US 20050075571A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2005/0075571 A1

Barnes (43) Pub. Date: Apr. 7, 2005

(54) SOUND ABSORPTION BACKINGS FOR ULTRASOUND TRANSDUCERS

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(21) Appl. No.: **10/665,334**

(22) Filed: **Sep. 18, 2003**

Publication Classification

(51) **Int. Cl.**[7] **A61B 8/14**

(52) **U.S. Cl.** **600/459**

(57) **ABSTRACT**

Sound absorption backings for ultrasound transducers are provided. A block of material with similar acoustic impedance to the transducer material is provided adjacent to the material. For example, a solid metal block of material with acoustic impedance that is similar to the acoustic impedance of silicon substrate used for a CMUT is provided. Since the solid block of material may provide high heat conductivity and a stiff mechanical support without acoustic attenuation, the block is formed to prevent reflections of acoustic energy back toward the sensor. In one embodiment, a Rayleigh dump is formed on a surface of the solid block of material away from the transducer material. Acoustically absorbing materials are provided along the surface with the Rayleigh dump. As acoustic energy propagates towards the surface, the acoustic energy is reflected at angles away from the transducer material. Some of the acoustic energy propagates through the surface into the attenuating material. After multiple reflections within the Rayleigh dump, the acoustic energy is eventually dissipated through the acoustic attenuation of the additional material alongside the surface.

