Appeal decision

Appeal No. 2018-12510

Appellant TAIYO YUDEN CO. LTD.

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The case of appeal against the examiner's decision of refusal of Japanese Patent Application No. 2015-18508, entitled "Multilayer capacitor and manufacturing method of the same", [the application published on Aug. 8, 2016: Japanese Unexamined Patent Application Publication No. 2016-143764] has resulted in the following appeal decision:

Conclusion

The appeal of the case was groundless.

Reason

No. 1 History of the procedures

The present application is an application filed on Feb. 2, 2015, and the history of the procedures thereof is shown as follows.

As of Dec. 27, 2017 : Notice of reasons for refusal
Mar. 2, 2018 : Submission of a written opinion and a written amendment
As of Jun. 22, 2018 : Decision of refusal
Sep. 19, 2018 : Submission of a written request for appeal and a written amendment
As of Aug. 20, 2019 : Notice of reasons for refusal
Oct. 23, 2019 : Submission of a written opinion and a written amendment
As of Nov. 11, 2019 : Notice of reasons for refusal
Dec. 27, 2019 : Submission of a written opinion and a written amendment

No. 2 The Invention

The invention according to Claim 1 of the scope of claims amended by the amendment as of Dec. 27, 2019 (hereinafter, referred to as "the Invention") is as follows.

"A multilayer capacitor, comprising:

an element body comprising: a plurality of first internal electrode layers and second internal electrode layers that contain Ni as a main component, contain metal of at least one of Pt, Ru, Rh, Re, Ir, Os, and Pd of 0.5 mol% or more and 5 mol% or less, and are arranged facing each other in a thickness direction; a plurality of dielectric layers that are made of dielectric material, and disposed between the plurality of internal electrode layers, respectively; a first side surface oriented in a direction orthogonal to the thickness direction, ends of the plurality of first internal electrode layers being exposed on the first side surface; and a second side surface oriented in a direction orthogonal to the thickness direction and in an opposing direction to the first side surface, ends of the plurality of second internal electrode layers being exposed on the second side surface;

a first external terminal that covers the first side surface, and is connected to the plurality of first internal electrode layers; and

a second external terminal that covers the second side surface, and is connected to the plurality of second internal electrode layers, wherein

each of the plurality of first internal electrode layers and the second internal electrode layers has a first thickness of 100 nm or more and 400 nm or less, and wherein

each of the plurality of dielectric layers has a second thickness that is 200 nm or more and 500 nm or less and is 1.2 times or more and 2 times or less that of the first thickness."

No. 3 Reasons for refusal

Reason 1 of the reasons for refusal by the body as of Nov. 11, 2019 is roughly as follows.

The inventions according to Claims 1 to 4 of this application are ones that could have been invented with ease by a person ordinarily skilled in the art in the technical field of the Invention before the application thereof, based on the inventions described in the following Cited Documents 1 and 2 distributed in Japan or abroad before the application, and, therefore, the Appellant should not be granted a patent for that in accordance with the provisions of Article 29(2) of the Patent Act.

Cited Document 1: Japanese Unexamined Patent Application Publication No. 2006-

319359

Cited Document 2: Japanese Unexamined Patent Application Publication No. 2011-108886

No. 4 Described matters in the Cited Documents and Cited Invention and the like

1 Cited Document 1

Cited Document 1 cited in the reasons for refusal as of Nov. 11, 2019 by the body (Japanese Unexamined Patent Application Publication No. 2006-319359) describes the following matters. Note that the underlines were applied by the body.

(1) "[0017]

The present invention has been made in view of such a situation, and the object thereof is to provide an electronic component such as a multilayer ceramic capacitor which can make it possible to suppress the grain growth of Ni particles in the firing stage, particularly when the thickness of the internal electrode layer is reduced; can effectively prevent the occurrence of spheroidization and electrode disconnection, cracks, and the like; and can effectively suppress a decrease in capacitance, and a method for manufacturing the same."

(2) "[0054]

First embodiment

First, an overall configuration of a multilayer ceramic capacitor will be described as an embodiment of an electronic component according to the present invention.

As shown in FIG. 1, the multilayer ceramic capacitor 2 according to the present embodiment includes a capacitor body (element body) 4, a first terminal electrode 6, and a second terminal electrode 8. The capacitor body 4 includes dielectric layers 10 and internal electrode layers 12, and the internal electrode layers 12 are alternately stacked between the dielectric layers 10. One internal electrode layer 12 that is alternately stacked is electrically connected to the inside of the first terminal electrode 6 that is formed outside the first end 4a of the capacitor body 4. Further, the other internal electrode layers 12 stacked alternately are electrically connected to the inside of the second terminal electrode 8 formed outside the second end 4b of the capacitor body 4.

