



(51) International Patent Classification:
G01N 27/72 (2006.01) **B82B 3/00** (2006.01)
A61B 5/157 (2006.01)

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(21) International Application Number:
PCT/KR2011/005340

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(22) International Filing Date:
20 July 2011 (20.07.2011)

(25) Filing Language: English

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(26) Publication Language: English

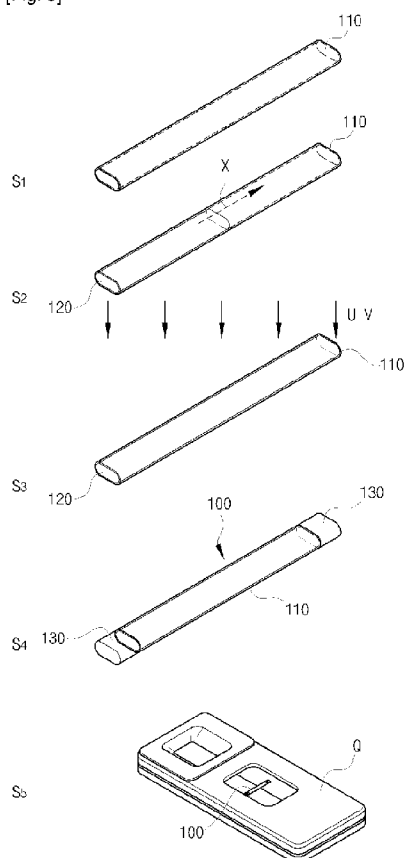
(30) Priority Data:
10-2010-0070001 20 July 2010 (20.07.2010) KR

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP,

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(54) Title: MAGNETIC NANOPARTICLE TUBE AND CARTRIDGE USING THE SAME AND METHOD OF MANUFACTURING THE SAME

[Fig. 3]



(57) Abstract: Provided is a magnetic nanoparticle tube available for a quality verification device of a medical instrument of a magnetic field measuring manner wherein the magnetic nanoparticle tube may include a capillary tube in which a tubular passage is formed and a magnetic curing filler containing magnetic nanoparticles to be filled into the capillary tube.





KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ,

Published:

— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

Description

Title of Invention: MAGNETIC NANOPARTICLE TUBE AND CARTRIDGE USING THE SAME AND METHOD OF MANUFACTURING THE SAME

Technical Field

- [1] The present invention relates to a manufacturing method of a structure body which may be used for verifying a quality of a measuring apparatus of a magnetic field measuring manner, and the structure body.

Background Art

- [2] In general, a device for inspecting or finding single or plural substance existence in a liquid sample such as urine or blood refers to as a diagnosis kit or a measuring cartridge. In more detail, recent diagnosis industry tends to focus on a Point-Of-Care Testing ("POCT"). Here, POCT refers to a device which may be used by an ordinary person who does not have expert knowledge outside a centralized inspection chamber. Recently, the diagnosis area tends to enlarge from a hospital to persons and point-of-care. As a medical instrument or a measuring apparatus to perform a predetermined diagnosis using the diagnosis kit, an electro-chemical blood analysis instrument, optical blood analysis instrument and measuring apparatus of a magnetic field measuring manner may be included. In particular, predetermined qualities of these measuring apparatus have to be kept and thus a quality verification device for confirming whether it is operated normally or not is provided to respective apparatus. The electro-chemical blood analysis instrument (Abbotti-STAT) among the instruments as described above copies voltage, current and resistance from a measuring cartridge using a quality verification device as shown in drawings and outputs maximum and minimum values of measurable signals as reference signals to determine whether the instrument is operated normally or not. On the contrary, the optical blood analysis instrument is driven in such a manner that test line image of a measuring cartridge is acquired and pixel intensity of the acquired image is measured. The qualities of these instruments, that is, whether they are operated normally or not is determined by copying the maximum and minimum pixel intensity of the test line of a measuring cartridge using a quality verification device.
- [3] FIG. 1 is a view of showing a sensing operation of a magneto resistance sensor. Here, the sensing operation is described as an example of Giant Magneto Resistance among magneto resistance sensors for clarity. As the magneto resistance sensor, the giant magneto resistance device of a spin-valve type is shown. As shown in FIG. 1, the magneto resistance sensor is configured such that a non-magnetic metal layer is in-