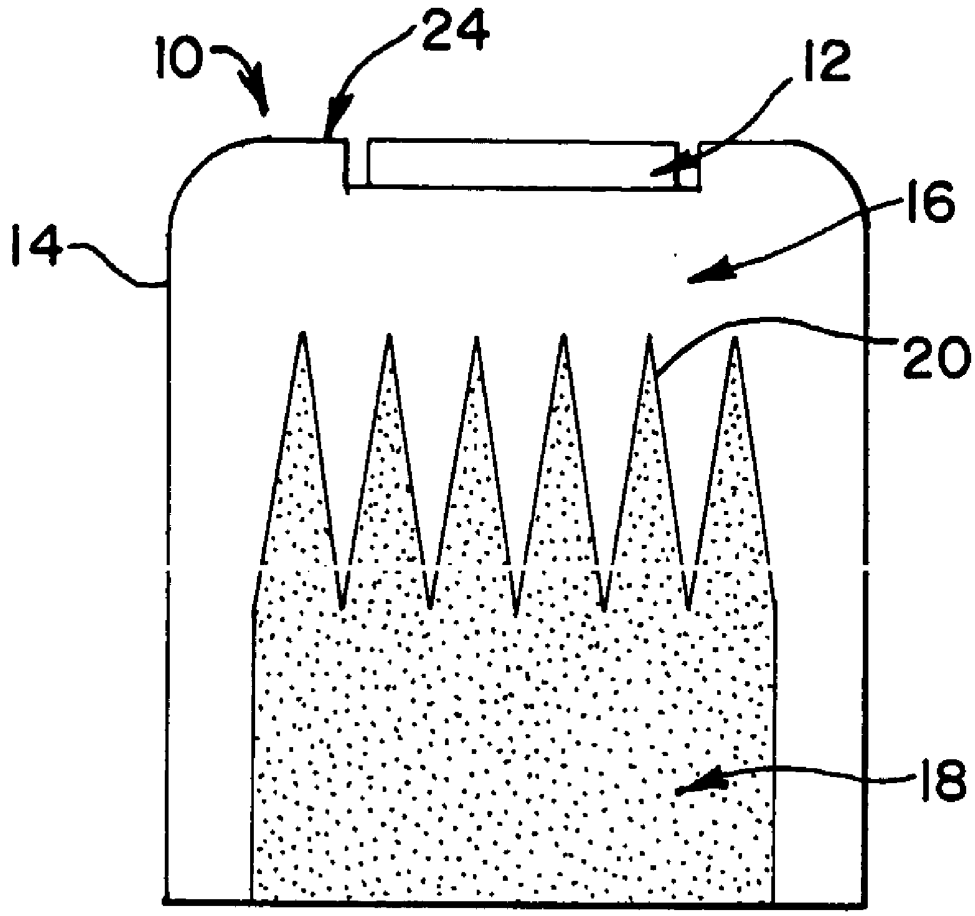


FIG. 1

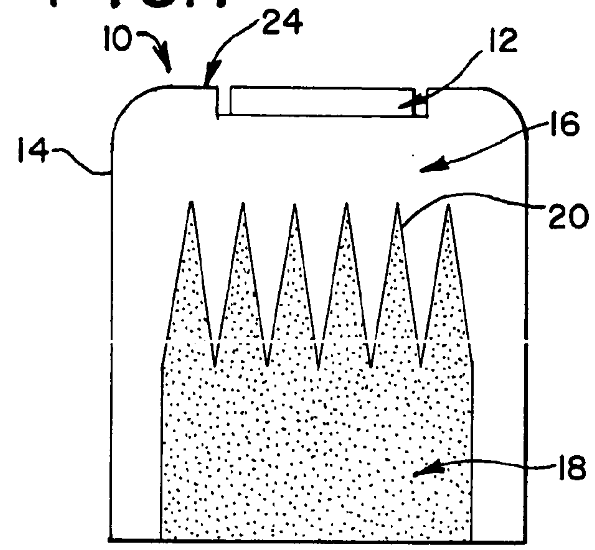


FIG. 2

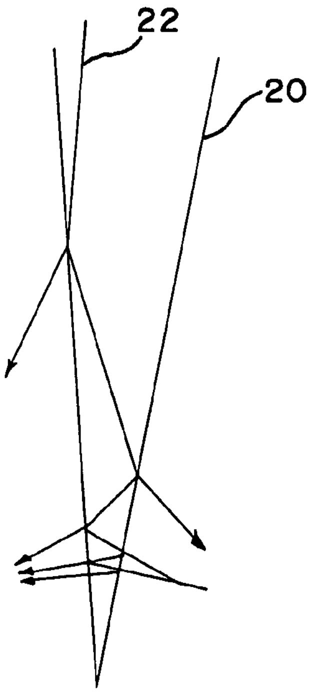
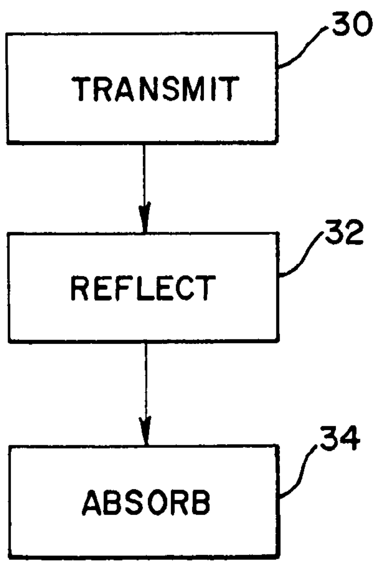


FIG. 3



SOUND ABSORPTION BACKINGS FOR ULTRASOUND TRANSDUCERS

BACKGROUND

[0001] The present invention relates to acoustic absorber for ultrasound transducers. In particular, sound absorbing backings are provided for ultrasound transducers.

[0002] In medical diagnostic ultrasound imaging, acoustic energy is generated by transducer material or devices. The acoustic energy is transmitted into a patient and echoes are received in response to the transmission. The transmissions are directional, such as propagating away from a surface of the transducer material adjacent to a patient. Transducer material generates acoustic energy along an axis in both directions. To prevent longitudinal waves propagating away (i.e., a backward traveling wave) from the patient from causing clutter or undesired reflections back to the transducer, a backing block is provided. The backing block absorbs acoustic energy to prevent undesired reflections.

[0003] For piezoelectric or PZT ceramic transducer materials, the backing block also defines the acoustic impedance at the surface of the transducer material away from the patient. The acoustic impedance of the PZT ceramic typically has an acoustic impedance of 20 to 30 MRayl and the backing blocks typically have an acoustic impedance of 3 to 12 MRayl. For example, an epoxy filled with small particles is used to absorb acoustic energy without scattering or reflecting the energy. The impedance discontinuity at this surface reflects some of the backward traveling wave. To minimize this reflection, a backing material must be used which has an acoustic impedance which matches the PZT, however absorbing materials with impedances this high do not exist and are difficult to synthesize. The amplitude of this reflection is generally 7% to 19% of the amplitude of the energy generated by the transducer, and by design is incorporated into the transducer response and influences the sensitivity and bandwidth. Its deleterious impacts are mitigated by the attenuation of this component in the PZT's mechanical and electrical losses, propagation away from the transducing material as electrical energy into the electrical circuitry, and propagation away from the transducing material as acoustic energy into the patient.

