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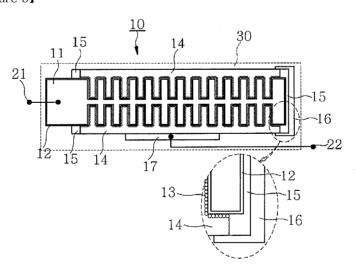
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(54) Title: METAL CAPACITOR AND MANUFACTURING METHOD THEREOF

#### [Figure 3]



(57) Abstract: A metal capacitor in which an electric conductivity is significantly improved by applying a metal material for an electrolyte and a manufacturing method thereof is provided. The capacitor includes: a metal member including a groove forming portion, an electrode withdrawing portion, and a sealing portion; a metal oxide film being formed on the metal member; a plurality of seed electrode layers; a plurality of main electrode layers being formed on the plurality of seed electrode layers to fill in the plurality of grooves formed on the groove forming portion of the metal member; an insulating layer being formed on the plurality of main electrode layers and the metal member to externally expose the electrode withdrawing portion of the metal member; a conductive connecting layer; a first lead terminal; and a sealing member sealing the metal member connected to the first and the second lead terminals.



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#### [DESCRIPTION]

#### [Invention Title]

# METAL CAPACITOR AND MANUFACTURING METHOD THEREOF

#### [Technical Field]

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The present invention relates to a metal capacitor and a manufacturing method thereof, and more particularly, to a metal capacitor in which an electric conductivity is significantly improved by applying a metal material for an electrolyte and a manufacturing method thereof.

## [Background Art]

An aluminum electrolytic capacitor is used to smooth a power output from a power circuit to be a predetermined value, or is used as a low frequency bypass. Hereinafter, a method of manufacturing the aluminum electrolytic capacitor will be briefly described.

An etching process of etching the surface of an aluminum foil is performed to enlarge a surface area of the aluminum foil and thereby increase an electric capacity. When the etching process is completed, a forming process of forming a dielectric substance on the aluminum foil is performed. When cathode and anode aluminum foils are manufactured through the etching process and the forming process, a slitting process of cutting the manufactured aluminum foil and a separator by as long as a desired width based on the length of a product is performed. When the slitting process is completed, a stitching process of stitching an aluminum lead patch, which is a lead terminal, to the aluminum foil is performed.

When the slitting of the aluminum foil and the separator is completed, a winding process of disposing the separator between the anode aluminum foil and

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the cathode aluminum foil, and then winding the separator and the aluminum foils in a cylindrical shape and attaching a tape thereto, so as to not be unwounded. When the winding process is completed, an impregnation process of inserting the wound device into an aluminum case and injecting an electrolyte is performed. When the injecting of the electrolyte is completed, a curing process of sealing the aluminum case using a sealing material is performed. When the curling process is completed, an aging process of restoring damage to the dielectric substance is performed. Through this, the assembly of the aluminum electrolytic capacitor is completed.

Due to the current development in digitalization and miniaturization of electronic devices, when applying the conventional aluminum electrolytic capacitor, there are some problems as follow.

Since the aluminum electrolytic capacitor uses the electrolyte, an electric conductive is comparatively low and thus a lifespan of the aluminum electrolytic capacitor is reduced in a high frequency area. Also, there are some constraints on improvement of reliability, a high frequency response, a low equivalent series resistance (ESR), and impedance. Also, due to comparatively high ripple pyrexia, there are some constraints on stability and environments, such as fuming and firing.

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#### [Disclosure]

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#### [Technical Problem]

The present invention is conceived to solve the above-described problems and thus provides a metal capacitor in which an electric conductivity is improved by about 10,000 to 1,000,000 folds by applying a metal material for an electrolyte, in comparison to when using a conventional electrolyte or an organic semiconductor, a multi-layer metal capacitor using the metal capacitor, and a manufacturing method thereof.

The present invention also provides a metal capacitor which can improve a miniaturization, a low equivalent series resistance (ESR), a reduction in ripple pyrexia, a long life, a heat-resistant stability, non-fuming, non-firing, and environment by using a metal material for an electrolyte, and a manufacturing method thereof.

#### [Technical Solution]

According to an aspect of the present invention, there is provided: a metal capacitor including: a metal member including a groove forming portion where a plurality of grooves is formed, an electrode withdrawing portion being formed on the groove forming portion, and a sealing portion; a metal oxide film being formed on the metal member; a plurality of seed electrode layers, each seed electrode layer being formed on the metal oxide film formed on the groove forming portion of the metal oxide; a plurality of main electrode layers being formed on the plurality of seed electrode layers to fill in the plurality of grooves formed on the groove forming portion of the metal member; an insulating layer being formed on the plurality of main electrode layers and the

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metal member to externally expose the electrode withdrawing portion of the metal member; a conductive connecting layer being formed on the plurality of main electrode layers and the insulating layer to face the electrode withdrawing portion of the metal member and connect the plurality of main electrode layers; a first lead terminal being connected to the electrode withdrawing portion of the metal member; a second lead terminal being connected to the main electrode layer; and a sealing member sealing the metal member connected to the first and the second lead terminals to externally expose the first and the second lead terminals.

