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(54) INTRAVASCULAR ULTRASONIC TRANSDUCER STRUCTURE

INTRAVASKULÄRE ULTRASCHALLWANDLERSTRUKTUR

STRUCTURE D'UN TRANSDUCTEUR ULTRASONORE INTRAVASCULAIRE

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Description

[Technical Field]

[0001] The present disclosure relates to an ultrasonic transducer structure for medical imaging.

[Background Art]

[0002] Ultrasound (US) imaging is equipment for imaging the structure and characteristics of an observation region in the human body by applying an ultrasonic signal to the observation region using an ultrasonic probe, receiving the ultrasonic signal reflected back from the tissue, and extracting information included in the signal. Its advantage is that real-time images with no adverse effect on the human body can be obtained at low costs, when compared to other medical imaging systems such as X-ray, CT, MRI, and PET.

[0003] On the other hand, intravascular ultrasound (IVUS) imaging technology refers to image processing technology and scheme for the real-time cross-sectional imaging of arteria in blood vessels or visualization of diseases occurred in blood vessels, and population aging and increasing number of people with chronic diseases such as cardiac diseases supports market growth, and low-cost treatments are required all over the world. Under this circumstance, IVUS can cope with the requirements that have been impossible to meet so far in early discovery and prevention of coronary artery diseases, and it has very high potential. Furthermore, as revealed from some international clinical research, this technology has more advantages than existing angiography, so it becomes popular. The use of IVUS for left main diseases, chronic complete obstruction, lower limb peripheral arterial diseases, and induction of blood vessel formation is a major challenging field of this technology.

[0004] For IVUS imaging, a core element, namely, a high frequency transducer needs to be produced with proper efficiency and costs. Because IVUS creates visual representations by inserting a transducer into the blood vessel, the diameter of the transducer should be 1 mm or less, and frequencies used to obtain high resolution images are high frequencies in 20-100 MHz bands. Because an IVUS transducer with small size, ability to transmit and receive ultrasound waves of high frequencies and disposability should be produced at a low cost, an efficient and economical production method is a key technical obstacle of IVUS imaging equipment. Prior Art Reference presented below describes an array ultrasonic transducer for IVUS imaging.

[Prior Art Reference]

[0005] Development of circular array ultrasonic transducer, Heewon Kim, Yongrae Roh, Acoustical Society of Korea in 2002, Proceedings of Summer meeting of the Acoustical Society of Korea Vol.21 No. 1. Document US6186952 represents the closest prior art disclosing the preamble of claim 1.

[Disclosure]

[Technical Problem]

[0006] The technical problem to be solved by the embodiments of the present disclosure is to overcome the limitation that it is impossible to provide an effective and economical yield in producing an ultrasonic transducer for IVUS with a high operating frequency, a very thin material of each component, and a very small aperture size enough that it can be inserted into the blood vessel, and to solve the problem which is an inability to achieve transducer characteristics desired by consumers due to the use of an adhesive in producing an ultrasonic transducer, and a failure to accomplish desired beam convergence due to natural focusing.

[Technical Solution]

[0007] To solve the technical problem, an ultrasonic transducer structure according to claim 1 is provided.

[0008] In the ultrasonic transducer structure according to another embodiment, the angle at which the ultrasonic transducer is oriented by the support may be determined to range between 0° and 90° from an insertion direction of the tube, to simultaneously obtain ultrasonic images of the insertion direction of the tube and a wall surface of the blood vessel into which the tube is inserted, or to estimate a Doppler frequency and calculate a blood flow velocity.

[0009] In the ultrasonic transducer structure according to another embodiment, the end of the tube at which the ultrasonic transducer is installed may have a cutting surface formed at a slant in consideration of the ultrasonic radiation direction of the ultrasonic transducer.

[0010] In the ultrasonic transducer structure according to another embodiment, the ultrasonic transducer may form a gradient such that a center surface is concave, to converge a beam to a geometrical focus of the ultrasonic transducer. Further, in the ultrasonic transducer structure according to another embodiment, the ultrasonic transducer may further include a convex lens attached to a front surface, to converge a beam to a geometrical focus of the ultrasonic transducer.

[0011] In the ultrasonic transducer structure according to another embodiment, the ultrasonic transducer may further include an optical source module which is inserted into a certain region of the ultrasonic transducer to emit an optical signal for photoacoustic imaging or optical coherence tomography (OCT) imaging.

[0012] In the ultrasonic transducer structure according to another embodiment, an electrical signal may be supplied to the backing layer, and ground may be created by connecting a housing to the matching layer.

[0013] In the ultrasonic transducer structure according to another embodiment, the ultrasonic transducer of a single element may consist of a sequential stack of the piezoelectric material, a first signal pad, a ground pad formed spaced apart from the first signal pad, a flexible printed circuit board (FPCB), and a second signal pad electrically connected to the first signal pad through a via penetrating the FPCB, the piezoelectric material may be lapped according to a preset thickness and formed on an upper surface of the first signal pad.

[Advantageous Effects]

[0014] The embodiments of the present disclosure propose an ultrasonic transducer which has a high operating frequency and an ultramicro aperture size and ensures economical efficiency without an adhesive, and accomplishing beam convergence through a geometrical focus.

[Description of Drawings]

[0015]

FIG. 1 is a cross-sectional view showing the structure of an intravascular ultrasonic transducer structure according to an embodiment of the present disclosure.

FIGS. 2A and 2B are diagrams illustrating a method for inducing beam convergence in the ultrasonic transducer structure of FIG. 1.

FIG. 3 is a perspective view showing an exposed part of the intravascular ultrasonic transducer structure of FIG. 1 according to another embodiment of the present disclosure.

FIG. 4 is a diagram illustrating an example of a method for photoacoustic or optical coherence tomography (OCT) imaging in the intravascular ultrasonic transducer structure of FIG. 1.

FIG. 5 is a diagram illustrating an example of a method for signal supply and grounding in the intravascular ultrasonic transducer structure of FIG. 1.

FIG. 6 is a cross-sectional view showing another embodiment of an ultrasonic transducer of a single element in the intravascular ultrasonic transducer structure of FIG. 1.

FIGS. 7A and 7B are plane views illustrating the intravascular ultrasonic transducer of FIG. 6 as viewed from top according to the producing process.

FIG. 7C is a diagram illustrating a method for producing a single element by dicing a stacked ultrasonic transducer, as the last stage of the producing process of FIGS. 7A and 7B.