terposed between two ferromagnetic metal layers wherein when the magnetic force of the first ferromagnetic metal layer is fixed and the magnetic force of the second ferromagnetic metal layer is controlled variably to be parallel to that of the first layer, only the electrons spins of which are oriented toward a specific direction can pass through a conductive body. That is, electric resistance difference or voltage difference which is induced inside the material, depending on magnetizing direction arrangements of the two ferromagnetic layers, is created, and it is recognized as a digital signal. Here, when the interlayer substance is conductive body, it is the GMR device. The diagnosis instrument using the magneto resistance sensor is a high sensitive point- of- care testing device through which magnetic particles accumulated on a lateral flow membrane can be measured quantitatively using the giant magneto resistance sensor.

- [4] However, in case of magnetic field measuring way, there is no a quality verification device capable of copying a fixed magnetic field value, differently from a quality verification device applied to electro-chemical or optical medical instrument, and thus it is difficult to confirm whether it is operated normally or not.

Disclosure of Invention

Technical Problem

- [5] An aspect of the present invention is directed to a method of manufacturing a nanoparticle tube provided with magnetic curing fillers to be filled into a capillary tube.
- [6] Another aspect of the present invention is directed to a structure body for verifying quality of a measuring apparatus of a magnetic measuring manner, using the nanoparticle tube.

Solution to Problem

- [7] According to an embodiment of the present invention, a magnetic nanoparticle tube includes: a capillary tube into which a tubular passage is formed; and a magnetic curing filler including magnetic nanoparticles which are filled into the capillary tube, enabling a quality verification for a measuring apparatus of a magnetic field measuring manner to be performed efficiently.
- [8] According to another embodiment of the present invention, a method of manufacturing a magnetic nanoparticle tube includes: injecting magnetic nanoparticle solution into a capillary tube into which a tubular passage is formed; and curing the magnetic nanoparticle solution, enabling the magnetic nanoparticle tube to be manufactured efficiently.

Advantageous Effects of Invention

- [9] According to the present invention, a magnetic nanoparticle tube provided with magnetic curing fillers to be filled into a capillary tube is manufactured efficiently and

a quality verification of a measuring apparatus of a magnetic field measuring manner is performed efficiently, using the magnetic nanoparticle tube.

Brief Description of Drawings

- [10] The above and other aspects, features and advantages of certain exemplary embodiments of the present invention will be more apparent from the following description taken in conjunction with the accompanying drawings, in which:
- [11] FIG. 1 is a view of showing a sensing operation of a magneto resistance sensor;
- [12] FIGS. 2 and 3 are views of showing a manufacturing process in order and manufacturing processes of a magnetic nanoparticle tube, respectively, according to the present invention;
- [13] FIG. 4 is a view of showing constitutional elements of a measuring apparatus, including a magneto resistance sensor; and
- [14] FIG. 5 is view of showing a magnetic field horizontal distribution around a magnetic nanoparticle tube including a magneto resistance sensor according to the present invention.
- [15]
- [16] <Reference Numerals>
- [17] 110: capillary tube
- [18] 120: magnetic nanoparticle solution (magnetic curing filler)
- [19] 130: molding material
- [20] 210: external magnetic field application device
- [21] 220: specimen fixing unit
- [22] 230: magneto resistance sensor

Mode for the Invention

- [23] Exemplary embodiments of the present invention will be described below in detail with reference to the accompanying drawings. Wherever possible, the same reference numerals will be used to refer to the same elements throughout the specification, and a duplicated description thereof will be omitted. It will be understood that although the terms "first", "second", etc. are used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another element.
- [24] FIGS. 2 and 3 are views of showing a manufacturing process in order and manufacturing processes of a magnetic nanoparticle tube, respectively, according to the present invention.
- [25] Referring to FIGS. 2 and 3, a manufacturing process of a magnetic nanoparticle tube according to the present invention comprises of injecting magnetic nanoparticle solution into a capillary tube into which a tubular passage is formed and curing the

magnetic nanoparticle solution.

