322, 332, and second parts 323, 333 including inserting holes 324, 334 to which the inserting shafts 322, 332 are inserted, where the first and second parts are connected to each other through the inserting shafts and the inserting holes so that the width between the upper-end and lower-end parts can be varied. In addition, bolt fixing means 325, 335 are further provided on the inserting holes 324, 334 to fix the insertion locations of the inserting shafts 322, 332.

In addition, the member fixing unit 4 is fixed to the tensile load measurement means 6 at its one end and has a test specimen member on its upper side which is attached with an adhesive or a magnet. A detailed description thereof will be given below.

As described above, the test specimen member fixed to the member fixing unit 4 includes the tensile test specimen 1 consisting of the testing piece 11, which is elongated laterally and includes a measuring portion (not shown), and the first and second pieces 12 and 13,

and the plate member 2 which has flat upper and lower surfaces and has one or more tensile test specimen 1 fixed thereon.

In addition, the test specimen member includes a plurality of tensile test specimens 1 and a plate member 2. The plurality of tensile test specimens 1 each having first and second pieces 12, 13 are provided on an upper surface of the plate member 2 in parallel rows in such a manner that the locations of the first and second pieces 12, 13 are alternately reversed, the first piece 12 being smaller in size than the second piece 13.

A configuration of the micro material tester according to the present invention will now be described in more detail.

Fig. 5 is an exploded perspective view of tensile means according to the present invention. The tensile means 5 comprises a piezoelectric actuator 51 which varies in width based on a change in voltage, connecting means 52 which interconnects the piezoelectric actuator 51 and the second piece 13 of the tensile test specimen 1 and elongates the tensile test specimen 1 through the piezoelectric actuator 51, and a second fixing part 312 including a plurality of adjusting bolts so that the tensile test specimen 1 and a silicon carbide line 522 can be aligned in a straight line by adjusting the

angular displacement of the tensile means 5.

The connecting means 52 includes a collet grip 521 which is fixed to an inner side of the piezoelectric actuator 51 and to which the silicon carbide line 522 is fixed at its front side, and an ultra-violet curing adhesive by which a front end of the silicon carbide line 522 is attached to an upper surface of the second piece 13 of the tensile test specimen 1.

The collet grip 521 is fixed to the piezoelectric actuator 51 at its one side. The collet grip 521 includes a collet shaft 523 and a cap nut 527. The collet shaft 523 includes an inserting hole 524 to which the silicon carbide line 522 is inserted, and a plurality of inclined separated members 526 including a spiral part 525 formed on its outer surface. The cap nut 527 is provided at a front side of the collet shaft 523 and includes a hole 528 configured to reduce the diameter of the inserting hole 524 to fix the silicon carbide line 522.

Fig. 6 is an enlarged perspective view of the tensile load measurement means 6 according to the present invention. The tensile load measurement means 6 includes first and second shafts 45, 46 and a rod cell 61. The first and second shafts 45, 46 are protruded on one side of the first fixing part 311 and on one end of

the member fixing unit 4, respectively. The rod cell 61 is provided between the first and second shafts 45, 46 and measures tensile load of the tensile test specimen 1 when the tensile test specimen 1 is elongated.

Meanwhile, the measuring portion measurement means 7 is configured to measure the measuring portion 111 formed in the tensile test specimen 1, as shown in Fig. 3. That is, the measuring portion measurement means 7 is configured to measure displacement of the measuring portion 111 by measuring interference fringes of reflected light.

Operation of the present invention will now be described in detail.

As shown in Figs. 3 to 6, to perform a tensile test using the micro material tester according to the present invention, a test specimen member on which one or more tensile test specimens 1 are provided in a cantilever manner is first prepared. Next, the prepared test specimen is placed on an upper side of the member fixing unit 4 which is fixed at its one side to the tensile load measurement means 6. One end of the tensile means 5 is attached to one unattached end of the tensile test specimen 1 using an adhesive.

Next, voltage is applied to the piezoelectric actuator 51 using an external signal to perform the

tensile test.

The piezoelectric actuator 51 becomes narrow in width due to the applied voltage so that the connecting means connected to the piezoelectric actuator 51 is elongated and the tensile test specimen 1 is thus elongated. That is, the tensile test specimen 1 is elongated by elongating the second piece 13 to which the silicon carbide line 522 constituting the tensile means 5 is fixed.

During the above-mentioned tensile test, the displacement of the measuring portion 111 formed in the middle of the tensile test specimen 1 can be measured by the measuring portion measurement means 7 located over the tensile test specimen 1.

