

**A Composition, an Audio Device,  
A Connector and Method of Making a Connector**

5 The present invention relates to a composition for use on audio devices. The invention also relates to a connector for audio devices including a new composition, and a method of making a connector. The invention relates in embodiments to a composition for application to a connector in an audio circuit. The invention also relates in embodiments to an audio device.

10 As used herein, the expression “audio circuit” refers to the electric or electronic drive circuits that are used to produce electrical signals that are themselves the input to audio devices such as speakers, headphones, amplifiers and the like.

15 The reproduction of sound or amplification of sound is an important technology that both enhances quality of life and also can be essential to the operation of the modern world. There are many well known technologies that are used in the reproduction of sound. These include, for example, speakers, smart-speakers, headphones, earphones, microphones, musical instrument cables, audio cables and adapters that can connected to any of the listed items.

20 Each of the items, on its own, is able to either produce sound as in the case of speakers or headphones, or to communicate sound through the transmission of electrical signals to enable the reproduction of sound to such devices. For example, audio cables and adapters can be used to plug in devices to enable the communication and production of sound from, say, a musical instrument such as an electric guitar to an amplifier.

30 The reproduction of the sound signal, which is then perceived and experienced by a user, is a well-known fundamental technology. Examples of known technologies that can be incorporated with or used as part of connectors or cables in the field of sound reproduction include EP2716796, US2020099147, GB579360, GB2351616, CN214428800, CN217387609 and US5158465.

An improved method and system is desired for the reproduction of sound.

According to a first aspect of the present invention, there is provided a composition for application to a connector in an audio circuit, the composition comprising: carbon nanotubes; a mineral component; and a metallic component.

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A composition is provided for application and use in audio circuits. The composition includes three components in the form of carbon nanotubes; a mineral component; and a metallic component. Typically, the composition can be provided in the form of a paste in a mixture with a solvent or liquid base such as water, which is preferably de-ionized water. In use the composition is applied at points or regions within an audio circuit, such as at the input points to a circuit, i.e. points or contacts at which input wires might be physically connected to an output device such as a speaker.

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The applicants have recognised that application of the specified composition to points or regions within an audio circuit produces a surprising and beneficial effect in terms of the sound produced by the audio circuit.

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In an embodiment, the mineral is selected from the group including quartz, sapphire, Amethyst, Moonstone, kyanite and Jade.

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In an embodiment, the metal is aluminium. The composition includes a metal which can be Aluminium or indeed any other metal. The advantage of aluminium is its easy availability and relatively low cost.

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In an embodiment, the composition is provided in the form of a paste

In an embodiment, the paste has a liquid base of in which the carbon nanotubes, the mineral component; and the metallic component are provided.

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In an embodiment, the liquid base is deionized water.

In an embodiment, the metal is selected from the group consisting of Gold (Au), Silver (Ag) and Copper (Cu).

In an embodiment, the carbon nanotubes, the mineral component; and the metallic component are provided in the ratio 2:1:1 by weight. Preferably the composition includes the specified components (carbon nanotubes, the mineral component; and the metallic component) in prescribed proportions by weight. The preferred ratio of weights is 2:1:1, although alternatives are also preferred. In an alternative the ratio is 3:2:2.

The ratio or amounts used per application of the composition can be varied in dependence on the use. Figure 9, for example shows ranges of weights per application that are varied in dependence on the system or device in which it is used. For example, it is preferred that when used with headphones, the weight of carbon nanotubes is between 0.01g and 0.03g per application, the weight of mineral is between 0.007g and 0.013g per application and the weight of metal is between 0.007g and 0.013g per application. In this context it will be understood that "per application" refers to the amount of material applied to a contact or a region in the particular usage.

In an embodiment, the composition is for application to an audio motherboard in which the application in which the carbon nanotubes, the mineral component; and the metallic component are

According to a second aspect of the present invention, there is provided a connector for use in an audio circuit, the connector having two or more contacts for receipt of an electronic audio-drive signal, the contacts having provided thereon a composition according to the first aspect of the present invention.

According to a third aspect of the present invention, there is provided an audio device comprising input contacts arranged to receive an input electrical signal via a wired connection, and to process the input electrical signal so as to generate an audio output, wherein the input contacts are arranged in use to be physically connected to input cables, the input contacts having provided thereon a composition according to the first aspect of the present invention.