- [26] In more detail, first, a capillary tube 110 having a predetermined diameter is prepared, as shown in step S1. The capillary tube may be made of various materials such as synthetic resin and glass, etc., and according to one embodiment of the present invention, it is made of glass. In particular, the capillary tube 110 may be prepared in such a manner that it is a hollow body and a tubular passage is formed therein. In this case, a section of the capillary tube may be one of circle, ellipse and quadrangle, and according to one embodiment of the present invention, the capillary tube has a quadrangle section.
- [27] Next, in step S2, magnetic nanoparticle solution 120 is injected into the capillary tube 110. The nanoparticle solution 120 may be a liquid component containing magnetic nanoparticles and more preferably may include curing fillers which are cured by heat, light and ultraviolet, etc., after being injected into the capillary tube 110. In addition, the magnetic nanoparticles as described above may be one of Fe, Ni and Co, or combination thereof and further the physical/chemical properties thereof are determined, depending on combination range of elements and chemical structure. Preferably, the magnetic nanoparticle may be 1-100nm in size and superparamagnetism substance may be used as the magnetic nanoparticle.
- [28] Meanwhile, the ultraviolet curing filler is used for solidifying the magnetic nanoparticle inside the capillary tube. That is, various materials which are cured by adding the curing agent and through external energy such as ultraviolet may be used, comprising anyone selected from Poly (Ethylene Glycol)-Diacrylate (PEG-DA), acrylic, epoxy resin, cyanoacrylates. Additionally, the curing agent being added to the material may comprise anyone selected from 2-Hydroxy-2-methyl-1-phenyl-propan-1-one, 1-Hydroxy-cyclohexyl-phenyl-ketone, 2-Hydroxy-1-[4-(2-hydroxyethoxy)phenyl]-1-propanone. As one example, the magnetic nanoparticle solution 120 may comprise Poly (Ethylene Glycol)-Diacrylate (PEG-DA) and 2-Hydroxy-2-methyl-1-phenyl-propan-1-one, and magnetic nanoparticles further be comprised. (Of course, it has to be understood that different curing agents may be added to the various materials in addition the combinations as described above.).
- [29] In more detail, if the material to which the curing agents are added is prepared by combining Poly (Ethylene Glycol)-Diacrylate (PEG-DA) and 2-Hydroxy-2-methyl-1-phenyl-propan-1-one, the solution containing Poly (Ethylene Glycol)-Diacrylate (PEG-DA) and 2-Hydroxy-2-methyl-1-phenyl-propan-1-one is 60~70 wt.% and the solution containing the magnetic nanoparticles is 30~40 wt.%.
- [30] Subsequently, in step S3, the capillary tube 110 filled with the magnetic nanoparticle solution 120 is cured to solidify the magnetic nanoparticle solution (Hereinafter, the solidified magnetic nanoparticle refers to as "magnetic curing filler"). Particularly, the

curing method may include a heat curing and light curing, etc., and an ultraviolet is used for curing the magnetic nanoparticle solution according to the present invention.

[31] After that, in step S4, one end of the capillary tube 110 is sealed using a sealing agent such as epoxy resin to complete the magnetic nanoparticle tube 100 according to the present invention. The magnetic nanoparticle tube 100 is attached to an inspection window of a measuring cartridge Q and then is quality-verified in such a manner that constant magnetic field value in a magnetic field measuring method is copied to determine whether it is operated normally or not. Here, the magnetic nanoparticle according to the present invention may be identical to the particle to be used in the measuring cartridge. That is, when the magnetic nanoparticle having same components as the magnetic nanoparticle to be used for the measuring cartridge, is used for the magnetic nanoparticle tube, the magnetic property thereof can be copied exactly.