That is, the displacement of the measuring portion 111 defined by two grooves or lines (not shown) can be precisely measured by measuring interference fringes of light reflected from the grooves or line markers.

In addition, tensile load of the tensile test specimen 1 can be measured by the tensile load measurement means 6 while measuring the displacement of the measuring portion 111 as described above. That is, the tensile load with respect to voltage applied to the tensile means 5 can be measured by the tensile load measurement means 6.

Accordingly, physical properties of a test specimen can be calculated according to test conditions by inputting displacement data and tensile load data of the tensile test specimen 1 with respect to voltage data inputted to the tensile means 5 to a control unit.

Meanwhile, Fig. 7 is a cross-sectional view showing member fixing means of the first embodiment constituting a micro material tester according to the present invention. The member fixing unit 4 in accordance with the first embodiment of the present invention includes a base heating plate 41 which is connected at its one end to one end of the tensile load measurement means 6 and is heated by an external power source, and an adhesive layer 42 which is coated on an upper side of the base heating plate 41 and through which a lower surface of the test specimen member is attached to an upper surface of the base heating plate 41 when the base heating plate 41 is heated and then cooled down. The adhesive layer 42 is formed of wax which is turned into liquid when heated and becomes solid again when cooled down.

Accordingly, the tensile test can be performed by heating the base heating plate 41 and attaching the test specimen member of the first embodiment to the base heating plate 41.

Also, Fig. 8 is a schematic perspective view

showing a member fixing unit of the second embodiment constituting a micro material tester according to the present invention, which is connected to the connecting means 52. The member fixing unit 4 according to the second embodiment of the present invention includes a base plate 43 which is connected at its one end to the tensile load measurement means 6 and which has a step protruded vertically on a part of its upper surface, and a magnet member 44 which is attached to one end of the test specimen member 21 which is made of a magnetic material and combined with the plate member 2.

Accordingly, the tensile test can be performed by fixing one end of the test specimen member of the second embodiment to the magnet member 44 provided on the base plate.

As apparent from the above description, it is possible to readily measure the physical properties of micro-sized materials used in a micro electro mechanical system by use of the test specimen member and the micro material tester according to the present invention.

While the present invention has been described with reference to exemplary embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the scope of the present invention as

defined by the following claims.

WHAT IS CLAIMED IS:

1. A micro material tester comprising:

a main body 3 including first and second fixing parts 311 and 312 which are provided on its both sides;

a member fixing unit 4 which is provided between the first and second fixing parts 311 and 312, and on which a test specimen member is fixed, the test specimen member including a tensile test specimen 1 consisting of a testing piece 11, which is laterally elongated and has a measuring portion 111, and first and second pieces 12 and 13 provided on both sides of the testing piece 11, and a plate member 2 which has flat upper and lower surfaces and on the upper surface of which the tensile test specimen 1 is laterally fixed by attaching the first piece 12 to the plate member 2;

tensile means 5 which is provided between an upper portion of the second piece 13 of the tensile test specimen 1 and the second fixing part 312 and elongates the tensile test specimen 1;

tensile load measurement means 6 which is provided between the member fixing unit 4 and the first fixing part 311 and measures tensile load when the tensile means 5 elongates the tensile test specimen 1; and

measuring portion measurement means 7 which is

provided over the member fixing unit 4 and measures the measuring portion 111 of the tensile test specimen 1.

2. The micro material tester of claim 1, further comprising control means 8 which controls power applied to the tensile means 5 using an external signal, receives measurement data of tensile load from the tensile load measurement means 6 in real time, and receives measurement data of the measuring portion 111 from the measuring portion measurement means 7 in real time.

3. The micro material tester of claim 1, wherein the plate member 2 is formed in a rectangular shape.

4. The micro material tester of claim 3, wherein a plurality of tensile test specimens 1 are provided in parallel rows on the plate member 2.

5. The micro material tester of claim 4, wherein the tensile test specimens 1 each having first and second pieces 12 and 13 are provided on an upper surface of the plate member 2 in parallel rows in such a manner that the locations of the first and second pieces 12 and 13 are alternately reversed, the first piece 12 being

smaller in size than the second piece 13.

6. The micro material tester of any one of claims 1 to 5, wherein the member fixing unit 4 includes:

a base heating plate 41 which is connected at its one end to one end of the tensile load measurement means 6 and is heated by an external power source; and

an adhesive layer 42 which is coated on the base heating plate 41 and through which a lower surface of the test specimen member is attached to an upper surface of the base heating plate 41 when the base heating plate 41 is heated and then cooled down.