[0055]

The internal electrode layers 12 are formed to include an alloy. The alloy constituting the internal electrode layers 12 has nickel (Ni) and at least one element selected from ruthenium (Ru), rhodium (Rh), rhenium (Re), and platinum (Pt). The content of Ni in the alloy is 80-100 mol% (excluding 100 mol%), preferably 87 to 100 mol% (excluding 100 mol%), more preferably 87-99.9 Mol%. The total content of Ru, Rh, Re, and Pt in the alloy is 0-20 mol% (excluding 0 mol%), preferably 0 to 13 mol% (excluding 0 mol%), more preferably 0.1-13 mol%. The ratio of each element of Ru, Rh, Re, and Pt is arbitrary. When the total content of Ru, Rh, Re, and Pt exceeds 20 mol%, there is a tendency for inconvenience, such as an increase in resistivity. In the alloy, various trace components such as S, P, and C may be contained in an amount of about 0.1 mol% or less. A preferred combination is any one of Ni-Rh, Ni-Re, and Ni-Pt.

[0056]

Although the internal electrode layers 12 are formed by, as will be described in detail later, transferring the internal electrode layer film 12a to a ceramic greensheet 10a as shown in FIGS. 2 and 3 and thus it is made of the same material as that of the internal electrode layer film 12a, its thickness is greater than that of the internal electrode layer film 12a, by the amount of horizontal shrinkage caused by firing. The thickness of each internal electrode layer 12 is preferably 0.1-1 μm.

[0057]

The material of the dielectric layers 10 is not particularly limited, and includes a dielectric material such as calcium titanate, strontium titanate and / or barium titanate. The thickness of each dielectric layer 10 is not particularly limited, but is generally several μm to several hundred μm. In particular, in this embodiment, the thickness is made thinner to the degree of preferably 5 μm or less, more preferably 3 μm or less."

(3) "[0066]

Next, separately from the carrier sheet 30, as shown in FIG. 2A, a carrier sheet 20 as a first support sheet is prepared, and a release layer 22 is formed thereon. Next, the internal electrode layer film 12a that will form the internal electrode layer 12 after firing is formed in a predetermined pattern on the surface of the release layer 22.

[0067]

The thickness of the formed internal electrode layer film 12a is preferably about 0.1-1 μm, more preferably about 0.1-0.5 μm. The internal electrode layer film 12a may be composed of a single layer, or may be composed of two or more layers having different compositions."

(4) "[0135]

Example 1

... Omitted ...

[0141]

Next, a mask on which a predetermined pattern for the internal electrode was formed was set on the surface of the release layer, and an internal electrode layer film (Ni alloy thin film) having a predetermined thickness (see each table) was formed by sputtering. As sputtering conditions, ultimate vacuum: 10-3 Pa or less, Ar gas introduction pressure: 0.5 Pa, output: 200 W, temperature: room temperature (20 degrees C) were set. Moreover, a sputtering target obtained by blending Ni and each additive element (Ru, Rh, Re, and Pt) into a predetermined composition as shown in each table, and cutting into a shape of about 4 inches in diameter and 3 mm in thickness, was used.

... Omitted ...

[0153]

The size of each sample thus obtained was 3.2 mm × 1.6 mm × 0.6 mm, the number of dielectric layers sandwiched between internal electrode layers was 21, the thickness of the dielectric layer was 1 μm, and the thickness of the internal electrode layer was 0.5 μm. Each sample was evaluated for electrical characteristics (capacitance C, resistivity, dielectric loss tan δ). The results are shown in the respective tables. The electrical characteristics (capacitance C, resistivity, dielectric loss tan δ) were evaluated as follows."

(5) "[0158]

[Table 1]

表1

	Ni mol%	Ru mol%	結晶子サイズ nm	X線ピーク強度比		静電容量 μF	抵抗率×10^{-8} Ω・m	tanσ	評価
				I(111)／I(200)	I(111)／I(220)				
比較例試料	100	0	68	3.3	1.9	0.88	6.8	0.01	×
実施例試料	99.95	0.05	65	3.2	4.0	0.90	7	0.01	○
実施例試料	99.9	0.1	65	3.2	4.0	1.00	7.5	0.01	○
実施例試料	99.5	0.5	66	3.4	4.5	1.01	7.8	0.01	○
実施例試料	99	1	67	3.4	4.6	1.05	8.2	0.01	○
実施例試料	98	2	63	3.3	4.7	1.07	8.5	0.01	○
実施例試料	97	3	65	3.2	7.7	1.11	8.9	0.01	○
実施例試料	95	5	65	3.1	5.0	1.17	9	0.02	○
実施例試料	89	11	63	3.1	6.0	1.18	22	0.03	○
実施例試料	80	20	64	3.1	6.0	1.18	26	0.08	○
比較例試料	70	30	67	3.0	8.0	1.16	75	0.2	×

合金膜の厚み＝0．3μm
焼成温度＝1200℃
焼成酸素分圧＝10^{-7}Pa
アニール温度＝1050℃
アニール時間＝2時間
アニール酸素分圧＝10^{-1}Pa

表１　Table 1

比較例試料　Comparison example sample

実施例試料　Example sample

結晶子サイズ　Crystallite size

X線ピーク強度比 X-ray peak intensity ratio

静電容量　Capacitance

抵抗率　Resistivity

評価　Evaluation

合金膜の厚み　Alloy film thickness

焼成温度　Burning temperature

焼成酸素分圧　Burning oxygen partial pressure

アニール温度　Annealing temperature

アニール時間＝２時間　Annealing time = 2 hours

アニール酸素分圧　Annealing oxygen partial pressure

[0159]