According to a fourth aspect of the present invention, there is provided a method of making a connector for use in an audio circuit, the method comprising applying to a

connector having two or more contacts for receipt of an electronic audio-drive signal, a composition according to the first aspect of the present invention.

Embodiments of the present invention will now be described in detail with  
5 reference to the accompanying drawings, in which:

Figure 1 is a view of a pair of ear bud headphones with the housing backing removed;

10 Figure 2 is a schematic view of the earbuds from an alternative perspective;

Figure 3 is a view of miniature speakers with the housing removed;

Figure 4 is a schematic view of an audio jack with the lower housing removed;

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Figure 5 is a view of a speaker cone with electrical contacts at the rear;

Figure 6 is a schematic view of the back of a female XLR;

20 Figure 7 is a view of a general layout for a speaker and headphone circuit including associated controllers; and

Figures 8 and 9 are tables showing exemplary composition constituents.

25 Figure 1 shows a schematic view of a pair of headphones with the rear housing removed. The headphones 2 include a left and right miniaturised speaker which are arranged, in use, to be positioned within a user's ear, as is very well known.

30 Looking at the figure, the headphones might be a conventional pair of headphones in as much as a number of the components are concerned. Accordingly, detailed description of functioning of the headphones will not be provided herewith. However, referring to the figure, the contacts 4 and 6 through which the input or drive signals to the headphones are received can be seen. Each of the left and right headphone of the pair includes two contacts 4 and 6.

The contacts 4 and 6 are points of connection to which input cables (not shown) are typically soldered. The input cables might typically come from a music player or a processor within a music player. The music player could be any known player such as, for example, an MP3 player or a mobile telephone having music playing functionality.

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A composition, to be described in detail below, is applied to the contacts 4 and 6, which has the technical effect of significantly improving the sound produced by the device itself. The connectors 4 and 6 could be, in one example, coupled to cables which themselves provide the flow of an electrical signal to drive an audio signal from speakers within the headphones. However, the contacts 4 and 6 could also simply be connected to outputs from a processor which itself is arranged to receive audio electronic signals via a wireless technology such as Bluetooth.

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As will be explained below, the output of the sound itself has been tested by regular users including musicians, music producers, Disc Jockeys (DJs) and professional studio mixers. The technology is applicable to headphones of all descriptions, including over-ear, in-ear, ear buds, Bluetooth and wired headphones together variation of speakers, instrument cables and connectors, to be described in greater detail below.

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The material provided to be arranged on the contacts 4 and 6 is a combination or composition made up at least of three components, being: a metallic component, a stone or mineral component, and a compound including carbon nano tubes. In other words, the material or composition for application to a connector in an audio circuit, comprises carbon nanotubes, a mineral and a metal.

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It has been shown by the applicants that the combination of carbon nano tubes and the other constituents of the composition improves the quality of the sound produced by the sound producing device when the composition is applied to components or connectors in the electronics chain that produces the sound.

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Examples of possible compositions will be given and described in detail below. For now, further examples of uses of the composition will be provided.

Referring to Figure 2, an example of the ear bud circuitry of Figure 1 is shown arranged within the housing of the ear buds. The housing 8 is of conventional shape and as can be seen, the known circuitry 10 is provided within the housing. The cover 12 is shown removed from one of the ear buds exposing the functional components, to be described in detail, themselves.

Contact points 4 and 6 are provided upon which has been arranged a module or layer of the composition described above. In other words, a composition including carbon nano tubes, a mineral and a metal is provided. Each application of the composition, i.e. the composition applied to each of the contacts 4 and 6 includes defined amounts of the various constituents. Typically, the composition is formed in a paste with a matrix solvent solution. The paste is applied to the region of interest and subsequently, once dried, leaves the solid residue of the composition described above.

It is preferred that the carbon nanotubes have lengths of between 5 and 20 micrometres, and cross-sectional diameters of between 1-3nm. Preferably the nanotubes have cross-sectional diameters of about 2nm.

Figure 3 shows a further stripped back example of a set of headphones. In this example, the sound generating components 14 can be seen together with the circuitry 16 provided on the rear of the sound producing components 14.

Cables 18 are shown which convey electronic drive signals from a processor (not shown). Contact points 20 and 22 are arranged with a layer of the composition, described above, provided thereon. The ends of the cables 18 are typically then soldered onto the composition itself.