[0004] In capacitive membrane ultrasound transducers (CMUT's) made from micro-machined silicon, several mechanisms contribute to undesired reflections back to the transducing element. The transducing mechanism is the electrostatic force between a membrane electrode and a substrate electrode. Opposite and equal forces act on these two electrodes. The force on the substrate electrode is associated with undesired signal. Also, as a CMUT membrane flexes to generate or receive acoustic energy, acoustic energy coupled into the supporting silicon substrate causes undesired reflections from the interface with the supporting material. As there is very little acoustic absorption in the silicon substrate, these acoustic signals must be attenuated in materials added to the device. Since silicon and other materials used for CMUT transducers has a longitudinal impedance of about 17 to 20 MRayl, backing block materials used for PZT transducers may also create a reflective interface with the substrate in CMUT's.

[0005] Appropriate materials available for use as backing blocks are limited. Additionally, many backing block materials may be selected to provide at least some heat conductivity. For manufacturing purposes, the backing block may be selected to be as stiff as possible for providing mechanical support to the assembled array. These and other considerations limit the available acoustically attenuating materials used for a backing block.

[0006] Other transducer related materials are selected for acoustic properties. Matching layers are used PZT transducers to transition acoustic impedance from the transducer material to a patient. Where a wedge or block is designed to be placed between the transducer and the patient, the wedge or block has similar acoustic impedance to the patient. To avoid reflections from a surface of a wedge not contacting the surface of the transducer or patient, a Rayliegh dump in an absorbing material may be added to that surface.

BRIEF SUMMARY

[0007] The present invention is defined by the following claims, and nothing in this section should be taken as a limitation on those claims. By way of introduction, the preferred embodiments described below include sound absorption backings for ultrasound transducers and methods of absorbing sound. A block of material with similar acoustic impedance to the transducer material is provided adjacent to the material. For example, a solid metal block of material with acoustic impedance that is similar to the acoustic impedance of a silicon substrate used for a CMUT is provided. Since the solid block of material may provide high heat conductivity and stiff mechanical support but without acoustic attenuation, the block is formed to prevent reflections of acoustic energy back to the transducer material. In one embodiment, an anechoic surface, such as a Rayleigh dump, is formed on a surface of the solid block of material away from the transducer material. Acoustically absorbing materials are provided along the anechoic surface. As acoustic energy contacts the surface, the acoustic energy is reflected at angles away from the transducer material. With each reflection, some of the acoustic energy propagates through the surface into the attenuating material. After multiple reflections on the surface, the acoustic energy traversing the surface is eventually dissipated through the acoustic attenuation of the additional material adjacent the surface. Less, minimal or no acoustic energy propagates back to the transducer material.

[0008] In a first aspect, an ultrasound transducer for converting between an acoustic and electrical energy is provided. A backing block is provided on at least one side of transducer material. The backing block includes an anechoic surface.

[0009] In a second aspect, an ultrasound transducer for converting between acoustic and electrical energy is provided. A transducer material is formed as an array of elements. A backing block is provided on at least one side of the transducer material. The backing block includes a block of a first material adjacent to the transducer material. The first material may have substantially no acoustic attenuation at a range of frequencies for operation of the array of elements.

[0010] In a third aspect, an ultrasound transducer for converting between acoustic and electrical energy is provided. A backing block is provided on at least one side of the transducer material. The backing block includes a solid block of a first material adjacent to the transducer material. The first material has a thermal conductivity greater than the transducer material.

[0011] In a fourth aspect, a capacitive membrane ultrasound transducer is provided for converting between acoustic and electrical energy. A silicon substrate has a plurality of flexible membranes. A backing block is adjacent to the silicon substrate. The backing block has a solid block of first material adjacent to the transducer material. A block of second material is positioned adjacent to the first material away from the silicon substrate. A surface of contact between the first and second materials has at least one area angled relative to the silicon substrate to reflect acoustic energy away from the silicon substrate.