[Table 2]

表2

	Ni mol%	Rh mol%	結晶子ｻｲｽﾞ nm	X線ﾋﾟｰｸ強度比 I(111)／I(200)	X線ﾋﾟｰｸ強度比 I(111)／I(220)	静電容量 μF	抵抗率×10^{-8} Ω・m	tanσ	評価
比較例試料	100	0	68	3.3	1.9	0.88	6.8	0.01	×
実施例試料	99.95	0.05	67	3.3	3.0	0.93	7	0.01	○
実施例試料	99.9	0.1	68	3.3	3.0	1	7.3	0.01	○
実施例試料	99.5	0.5	65	3.5	3.5	1.02	7.4	0.01	○
実施例試料	99	1	65	3.5	3.5	1.07	7.6	0.01	○
実施例試料	98	2	64	3.5	3.7	1.09	7.6	0.01	○
実施例試料	97	3	63	3.8	3.9	1.12	7.6	0.01	○
実施例試料	94	6	60	4.2	4.0	1.15	7.8	0.01	○
実施例試料	92	8	58	4.9	4.4	1.15	14	0.01	○
実施例試料	80	20	59	5.2	4.4	1.16	23	0.07	○
比較例試料	70	30	59	5	5.1	1.16	79	0.19	×

合金膜の厚み＝0．3μm
焼成温度＝1200℃
焼成酸素分圧＝10^{-7}Pa
アニール温度＝1050℃
アニール時間＝2時間
アニール酸素分圧＝10^{-1}Pa

表２　　Table 2

比較例試料　　Comparison example sample

実施例試料　　Example sample

結晶子サイズ　　Crystallite size

X線ピーク強度比 X-ray peak intensity ratio

静電容量　　Capacitance

抵抗率　Resistivity

評価　Evaluation

合金膜の厚み　　Alloy film thickness

焼成温度　　Burning temperature

焼成酸素分圧　　Burning oxygen partial pressure

アニール温度　　Annealing temperature

アニール時間＝２時間　　Annealing time = 2 hours

アニール酸素分圧　　Annealing oxygen partial pressure

[0160]

[Table 3]

表3

	Ni mol%	Re mol%	結晶子サイズ nm	X線ピーク強度比		静電容量 μF	抵抗率×10^{-8} Ω・m	tanσ	評価
				I(111)／I(200)	I(111)／I(220)				
比較例試料	100	0	68	3.3	1.9	0.88	6.8	0.01	×
実施例試料	99.95	0.05	67	3.4	3.5	0.92	7	0.01	○
実施例試料	99.9	0.1	65	3.6	4.0	1.03	7.5	0.01	○
実施例試料	99.5	0.5	64	3.7	4.2	1.05	7.7	0.01	○
実施例試料	99	1	68	4.0	5.5	1.06	8	0.01	○
実施例試料	98	2	66	5.2	6.5	1.09	8.9	0.01	○
実施例試料	97	3	66	5.7	7.1	1.13	11.5	0.02	○
実施例試料	94	6	67	6.1	7.9	1.16	13	0.02	○
実施例試料	89	11	64	14	66	1.16	25	0.02	○
実施例試料	80	20	62	15	64	1.17	29	0.07	○
比較例試料	70	30	60	14	70	1.16	85	0.19	×

合金膜の厚み＝0．3μm
焼成温度＝1200℃
焼成酸素分圧＝10^{-7}Pa
アニール温度＝1050℃
アニール時間＝2時間
アニール酸素分圧＝10^{-1}Pa

表３　Table 3

比較例試料　Comparison example sample

実施例試料　Example sample

結晶子サイズ　Crystallite size

X線ピーク強度比 X-ray peak intensity ratio

静電容量　Capacitance

抵抗率　Resistivity

評価　Evaluation

合金膜の厚み　Alloy film thickness

焼成温度　Burning temperature

焼成酸素分圧　Burning oxygen partial pressure

アニール温度　Annealing temperature

アニール時間＝２時間　Annealing time = 2 hours

アニール酸素分圧　Annealing oxygen partial pressure

[0161]

[Table 4]

表4

	Ni mol%	Pt mol%	結晶子サイズ nm	X線ピーク強度比 I(111)／I(200)	I(111)／I(220)	静電容量 μF	抵抗率×10^{-8} Ω・m	tanσ	評価
比較例試料	100	0	68	3.3	1.9	0.88	6.8	0.01	×
実施例試料	99.95	0.05	63	3.3	4.3	1	7.1	0.01	○
実施例試料	99.9	0.1	65	3.3	4.3	1.05	7.5	0.01	○
実施例試料	99.5	0.5	67	3.4	4.6	1.06	7.5	0.01	○
実施例試料	99	1	68	3.4	4.7	1.07	7.5	0.01	○
実施例試料	98	2	67	3.6	4.7	1.1	8	0.01	○
実施例試料	97	3	66	3.6	4.7	1.11	8.5	0.02	○
実施例試料	94	6	64	3.7	4.7	1.15	9.5	0.02	○
実施例試料	89	11	64	3.8	5.2	1.16	13.6	0.03	○
実施例試料	80	20	65	3.9	5.5	1.16	20.5	0.05	○
比較例試料	70	30	69	4.5	7	1.14	71	0.18	×