[Detailed Description of Main Elements]

[0016]

10: Ultrasonic transducer
11: Piezoelectric material
13: Matching layer
15: Backing layer
17: Lens
19: Optical source module
20: Intravascular tube
30: Support
40: Wire
50: Housing
100: Ultrasonic transducer with stacked structure
101: Single element ultrasonic transducer
110: FPCB
111: First signal pad
112: Second signal pad
113: Ground pad
114: Piezoelectric material
115: Via

[Best Mode]

[0017] Hereinafter, the basic idea employed by the embodiments of the present disclosure is first presented in brief, and then, specific technical means will be described in a sequential order.

[Mode for Invention]

[0018] Hereinafter, preferred experiments are described in sufficient detail to enable those skilled in the art to easily practice the disclosure with reference to the accompanying drawing. However, it will be obvious to those skilled in the art that these embodiments are intended to describe the present disclosure in further detail, and the scope of the disclosure is not limited thereby.

[0019] FIG. 1 is a cross-sectional view showing the structure of an intravascular ultrasonic transducer structure according to an embodiment of the present disclosure, largely including the ultrasonic transducer 10: 11, 13, 15, a support 30 and a tube 20.

[0020] The tube 20 is an outer body for intravascular IVUS.

[0021] The ultrasonic transducer 10 is a single element which consists of a stack of the matching layer 13, the piezoelectric material 11 and the backing layer 15 and is installed at the end of the tube 20 to obtain an ultrasonic image. The ultrasonic transducer 10 may be produced as a single element by forming the piezoelectric material 11 lapped according to a preset thickness, depositing a conductive material on the lapped surface of the piezoelectric material 11, casting a front surface and a rear surface of the piezoelectric material 11 having the deposited conductive material to respectively form the matching layer 13 and the backing layer 15 and lapping according to a preset thickness, and dicing bulk material consisting of a stack of the matching layer 13, the piezoelectric material 11 and the backing layer 15 along the stack direction to allow the insertion into the tube 20.

[0022] The support 30 is positioned between one side wall of the tube 20 and the ultrasonic transducer 10: 11, 13, 15 to form an angle at which the ultrasonic transducer 10: 11, 13, 15 is oriented, and acts as an adjuster to make an ultrasonic radiation angle of the ultrasonic transducer 10: 11, 13, 15 different from an insertion angle of the tube 20. That is, the support 30 may be embodied as a sort of pad which is fixed to the tube 20 to adjust the angle of the ultrasonic transducer 10: 11, 13, 15.

[0023] Here, the angle at which the ultrasonic transducer 10: 11, 13, 15 is oriented by the support 30 is determined to range between 0° and 90° from the insertion direction of the tube 20, inducing the simultaneous acquisition of ultrasonic images of the insertion direction of the tube 20 and the wall surface of the blood vessel into which the tube 20 is inserted. Through the support 30, the ultrasonic transducer structure according to this embodiment has an advantage; not only either the blood vessel wall surface or the front in the insertion direction of the tube can be observed but also both can be observed simultaneously. In addition, through the support 30, the ultrasonic transducer structure according to this embodiment may estimate a Doppler frequency and calculate a blood flow velocity.

[0024] Also, the end of the tube 20 at which the ultrasonic transducer 10: 11, 13, 15 is installed preferably has a cutting surface formed at a slant in consideration of the ultrasonic radiation direction of the ultrasonic transducer.

[0025] On the other hand, the embodiment of the present disclosure presented through FIG. 1 is intended to use the properties of a tube in producing an ultrasonic transducer for beam convergence. An element used for an IVUS transducer has a size limited by the width of the blood vessel. However, the size in the depth-wise direction of the blood vessel is not limited. Thus, the element may be produced with a long size in the depth-wise direction of the blood vessel. To this end, preferably, the ultrasonic transducer 10: 11, 13, 15 is formed in rectangular shape, the length of the short side of the ultrasonic transducer 10: 11, 13, 15 is at least less than or equal to the diameter of the tube, the length of the long side of the ultrasonic transducer 10: 11, 13, 15 is larger than or equal to the diameter of the tube, and the long side of the ultrasonic transducer 10: 11, 13, 15 is inserted along the inner wall surface of the tube. Through this structure, the ultrasonic transducer can improve the resolution of an image through beam convergence.

[0026] FIGS. 2A and 2B are diagrams showing an example of two methods for describing a method for inducing beam convergence in the ultrasonic transducer structure of FIG. 1.

[0027] A general element used for a transducer in the blood vessel is produced in oval or square shape. That is, because the element is very small in size, natural focusing is created. A weak point of beam convergence using natural focusing is that it is impossible to converge to a point desired by a user and the convergence effect remarkably reduces. Thus, the method proposed in FIGS. 2A and 2B is producing the element in rectangular shape. Because the diameter size of the blood vessel is limited as described previously, it is possible to converge a beam even in one direction by producing the element with an increased size in the depth-wise direction of the blood vessel.

[0028] In FIG. 2A, the ultrasonic transducer 11, 13, 15 forms a gradient such that a center surface is concave, to converge a beam to a geometrical focus of the ultrasonic transducer. This can be realized by a method which forms a gradient in the rectangular element (ultrasonic transducer) using a heated iron bead.

[0029] In FIG. 2B, the ultrasonic transducer 11, 13, 15 further includes a convex lens 17 attached to the front surface, to converge a beam to the geometrical focus of the ultrasonic transducer.

[0030] FIG. 3 is a perspective view showing an exposed part of the intravascular ultrasonic transducer structure of FIG. 1 according to another embodiment of the present disclosure.

[0031] As described previously, it is shown that the single element ultrasonic transducer 10 is located at the end of the tube 20 such that it is fixed and arranged at a slant by the support 30. Through this structure, both the wall surface of the blood vessel into which the tube 20 is inserted and the traveling direction of the tube can be simultaneously observed, and the support of which the angle is freely adjusted according to the need can be used. Particularly, when this slant is used, advantages are that images can be obtained not only when the tube 20 goes backward but also when the tube 20 goes forward (is inserted), and a Doppler (blood flow velocity) can be measured.

[0032] FIG. 4 is a diagram illustrating an example of a method for photoacoustic or optical coherence tomography (OCT) imaging in the intravascular ultrasonic transducer structure of FIG. 1.

[0033] Photoacoustic (PA) imaging involves applying photons to an observation region in the human body, receiving ultrasonic signals directly generated by the photons absorbed into the tissues, and extracting image information from the signals. This unique situation in which ultrasonic waves are generated by absorption of photons in the tissues is a phenomenon appearing because the tissues are heated when absorbing photons, and when an absorbent tissue structure is irradiated by a pulsed laser, the temperature of the tissues changes, and as a result, the structure of the tissues expands. From this expanding structure, pressure waves propagate outside, and these pressure waves may be detected by the ultrasonic transducer. Accordingly, photoacoustic and ultrasound may share their configuration in certain parts (detecting/receiving).