Figure 4 shows an example of an alternative use of the current technology, as part of a jack connector 24. Thus, in this example the jack connector can be used to couple an electronic signal to a set of headphones (not shown).

The example shown here is a conventional TRS type male audio jack including a tip 26, a ring 28 and a sleeve 30. Inputs 32, 34 and 36 are provided respectively for each of the TRS components.

A strain relief clamp 38 is provided, but is not relevant in the current example to the innovation.

5           The tip and ring 26 and 28 are for providing or receiving signals for the communication of sound. The inputs 32 and 34 of the jack 24 are, in this example, provided, in the regions 40 and 42, with a layer or application of the composition described above. Again, as in the example described above, the composition can be applied together with a solvent matrix which will then dry, leaving a residual layer of solid  
10       material.

          In another example, a suitably sized jack connector such as a guitar jack can be connected to a lead to couple electronic drive signals from a guitar pick up to a guitar amplifier.

15           Figure 5 shows an example of a speaker 44 having electrical inputs 46 and 48. These are typically, in use, connected to cables or connectors which provided an electrical signal to drive the speaker 44 and generate sound. The speaker has a speaker cone 45, arranged to oscillate and generate and transmit sound as is well known. As in the previous examples, it is envisaged that a layer of composition is applied to the connectors 46 and 48 so as to improve the sound quality generated by the  
20       speaker cone 45 of the speaker 44.

          Figure 6 shows respectively the backs of a male 50 and female 52 XLR  
25       connector. As is well known, XLR connectors are used for various audio purposes including microphones and loudspeakers. XLR connectors are typically provided with three connecting (input/output) pins but models with different numbers of pins are also available.

30           In the example shown in Figure 6, referring to the male connector 50, three connection points are shown. They are a shield/ground, a positive and a negative connection point. The composition described above, is, in one example, applied to the positive and negative connection points in a similar manner to that described above with

respect to the jack and shown in Figure 5. The composition can be provided on any or all of the connection points (1 to 3) of the connector 50.

A similar arrangement is typically provided in the example of the female XLR connector 52 also shown in Figure 6. The composition can, as will the male XLR described above, be provided on any or all of the connection points (1 to 3) of the connector 52.

Figure 7 shows a schematic layout including a control PCB 54 connected to speakers 56. The PCB 54 has inputs 58 and outputs 60. The inputs 58 are coupled to a drive circuit 62 which also has a power driver without outputs 64.

As will be understood, in use, a signal is typically provided from the drive circuit 62 to the inputs 58. After processing on the PCB in an appropriate manner, outputs are provided to the speakers 56 from the output connectors 60.

The composition described herein is typically applied, in the same manner as described above, to the connectors 58 and 60 and also to the audio signal outputs 66 on the drive circuit 62.

The schematic arrangement can be used for any of the components shown in and described herein.

In more detail, the composition itself is now described. The composition is preferably provided in the form a paste which can be applied to connecting points on either a circuit to provide an audio drive signal or an input to an audio device, as described above.

Figure 8 is a table showing the exemplary amounts of the constituents in the composition to be applied in the different listed applications. For example, for a motherboard, such as that shown as component 54 in Figure 7, typically for each application of the composition, the constituents are provided in the amounts of 0.02g of carbon nano tube, 0.01g of a mineral such as ground quartz, ground sapphire or , ground kyanite, and 0.01g of aluminium. The usage in other applications can be seen from the table in Figure 8. It will be appreciated that the amounts specified are provided

in a paste format in combination with the liquid base or solvent such as de-ionized water. Once in position a lacquer or fixing agent, as will be known to a person of skill in the art, is preferably applied to permanently fix the applied composition at the desired location.

5           In one example a UV curable lacquer or resin is used that is applied as a layer above or on top of the composition, and is then hardened or cured using UV radiation. The lacquer preferably extends beyond the footprint of the composition so as to act as an anchor to the surface upon which the composition and lacquer is arranged.

10           Each application is applied with reference to the mass of the constituents. The thickness or two-dimensional spread of the applied amount of composition will vary on each use. If there is a greater area available then a thinner layer can be applied, whereas if surface area is limited the thickness of the application will be higher. In other words, what is important is that for each application on, say, an audio motherboard, the  
15           composition will preferably include 0.02g of carbon nano tube, 0.01g of a mineral such as ground quartz, sapphire, or Kyanite, and 0.01g of aluminium.