7. The micro material tester of claim 6, wherein the adhesive layer 42 is made of wax.

8. The micro material tester of any one of claims 3 to 5, wherein a test plate member 21 is provided below the plate member 2, the test plate member 21 being made of a magnetic material.

9. The micro material tester of claim 8, wherein the member fixing unit 4 includes:

a base plate 43 which is connected at its one end to the tensile load measurement means 6 and which has a

step protruded vertically on a part of its upper surface; and

a magnet member 44 which is attached to an upper surface of the base plate 43 and one side of the step and to which one end of the plate member 2 is attached.

10. The micro material tester of claim 1 or 2, wherein the tensile means 5 includes:

a piezoelectric actuator 51 which is provided on an inner side of the second fixing part 312 and varies in its width according to a change in voltage; and

connecting means which connects the piezoelectric actuator 51 and the second piece 13 of the tensile test specimen 1 to elongate the tensile test specimen 1 through the piezoelectric actuator 51.

11. The micro material tester of claim 10, wherein the connecting means 52 includes:

a collet grip 521 which is fixed to an inner side of the piezoelectric actuator 51 and to which a silicon carbide line 522 is fixed at its front side; and

an ultra-violet curing adhesive by which a front end of the silicon carbide line 522 is attached to an upper surface of the second piece 13 of the tensile test specimen 1.

12. The micro material tester of claim 11, wherein the collet grip 521 includes:

a collet shaft 523 which is fixed at its one side to the piezoelectric actuator 51 and includes an inserting hole 524 to which the silicon carbide line 522 is inserted, and a plurality of inclined separated members 526 including a spiral part 525 formed on its outer surface; and

a cap nut 527 which is provided at a front side of the collet shaft 523 and includes a hole 528 configured to reduce the diameter of the inserting hole 524 to fix the silicon carbide line 522.

13. The micro material tester of claim 1 or 2, wherein the tensile load measurement means 6 includes:

first and second shafts 45 and 46 which are protruded on one side of the first fixing part and on one end of the member fixing unit 4, respectively; and

a rod cell 61 which is provided between the first and second shafts 45 and 46 and measures tensile load of the tensile test specimen 1 when the tensile test specimen 1 is elongated.

14. The micro material tester of claim 1, wherein

the main body 3 includes:

an upper-end part 30 to which the first fixing part 311 is fixed and a lower-end part 31 to which the second fixing part 312 is fixed; and

left-end and right-end parts 32 and 33 which connect the upper-end and lower-end parts 30 and 31 to each other.

15. The micro material tester of claim 14,

wherein the left-end and right-end parts 32 and 33 include: first parts 321, 331 including inserting shafts 322, 332; and second parts 323, 333 including inserting holes 324, 334 to which the inserting shafts 322, 332 are inserted, the first and second parts being connected to each other through the inserting shafts and the inserting holes so that the width between the upper-end and lower-end parts can be varied, and

wherein bolt fixing means 325, 335 are provided on the inserting holes 324, 334 to fix inserting locations of the inserting shafts 322, 332.