合金膜の厚み＝0．3μm
焼成温度＝1200℃
焼成酸素分圧＝10^{-7}Pa
アニール温度＝1050℃
アニール時間＝2時間
アニール酸素分圧＝10^{-1}Pa

表４　Table 4

比較例試料　Comparison example sample

実施例試料　Example sample

結晶子サイズ　Crystallite size

X線ピーク強度比 X-ray peak intensity ratio

静電容量　Capacitance

抵抗率　Resistivity

評価　Evaluation

合金膜の厚み　Alloy film thickness

焼成温度　Burning temperature

焼成酸素分圧　Burning oxygen partial pressure

アニール温度　Annealing temperature

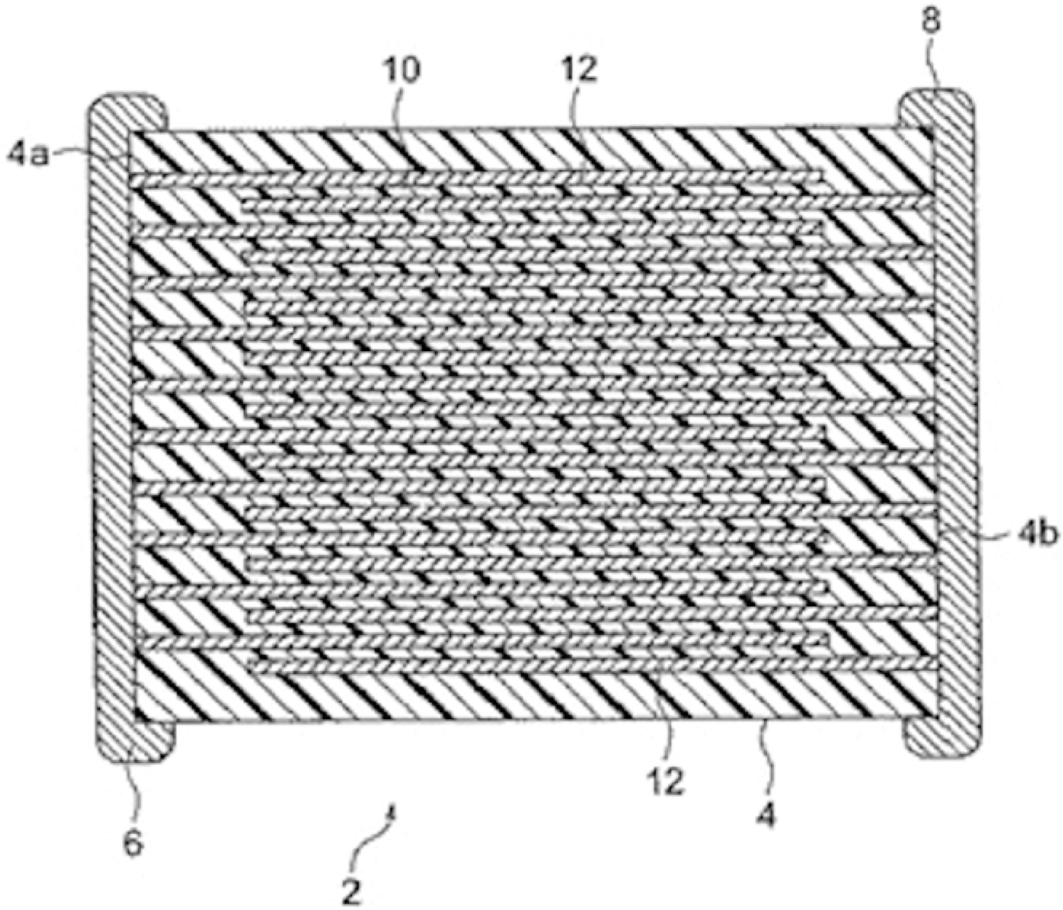
アニール時間＝２時間　Annealing time = 2 hours

アニール酸素分圧　Annealing oxygen partial pressure

"

(6) "[FIG. 1]

FIG. 1



"

· According to the descriptions of paragraph [0054], the multilayer ceramic capacitor 2 has the capacitor body (element body) 4, the first terminal electrode 6, and the second terminal electrode 8.

· According to descriptions of paragraph [0057], the dielectric layers 10 are constituted of a dielectric material such as barium titanate or the like.

According to descriptions of paragraph [0141] and [Table 1]-[Table 4], a film for an internal electrode is formed by a sputtering method using a sputtering target blended into the composition of NiRu including Ru of 0.5-5 mol%, NiRh including Rh of 0.5-3 mol%, NiRe including Re of 0.5-3 mol%, or NiPt including Pt of 0.5-3 mol%, and, according to paragraph [0066], the internal electrode layers 12 are composed by burning the film for an internal electrode. In view of the above, the internal electrode layers 12 are of the composition of NiRu including Ru of 0.5-5 mol%, NiRh including Rh of 0.5-3 mol%, NiRe including Re of 0.5-3 mol%, or NiPt including Pt of 0.5-3 mol%.