[0034] To this end, in the ultrasonic transducer structure proposed in FIG. 4, the ultrasonic transducer 10 may further include an optical source module (not shown) which is inserted into a certain region 19 of the ultrasonic transducer 10 to emit optical signals for photoacoustic imaging. That is, by forming a hole in the ultrasonic transducer 10 and inserting an optical source module, an ultrasonic image as well as a photoacoustic image can be obtained. In addition, the optical source module can be also used to obtain an optical coherence tomography image, and through this, ultrasonic and optical coherence tomography fusion images of blood vessel diseases can be obtained.

[0035] FIG. 5 is a diagram illustrating an example of a method for signal supply and grounding in the intravascular ultrasonic transducer structure of FIG. 1, and in the ultrasonic transducer structure proposed by the embodiments of the present disclosure, an electrical signal is supplied to the backing layer 15, and ground is created by connecting a housing 50 to the matching layer 13.

[0036] Referring to FIG. 5, a wire 40 is connected to the conductive backing layer 15 part by using a conductive adhesive to supply a signal, and ground is created by connecting the housing 50 and the conductive matching layer 13 through chrome or gold deposition. Of course, the configuration of FIG. 5 is just an example, and the conductive backing layer 15 may be connected to the housing material by depositing chrome/gold, and the conductive matching layer 13 may be connected to a wire. Also, in connecting to the housing material, a wire may be used, and connection may be also established by depositing materials other than chrome/gold.

[0037] On the other hand, it is hereinafter intended to propose another IVUS transducer production technology, including making each material that forms an IVUS ultrasonic transducer at a desired thickness using FPCB first, and then, performing matching and dicing to produce a plurality of individual IVUS transducers at the same time.

[0038] FIG. 6 is a cross-sectional view showing another embodiment of an ultrasonic transducer of a single element in the intravascular ultrasonic transducer structure of FIG. 1, including two signal pads 111, 112, a ground pad 113 and a piezoelectric material 114 with respect to a flexible printed circuit board (FPCB) 110.

[0039] The first signal pad 111 is formed on an upper surface of the FPCB 110, the second signal pad 112 is formed on a lower surface of the FPCB 110, the first signal pad 111 and the second signal pad 112 are electrically connected through at least one via 115 which passes through the FPCB 110.

[0040] The ground pad 113 is located on the upper surface of the FPCB 110 made of polyimide, and is spaced apart from the first signal pad 111.

[0041] The piezoelectric material 114 is lapped according to a preset thickness and is formed on an upper surface of the first signal pad 111. Also, a conductive material may be deposited on the upper surface of the FPCB 110 to connect the piezoelectric material 114 to the ground pad 113, and the conductive material may be chrome or gold, but is not limited thereto.

[0042] Bulk material 100 consisting of a stack of the piezoelectric material 114, the first signal pad 111, the ground pad 113, the FPCB 110 and the second signal pad 112 is diced along the stack direction to produce single elements which are less than or equal to a threshold size for intravascular ultrasound (IVUS). For example, the threshold size may be determined to be less than or equal to 1 mm $\times$ 1 mm that is at least smaller than the cross section of the blood vessel.

[0043] When the FPCB is used as above, there are advantages; signal supply and grounding is accomplished through the signal and ground pads located on the FPCB with no need to use a conductive material for both the backing layer and the matching layer to facilitate signal supply and grounding in the same way as a conventional process, the backing layer (not shown) may match a lower surface of the second signal pad 112 and the matching layer (not shown) may match an upper surface of the piezoelectric material 114, and an ultrasonic transducer can be produced while not limiting the matching layer and the backing layer to a conductive material. That is, there is no limitation, whether conductive materials or nonconductive materials. Thus, in the case of this embodiment, as the process technology can obtain best transducer performance as described previously, it is advantageous for realizing high frequency characteristics of an IVUS transducer.

[0044] FIGS. 7A and 7B are plane views illustrating the intravascular ultrasonic transducer of FIG. 6 as viewed from top according to the producing process.

[0045] In FIG. 7A, it is assumed that the first signal pad 111 and the ground pad 113 are formed spaced apart from each other on the upper surface of the FPCB 110, and the second signal pad (not shown) is formed on the lower surface of the FPCB 120. Under this circumstance, it is shown that a via 115 hole for connecting the first signal pad 111 and the second signal pad (not shown) is formed to electrically connect the two (first signal pad and second signal pad). FIG. 7B shows that subsequent to the process of FIG. 7A, the piezoelectric material 114 is formed on the first signal pad.

[0046] FIG. 7C is a diagram illustrating a method for producing a single element by dicing a stacked ultrasonic transducer, as the last stage of the producing process of FIGS. 7A and 7B, and the stacked ultrasonic transducer 100 is diced perpendicular to the plane along the stack direction to consecutively produce a plurality of single elements 101. The IVUS ultrasonic transducer using FPCB as produced in this way can be now used as the ultrasonic transducer shown in FIGS. 1 through 5 as introduced previously.

[0047] Hereinabove the present disclosure has been described with respect to a variety of embodiments. Those skilled in the art will appreciate that the present disclosure may be embodied in modified form without departing from the essential features of the present disclosure. Therefore, the disclosed embodiments should be considered in illustrative aspects, not limitative aspects. The scope of the present disclosure is defined in the appended claims, not in the foregoing description, and all differences within the equivalent scope of the claims should be construed as being included in the present disclosure.

Claims

1. An ultrasonic transducer structure comprising:

   a tube (20) for insertion into a blood vessel for IVUS;
   an ultrasonic transducer (10) of a single element consisting of a stack of a matching layer, a piezoelectric material and a backing layer, and installed at an end of the tube to obtain an ultrasonic image; and
   a support (30) positioned between one side wall of the tube and the ultrasonic transducer to form an angle at which the ultrasonic transducer is oriented, and to adjust the angle to make an ultrasonic radiation angle of the ultrasonic transducer different from an insertion angle of the tube, wherein the ultrasonic transducer is rectangular in shape,
   characterised in that a length of a short side of the ultrasonic transducer is at least less than or equal to a diameter of the tube, and a length of a long side of the ultrasonic transducer is larger than or equal to the diameter of the tube, and the long side of the ultrasonic transducer is insertable along an inner wall surface of the tube.