[32] Meanwhile, referring to FIG. 3 showing the manufacturing processes of steps S3 and S4, the magnetic nanoparticle tube as manufactured in the above manner includes a capillary tube 110 into which a tubular passage is formed, and a magnetic curing filler 120 comprising magnetic nanoparticles to be filled into the capillary tube 110 wherein both ends of the capillary tube are sealed with a sealing material 130.

[33] In this case, the magnetic curing filler 120 may comprise ultraviolet curing filler to which the magnetic nanoparticle is added and for example it may comprise Poly (Ethylene Glycol)-Diacrylate (PEG-DA) and 2-Hydroxy-2-methyl-1-phenyl-propan-1-one. Here, the magnetic particle to be contained in the ultraviolet curing filler is not specially limited, but the magnetic particle having same components as the magnetic particle contained the measuring cartridge may be preferable. Furthermore, a section of the capillary tube may be one of a circle, ellipse and quadrangle.

[34] FIG. 4 is a view of showing constitutional elements of a measuring apparatus, including a magneto resistance sensor. That is, the measuring apparatus may include a magneto resistance sensor MR for sensing magnetic components of a specimen to which magnetic particles are connected, and external magnetic field application device for applying external magnetic field to the magneto resistance sensor and further include a scanning portion for scanning magnetic signal sensed by the magneto resistance sensor to complete a detection system.

[35] In more detail, the detection system may include a specimen to be detected, a specimen fixing unit 220, an external magnetic field application device 210 for applying external magnetic field to the specimen, and a magneto resistance sensor 230. Using this basic configuration the specimen is mounted to the specimen fixing unit 220 and external magnetic field is applied from the external magnetic field application device 210 to the specimen and the magnetic signal with respect to the specimen

connected to magnetic components (magnetic particles) is sensed by the magneto resistance sensor 230 for separating it from electric components to be analyzed.

- [36] For verifying a quality of the measuring apparatus, when a measuring cartridge provided with the magnetic nanoparticle tube according to the present invention is set to the measuring apparatus and horizontal components of the magnetic field around the magnetic nanoparticle is measured, a constant quality (whether it is operated normally or not) can be confirmed.
- [37] FIG. 5 is view of showing a magnetic field horizontal distribution around a magnetic nanoparticle tube according to the present invention, which is measured using the measuring apparatus provided with the magneto resistance sensor. That is, when vertical or horizontal components of external magnetic field is applied to the magneto resistance sensor 230, the magnetic field Z caused from a strong magnetic reaction is formed around the magnetic nanoparticle tube and horizontal component W of the magnetic field around the magnetic nanoparticle tube is measured to confirm whether it is operated normally or not, comparing to a constant reference value.
- [38] While the invention has been shown and 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 spirit and scope of the invention as defined by the appended claims. Therefore, the scope of the invention is defined not by the detailed description of the invention but by the appended claims, and all differences within the scope will be construed as being included in the present invention.