          It has been demonstrated by the applicant that the combination of the carbon nano tubes, the metal such as aluminium and the mineral such as ground quartz or  
20           sapphire, improves the sound stage generated by the appliance in question. The addition of the quartz or sapphire to the composition improves the clarity of the sound. Furthermore, by experiment, it has been demonstrated that it also increases and improves the azimuth and zenith sound localisation. Other suitable metals and minerals or stones can be used in the composition. Examples of suitable metals include Gold  
25           (Au), Silver (Ag) and Copper (Cu) but other metals could also be used. Examples of minerals or stones that could be used include Amethyst, Moonstone and Jade.

          It is also possible to use mixtures of two or more metals and/or two or more minerals in the composition. It has been shown that different constituents can have a  
30           different effect on the ultimate sound produced by the audio device. For example, Amethyst flattens the low and the high frequency components of the sound signal. This has benefit for use in speakers market. The sound produced can thus be changed if a different mineral component is used such as Sapphire or Quartz in a connector.

The mineral component can be selected or varied in dependence on application. it has been shown by the applicants that quartz influences the low and mid-range frequencies, whereas sapphire influences the mid and high range frequencies. Kyanite  
5 enhances the spatial effect, making it wider and more immersive. Preferably, the mineral composition is a mixture of quartz and sapphire such that the total amount applied is as indicated in the table. The proportion of quartz to sapphire in the mineral component of the composition can be 20:80, 30:70, 40:60 or 50:50 (or vice versa).

10 Figure 9 shows a further example in which preferred ranges for the amounts of the different materials are indicated according to desired a1 to 3, the amounts of the constituents in the composition will be 0.01 to 0.03g of carbon nano-tubes, 0.007 to 0.013g of a mineral such as quartz or sapphire and 0.007 to 0.013g of a metal such as Aluminium. Preferably the materials are formed as a mixture or paste with a liquid base,  
15 such as a solvent which can be any suitable solvent or liquid including distilled water and de-ionised water. When mixed with the liquid base or solvent such as de-ionised water, a paste is formed which can be applied to the regions of interest on the head[hones, i.e. the contacts for the input cables.

20 The mixture can be applied manually, e.g. with an applicator such as a brush or, preferably in a manufacturing process can be applied in any known way of applying a composition such as a paste or slurry to a region of interest. In other words, the application of the composition can be printed on or applied using know mask technology.

25 What is important is that a composition that includes the specified amounts of the constituents is applied to each of the contact points in question.

The current method and apparatus guarantees that exceptionally life like reproduction is achieved. The technology ensures that the sound of each instrument in  
30 a musical is clearly audible. Furthermore, the acoustic character of the environment can now be experienced with greater precision. In effect, it makes a listener feel as if they are part of a musical performance as opposed to merely an observer. Further applications include the speakers and the audio systems within mobile telephones, television sets and microphones.

The composition, when applied in the manner described above, has an effect on the resistance and resistivity of the connections and this, it is understood, improves the sound quality from the audio device.

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The low cost of producing the composition is a significant advantage. By the standards of other technologies that are sometimes used to improve the sound quality of audio devices, use of the composition described herein is low cost and effective.

Use of the composition lowers the input resistance to the audio circuit (whether that is into a speaker, a cable or a connector).

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The technology described herein has been tested on numerous audio devices as will be described below. The examples, to be described, include Yamaha HS5 monitor speakers and several headphones. A testing panel was assembled comprising professional sound engineers, musicians, audiophiles, music lovers, DJs and professional music producers.

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The composition can be applied as described herein to any audio device. Examples include speakers, sound-bars, headphones, earphones, amplifiers, audio mixers, microphones, mobile phones, TV's, musical instruments, all audio cables (XLR, Jack, Speak-On, RCA etc.).

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Tests on the devices have indicated that the input resistance/impedance of the device, azimuth and zenith, static and moving sounds (distance and velocity) and the dynamic range are all affected by use of the composition in the manner described herein.

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When used on a Yamaha HS5 speaker, modified in the manner described herein, the effect was to produce sound that is experienced and perceived as having greater clarity, better separation of lead vocals, background vocals and instruments when used with music having these constituent elements, an immersive and spatial sound stage and to create an effect on a user such that the point of output origin is no longer discernable.