Furthermore, according to descriptions of paragraph [0054], the capacitor body 4 has the dielectric layers 10 and the internal electrode layers 12, and, between the dielectric layers 10, these internal electrode layers 12 are stacked alternately.

Therefore, the capacitor body 4 has the dielectric layers 10 constituted of a dielectric material such as barium titanate, and the internal electrode layers 12 of the composition of NiRu including Ru of 0.5-5 mol%, NiRh including Rh of 0.5-3 mol%, NiRe including Re of 0.5-3 mol%, or NiPt including Pt of 0.5-3 mol%, and, between the dielectric layers 10, these internal electrode layers 12 are stacked alternately.

· According to descriptions of paragraph [0054], one internal electrode layer 12 stacked alternately is electrically connected to the inside of the first terminal electrode 6 formed outside the first end 4a of the capacitor body 4, and, in addition, the other internal electrode layer 12 stacked alternately is electrically connected to the inside of the second terminal electrode 8 formed outside the second end 4b of the capacitor body 4.

According to [FIG. 1], the first end 4a is a side surface in a direction orthogonal to the lamination direction, and the second end 4b is a side surface in a direction that is orthogonal to the lamination direction and in a direction opposite to the side surface of the first end 4a. In addition, according to [FIG. 1], the first terminal electrode 6 is formed so as to cover the first end 4a, and the second terminal electrode 8 is formed so as to cover the second end 4b.

Therefore, one internal electrode layer 12 stacked alternately is electrically connected to the inside of the first terminal electrode 6 formed so as to cover the first end 4a, which is a side surface of the capacitor body 4 in a direction orthogonal to the lamination direction, outside the first end 4a, and, in addition, the other internal electrode layers 12 stacked alternately are electrically connected to the inside of the second terminal electrode 8 formed so as to cover the second end 4b, which is a side surface of the capacitor body 4 in a direction orthogonal to the lamination direction and in a direction opposite to the side surface of the first end 4a, outside the second end 4b.

· According to paragraph [0153], the thickness of the dielectric layer sandwiched between the internal electrode layers is 1 μm, and the thickness of the internal electrode layer is 0.5 μm.

From the above, in Cited Document 1, as a multilayer ceramic capacitor, there is described the following invention (hereinafter, referred to as "Cited Invention").

[Cited Invention]
"A multilayer ceramic capacitor 2, comprising:

a capacitor body (element body) 4, a first terminal electrode 6, and a second terminal electrode 8, wherein

the capacitor body 4 has dielectric layers 10 constituted of a dielectric material such as barium titanate, and internal electrode layers 12 of composition of NiRu including Ru of 0.5-5 mol%, NiRh including Rh of 0.5-3 mol%, NiRe including Re of 0.5-3 mol%, or NiPt including Pt of 0.5-3 mol%, and, between the dielectric layers 10, these internal electrode layers 12 are stacked alternately, wherein

one internal electrode layer 12 stacked alternately is electrically connected to the inside of the first terminal electrode 6 formed so as to cover the first end 4a, which is a side surface of the capacitor body 4 in a direction orthogonal to the lamination direction, outside the first end 4a, and, in addition, the other internal electrode layer 12 stacked alternately is electrically connected to the inside of the second terminal electrode 8 formed so as to cover the second end 4b, which is a side surface of the capacitor body 4 in a direction orthogonal to the lamination direction and in a direction opposite to the side surface of the first end 4a, outside the second end 4b, and wherein

the thickness of the dielectric layer sandwiched between the internal electrode layers is 1 μm, and the thickness of the internal electrode layer is 0.5 μm."

2 Cited Document 2

Cited Document 2 (Japanese Unexamined Patent Application Publication No. 2011-108886) cited in the reasons for refusal as of Nov. 11, 2019 by the body describes the following matters. Note that the underlines were applied by the body.

(1) "[0016]

In addition, <u>the thin film capacitor 100 includes a laminated body constituted of the base electrode 2, the dielectric layer 4, the internal electrode 8, the dielectric layer 6, and the upper electrode 10</u>, and the insulating cover layer 14 that fills a space between a pair of the terminal electrodes 12a and 12b. Furthermore, the thin film capacitor 100 includes an insulating protective layer 18 that covers the space between the terminal electrodes 12a and 12b and the cover layer 14. Hereinafter, each part which constitutes the thin film capacitor 100 will be described."

(2) "[0019]

The dielectric layers 4 and 6 are made of a perovskite-based dielectric material. Here, the perovskite-based dielectric material in the present embodiment includes a (ferro) dielectric material having a perovskite structure such as $BaTiO_3$ (barium titanate), $(Ba_{1-x}Sr_x)$ TiO_3 (barium strontium titanate), $(Ba_{1-x}Ca_x)$ TiO_3, $PbTiO_3$, or $Pb(Zr_xTi_{1-x})O_3$, and a composite perovskite relaxer type ferroelectric material represented by $Pb(Mg_{1/3}Nb_{2/3})O_3$, and the like. Here, in the above-described perovskite structure and perovskite relaxer type ferroelectric material, the ratio of A site to B site is usually an integer ratio, but may be purposefully shifted from the integer ratio in order to improve characteristics. In order to control the characteristics of the dielectric layers 4 and 6, the dielectric layers 4 and 6 may appropriately contain additive substances as subcomponents.