FIG.1

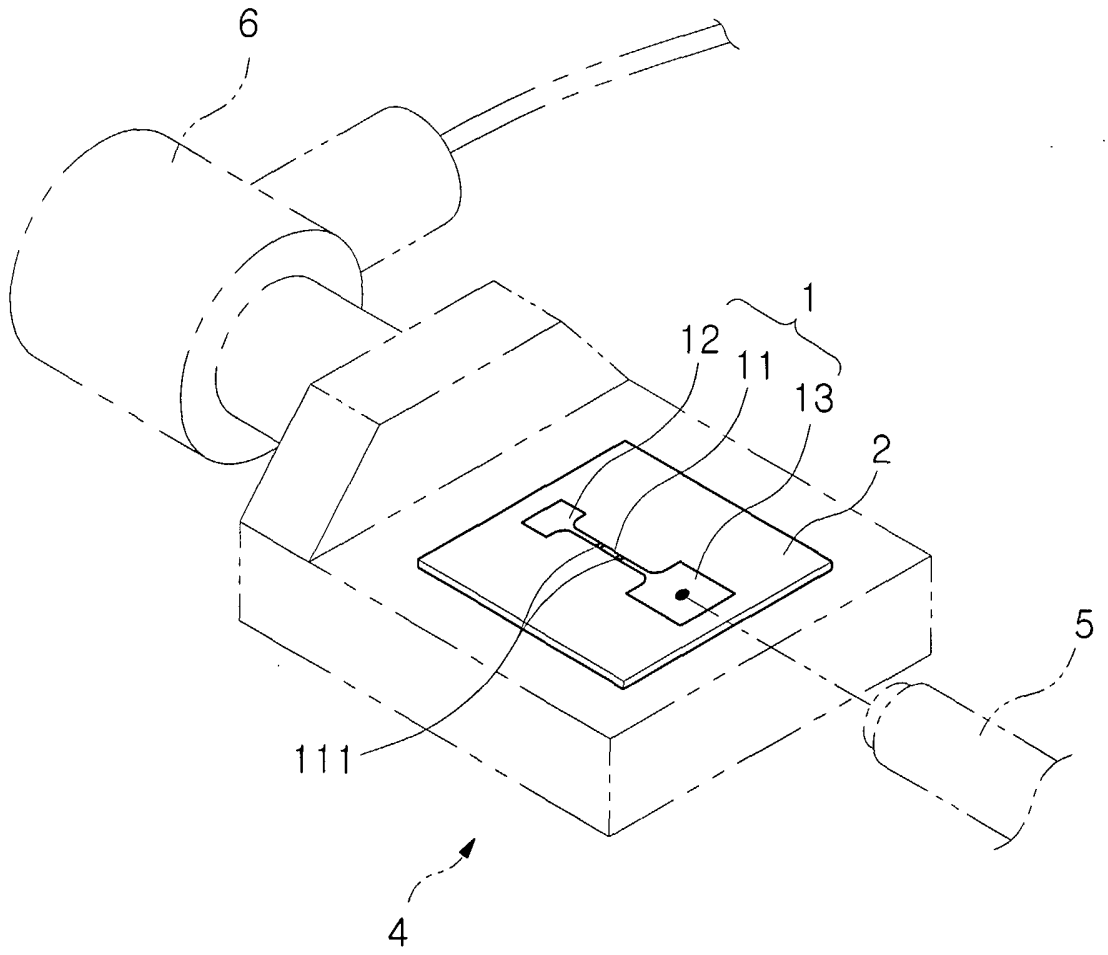


FIG.2

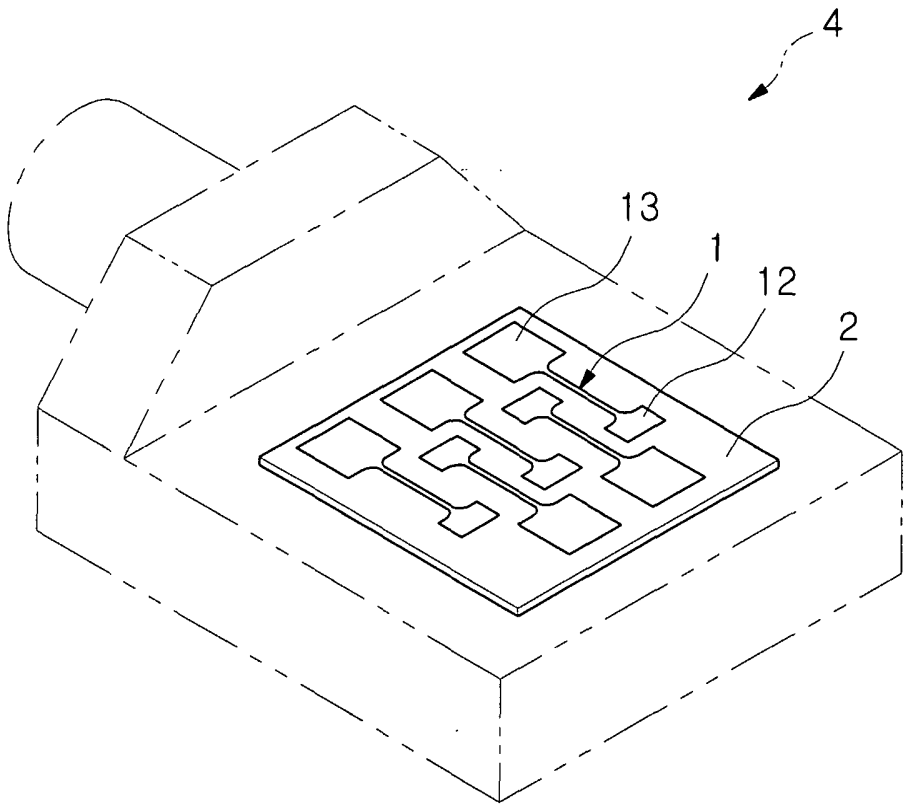


FIG.3

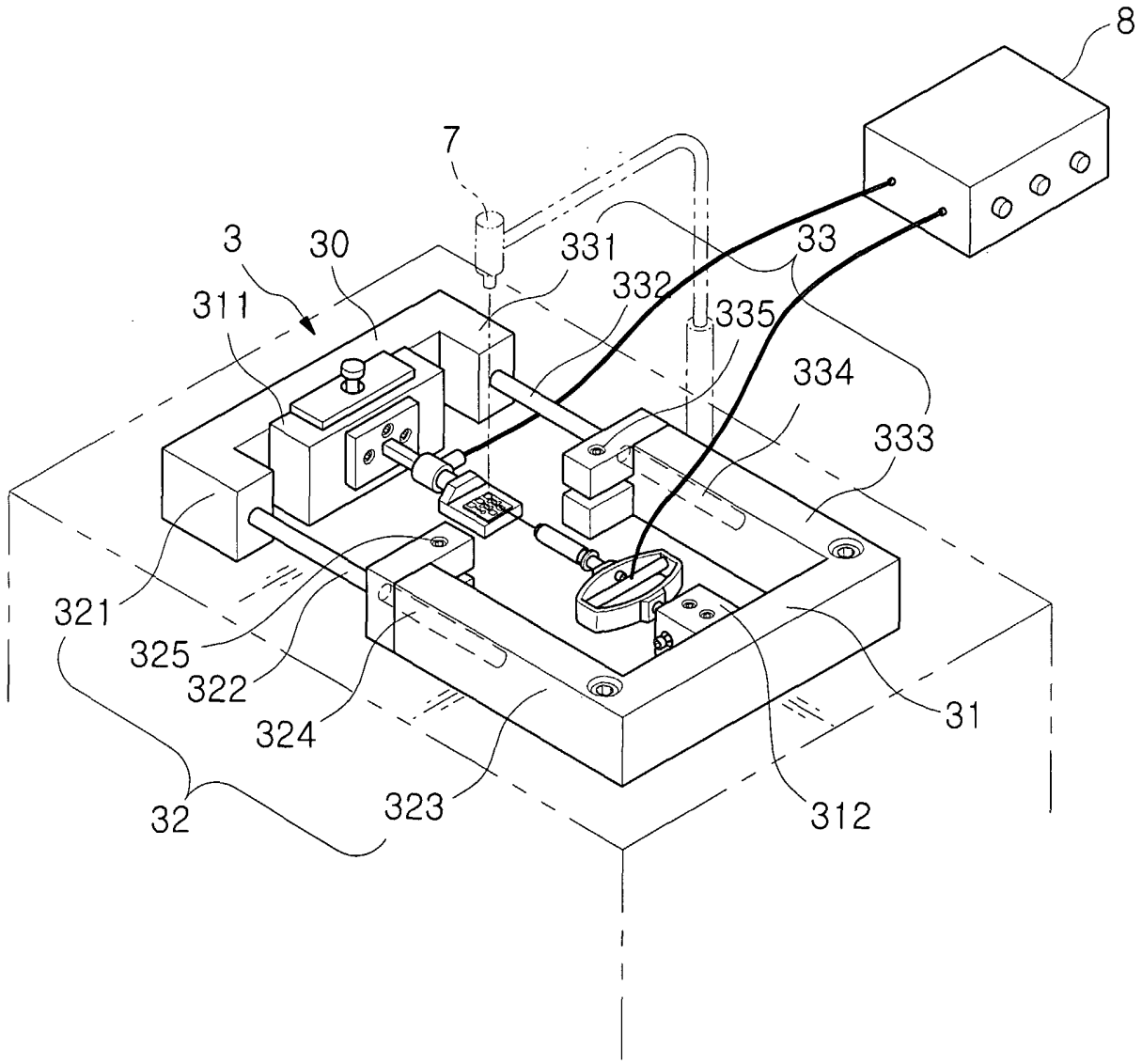


FIG.4

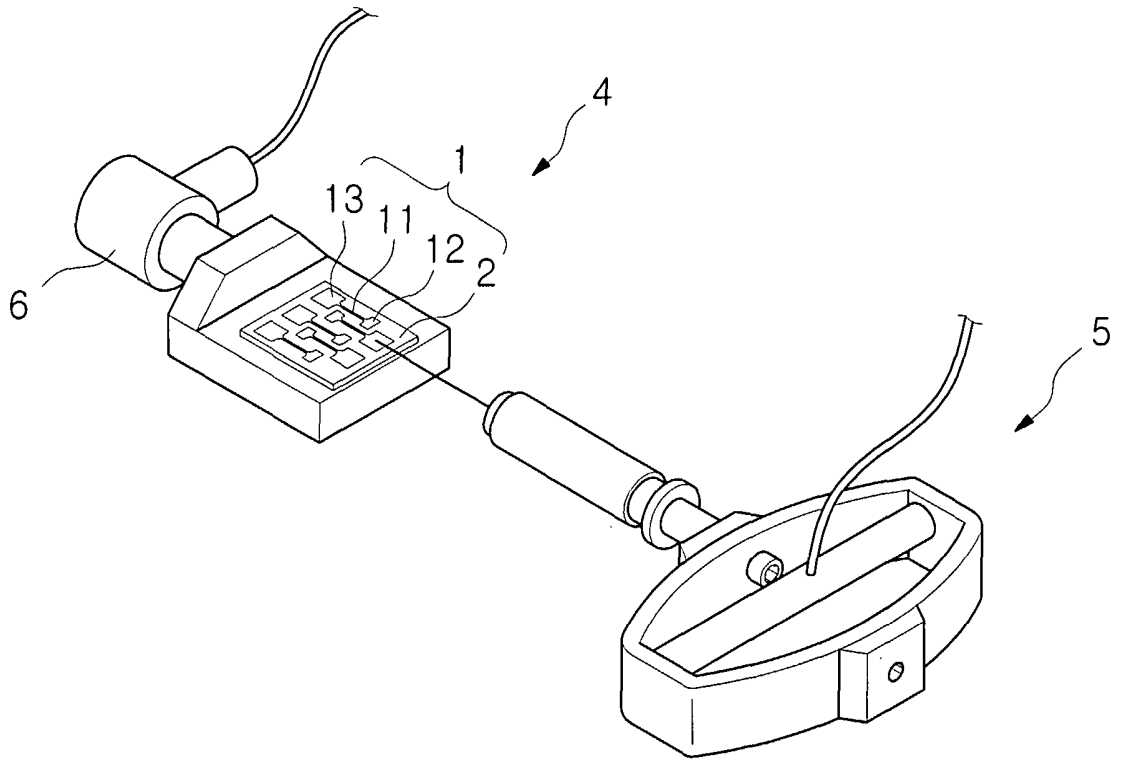


FIG.5

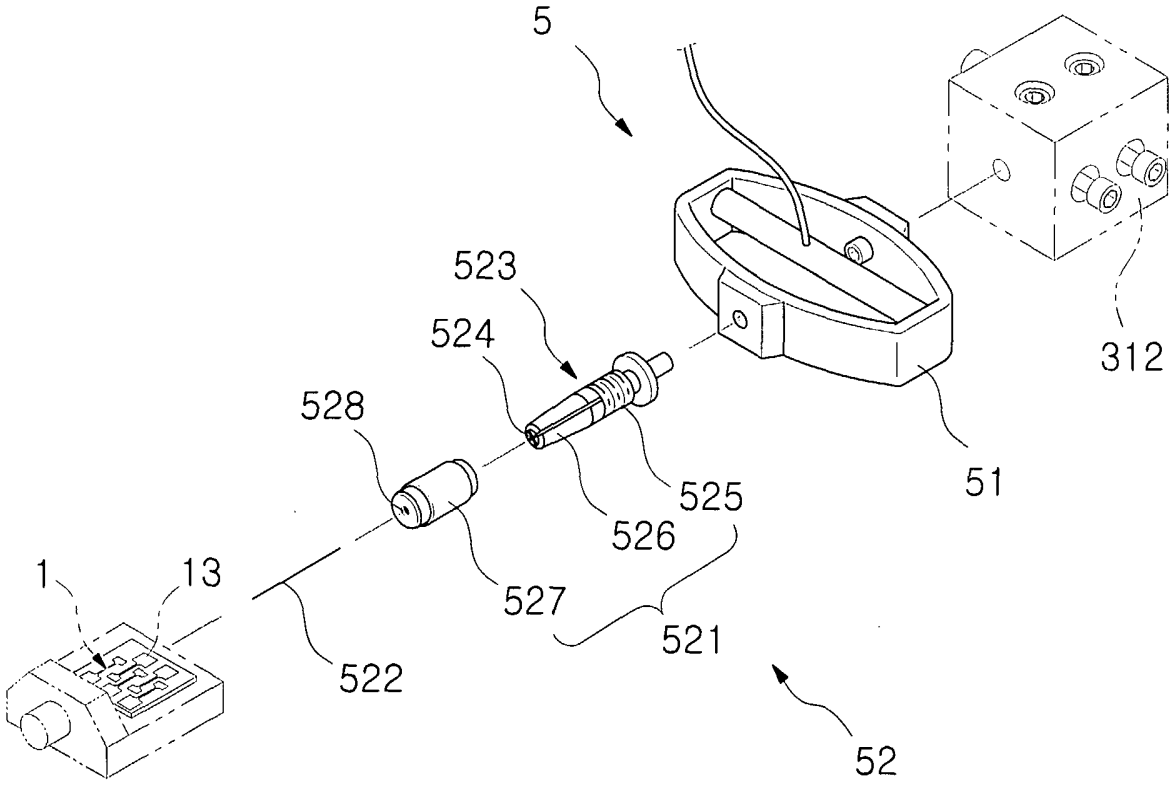


FIG.6

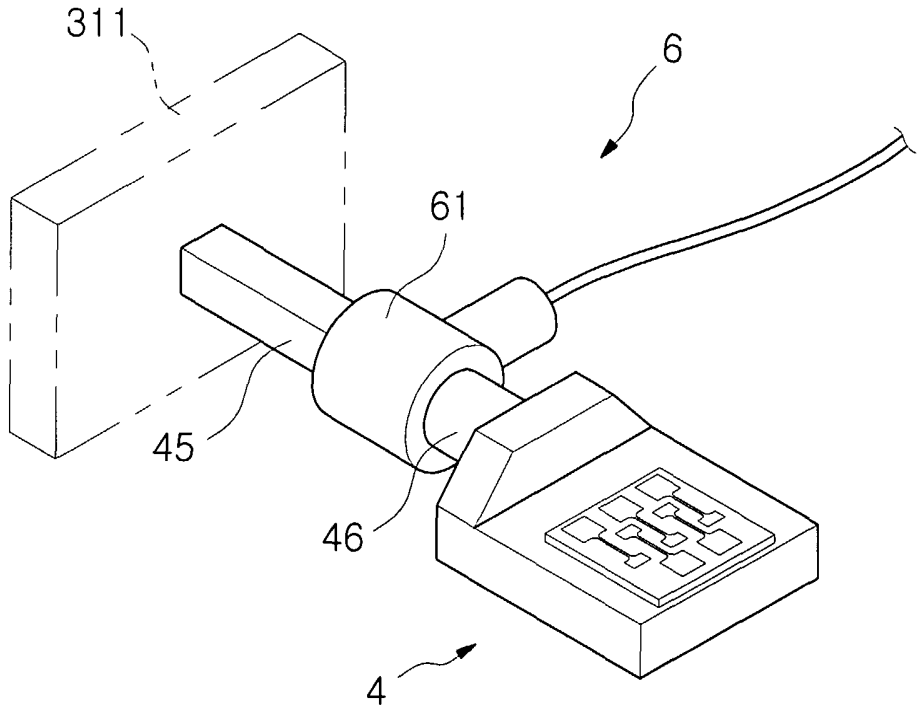


FIG.7