Claims

- [Claim 1] A magnetic nanoparticle tube comprising:
a capillary tube into which a tubular passage is formed; and
a magnetic curing filler comprising magnetic nanoparticles which are filled into the capillary tube.
- [Claim 2] The magnetic nanoparticle tube of claim 1, wherein the magnetic curing filler is an ultraviolet curing filler to which the magnetic nanoparticles are added.
- [Claim 3] The magnetic nanoparticle tube of claim 2, wherein the nanoparticle is comprised of one selected from Fe, Ni and Co, or at least two compounds of Fe, NI and Co.
- [Claim 4] The magnetic nanoparticle tube of claim 3, wherein the magnetic nanoparticle is superparamagnetism substance.
- [Claim 5] The magnetic nanoparticle tube of claim 4, wherein the magnetic nanoparticle is 1nm-100nm in size.
- [Claim 6] The magnetic nanoparticle tube of claim 2, wherein the magnetic curing filler is prepared by adding curing agent to one selected from a group of Poly (Ethylene Glycol)-Diacrylate (PEG-DA), acryl, epoxy resin, and cyanoacrylates and is cured through external energy.
- [Claim 7] The magnetic nanoparticle tube of claim 6, wherein the curing agent is one selected from a group of
2-Hydroxy-2-methyl-1-phenyl-propan-1-one,
1-Hydroxy-cyclohexyl-phenyl-ketone, and
2-Hydroxy-1-[4-(2-hydroxyethoxy)phenyl-1-propanone.
- [Claim 8] The magnetic nanoparticle tube of claim 6, wherein a section of the capillary tube is one of a circle, ellipse and quadrangle.
- [Claim 9] The magnetic nanoparticle tube of claim 8, wherein both ends of the capillary tube are sealed by a sealing agent.
- [Claim 10] A method of manufacturing a magnetic nanoparticle tube comprising:
injecting magnetic nanoparticle solution into a capillary tube into which a tubular passage is formed; and
curing the magnetic nanoparticle solution.
- [Claim 11] The method of manufacturing a magnetic nanoparticle tube of claim 10, wherein the injecting of magnetic nanoparticle solution comprises of injecting ultraviolet curing filler solution containing magnetic nanoparticles.
- [Claim 12] The method of manufacturing a magnetic nanoparticle tube of claim 11,

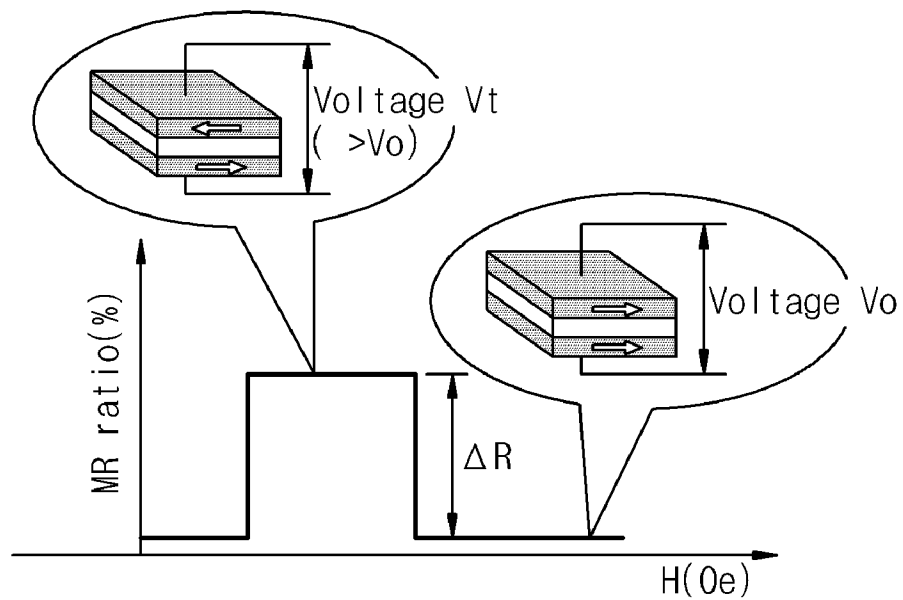
wherein the magnetic nanoparticle solution consists of a curing solution 60-70 wt.% and a solution containing the magnetic nanoparticles 30-40 wt. % wherein the curing solution is prepared by mixing anyone selected from a group of Poly (Ethylene Glycol)-Diacrylate (PEG-DA), acryl, epoxy resin and cyanoacrylates, and anyone selected from a group of 2-Hydroxy-2-methyl-1-phenyl-propan-1-one, 1-Hydroxy-cyclohexyl-phenyl-ketone, and 2-Hydroxy-1-[4-(2-hydroxyethoxy)phenyl-1-propanone.