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According to another aspect of the present invention, there is provided a method of forming a metal capacitor, including: forming a groove forming portion that includes a plurality of grooves on both surfaces to thereby form a metal member integrally formed with an electrode withdrawing portion and a sealing portion by using a direct current (DC) etching scheme; forming a metal oxide film on the metal member by using an anodizing scheme when the groove forming portion, the electrode withdrawing portion, and the sealing portion are integrally formed on the metal member; forming a plurality of seed electrode layers on the metal oxide layer formed in the groove forming portion to be penetrated into the metal oxide layer, when the metal oxide film is formed; forming a plurality of main electrode layers to fill in the plurality of grooves formed on the groove forming portion of the metal member by using the plurality of seed electrode layers as media, when the plurality of seed electrode layers is formed; forming an insulating layer on the plurality of main electrode layers and the metal member to externally expose the electrode withdrawing portion of the metal member by using a chemical vapor deposition (CVD) scheme, when the

plurality of main electrode layers is formed; forming a conductive connecting layer on the plurality of main electrode layers and the insulating layer to face the electrode withdrawing portion of the metal member in order to connect the plurality of main electrode layers, when the insulating layer is formed; connecting first and second lead terminals on the main electrode layers and the electrode withdrawing portion of the metal member, when the conductive connecting layer is formed; and sealing the metal member with a sealing member to externally expose the first and the second lead terminals, when the first and the second lead terminals are connected.

### [Advantageous Effects]

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According to the present invention, it is possible to improve an electric conductivity by about 10,000 to 1,000,000 folds by applying a metal material for an electrolyte, in comparison to when using a conventional electrolyte or an organic semiconductor. Also, since the serial multi-laying is possible, high-voltage is enabled. Also, since the polarity has no directivity, a relatively higher safety is provided. Also, it is possible to improve a miniaturization, a low equivalent series resistance (ESR), a reduction in ripple pyrexia, a long life, a heat-resistant stability, non-fuming, non-firing, and environment.

### [Description of Drawings]

- FIG. 1 is a perspective view of a metal capacitor according to a first embodiment of the present invention;
- FIG. 2 is a cross-sectional view cut along A1-A2 line of the metal capacitor shown in FIG. 1;
- FIG. 3 is a cross-sectional view cut along B1-B2 of the metal capacitor shown in FIG. 1;

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FIGS. 4A through 4G are cross-sectional views illustrating a method of manufacturing the metal capacitor according to the first embodiment of the present invention;

FIG. 5 is a cross-sectional view of a metal capacitor according to a second embodiment of the present invention; and

FIG. 6 is a cross-sectional view of a metal capacitor according to a third embodiment of the present invention.

#### [Best Mode]

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(First embodiment)

Hereinafter, a configuration of a metal capacitor according to a first embodiment of the present invention will be described with reference to FIGS. 1 through 3.

FIG. 1 is a perspective view of a metal capacitor 10 according to the first embodiment of the present invention, FIG. 2 is a cross-sectional view cut along A1-A2 line of the metal capacitor shown in FIG. 1, and FIG. 3 is a cross-sectional view cut along B1-B2 of the metal capacitor shown in FIG. 1. As shown in the figures, the metal capacitor 10 according to the first embodiment of the present invention includes a metal member 11, a metal oxide film 12, a plurality of seed electrode layers 13, a plurality of main electrode layers 14, an insulating layer 15, a conductive conducting layer 16, a first lead terminal 21, a second lead terminal 22, and a sealing member 30. Hereinafter, the configuration thereof will be sequentially described.

As shown in FIG. 4B, the metal member 11 is formed with a groove forming portion 11a that is provided by arranging a plurality of grooves 11d on its both surfaces. An electrode withdrawing portion 11b and a sealing portion

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11c are formed in one end and another end of the groove forming portion 11a. When the electrode withdrawing portion 11b is formed in the one end of the groove forming portion 11a and the sealing portion 11c is formed in the other end of the groove forming portion 11a to face the electrode withdrawing portion 11b. The groove forming portion 11a, and the electrode withdrawing portion 11b and the sealing portion 11c that are formed in the one end and the other end of the groove forming portion 11a are integrally formed on the metal member 11. The metal member where the groove forming portion 11a, the electrode withdrawing portion 11b, and the sealing portion 11c are integrally formed uses any one of aluminum (Al), niobium (Nb), tantalum (Ta), titanium (Ti), and zirconium (Zr). The plurality of grooves 11d that is formed in the groove forming portion 11a of the metal member 11 using various types of metal materials is formed in a cylindrical shape to readily form the grooves 11d.