2. The ultrasonic transducer structure according to claim 1, wherein the angle at which the ultrasonic transducer (10) is oriented by the support can be determined to range between 0° and 90° from an insertion direction of the tube (20), to simultaneously obtain ultrasonic images of the insertion direction of the tube (20) and a wall surface of the blood vessel into which the tube (20) is inserted, or to estimate a Doppler frequency and calculate a blood flow velocity.

3. The ultrasonic transducer structure according to claim 1, wherein the ultrasonic transducer (10) forms a gradient such that a center surface is concave, to converge a beam to a geometrical focus of the ultrasonic transducer.

4. The ultrasonic transducer structure according to claim 1, wherein the ultrasonic transducer (10) further comprises a convex lens attached to a front surface, to converge a beam to a geometrical focus of the ultrasonic transducer.

5. The ultrasonic transducer structure according to claim 1, wherein the ultrasonic transducer (10) further comprises an optical source module which is insertable into a certain region of the ultrasonic transducer to emit an optical signal for photoacoustic imaging or optical coherence tomography (OCT) imaging.

6. The ultrasonic transducer structure according to claim 1, wherein an electrical signal is to be supplied to the backing layer, and ground is to be created by connecting a housing to the matching layer.

7. The ultrasonic transducer structure according to claim 1, wherein the ultrasonic transducer (10) of a single element consists of a sequential stack of the piezoelectric material, a first signal pad, a ground pad formed spaced apart from the first signal pad, a flexible printed circuit board (FPCB), and a second signal pad electrically connected to the first signal pad through a via penetrating the FPCB, the piezoelectric material has been lapped according to a preset thickness and is formed on an upper surface of the first signal pad.

8. The ultrasonic transducer structure according to claim 7, wherein a conductive material has been deposited on an upper surface of the FPCB to connect the piezoelectric material to the ground pad.

9. The ultrasonic transducer structure according to claim 7, wherein the ultrasonic transducer (10) forms a gradient such that a center surface is concave, to converge a beam to a geometrical focus of the ultrasonic transducer.

Patentansprüche

1. Ultraschallwandlerstruktur, umfassend:

   ein Rohr (20) zum Einführen in ein Blutgefäß für intravaskulären Ultraschall (IVUS);
   einen Ultraschallwandler (10) eines einzelnen Elements, das aus einem Stapel einer Anpassungsschicht, einem piezoelektrischen Material und einer Trägerschicht besteht und an einem Ende des Rohrs eingebaut wird, um ein Ultraschallbild zu erhalten; und
   eine Abstützung (30), die zwischen einer Seitenwand des Rohrs und dem Ultraschallwandler angeordnet ist, um einen Winkel zu bilden, mit dem der Ultraschallwandler ausgerichtet ist, und um den Winkel einzustellen, um einen Ultraschall-Abstrahlwinkel des Ultraschallwandlers zu erzeugen, der sich von dem Einführwinkel des Rohrs unterscheidet, wobei der Ultraschallwandler eine rechteckige Form hat,
   dadurch gekennzeichnet, dass
   eine Länge einer kurzen Seite des Ultraschallwandlers mindestens kleiner oder gleich einem Durchmesser des Rohrs ist und eine Länge einer langen Seite des Ultraschallwandlers größer

oder gleich dem Durchmesser des Rohrs ist, und

die lange Seite des Ultraschallwandlers entlang einer inneren Wandoberfläche des Rohrs einführbar ist.

2. Ultraschallwandlerstruktur gemäß Anspruch 1, wobei der Winkel, mit dem der Ultraschallwandler (10) durch die Abstützung ausgerichtet ist, so bestimmt werden kann, dass er in einem Bereich zwischen 0° und 90° von einer Einführrichtung des Rohrs (20) liegt, um gleichzeitig Ultraschallbilder der Einführrichtung des Rohrs (20) und einer Wandoberfläche des Blutgefäßes zu erhalten, in das das Rohr (20) eingeführt wird, oder eine Dopplerfrequenz zu schätzen und eine Fließgeschwindigkeit des Blutes zu berechnen.

3. Ultraschallwandlerstruktur gemäß Anspruch 1, wobei der Ultraschallwandler (10) einen Gradienten ausbildet, sodass eine Mitteloberfläche konkav ist, um einen Strahl auf einen geometrischen Brennpunkt des Ultraschallwandlers zu fokussieren.

4. Ultraschallwandlerstruktur gemäß Anspruch 1, wobei der Ultraschallwandler (10) ferner eine konvexe Linse umfasst, die an einer vorderen Oberfläche angebracht ist, um einen Strahl auf einen geometrischen Brennpunkt des Ultraschallwandlers zu fokussieren.

5. Ultraschallwandlerstruktur gemäß Anspruch 1, wobei der Ultraschallwandler (10) ferner ein Lichtquellenmodul umfasst, das in einen bestimmten Bereich des Ultraschallwandlers einführbar ist, um ein optisches Signal zur photoakustischen Bildgebung oder Bildgebung mit optischer Kohärenztomographie (OCT) auszusenden.

6. Ultraschallwandlerstruktur gemäß Anspruch 1, wobei ein elektrisches Signal an die Trägerschicht zu liefern ist und eine Erdung dadurch zu schaffen ist, dass ein Gehäuse mit der Anpassungsschicht verbunden wird.

7. Ultraschallwandlerstruktur gemäß Anspruch 1, wobei der Ultraschallwandler (10) eines einzelnen Elements aus einem in einer Abfolge sortierten Stapel des piezoelektrischen Materials, einer ersten Signalplatte, einer Erdungsplatte, die von der ersten Signalplatte beabstandet ausgebildet ist, einer flexiblen gedruckten Leiterplatte (Flexible Printed Circuit Board / FPCB) und einer zweiten Signalplatte, die über ein die FPCB durchdringendes Kontaktloch elektrisch mit der ersten Signalplatte verbunden ist, besteht,

das piezoelektrische Material gemäß einer voreingestellten Dicke geläppt wurde und auf einer oberen Oberfläche der ersten Signalplatte ausgebildet ist.

8. Ultraschallwandlerstruktur gemäß Anspruch 7, wobei ein leitfähiges Material auf einer oberen Oberfläche der FPCB abgeschieden wurde, um das piezoelektrische Material mit der Erdungsplatte zu verbinden.

9. Ultraschallwandlerstruktur gemäß Anspruch 7, wobei der Ultraschallwandler (10) einen Gradienten ausbildet, sodass eine Mitteloberfläche konkav ist, um einen Strahl auf einen geometrischen Brennpunkt des Ultraschallwandlers zu fokussieren.