[0012] In a fifth aspect, a method for attenuating acoustic energy in a backing block is provided. Acoustic energy is transmitted into the backing block. The acoustic energy reflects off of a Rayleigh dump surface in the backing block. The acoustic energy passing through the surface is absorbed.

[0013] Further aspects and advantages of the invention are discussed below in conjunction with the preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The components in the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention. Moreover, in the figures, like reference numerals designate corresponding parts throughout the different views.

[0015] **FIG. 1** is a cross-section diagram of one embodiment of an ultrasound transducer with transducer material and a backing block;

[0016] **FIG. 2** is a graphical representation of acoustic reflections in one embodiment of a Rayleigh dump; and

[0017] **FIG. 3** is a flowchart diagram of one embodiment of a method for attenuating acoustic energy in a backing block.

DETAILED DESCRIPTION OF THE DRAWINGS AND PRESENTLY PREFERRED EMBODIMENTS

[0018] Available backing block materials for attenuating ultrasound energy with similar acoustic impedance to silicon for CMUT transducers are limited. For example, longitudinal wave acoustic impedance of aluminum and silicon are a good match, resulting in low acoustic reflection coefficients from the interface between the two materials. Acoustic power launched into the substrate enters the aluminum with little reflection, resulting in no or limited reflection. Aluminum provides little or no acoustic attenuation, so the acoustic energy is deposited into an absorbing material. Absorbing materials with acoustic impedance similar to aluminum and silicon may be difficult to synthesis or may be unavailable. An anechoic Rayleigh dump is formed on the surface of the aluminum spaced away from the transducer material. The Rayleigh dump acts to deposit the acoustic power into an absorber placed on the surface of the aluminum. Due to the shape of the Rayleigh dump, little or no acoustic energy is reflected back towards the transducer material even with the differences in acoustic impedance between the aluminum and the acoustically absorbing material.

[0019] While a specific embodiment is discussed above, embodiments using ceramic or piezoelectric transducer materials with different metals or non-metal backing block materials may be used. The use of an anechoic surface may allow selection of materials that have different acoustic impedances, thermal conductivities, little or no acoustic attenuation or other desired characteristics.

[0020] **FIG. 1** shows one embodiment of a cross-section view of a transducer **10**. The transducer **10** has a linear array of elements, a multi-dimensional array of elements or a single element. Any of various transducer stacking materials, including signal traces, electrodes, matching layers and/or lens may be used. The transducer **10** converts between acoustic and electrical energy. The transducer **10** is used for medical diagnostic ultrasound imaging in one embodiment, but may be used for sonar, materials testing or other ultrasound transmission and reception.

[0021] The transducer **10** shown in **FIG. 1** includes transducer material **12** and a backing block **14**. The transducer material **12** is piezoelectric, piezoelectric composite, silicon, other CMOS processed material, or other now known or later developed materials for converting between acoustical and electrical energies. In one embodiment, the transducer material **12** is a silicon substrate with one or more flexible membranes formed within or on the silicon substrate. The flexible membrane has an electrode on at least one surface for transducing between energies using a capacitive effect, such as provided in capacitive membrane ultrasound transducers. The membrane is formed with silicon or other materials deposited or formed on the silicon substrate.

[0022] As shown in **FIG. 1**, the transducer material **12** corresponds to a cross-section of a single element in a linear array. The remaining elements of the array extend along the backing block **14** perpendicular to the plane of **FIG. 1**. In alternative embodiments, the transducer material **12** shown comprises a linear array extending from the left side to the right side of **FIG. 1** with the full extent of the array shown. The backing block **14** in either of the array embodiments is positioned adjacent to the silicon substrate and extends along at least one, two, all or a subset of the elements of the array.