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The metal oxide film 12 is formed on the metal member 11, and uses any one of alumina( $Al_2O_3$ ), oxide niobium( $Nb_2O_5$ ), monoxide niobium (NbO), oxide tantalum( $Ta_2O_5$ ), oxide titanium ( $TiO_2$ ), and oxide zirconium( $ZrO_2$ ) according to the material of the metal member 11. When forming the metal oxide film 12, the metal oxide film 12 is formed on the metal member 11, that is, on the whole surface of the metal member 11 that includes a surface where the grooves 11d are formed and a side 11e.

The plurality of seed electrode layers 13 is formed on the metal oxide film 12 that is formed in the groove forming portion 11a of the metal member 11, so that the main electrode layer 14 may be filled in the surface of the plurality of grooves 11d and be formed.

The plurality of main electrode layers 14 is formed on the plurality of

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seed electrode layers 13 formed on both surfaces of the groove forming portion 11a to fill in the plurality of grooves 11d formed on the groove forming portion 11a of the metal member 11.

The insulating layer 15 is formed on the side 11e of the metal member 11 and the plurality of main electrode layers 14 along the side 11e of the metal member 11 so that the electrode withdrawing portion 11b of the metal member may be externally exposed. The insulating layer 15 is formed on all the remaining side 11e of the metal member 11, excluding the surface where the plurality of grooves 11d is formed. In this instance, the electrode withdrawing portion 11b is formed to be externally exposed and the insulating layer 15 is formed of insulating tape or resin type material.

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The conductive connecting layer 16 is formed on the plurality of main electrode layers 14 and the insulating layer 15 to face the electrode withdrawing portion 11b of the metal member 11 and connect the plurality of main electrode layers 14. The conductive connecting layer 16 that is conductively connected to the plurality of main electrode layers 14 is formed on the opposite surface of the electrode withdrawing portion 11b to face the electrode withdrawing portion 11b.

Each of the conductive connecting layer 16 connecting the plurality of main electrode layers 14, the seed electrode layer 13, and the main electrode layer 14 uses any one of aluminum (Al), copper (Cu), zinc (Zn), silver (Ag), nickel (Ni), tin (Sn), indium (In), palladium (Pd), platinum (Pt), cobalt (Co), ruthenium (Ru), and gold (Au).

The first lead terminal 21 is connected to the electrode withdrawing portion 11b of the metal member 11. In this case, the first lead terminal 21

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may connect the electrode withdrawing portion 11b and the metal oxide film 12 formed on the electrode withdrawing portion 11b, or may connect the metal oxide film 12 and the electrode withdrawing portion 11b after removing a part to be connected to the first lead terminal 21. When the first lead terminal 21 is connected, the second lead terminal is connected to the main electrode layer 14. Through this, the non-polar metal capacitor 10 is constructed.

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In order to more readily connect the second lead terminal 22 to the main electrode layers 14, one of the main electrode layers 14 further include a conductive adhesive layer 17 for connecting the second lead terminal 22. The conductive adhesive layer 17 is formed using conductive epoxy or plating. The sealing member 30 seals the metal member 11 connected to the first and the second lead terminals 21 and 22, so that the first and the second lead terminals 21 and 22 may be externally exposed. The sealing member 30 uses EMC molding material or a cover member with an empty inside.

Hereinafter, a manufacturing method of the metal capacitor 10 according to the first embodiment will be described with reference to the accompanying drawings.

As shown in FIGS. 4A and 4B, when a member 1 such as film, foil, etc., of a metal material is provided, the groove forming portion 11a where the plurality of grooves 11d is arranged on both surfaces of the member 1 is formed and thereby the metal member 11 integrally formed with the electrode withdrawing portion 11b and the sealing portion 11c on one end and the other end is formed. The plurality of grooves 11d formed in the groove forming portion 11a is formed in the shape of a circle or a polygon and has a diameter of about 1 nm through about 100 µm. When the thickness of the metal member

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11 is 1  $\mu m$ , the depth of the metal member 11 is formed to be less than about 0.5  $\mu m$ . For example, when the thickness of the metal member 11 is 300  $\mu m$ , the depth of the metal member 11 is formed to be less than 150  $\mu m$ .

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As shown in FIG. 4C, when the groove forming portion 11a, the electrode withdrawing portion 11b, and the sealing portion 11c are integrally formed on the metal member 11, a forming process of forming the metal oxide film 12 on the metal member 11 by using an anodizing scheme is performed. As shown in FIG. 4D, when the metal oxide film 12 is formed, the plurality of seed electrode layers 13 is formed on the metal oxide film 12 that is formed in the groove forming portion 11a to be penetrated into the metal oxide film 12 by using an electroless plating or an electroplating. As shown in FIG. 4E, when the plurality of seed electrode layers 13 is formed, the plurality of main electrode layers 14 is formed to fill in the plurality of grooves 11d formed in the groove forming portion 11a by using the plurality of seed electrode layers 13 as media, by using the electroless plating or the electroplating.