[Claim 13] The method of manufacturing a magnetic nanoparticle tube of claim 11, wherein the curing of a magnetic nanoparticle solution comprises of irradiating ultraviolet to the capillary tube into which the magnetic nanoparticle solution is injected.

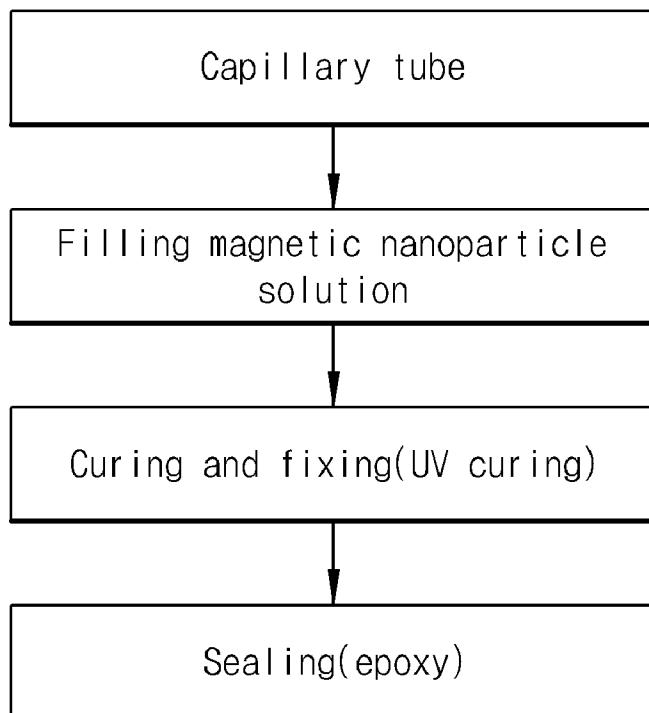
[Claim 14] The method of manufacturing a magnetic nanoparticle tube of claim 13, further comprising of sealing both ends of the capillary tube with a sealing agent after curing the magnetic nanoparticles.

[Claim 15] A measuring cartridge which is used in a measuring apparatus using a magneto resistance sensor provided with the magnetic nanoparticle tube which comprises magnetic curing filler containing magnetic nanoparaticles to be filled into the capillary tube into which a tubular passage is formed.