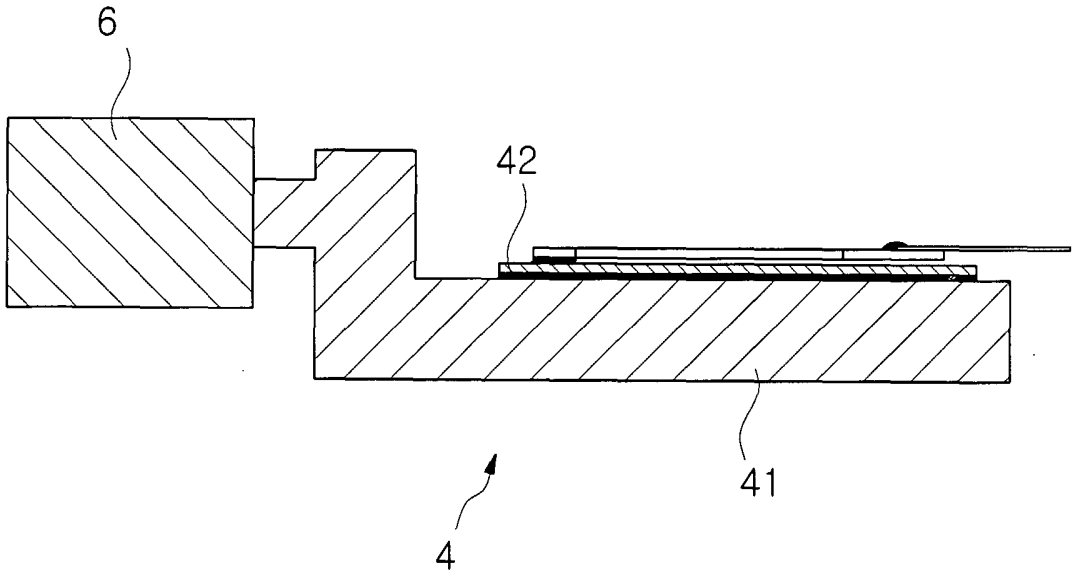
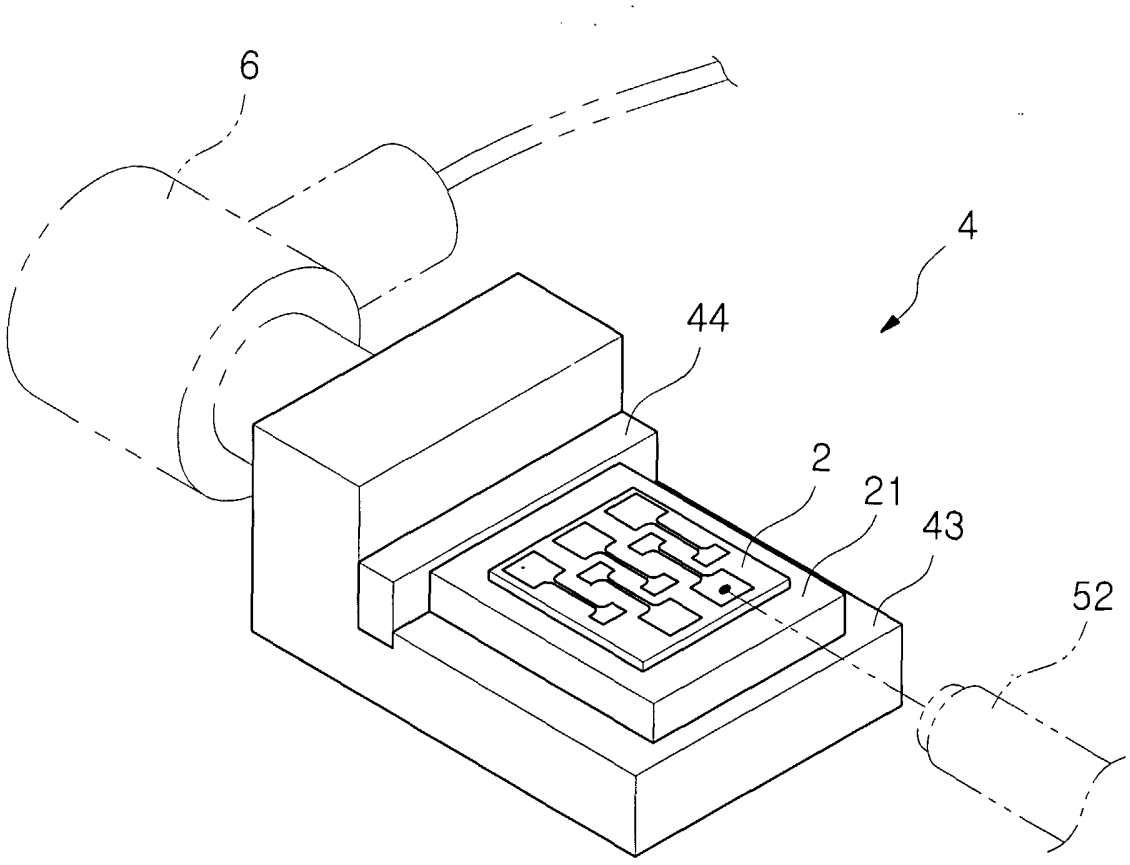


FIG.8



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2005/000291

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 G01N 3/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7 G01N 3/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Patents and applications for inventions since 1975
Korean Utility models and applications for Utility models since 1975
Japanese Utility models and applications for Utility models since 1975

Electronic data base consulted during the internationl search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 15-207432 A(KANSAI) 25 JULY 2003 page 2, Fig 1	1-15
A	JP 15-149108A(TOSHIBA CORP) 21 MAY 2003 page 3-4, Fig 1	1-15
A	JP 9-218142A(SEIKO INSTRUMENTS INC) 19 AUGUST 1997 page1-5 , Fig 1	1-15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
17 OCTOBER 2005 (17.10.2005)	**18 OCTOBER 2005 (18.10.2005)**

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Authorized officer
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Telephone No. 82-42-481-5497

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR2005/000291

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