As shown in FIGS. 4F and 4G, when the plurality of main electrode layers 14 is formed, a non-through type metal member 10a is formed by forming the insulating layer 15 on the plurality of main electrode layers 14 and the side 11e of the metal member 11 along the side 11e of the metal member 11 by using a CVD scheme, so that the electrode withdrawing portion 11b of the metal member 11 may be externally exposed. The insulating layer 15 is formed using an insulating tape or a resin material. As shown in FIG. 4H, when the insulating layer 15 is formed, a conductive connecting layer 16 is formed on the plurality of main electrode layers 14 and the insulating layer 15 to face the electrode withdrawing portion 11b of the metal member 11 in order

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to connect the plurality of main electrode layers 14. A process of forming a conductive adhesive layer on the main electrode layer 14 connected to the second lead terminal 22 in order to improve the adhesiveness of the first and the second lead terminals 21 and 22 is further provided between the process of forming the conductive connecting layer 14 and the process of connecting the first and the second lead terminals 21 and 22. The method of forming the conductive adhesive layer 17 uses any one of a scheme of spraying metal adhesives or solder paste, the electroplating, and the electroless plating.

As shown in FIG. 4H, when the conductive connecting layer 16 is formed, the first and the second lead terminals 21 and 22 are connected to the electrode withdrawing portion 11b of the metal member 11 and each of the main electrode layers 14a. As shown in FIG. 3, when the first and the second lead terminals 21 and 22 are connected, the metal member 11 is sealed with the sealing member 30 so that the first and the second lead terminals 21 and 22 may be externally exposed. When sealing the metal member 11 with the sealing member 30, the metal member 11 is sealed using molding material or a cover member with an empty inside.

#### (Embodiment 2)

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A metal capacitor 110 using the non-through type metal member 10a constituting the metal capacitor 10 according to the first embodiment of the present invention will be described with reference to the accompanying drawing.

As shown in FIG. 5, the metal capacitor 110 according to the second embodiment of the present invention includes a plurality of non-through type metal members 10a, a conductive adhesive layer 17, a third lead terminal 23, a

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fourth lead terminal 24, and a sealing member 30. Hereinafter, the configuration thereof will be sequentially described.

As shown in FIG. 4H, each of the plurality of non-through type metal members 10a includes the metal member 11, the metal oxide film 12, the plurality of seed electrode layers 13, the plurality of main electrode layers 14, the insulating layer 15, and the conductive connecting layer 16. The configuration thereof has been described above when describing the metal capacitor 10, and thus further detailed descriptions will be omitted here. As shown in FIG. 5, the plurality of non-through type metal members 10a is disposed in turn to make the electrode withdrawing portion 11b face one direction and another direction.

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The conductive adhesive layer 17 is disposed between the main electrode layers 14 of the plurality of non-through type metal members 10a and thereby adheres the plurality of non-through type metal members 10a where the electrode withdrawing portion 11b is disposed in turn to face the one direction and the other direction.

The third lead terminal 23 is connected to the electrode withdrawing portion 11b of the non-through type metal members 10a that faces one end, and the fourth lead terminal 24 is connected to the electrode withdrawing portion 11b of the non-through type metal members 10a that faces the other end. Through this, non-polar metal capacitor 110 is constructed. Specifically, since each of the third and the fourth lead terminals 23 and 24 is connected to the electrode withdrawing portion 11b of the metal member 11 formed with the metal oxide film 12 having the same polarity. Accordingly, the metal capacitor 110 is constructed to have the non-polarity.

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When the third and the fourth lead terminals 23 and 24 are connected, the sealing member 30 seals the plurality of non-through type metal members 10a so that the third and the fourth lead terminals 23 and 24 may be externally exposed.

#### (Embodiment 3)

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A polar metal capacitor 120 using the non-through type metal member 10a constituting the metal capacitor 10 according to the first embodiment of the present invention will be described with reference to the accompanying drawing.

As shown in FIG. 6, the meal capacitor 120 according to the third embodiment of the present invention includes a plurality of non-through type metal members 10a, a conductive adhesive layer 17, a first polar lead terminal 25, and a second polar lead terminal 26. Hereinafter, the configuration thereof will be sequentially described.

As shown in FIG. 4H, each of the plurality of non-through type metal members 10a includes the metal member 11, the metal oxide film 12, the plurality of seed electrode layers 13, the plurality of main electrode layers 14, the insulating layer 15, and the conductive connecting layer 16. The configuration thereof has been described above when describing the metal capacitor 10, and thus further detailed descriptions will be omitted here. As shown in FIG. 6, the plurality of non-through type metal members 10a is disposed to make the electrode withdrawing portion 11b face the same direction.

When the electrode withdrawing portions 11b of the plurality of nonthrough type metal members 10a are disposed to face the same direction, the

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conductive adhesive layer 17 is interposed between the main electrode layers 14 of the plurality of non-through type metal members 10a and thereby adheres the plurality of non-through type metal members 10a.

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The first polar lead terminal 25 is connected to the electrode withdrawing portions 11b of the plurality of non-through type metal members 10a and the second polar lead terminal 26 is connected to one of the main electrode layers 14 of the plurality of non-through type metal members 10a. Through this, the polar metal capacitor 120 is constructed. In this instance, the first polar lead terminal 25 is connected to the electrode withdrawing portion 11b of the metal member 11 that is formed on the metal oxide film 12 to be a positive electrode, and thus functions as an anode electrode. The second polar lead terminal 26 connected to the main electrode layer 14 not formed on the metal oxide film to be a negative electrode and thus functions as a cathode electrode.