[0020]

The thickness of each of the dielectric layers 4 and 6 is 50-1000 nm.

[0021]

Also, each of the dielectric layer 4 sandwiched between the base electrode 2 (lower electrode) and the internal electrode 8 (upper electrode), and the dielectric layer 6 sandwiched between the internal electrode 8 (lower electrode) and the upper electrode 10 (upper electrode) has a hexagonal crystal structure.

[0022]

Next, the internal electrode 8 provided between the dielectric layers 4 and 6, and the upper electrode 10 will be described. The internal electrode 8 and the upper electrode 10 are made of a conductive material. Specifically, the conductive metal may be an alloy or an intermetallic compound containing nickel (Ni) as a main component, and further containing at least one member selected from the group consisting of platinum (Pt), palladium (Pd), iridium (Ir), rhodium (Rh), ruthenium (Ru), osmium (Os), rhenium (Re), tungsten (W), chromium (Cr), tantalum (Ta), silver (Ag), and copper (Cu) (hereinafter referred to as "additive element"). When a material containing Ni as a main component is used for the internal electrode 8 and the upper electrode 10, the content is preferably 50 mol% or more with respect to the entirety of the internal electrode 8 and the upper electrode 10. When the internal electrode 8 and the upper electrode 10 contain the additive element, the internal electrode 8 and the upper electrode 10 are prevented from being interrupted. The internal electrode 8 and the upper electrode 10 may contain a plurality of types of additive elements. In the

thin film capacitor 100 of this embodiment, the internal electrode 8 and the upper electrode 10 are formed of the same material, but may be formed of different conductive materials.
[0023]
The thicknesses of the internal electrode 8 and the upper electrode 10 are preferably 50 to 1000 nm. When the internal electrode 8 and the upper electrode 10 are thinner than 50 nm, the content of carbon in the dielectric layers 4 and 6 provided on the lower side in the stacking direction of the internal electrode 8 and the upper electrode 10 decreases during firing in the method of fabricating the thin film capacitor 100 described later, making it difficult to produce the dielectric layers 4 and 6 having a hexagonal crystal structure. Further, when the thicknesses of the internal electrode 8 and the upper electrode 10 are thicker than 1000 nm, there is a problem that the dielectric layers 4 and 6 provided on the lower side in the stacking direction of each layer cannot be sufficiently fired."

(3) "[0077]
[Study 5]
Next, a plurality of types of capacitor structures were fabricated using the same method as in Study 1-2 except that the thicknesses of the internal electrode and the upper electrode were varied, and conditions under which a dielectric layer having a hexagonal crystal structure is formed were studied.
[0078]
Specifically, as in Study 1-2, after preparing a metal foil to be a base electrode, the dielectric film formation (S01), calcination (S02), and electrode layer formation (S03) were repeated twice, and formation of a cover precursor layer was performed (S04), and, subsequently, this was fired to produce a capacitor structure. At this time, eight types of capacitor structures having the thicknesses of the internal electrode and the upper electrode of 35, 50, 100, 200, 500, 800, 1000, and 1200 nm, respectively (the thicknesses of the internal electrode and the upper electrode are supposed to be the same) were fabricated. Application of the solution was performed so that the dielectric layer and the cover layer had a thickness of 400 nm. In addition, the fabrication conditions other than the thicknesses of the internal electrode and the upper electrode were the same as those in Study 1-2, calcination was performed in the atmosphere at 400°C. for 10 minutes, and firing was performed in a vacuum at 750°C. for 30 minutes.
[0079]
Cross-sectional TEM images of the dielectric layer between the internal

electrode and the upper electrode in the eight types of capacitor structures having different thicknesses of the internal electrode and the upper electrode obtained by the above method were photographed to confirm the crystal system. In addition, the presence or absence of interruption of the internal electrode and the upper electrode was observed. The results are shown in Table 4.

[0080]

[Table 4]

内部電極及び上部電極の厚さ(nm)	誘電体層の結晶系	電極の途切れ
35	六方晶系	あり
50	六方晶系	なし
100	六方晶系	なし
200	六方晶系	なし
500	六方晶系	なし
800	六方晶系	なし
1000	六方晶系	なし
1200	六方晶系(アモルファスが混合)	なし

内部電極及び上部電極の厚さ(nm) Thickness of internal electrode and upper electrode (nm)

誘電体層の結晶系 Crystal system of dielectric layer

電極の途切れ Electrode interruption

六方晶系 Hexagonal system

（アモルファスが混合） (amorphous portions are mixed)

あり Existing

なし Not existing

"

· According to the descriptions of paragraph [0016], the thin film capacitor 100 is one that includes a laminated body constituted of the base electrode 2, the dielectric layer 4, the internal electrode 8, the dielectric layer 6, and the upper electrode 10.