[0023] The backing block **14** includes two materials **16** and **18** with an anechoic surface **20**. The backing block **14** is positioned adjacent to the transducer material **12** to prevent undesired signals propagating through the backing block **14** from reflecting back to the transducer material **12**. The anechoic surface **20** is a Rayleigh dump in one embodiment, but other now known or later developed anechoic surfaces may be used. The surface **20** is spaced away from the transducer material **12** and includes one or more peaks in cross-section. For example, the surface **20** forms a plurality of pyramids in three-dimensional space. As another example, the surface **20** forms a plurality of parallel ridges extending in parallel width, perpendicular to or at an angle relative to the direction of the array of elements. As shown in cross-section of **FIG. 1**, the pyramids or ridges provide a plurality of peaks in cross-section. Due to the shape of the surface **20**, at least one area of the surface **20** is angled relative to the transducer material **12** to reflect acoustic energy away from the transducer material **12**. The angle between the faces of the surface **20** is about 20 degrees in one embodiment, but may be greater or lesser. While all the peaks of the surface **20** are shown as a same height, the peaks or valleys may vary or be different along one or more dimensions. The width between the peaks is larger than a single wavelength. While shown as having six peaks and an associated five valleys of the second material **18** or five peaks with six valleys of the first material **16**, any number of peaks and valleys may be provided for the surface **20** including a single peak or valley. The distance between the peaks or valleys is at least five wavelengths in one embodiment, but a lesser or varying distance may be used. For a typical one-dimensional medical imaging array, about five wavelengths distance may translates to about five, six or fewer peaks or valleys. While shown as having peaks and associated valleys running parallel, the distance between the peaks and valleys may vary along their length.

[0024] **FIG. 2** shows incident acoustic energy **22** into a valley or dump formed in the surface **20**. As the incident energy contacts the surface **26**, some of the energy reflects at an angle from the surface while some energy is passed through the surface. Following the first reflection, multiple reflections are repeated at decreasing angles. The decreasing angles approach an angle perpendicular to the two side walls of the surface **20**, avoiding or minimizing reflections back towards the transducer material **12**. After a number of reflections, the angle incident reaches 90 degrees and the acoustic wave begins to be reflected back towards the transducer material **12**. Since the acoustic energy loses power with each reflection, minimal energy is reflected back to the ultrasound transducer **12**.

[0025] Due to the characteristics of the second material **18** used to form the surface **20**, the acoustic energy passing through the surface **20** is attenuated or absorbed. The Rayleigh dump or surface **20** is formed at an interface between the two different materials **16**, **18**, but may be formed spaced from one or both of the two materials by a third material.

[0026] The first material **16** is any of various now known or later developed materials with an acoustic impedance matched to the acoustic impedance of the transducer material **12**. Matched acoustic impedance includes acoustic impedance within 10% or a same acoustic impedance between the material **16** and the transducer material **12**, but a greater difference may be provided. For example, where the transducer material **12** is silicon or a CMUT transducer, the material **16** is a metal material, such as a solid block of aluminum or other metal. Solid is material with a consistent molecular make-up, such as without filler particles. Silicon substrate has a longitudinal acoustic impedance of about 17 to 20 MRayl. Aluminum has a longitudinal wave acoustic impedance of about 17 MRayl. Other materials with matched or similar longitudinal wave acoustic impedances to silicon include Bearing Babbitt (23.2 MRayl), tin (24.2 MRayl), lead (24.6 MRayl), indium (18.7 MRayl), solder, silicon, beryllium (24.1 MRayl), cadmium (24.0 MRayl), flint glass (16.0 MRayl), Macor (14.0 MRayl), lead Metaniobate (20.5 MRayl), liquid sodium (21.32 MRayl), granite (17.6 MRayl) and Bismuth (21.5 MRayl). Other materials for matching to a silicon substrate or for matching to other transducer materials may be used. Similar or the same materials may have different acoustic impedance values.

[0027] In one embodiment, the material **16** is a solid block of material, such as a solid block of metal or metal alloy. In other embodiments, additional materials are formed within or as part of the material **16**, such as providing fluid cooling channels, pockets of filler material or other particles. As an alternative, the material **16** is a liquid material enclosed within a housing with similar acoustic impedance. Where cooling channels or liquid coolants are provided in the material **16**, liquids with similar acoustic impedances are used to avoid reflections.