The metal member 11 that includes the electrode withdrawing portion 11b connected to the first polar lead terminal 25 may function as the negative electrode. When the metal member 11 functions as the negative electrode, the main electrode layer 14 functions as the positive electrode. Accordingly, when the second polar lead terminal 26 is applied to the cathode electrode, the first polar lead terminal 25 is applied to the anode electrode. Conversely, when the second polar lead terminal 26 is applied to the anode electrode, the first polar lead terminal 25 is applied to the cathode electrode. Also, when the first polar lead terminal 25 is applied to the cathode electrode, the second polar lead terminal 26 is applied to the anode electrode, the second polar lead terminal 25 is applied to the anode electrode, the second polar lead terminal 25 is applied to the anode electrode, the second polar lead terminal 25 is applied to the anode electrode, the second polar

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lead terminal 26 is applied to the cathode electrode.

The conductive adhesive layer 17 is formed on the main electrode layer 14 connected with the second polar lead terminal 26 that functions as either the cathode electrode or the anode electrode. When the first and the second polar lead terminal 25 and 26 that function as the anode or the cathode electrode are connected, the sealing member 30 seals non-through type metal members 10a so that the first and the second polar lead terminal 25 and 26 may be externally exposed.

When constructing the metal capacitors 110 and 120 by disposing the metal capacitors 10, it is possible to obtain a metal capacitor with the high voltage and the high capacity.

# [Industrial Applicability]

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A metal capacitor according to the present invention may be applicable to a smoothing circuit of a power circuit, a noise filter, a bypass filter, and the like.

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#### [CLAIMS]

#### [Claim 1]

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A metal capacitor comprising:

a metal member comprising a groove forming portion where a plurality of grooves is formed, an electrode withdrawing portion formed on the groove forming portion, and a sealing portion;

a metal oxide film being formed on the metal member;

a plurality of main electrode layers, each main electrode layer being formed on the metal oxide film that is formed on the groove forming portion of the metal member;

an insulating layer being formed on the main electrode and the metal member to expose the electrode withdrawing portion of the metal member; and

a conductive connecting layer being formed on the plurality of main electrode layers and the insulating layer to face the electrode withdrawing portion of the metal member and connect the plurality of main electrode layers.

#### [Claim 2]

The metal capacitor of claim 1, wherein a lead terminal is connected to the electrode withdrawing portion of the metal member and each of the main electrode layers.

#### [Claim 3]

A metal capacitor comprising:

a metal member comprising a groove forming portion where a plurality of grooves is formed, an electrode withdrawing portion being formed on the groove forming portion, and a sealing portion;

a metal oxide film being formed on the metal member;

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a plurality of seed electrode layers, each seed electrode layer being formed on the metal oxide film formed on the groove forming portion of the metal oxide;

a plurality of main electrode layers being formed on the plurality of seed electrode layers to fill in the plurality of grooves formed on the groove forming portion of the metal member;

an insulating layer being formed on the plurality of main electrode layers and the metal member to externally expose the electrode withdrawing portion of the metal member;

a conductive connecting layer being formed on the plurality of main electrode layers and the insulating layer to face the electrode withdrawing portion of the metal member and connect the plurality of main electrode layers;

A first lead terminal being connected to the electrode withdrawing portion of the metal member;

a second lead terminal being connected to the main electrode layer; and a sealing member sealing the metal member connected to the first and the second lead terminals to externally expose the first and the second lead terminals.

#### 【Claim 4】

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The metal capacitor of claim 3, wherein the metal member is integrally formed with the groove forming portion that includes the plurality of grooves on both surfaces, the electrode withdrawing portion formed on the groove forming portion, and the sealing portion.

#### [Claim 5]

The metal capacitor of claim 3, wherein the metal member uses any one

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of aluminum (Al), niobium (Nb), tantalum (Ta), titanium (Ti), and zirconium (Zr).

#### [Claim 6]

The metal capacitor of claim 3, wherein the plurality of grooves formed in the groove forming portion of the metal member is formed in the shape of a circle or a polygon.

#### [Claim 7]

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The metal capacitor of claim 3, wherein the metal oxide film uses any one of alumina( $Al_2O_3$ ), oxide niobium( $Nb_2O_5$ ), monoxide niobium (NbO), oxide tantalum( $Ta_2O_5$ ), oxide titanium ( $TiO_2$ ), and oxide zirconium( $ZrO_2$ ).

#### [Claim 8]

The metal capacitor of claim 3, wherein each of the seed electrode layer, the main electrode layer, and the conductive connecting layer uses any one of aluminum (Al), copper (Cu), zinc (Zn), silver (Ag), nickel (Ni), tin (Sn), indium (In), palladium (Pd), platinum (Pt), cobalt (Co), ruthenium (Ru), and gold (Au).