· According to the descriptions of paragraphs [0019] and [0078], the dielectric layers 4 and 6 are made of a dielectric material of $BaTiO_3$ (barium titanate), and have thicknesses of 400 nm.

· According to the descriptions of paragraphs [0022] and [0078], the internal electrode 8 is made of an alloy containing nickel (Ni) as a main component, and further containing at least one member selected from the group consisting of platinum (Pt), palladium (Pd), iridium (Ir), rhodium (Rh), ruthenium (Ru), osmium (Os), and rhenium (Re), and has a thickness of 100 nm or 200 nm.

According to the above-mentioned descriptions, in Cited Document 2, there is described the following technology (hereinafter, referred to as "Technology Described in Cited Document 2").

[Technology Described in Cited Document 2]
A technology in which "in the thin film capacitor 100 including a laminated body constituted of the base electrode 2, the dielectric layer 4, the internal electrode 8, the dielectric layer 6, and the upper electrode 10, the dielectric layers 4 and 6 are made of a dielectric material of $BaTiO_3$ (barium titanate) and have a thickness of 400 nm, and the internal electrode 8 is made of an alloy containing nickel (Ni) as a main component, and further containing at least one member selected from the group consisting of platinum (Pt), palladium (Pd), iridium (Ir), rhodium (Rh), ruthenium (Ru), osmium (Os), and rhenium (Re), the internal electrode 8 having the thickness of 100 nm or 200 nm".

No. 5 Comparison between the Invention and Cited Invention
1 According to the descriptions of FIG. 1 and paragraph [0017] of the description of the present application, it can be said that the "thickness direction" of the Invention is a lamination direction of the internal electrode layers.

In view of the above, "the internal electrode layers 12 of composition of NiRu including Ru of 0.5-5 mol%, NiRh including Rh of 0.5-3 mol%, NiRe including Re of 0.5-3 mol%, or NiPt including Pt of 0.5-3 mol%" of Cited Invention correspond to "a plurality of first internal electrode layers and second internal electrode layers that" "contain Ni as a main component, contain metal of at least one of Pt, Ru, Rh, and Re" "of 0.5 mol% or more and 5 mol% or less, and are arranged facing each other in a thickness direction" of the Invention.

2 "The dielectric layers 10" "constituted of a dielectric material such as barium titanate" and with respect to which "the internal electrode layers 12 are stacked alternately" of

Cited Invention correspond to "a plurality of dielectric layers that are made of dielectric material, and are disposed between the internal electrode layers, respectively" of the Invention.

3 In Cited Invention, since "one internal electrode layer 12 stacked alternately is electrically connected to the inside of the first terminal electrode 6 formed so as to cover the first end 4a, which is a side surface of the capacitor body 4 in a direction orthogonal to the lamination direction, outside the first end 4a", it is obvious that an end of "one internal electrode layer 12" is exposed at "the first end 4a" of "the capacitor body 4".

In view of the above, "one internal electrode layer 12" of Cited Invention corresponds to "the first internal electrode layer" of the Invention, and "the first end 4a" of Cited Invention corresponds to "a first side surface oriented in a direction orthogonal to the thickness direction, ends of the plurality of first internal electrode layers being exposed on the first side surface" of the Invention.

In a similar fashion, "the other internal electrode layer 12" of Cited Invention corresponds to "the second internal electrode layer" of the Invention, and "the second end 4b" of Cited Invention corresponds to "a second side surface oriented in a direction orthogonal to the thickness direction and in an opposing direction to the first side surface, ends of the plurality of second internal electrode layers being exposed on the second side surface" of the Invention.

4 According to the above-mentioned 1 to 3, since "the capacitor body (element body) 4" of Cited Invention has "the first internal electrode layers and the second internal electrode layers", "the dielectric layers", "the first side surface", and "the second side surface" referred to in the Invention, it corresponds to "element body" of the Invention.

5 Since "the first terminal electrode 6" of Cited Invention is one that "covers the first end 4a", and "is electrically connected to" "one internal electrode layer 12", it corresponds to "a first external terminal that covers the first side surface, and is connected to the plurality of first internal electrode layers" of the Invention.

Similarly, "the second terminal electrode 8" of Cited Invention "covers the second end 4b", and "is electrically connected" to "the other internal electrode layer 12", and thus it corresponds to "a second external terminal that covers the second side surface, and is connected to the plurality of second internal electrode layers" of the Invention.

6 The Invention is one in which "each of the plurality of first internal electrode layers and the second internal electrode layers has a first thickness of 100 nm or more and 400 nm or less, and wherein each of the plurality of dielectric layers has a second thickness that is 200 nm or more and 500 nm or less and is 1.2 times or more and 2 times or less the first thickness", whereas, Cited Invention is different in a point that, although the thickness of the dielectric layer is greater than the thickness of the internal electrode layer (two times), "the thickness of the dielectric layer is 1 μm, and the thickness of the internal electrode layer is 0.5 μm".

7 According to the above-mentioned 1 to 5, "the multilayer ceramic capacitor 2" of Cited Invention has "the element body", "the first external terminal", and "the second external terminal" referred to in the Invention, and corresponds to "multilayer capacitor" of the Invention.