[0028] Different ones of first materials may be used in different situations or for different reasons. For example, granite and other metallic materials have thermal conductivities greater than the transducer material **12**. Since thermal considerations may be important for ultrasound applications, a higher thermal conductivity may be desired. In addition to having a higher thermal conductivity, the temperature coefficient match may be an important consideration in order to avoid distortion of a transducer due to internal thermal gradients. Rigidity, stiffness or mechanical support may be important for forming the transducer **10**. The material **16** acts to support the back of the transducer material **12**. Various materials, such as a solid block of aluminum, granite, flint glass, Macor and tin, may provide non-brittle, durable materials for supporting the manufacturer and use of the array **10**.

[0029] Many of the materials discussed above for adjacent to the transducer material **12** provide no, minimal or limited acoustic attenuation at a range of frequencies of operation of the array of elements. For example, a solid block of aluminum material **16** provides no or little acoustic attenuation at 1 to 12 MHz frequency range. To absorb the acoustic energy and avoid reflections back to the transducer material from the backing block **14**, the second material **18** forming the anechoic surface **20** is an acoustic attenuative material.

[0030] The second material **18** is any of now known or later developed materials for attenuating acoustic energy, such as ultrasound acoustic energy. For example, a cured epoxy with or without filler material is used. Where filler material is provided, the filler material is small enough to avoid reflections of acoustic energy. The second material **18** has an acoustic impedance that is at least 30 percent less than the acoustic impedance of the transducer material **12** in one embodiment. In alternative embodiments, a lesser difference in acoustic impedance is provided. In one embodiment the second material **18** is selected to have as high a longitudinal wave acoustic impedance as possible while still attenuating the ultrasound energy. For example, filler material is added to synthesize an acoustic impedance of about 12 MRayl or more. Materials with any acoustic impedance may be used, such as materials with a range of 3 to 12 MRayl. Higher or lower impedance may be provided. Where the first material **16** provides a rigid structure, the second material **18** is selected for desired attenuation properties with minimal or no consideration of rigidity. For example, acoustically absorbing gels, foams, epoxies, liquids, or other materials with excellent, no or some mechanical support are used. The second material **18** may have a lesser thermal conductivity than the first material **18** since the first material **16** acts to cool the transducer **10**, allowing the second material **18** to be selected for acoustic properties rather than thermal conduction properties. Combinations of different materials may also be provided in a mixed or structural combination on a micro or macro level.

[0031] The second material **18** is spaced from the transducer material **12** by the first material **16**. The acoustically attenuative material **18** is positioned at the surface **20** adjacent to the block of the first material **16**. In alternative embodiments, the second acoustically attenuative material **18** is spaced from the surface **20** by one or more other materials which, if they are made of a material with an impedance intermediate between the impedances of materials **16** and **18**, may function as a quarter-wave matching layer for the surface **20**. The Rayleigh dump or anechoic surface **20** passes ultrasound energy into the acoustically attenuative material **18**. Since the material **18** has a greater acoustic absorption than metal or other material **16** adjacent to the transducer material **12**, the acoustic energy is primarily attenuated by the second material **18**.

[0032] The backing block **14** and the first material **16** are shaped in cross section as shown in **FIG. 1**, but other shapes may be used. A lip or edge **24** is provided on one or both sides of the transducer material **12**. The edge **24** supports signal traces that contact an upper surface of the transducer material **12**. Where signal traces are formed along the lower surface of the transducer material **12**, the backing block **14** includes the lip **24** or is flat without the lip **24**. For supporting the second material **18** within the backing block **14**, the first material **16** extends downward to house the second material **18** on the sides. In alternative embodiments, the second material **18** extends all the way to the sides of the backing block **14** without the housing of the first material **16**.

[0033] The backing block **14** is manufactured by forming the first material **16** in a desired shape and then forming the second material **18** on or within the first material **16**. For example, the first material **16** is an extruded metal block, wire cut at the ends with or without an additional end cap formed on the material **16**. Any of various extrusion, molding, cutting or other now known or latter developed processes for forming the first material **16** under the desired shape may be used. The second material **18** is then molded in, deposited in, or cured in the first material **16**. For example, an epoxy with or without filler is poured within the first material **16** and allowed to cure. Alternatively, the second material **18** is formed using extrusion, molding, thermoplastic injection or cutting processes to mate with the first material **16**. The second material **18** bonds to the first material **16**. Alternatively, an additional bonding agent is provided along the surface **20**. In yet another embodiment, a bonded or attached plate is positioned over the first material **16** and second material **18** to maintain the second material **18** adjacent to the surface **20** and the first material **16**, as might be used to contain an attenuating fluid or freely flowing plastic material. The transducer material **12** is then stacked, bonded or otherwise formed adjacent to or on the backing block **14**.