## [Claim 9]

The metal capacitor of claim 3, wherein one of the plurality of main electrode layers further comprises a conductive adhesive layer for connecting the second lead terminal.

## [Claim 10]

The metal capacitor of claim 3, wherein the sealing member is sealed by molding material or a cover member with an empty inside, the sealing member seals the metal member in any one of a planar or cylindrical shape, and in the case of sealing the metal member in the cylindrical shape, winds the metal member and then seals the wound metal member.

#### [Claim 11]

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A metal capacitor comprising:

a plurality of non-through type metal members, each comprising: a metal member comprising a groove forming portion where a plurality of grooves is formed, an electrode withdrawing portion being formed on the groove forming portion, and a sealing portion; a metal oxide film being formed on the metal member; a plurality of seed electrode layers, each seed electrode layer being formed on the metal oxide film formed on the groove forming portion of the metal oxide; a plurality of main electrode layers being formed on the plurality of seed electrode layers to fill in the plurality of grooves formed on the groove forming portion of the metal member; an insulating layer being formed on the plurality of main electrode layer and the metal member to externally expose the electrode withdrawing portion of the metal member; and a conductive connecting layer being formed on the plurality of main electrode layers and the insulating layer to face the electrode withdrawing portion of the metal member and connect the plurality of main electrode layers, wherein the electrode withdrawing portions are disposed in turn to face one direction and another direction;

- a conductive adhesive layer being interposed between the main electrode layers of the plurality of non-through type metal members to adhere the plurality of non-through type metal members;
- a third lead terminal being connected to the electrode withdrawing portions of the plurality of non-through type metal members;
- a fourth lead terminal being connected to the electrode withdrawing portions of the plurality of non-through type metal members; and

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a sealing member sealing the plurality of non-through type metal members connected to the third and the fourth lead terminals to externally expose the third and the fourth lead terminals.

# [Claim 12]

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A metal capacitor comprising:

a plurality of non-through type metal members, each comprising: a metal member comprising a groove forming portion where a plurality of grooves is formed, an electrode withdrawing portion being formed on the groove forming portion, and a sealing portion; a metal oxide film being formed on the metal member; a plurality of seed electrode layers, each seed electrode layer being formed on the metal oxide film formed on the groove forming portion of the metal oxide; a plurality of main electrode layers being formed on the plurality of seed electrode layers to fill in the plurality of grooves formed on the groove forming portion of the metal member; an insulating layer being formed on the plurality of main electrode layer and the metal member to externally expose the electrode withdrawing portion of the metal member; and a conductive connecting layer being formed on the plurality of main electrode layers and the insulating layer to face the electrode withdrawing portion of the metal member and connect the plurality of main electrode layers, wherein the electrode withdrawing portions are disposed in turn to face the same direction;

a conductive adhesive layer being interposed between the main electrode layers of the plurality of non-through type metal members to adhere the plurality of non-through type metal members;

a first polar lead terminal being connected to the electrode withdrawing portions of the plurality of non-through type metal members;

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a second polar lead terminal being connected to one of the main electrode layers of the plurality of non-through type metal members; and

a sealing member sealing the plurality of non-through type metal members connected to the first and the second polar lead terminals to externally expose the first and the second polar lead terminals.

#### [Claim 13]

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The metal capacitor of claim 12, wherein the first polar lead terminal is applied to an anode electrode when the second polar lead terminal is applied to a cathode electrode, and the first polar lead terminal is applied to the cathode electrode when the second polar lead terminal is applied to the anode electrode.

#### [Claim 14]

The metal capacitor of claim 12, wherein the second polar lead terminal is applied to an anode electrode when the first polar lead terminal is applied to a cathode electrode, and the second polar lead terminal is applied to the cathode electrode when the first polar lead terminal is applied to the anode electrode.

#### [Claim 15]

The metal capacitor of claim 12, wherein one of the main electrode layers of the plurality of non-through type metal members connected to the second polar lead terminal further comprises a conductive adhesive layer.

#### [Claim 16]

A method of forming a metal capacitor, comprising:

forming a groove forming portion that includes a plurality of grooves on both surfaces to thereby form a metal member integrally formed with an electrode withdrawing portion and a sealing portion by using a direct current

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#### (DC) etching scheme;

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forming a metal oxide film on the metal member by using an anodizing scheme, when the groove forming portion, the electrode withdrawing portion, and the sealing portion are integrally formed on the metal member;

forming a main electrode layer on the metal oxide film to fill in the plurality of grooves formed in the groove forming portion of the metal member by using an electroless planting or an electroplating, when the metal oxide film is formed;

forming an insulating layer on the metal electrode layer and the metal member to externally expose the electrode withdrawing portion of the metal member by using a CVD scheme, when the main electrode layer is formed; and

forming the conductive connecting layer, connecting the plurality of main electrode layers to the plurality of main electrode layers and the insulating layer, to face the electrode withdrawing portion of the metal member, when the insulating layer is formed.