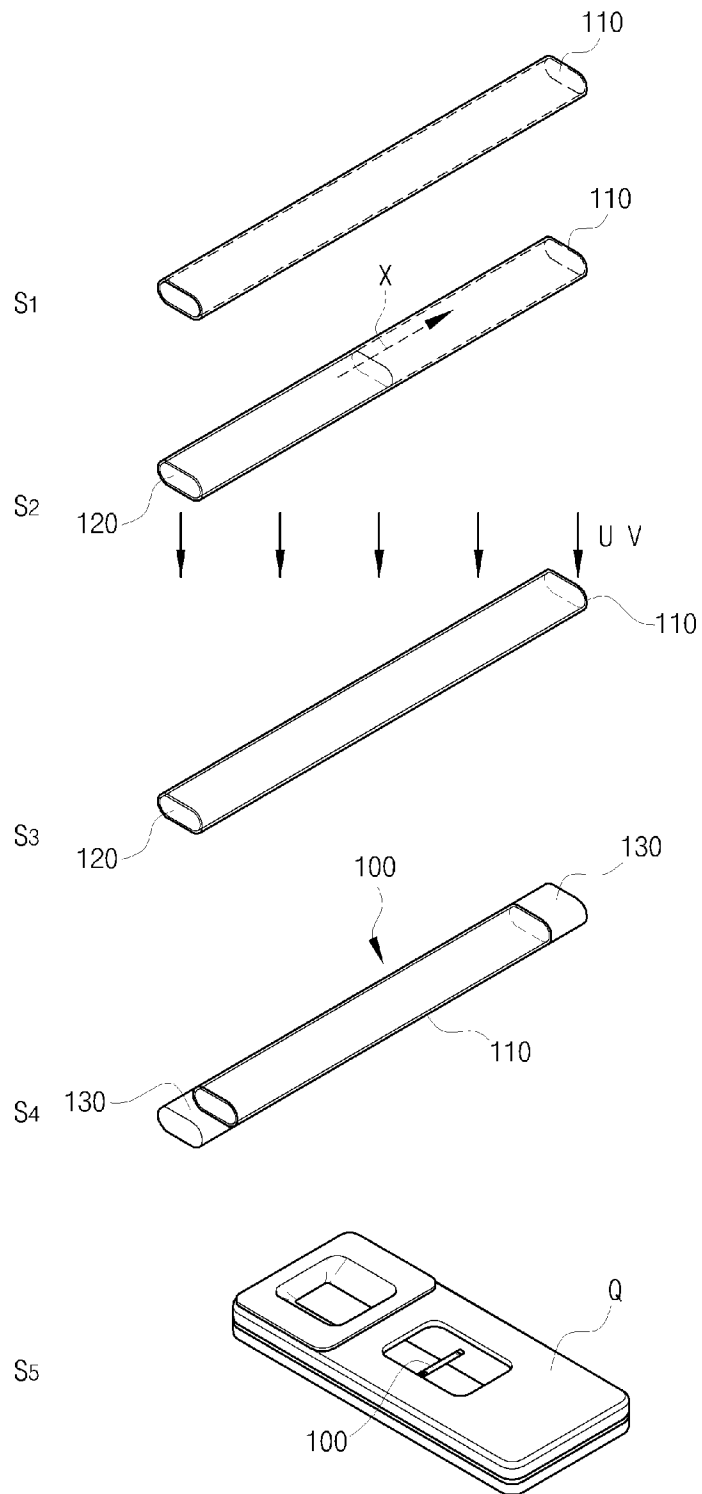
[Fig. 1]



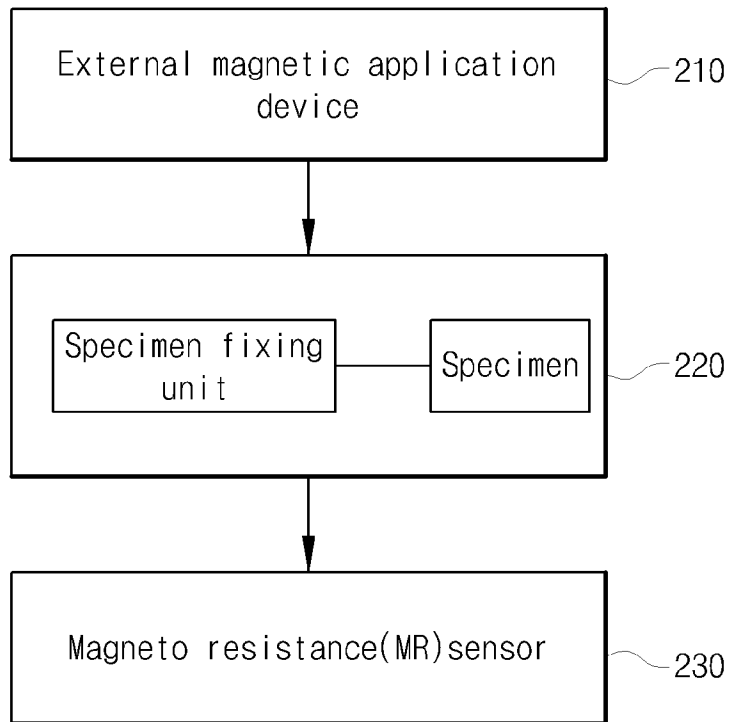
[Fig. 2]



[Fig. 3]



[Fig. 4]



[Fig. 5]