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Furthermore, in dependence on the speaker setup the sound is experienced differently. Specifically, if the speakers e.g. are positioned 1.5 to 2 meters from the wall the listening experience is different depending on the positioning of the listener.

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- i. In front and in the middle of the speakers.
  - ii. at the back and in the middle of the speakers.
  - iii. in the middle and between the speakers.

10 The point of output origin is no longer discernable as the soundstage fills the space at the back, at the front and above the speakers, giving the stereo soundstage a new dimension of depth, space and separation.

Speakers with the composition applied were tested outdoors. The speakers were tested in a garden with a swimming pool and in an open field.

15 In general, the produced sound is experienced and perceived as being captured/projected above the speakers with improved clarity, better separation of lead vocals, background vocals and instruments, . an immersive and spatial sound stage, no loss of sound quality compared with in-door experience. A listener sweet spot is  
20 identified in front of the speakers.

Furthermore, when the user is positioned behind the speakers, the sound is experienced as originating played 3 to 4 meters away from a position in front of the speakers.

25 Tests were done on a number of different headphones including over-ear, in-ear, ear-phones etc.

Four exemplary devices tested are as follows:

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1. British Airways free give away in-ears for use during the flight (wired),
  2. Peavey Headphone (wired),
  3. MPOW 18 Headphone (wired),
  4. Vivian Infinity GT1 earphone (blue tooth).

In general, the produced sound is experienced and perceived as having greater clarity, better separation of lead vocals, background vocals and instruments, being more immersive and improved spatial sound stage.

5           With respect to a speaker such as the Yamaha HS5 speaker discussed above, when using an unmodified connector the sound signature from the speaker is 40-50%. When using a modified cable in the setup the "sound signature" is increased to 50% to 65%. Adding, in addition to the modified cable, a modified XLR connector on output increases the sound signature to 65% to 75%.

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          If a modified XLR connector is used with a non-modified speaker, the input impedance of the speaker will decrease by more than 50% as compared to use with a non-modified XLR connector.

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          If a modified XLR connector is used with a non-modified cable the impedance of the speaker will similarly decrease by more than 50% as compared to use with a non-modified XLR connector.

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          Embodiments of the present invention have been described with particular reference to the examples illustrated. However, it will be appreciated that variations and modifications may be made to the examples described within the scope of the present invention.

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## Claims

1. A composition for application to a connector in an audio circuit, the composition comprising:  
5 carbon nanotubes;  
a mineral component; and  
a metallic component.
2. A composition according to claim 1, in which the mineral is selected from the  
10 group including quartz, sapphire, Amethyst, Moonstone, Kyanite and Jade.
3. A composition according to claim 1 or 2, in which the metal is aluminium.
4. A composition according to any of claims 1 to 3 in which the composition is  
15 provided in the form of a paste
5. A composition according to any of claim 4, in which the paste has a liquid base of  
in which the carbon nanotubes, the mineral component; and the metallic component are  
provided.  
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6. A composition according to any of claim 4, in which the liquid base is deionized  
water.
7. A composition according to any of claims 1 to 6, in which the metal is selected  
25 from the group consisting of Gold (Au), Silver (Ag) and Copper (Cu).
8. A composition according to any of claims 1 to 7, in which the carbon nanotubes,  
the mineral component; and the metallic component are provided in the ratio 2:1:1 by  
weight.  
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9. A composition according to any of claims 1 to 8, for application to an audio  
motherboard in which the application in which the carbon nanotubes, the mineral  
component; and the metallic component are

10. A connector for use in an audio circuit, the connector having two or more contacts for receipt of an electronic audio-drive signal, the contacts having provided thereon a composition according to any of claims 1 to 9.

5 11. An audio device comprising input contacts arranged to receive an input electrical signal via a wired connection, and to process the input electrical signal so as to generate an audio output, wherein the input contacts are arranged in use to be physically connected to input cables, the input contacts having provided thereon a composition according to any of claims 1 to 9.

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12. An audio device according to claim 11, in which the audio device is selected from the group including a speaker, headphones, an amplifier, over-ear ear-phones and in-ear ear-phones.

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13. A method of making a connector for use in an audio circuit, the method comprising applying to a connector having two or more contacts for receipt of an electronic audio-drive signal, a composition according to any of claims 1 to 9.

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