#### [Claim 17]

A method of forming a metal capacitor, comprising:

forming a groove forming portion that includes a plurality of grooves on both surfaces to thereby form a metal member integrally formed with an electrode withdrawing portion and a sealing portion by using a direct current (DC) etching scheme;

forming a metal oxide film on the metal member by using an anodizing scheme when the groove forming portion, the electrode withdrawing portion, and the sealing portion are integrally formed on the metal member;

forming a plurality of seed electrode layers on the metal oxide layer

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formed in the groove forming portion to be penetrated into the metal oxide layer by using an electroless plating or a electroplating, when the metal oxide film is formed;

forming a plurality of main electrode layers to fill in the plurality of grooves formed on the groove forming portion of the metal member by using the plurality of seed electrode layers as media, when the plurality of seed electrode layers is formed;

forming an insulating layer on the plurality of main electrode layers and the metal member to externally expose the electrode withdrawing portion of the metal member by using a chemical vapor deposition (CVD) scheme, when the plurality of main electrode layers is formed;

forming a conductive connecting layer on the plurality of main electrode layers and the insulating layer to face the electrode withdrawing portion of the metal member in order to connect the plurality of main electrode layers, when the insulating layer is formed;

connecting first and second lead terminals on the main electrode layers and the electrode withdrawing portion of the metal member, when the conductive connecting layer is formed; and

sealing the metal member with a sealing member to externally expose the first and the second lead terminals, when the first and the second lead terminals are connected.

#### [Claim 18]

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The method of claim 17, wherein each of the plurality of grooves formed in the groove forming portion while integrally forming the groove forming portion, the electrode withdrawing portion, and the sealing portion in

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one end and another end of the groove forming portion is formed in the shape of a circle or a polygon and has a diameter of about 1nm through about 100 µm.

## [Claim 19]

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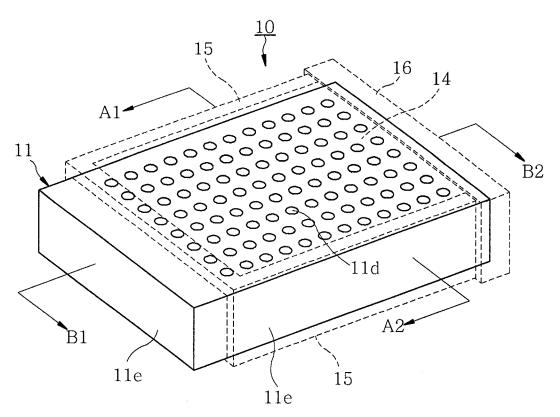
10

The method of claim 17, wherein forming a conductive adhesive layer on the main electrode layer connected to the second lead terminal in order to improve the adhesiveness of the first and the second lead terminals is further provided between the forming of the conductive connecting layer and the connecting of the first and the second lead terminals, and the forming of the conductive adhesive layer uses any one of a scheme of spraying metal adhesives or solder paste, an electroless plating, an electroplating.

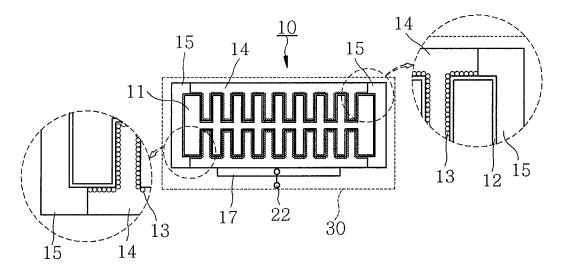
1/6

# [DRAWINGS]

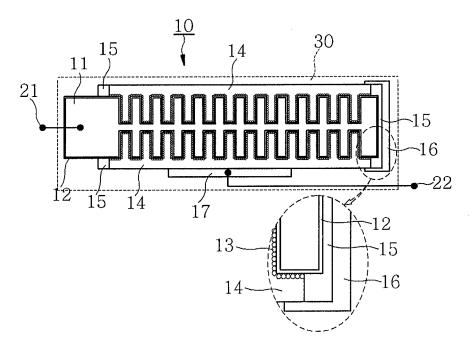
[Figure 1]



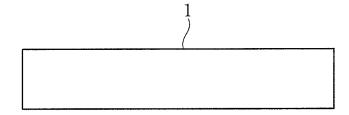
[Figure 2]



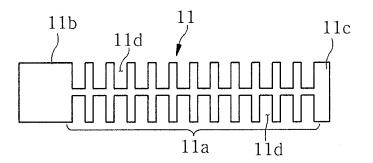
[Figure 3]



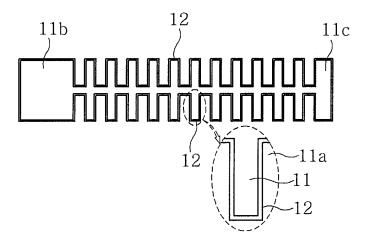
[Figure 4A]