Revendications

1. Structure d'un transducteur ultrasonore comprenant :

un tube (20) destiné à être inséré dans un vaisseau sanguin pour l'imagerie par ultrasons intravasculaire (IVUS) ;

un transducteur ultrasonore (10) fait d'un seul élément consistant en un empilement d'une couche d'adaptation, d'un corps piézoélectrique et d'une couche de support, et installé à une extrémité du tube pour obtenir une image ultrasonore ; et un support (30) placé entre une paroi latérale du tube et le transducteur ultrasonore pour former un angle suivant lequel le transducteur ultrasonore est orienté, et pour ajuster l'angle afin d'obtenir un angle de rayonnement ultrasonore du transducteur ultrasonore qui soit différent d'un angle d'insertion du tube, où le transducteur ultrasonore a une forme rectangulaire,

caractérisée ce qu'une longueur d'un petit côté du transducteur ultrasonore est au moins inférieur ou égal à un diamètre du tube, et une longueur d'un grand côté du transducteur ultrasonore est supérieur ou égal au diamètre du tube, et

le grand côté du transducteur ultrasonore peut être inséré le long d'une surface de paroi intérieure du tube.

2. Structure d'un transducteur ultrasonore selon la revendication 1, dans laquelle l'angle suivant lequel le transducteur ultrasonore (10) est orienté par le support peut être déterminé pour aller de 0° à 90° à partir d'une direction d'insertion du tube (20), afin d'obtenir simultanément des images ultrasonores de la direction d'insertion du tube (20) et d'une surface de paroi du vaisseau sanguin dans lequel le tube (20) est inséré, ou afin d'estimer une fréquence Doppler et calculer une vitesse de débit sanguin.

3. Structure d'un transducteur ultrasonore selon la revendication 1, dans laquelle le transducteur ultrasonore (10) forme un gradient de telle sorte qu'une surface centrale est concave, pour faire converger un faisceau vers un foyer géométrique du transducteur ultrasonore.

4. Structure d'un transducteur ultrasonore selon la revendication 1, dans laquelle le transducteur ultrasonore (10) comprend en outre une lentille convexe fixée à une surface avant pour faire converger un faisceau vers un foyer géométrique du transducteur ultrasonore.

5. Structure d'un transducteur ultrasonore selon la revendication 1, dans laquelle le transducteur ultrasonore (10) comprend en outre un module de source optique qui peut être inséré dans une certaine région du transducteur ultrasonore pour émettre un signal optique pour une imagerie photo-acoustique ou imagerie de tomographie par cohérence optique (OCT).

6. Structure d'un transducteur ultrasonore selon la revendication 1, dans laquelle un signal électrique doit être appliqué à la couche de support, et la masse doit être créée en connectant un boîtier à la couche d'adaptation.

7. Structure d'un transducteur ultrasonore selon la revendication 1, dans laquelle le transducteur ultrasonore (10) fait d'un seul élément consiste en un empilement successif du corps piézoélectrique, d'une première plaquette de signal, d'une plaquette de masse formée en étant espacée de la première plaquette de signal, d'un circuit imprimé souple (FPCB), et d'une seconde plaquette de signal connectée électriquement à la première plaquette de signal par une traversée pénétrant le circuit imprimé souple,
le corps piézoélectrique a été rodé selon une épaisseur prédéfinie et est formé sur une surface supérieure de la première plaquette de signal.

8. Structure d'un transducteur ultrasonore selon la revendication 7, dans laquelle un matériau conducteur a été déposé sur une surface supérieure du circuit imprimé souple afin de connecter le corps piézoélectrique à la plaquette de masse.

9. Structure d'un transducteur ultrasonore selon la revendication 7, dans laquelle le transducteur ultrasonore (10) forme un gradient de telle sorte qu'une surface centrale est concave, pour faire converger un faisceau vers un foyer géométrique du transducteur ultrasonore.