[0034] **FIG. 3** shows one embodiment of a method for attenuating acoustic energy in a backing block. The transducer of **FIG. 1** or another transducer is used to implement this method. Additional, different or fewer acts may be provided.

[0035] In act **30**, acoustic energy is transmitted into a backing block. Acoustic energy is generated from a transducer material as a longitudinal or other wave modes extending as a wave from the transducer material. Energy extending towards a patient or surface to be sensed is desired, but energy extending in the opposite direction is undesired. For example, a membrane of a capacitive membrane ultrasound transducer flexes in response to electrical signals. The flexing generates acoustical energy that is transmitted perpendicularly in both directions away from the membrane. The backing block absorbs the acoustic energy transmitted in the undesired direction to avoid echoes.

[0036] In act **32**, the acoustic energy transmitted into the backing block is reflected off of an anechoic dump surface in the backing block. Due to the angle of the anechoic surface, the reflected wave is initially scattered away from the sensor. After a number of reflections, the angle incidence of the waveform reaches 90 degrees. The acoustic energy that remains is then reflected multiple times within the anechoic surface or Rayleigh dump, eventually being reflected back towards the sensor with no or a greatly reduced power.

[0037] In act **34**, the acoustic energy passing through the surface into the material **18** is converted to heat as it propagates through the material **18** by the losses of the material. At each reflection, some of the acoustic power or energy passes through the surface rather than being reflected off of the surface. As each reflection occurs, more or additional acoustic power is passed through the surface and absorbed by an acoustically attenuative material.

[0038] In another embodiment, the first material **16**, such as an aluminum member, is formed into a structural frame for the entire transducer such that there are no surfaces behind the transducer material **12** that reflect back toward the transducer material **12**. The first material **16** acts as a wave guide. The acoustic absorber is located remotely from the transducer material **12**. The waveguide may be coated with acoustic absorbent material along the length of the waveguide. An acoustic dump is provided at the terminus. Heat generated by the absorption of the acoustic energy is away from the transducer material **12**. The heat generation from absorption is removed from proximity to the patient.

[0039] While the invention has been described above by reference to various embodiments, it should be understood that many changes and modifications can be made without departing from the scope of the invention. For example, piezoelectric or composite ceramic transducer materials may be used with any of various backing block materials. Even though a backing block material may attenuate acoustic energy, a Rayleigh dump or anechoic surface may assist in acoustic absorption or allow smaller backing blocks.

[0040] It is therefore intended that the foregoing detailed description be regarded as illustrative rather than limiting, and that it be understood that it is the following claims, including all equivalents, that are intended to define the spirit and scope of this invention.

I (We) claim:

1. An ultrasound transducer for converting between acoustic and electrical energy, the transducer comprising:

transducer material;

a backing block on at least one side of the transducer material, the backing block including an anechoic surface.

2. The transducer of claim 1 wherein the transducer material comprises a capacitive membrane connected with silicon, the backing block adjacent the silicon.

3. The transducer of claim 1 wherein the transducer material comprises an array of elements, the array of elements adjacent the backing block.

4. The transducer of claim 1 wherein the anechoic surface comprises a Rayleigh dump with a surface having one of: at least one peak, at least one valley and combinations thereof in cross-section.

5. The transducer of claim 1 wherein the backing block comprises first and second different materials, the anechoic surface being at an interface of the first material with the second material.

6. The transducer of claim 5 wherein the first material is adjacent to the transducer material and the second material is spaced from the transducer material by the first material, the first material having an acoustic impedance within 10% of an acoustic impedance of the transducer material, the second material having an acoustic impedance at least 30% less than the acoustic impedance of the transducer material.

7. The transducer of claim 1 wherein the backing block comprises a block of material having acoustic impedance within 10% of an acoustic impedance of the transducer material.