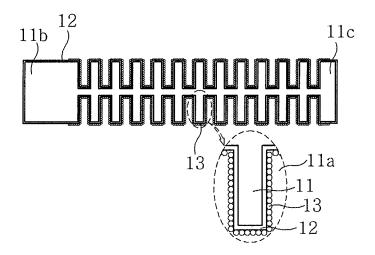
[Figure 4B]



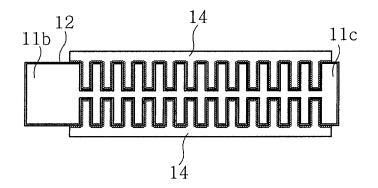
[Figure 4C]



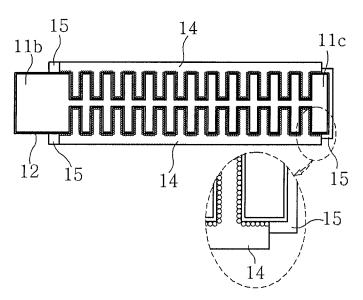
[Figure 4D]



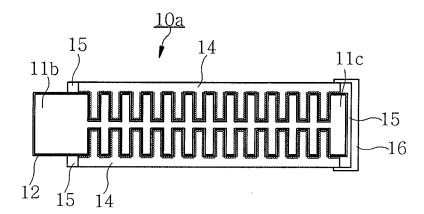
[Figure 4E]



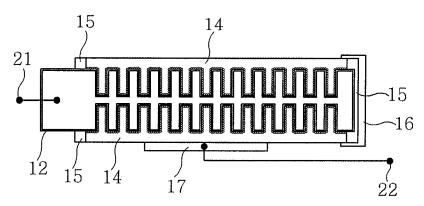
[Figure 4F]



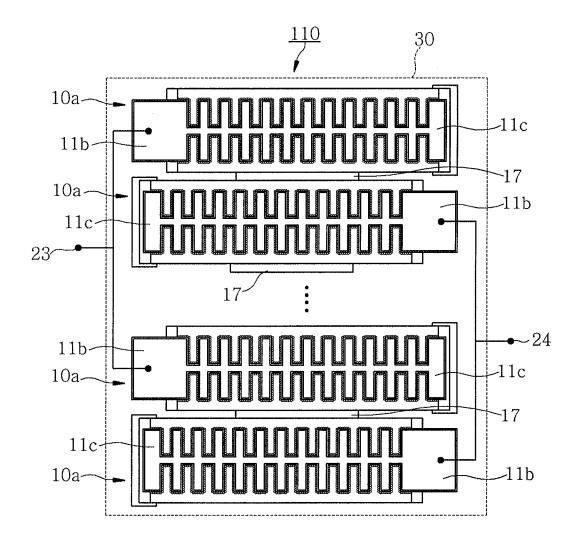
[Figure 4G]



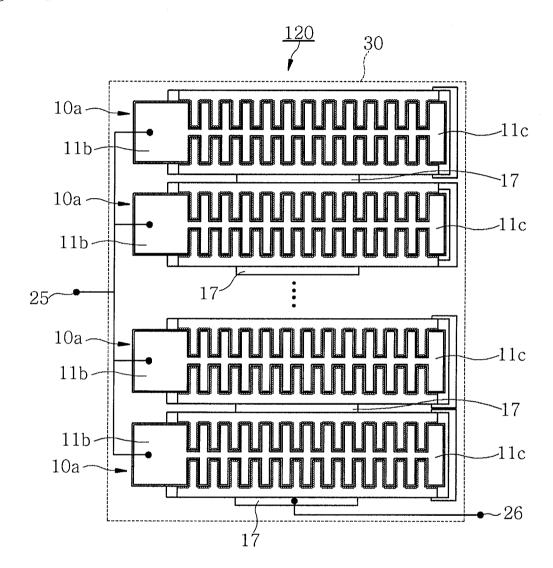
[Figure 4H]



[Figure 5]



[Figure 6]



International application No. **PCT/KR2008/000270** 

#### A. CLASSIFICATION OF SUBJECT MATTER

#### H01G 9/15(2006.01)i

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

#### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 8: H01G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Korean utility models and applications for utility model since 1975.

Korean utility models and applications for utility model since 1975.

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) eKIPASS(KIPO internal)

#### C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
А	US 6,934,143 B2( YOU-HUA CHOU ) 23 August 2005 See abstract and fig1A.	1-19
A	US 7,126,809 B2( OSAMU IIOKA et al. ) 24 October 2006 See abstract and fig5.	1-19
A	US 5,559,667 A( DA VID A. EVANS ) 24 September 1996 See abstract and fig9.	1-19

		Further	documents	are	listed	in	the	cont	inua	ıtion	of:	Box	C
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See patent family annex.

- \* Special categories of cited documents:
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- O" document referring to an oral disclosure, use, exhibition or other means
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- "&" document member of the same patent family

Date of mailing of the international search report

Date of the actual completion of the international search 26 JUNE 2008 (26.06.2008)

26 JUNE 2008 (26.06.2008)

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#### INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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