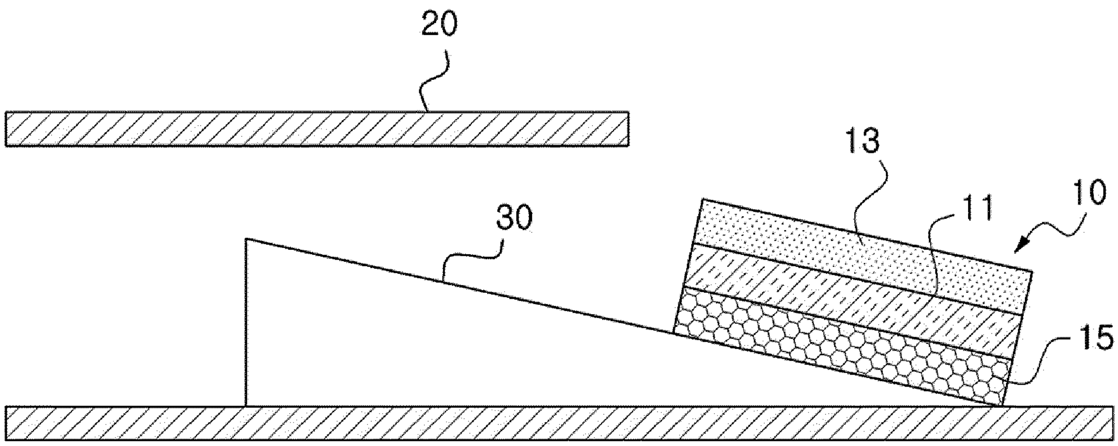

FIG. 1

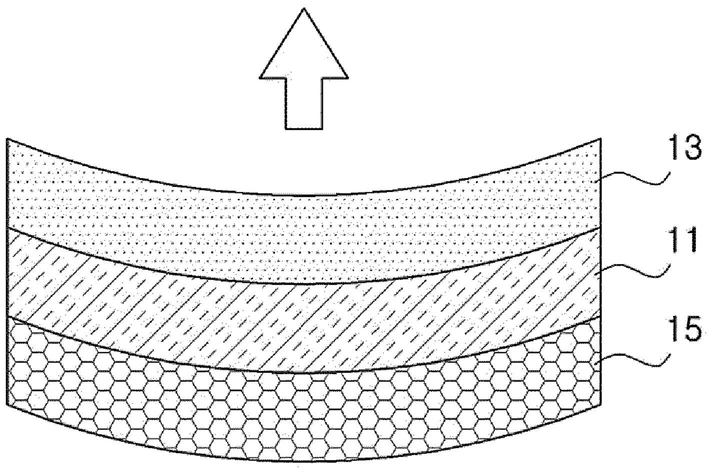

FIG. 2A

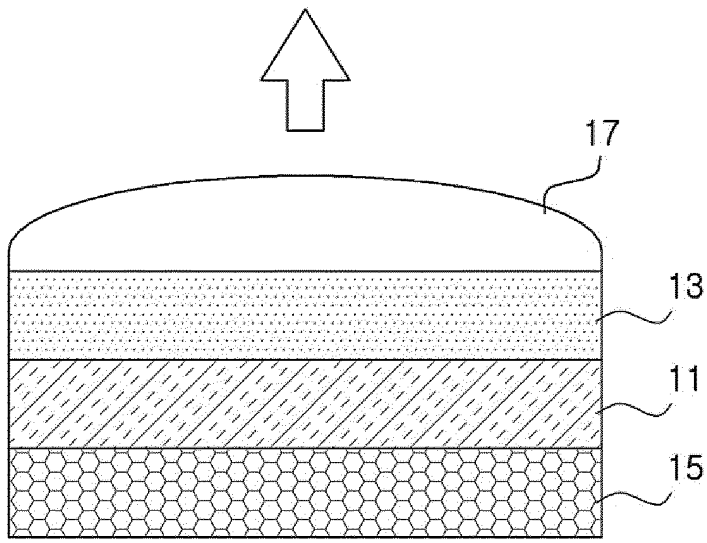

FIG. 2B

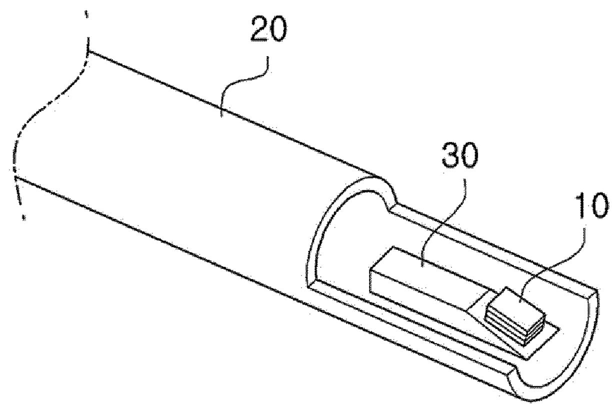

FIG. 3

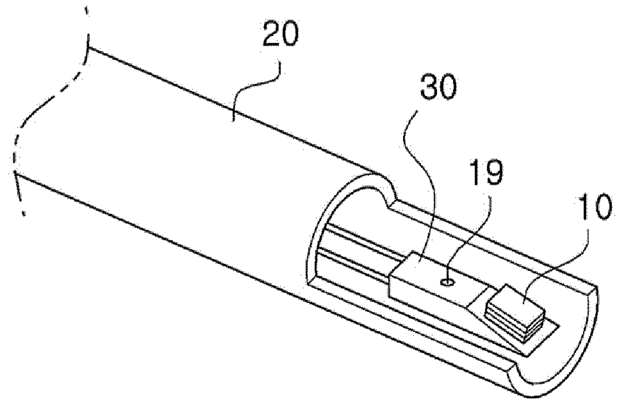

FIG. 4

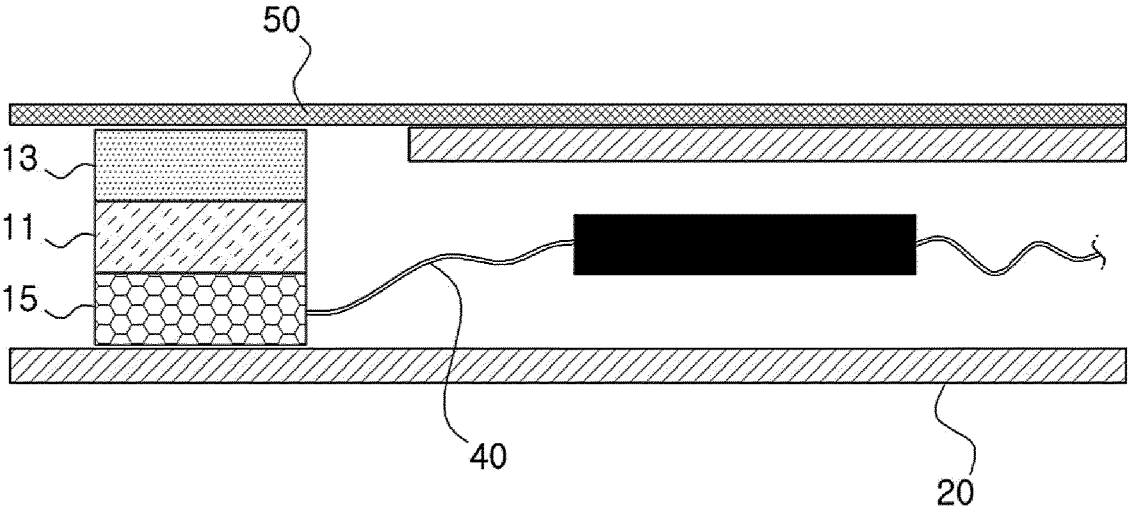

FIG. 5

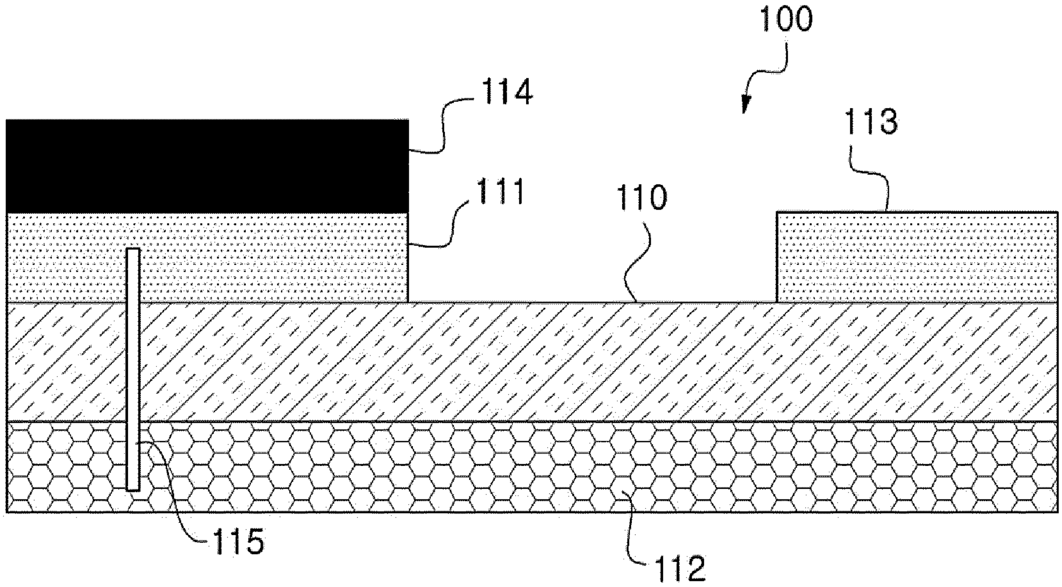

FIG. 6

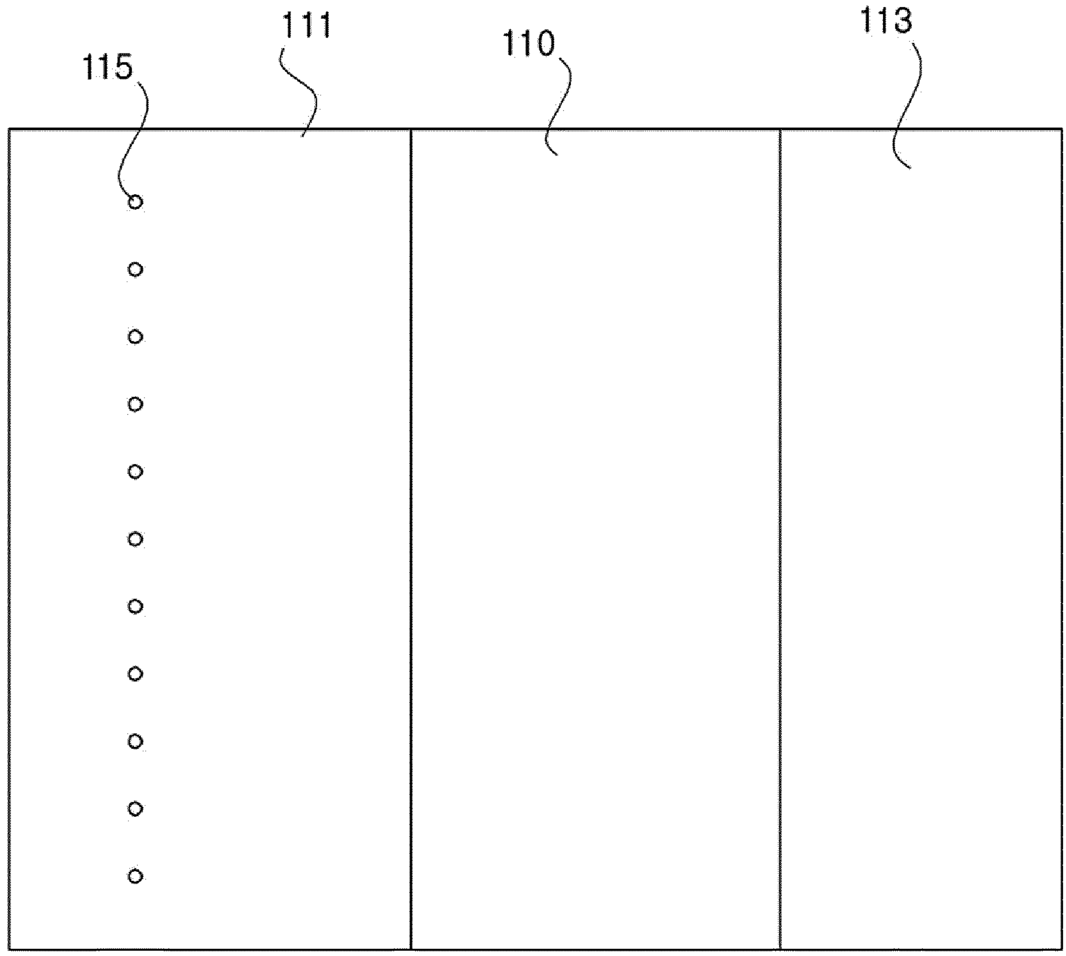

FIG. 7A

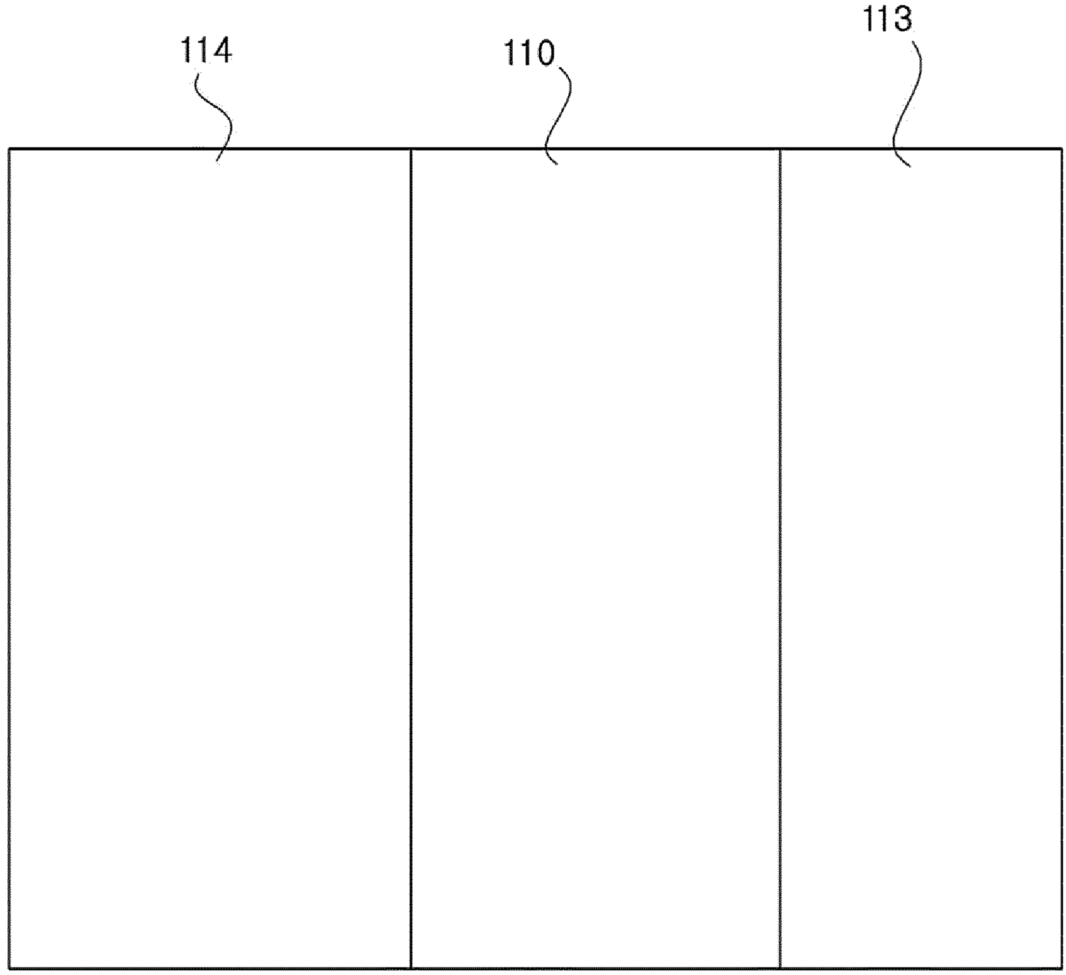

FIG. 7B

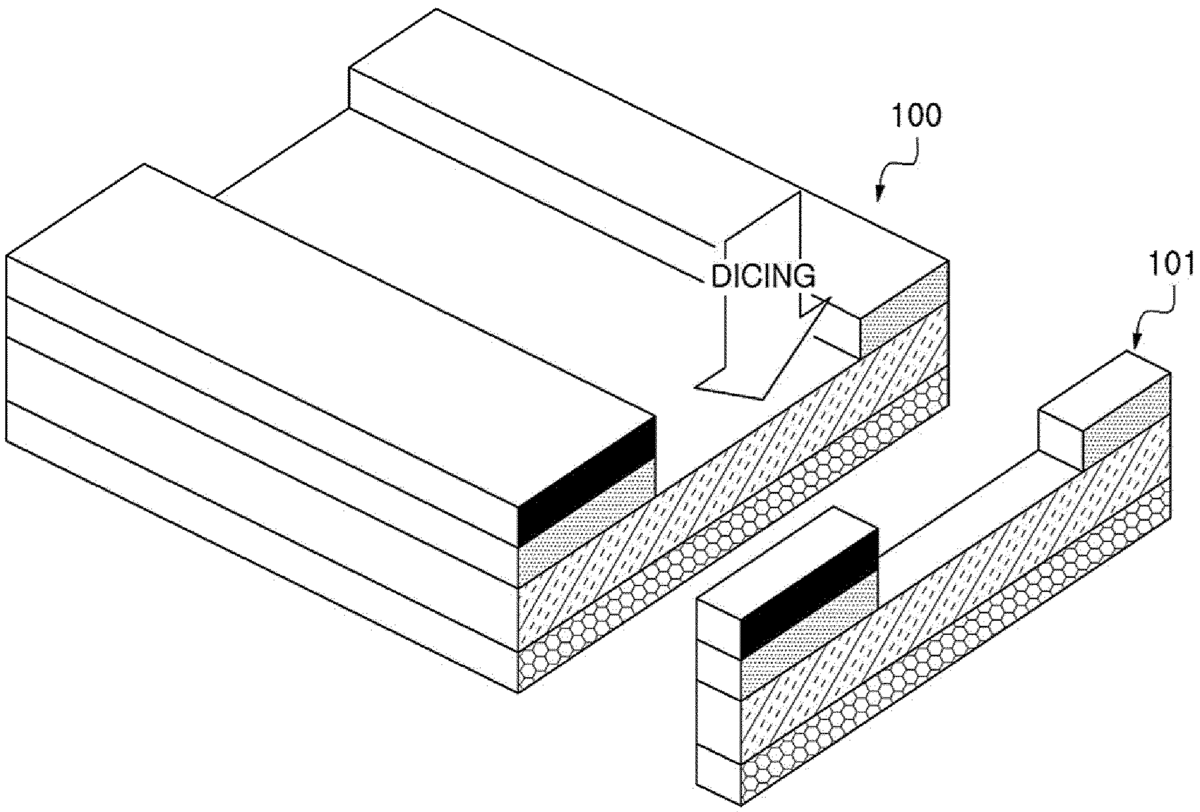

FIG. 7C

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 6186952 B **[0005]**