8. The transducer of claim 7 wherein the block of material comprises a metal material.

9. The transducer of claim 8 wherein the metal material comprises one of: Aluminum and an Aluminum alloy.

10. An ultrasound transducer for converting between acoustic and electrical energy, the transducer comprising:

transducer material having an array of elements;

a backing block on at least one side of the transducer material, the backing block including a block of first material adjacent to the transducer material, the first material having substantially no acoustic attenuation at a range of frequencies for operation of the array of elements.

11. The transducer of claim 10 wherein the first material comprises metal.

12. The transducer of claim 11 wherein the first material comprises Aluminum.

13. The transducer of claim 10 wherein the block of first material has a surface with a Rayleigh dump.

14. The transducer of claim 13 wherein the backing block further comprises an acoustically attenuative second material positioned at the Rayleigh dump adjacent to the block of first material.

15. The transducer of claim 10 wherein the first material has a thermal conductivity greater than the transducer material.

16. The transducer of claim 10 wherein the transducer material comprises silicon.

17. An ultrasound transducer for converting between acoustic and electrical energy, the transducer comprising:

transducer material;

a backing block on at least one side of the transducer material, the backing block including a solid block of first material adjacent to the transducer material, the first material having a thermal conductivity greater than the transducer material.

18. The transducer of claim 17 wherein the solid block of material comprises a solid metal.

19. The transducer of claim 17 wherein the solid block of material has a surface spaced away from the transducer material with a Rayleigh dump, a second material with a lesser thermal conductivity than the first material positioned adjacent to the Rayleigh dump.

20. The transducer of claim 17 wherein the first material has an acoustic impedance within 25% of an acoustic impedance of the transducer material.

21. A capacitive membrane ultrasound transducer for converting between acoustic and electrical energy, the transducer comprising:

a silicon substrate supporting a plurality of flexible membranes;

a backing block adjacent the silicon substrate, the backing block having a solid block of first material adjacent to the transducer material, a block of second material positioned adjacent to the first material away from the silicon substrate wherein a surface of contact between the first and second materials has at least one area angled relative to the silicon substrate to reflect acoustic energy away from the silicon substrate.

22. The transducer of claim 21 wherein the surface of contact forms a Rayleigh dump.

23. The transducer of claim 21 wherein the solid block of first material comprises a metal material, the second material having a greater acoustic absorption than the metal material.

24. A method for attenuating acoustic energy in a backing block, the method comprising:

(a) transmitting acoustic energy into the backing block;

(b) reflecting the acoustic energy off of a Rayliegh dump surface in the backing block; and

(c) absorbing the acoustic energy passing through the surface.

25. The method of claim 24 wherein (b) and (c) comprises providing the surface between a solid block of a first material and a second material, the second material having a greater acoustic attenuation than the first material.

26. The method of claim 24 wherein (a) comprises transmitting with a membrane of a capacitive membrane ultrasound transducer.

27. The transducer of claim 1 wherein the backing block comprises a wave guide.

* * * * *

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专利名称(译)	超声换能器的吸声背板		
公开(公告)号	[US20050075571A1](US20050075571A1)	公开(公告)日	2005-04-07
申请号	US10/665334	申请日	2003-09-18
[标]申请(专利权)人(译)	美国西门子医疗解决公司		
申请(专利权)人(译)	西门子医疗解决方案USA，INC.		
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[标]发明人	BARNES STEPHEN R		
发明人	BARNES, STEPHEN R.		
IPC分类号	A61B8/14 G10K11/00		
CPC分类号	G10K11/002		
外部链接	Espacenet USPTO		

摘要(译)

提供了用于超声换能器的吸声背衬。在材料附近提供与换能器材料具有相似声阻抗的材料块。例如，提供具有声阻抗的固体金属块材料，其类似于用于CMUT的硅衬底的声阻抗。由于固体材料块可以提供高导热率和刚性机械支撑而没有声学衰减，因此形成块以防止声能反射回传感器。在一个实施例中，瑞利倾倒形成在固体材料块的远离换能器材料的表面上。沿着表面提供声学吸收材料和瑞利倾倒。当声能朝向表面传播时，声能以远离换能器材料的角度被反射。一些声能通过表面传播到衰减材料中。在瑞利倾倒内的多次反射之后，声能最终通过沿着表面的附加材料的声学衰减而消散。