Non-patent literature cited in the description

- **HEEWON KIM ; YONGRAE ROH.** Proceedings of Summer meeting of the Acoustical Society of Korea. Acoustical Society of Korea, 2002, vol. 21 **[0005]**

patsnap

专利名称(译)	血管内超声换能器结构

公开(公告)号	EP3089479B1	公开(公告)日	2019-03-13
申请号	EP2015743308	申请日	2015-01-28

申请(专利权)人(译)	西江大学研究基金会
当前申请(专利权)人(译)	西江大学研究基金会
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发明人	CHANG, JIN HO SONG, TAI-KYONG YOO, YANG MO LEE, JUNSU
IPC分类号	A61B8/12 H01L41/337 B06B1/06 A61B8/08 A61B8/00
CPC分类号	A61B8/0891 A61B8/12 A61B8/4483 B06B1/0648 H01L41/337 H01L41/083 H01L41/27 H01L41/35
优先权	1020140011682 2014-01-29 KR 1020140011683 2014-01-29 KR
其他公开文献	EP3089479A1 EP3089479A4
外部链接	Espacenet

摘要(译)

本发明涉及一种血管内超声换能器的制造方法及其结构，该制造超声换能器的方法是通过以下方法制造单个元件：形成根据预先设定的厚度研磨的压电元件;在压电元件的研磨表面上沉积导电材料;通过铸造已经沉积了导电材料的压电元件的前表面和后表面来形成匹配层和后表面层;根据预先设定的厚度研磨;并且沿着堆叠方向切割散装材料，该堆叠材料是匹配层，压电元件和后表面层的堆叠，使得元件的尺寸小于血管内超声（IVUS）的临界尺寸。

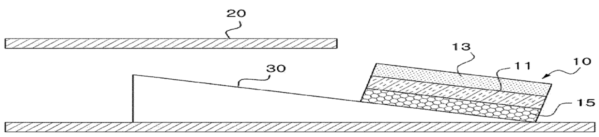

FIG. 1

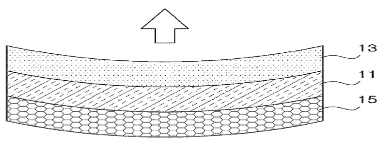

FIG. 2A

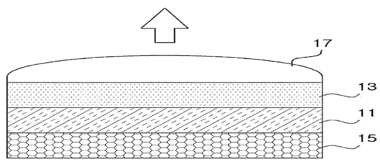

FIG. 2B