Therefore, it can be said that there are the following corresponding feature and different feature between the Invention and Cited Invention.

<Corresponding Feature>

"A multilayer capacitor, comprising:

an element body comprising: a plurality of first internal electrode layers and second internal electrode layers that contain Ni as a main component, contain metal of at least one kind of Pt, Ru, Rh, and Re of 0.5 mol% or more and 5 mol% or less, and are arranged facing each other in a thickness direction; a plurality of dielectric layers that are made of dielectric material, and disposed between the plurality of internal electrode layers, respectively; a first side surface oriented in a direction orthogonal to the thickness direction, ends of the plurality of first internal electrode layers being exposed on the first side surface; and a second side surface oriented in a direction orthogonal to the thickness direction and in an opposing direction to the first side surface, ends of the plurality of second internal electrode layers being exposed on the second side surface;

a first external terminal that covers the first side surface, and is connected to the plurality of first internal electrode layers; and

a second external terminal that covers the second side surface, and is connected to the plurality of second internal electrode layers."

<Different Feature>

The Invention is limited to "each of the plurality of first internal electrode layers and the second internal electrode layers has a first thickness of 100 nm or more and 400 nm or less, and wherein each of the plurality of dielectric layers has a second thickness that is 200 nm or more and 500 nm or less and is 1.2 times or more and 2 times or less the first thickness", whereas, in Cited Invention, although the thickness of the dielectric layer is greater than the thickness of the internal electrode layer (two times), "the thickness of the dielectric layer is 1 μm, and the thickness of the internal electrode layer is 0.5 μm".

No. 6 Judgment

1 Regarding <Different Feature>

It is described in paragraph [0057] of Cited Document 1 that "The thickness of each dielectric layer is made thinner to the degree of ..., more preferably 3 μm or less.", and in paragraph [0067] that "The thickness of the formed internal electrode layer film 12a is ... more preferably about 0.1 to 0.5 μm.", and thus the thickness of the dielectric layer of Cited Invention can be changed accordingly to a value of 3 μm or less, and the thickness of the internal electrode layer to a value of 0.1-0.5 μm.

In view of the above, since the technology described in Cited Document 2 (to make the thickness of the dielectric layer be 400 nm, and the thickness of the internal electrode be 100 nm or 200 nm) relates to a capacitor including a laminated body constituted of dielectric layers and an internal electrode made of materials similar to those of Cited Invention, it would have been achieved by a person skilled in the art with ease to make, by applying the technology described in Cited Document 2 to the Cited Invention, the dielectric layer have the thickness of 400 nm (0.4 μm), and the internal electrode layer have the thickness of 100 nm or 200 nm (0.1 μm or 0.2 μm).

In addition, as described above, since the thickness of dielectric layer and the thickness of the internal electrode layer can be selected to be 400 nm (0.4 μm) and 200 nm (0.2 μm), respectively, it would have been achieved by a person skilled in the art with ease to make "the second thickness (the thickness of the dielectric layer)" be in the range of "1.2 times or more and 2 times or less the first thickness (the thickness of the internal electrode layer)".

Note that, in the description of the present application, it is only described in paragraph [0031] that "by making the first thickness and the second thickness be in the numerical value ranges described above, the multilayer capacitor can be miniaturized." and the like, and, therefore, no critical significance can be acknowledged in the ranges of the first thickness (100 nm or more and 400 nm or less) and the second thickness (200 nm or more and 500 nm or less).

In addition, in paragraph [0031] of the description of the present application, it is described that "By making the first thickness and the second thickness be in the numerical value ranges described above, the multilayer capacitor can be miniaturized. In addition, by making the second thickness be thicker than the first thickness, ... cracking and delamination can be prevented. Further, by making the second thickness be 1.2 times or more and 5 times or less the first thickness, cracking and delamination can be prevented more effectively.", and, as Test Example 1, it is described that when the second thickness was made to be 500 nm, when a value of "second thickness/the first thickness" was 1.2 to 5, no occurrence of any of cracking and delamination was observed ([Table 1]), and, as Test Example 2, that, when the second thickness was made to be 500 nm and the first thickness was 50 nm or more and 400 nm or less, no occurrence of any of cracking and delamination was observed ([Table 2]). From these descriptions, the effect to prevent cracking and delamination is one that can be obtained if the thickness of the dielectric layer (the second thickness) is greater than the thickness of the internal electrode layer (the first thickness), and thus critical significance cannot be acknowledged in making "the second thickness" be in the range of "1.2 times or more and 2 times or less the first thickness".

According to the above, it is recognized that it would have been achieved by a person skilled in the art with ease to obtain the constitution of the Invention concerning the different feature by applying Technology Described in Cited Document 2 to Cited Invention.

2 Regarding the written opinion of Dec. 27, 2019

In the written opinion submitted on Dec. 27, 2019, the Appellant alleges that Cited Document 1 and Cited Document 2 have absolutely different problems to be solved from each other, and thus it cannot be thought that a person skilled in the art coming into contact with Cited Document 1 bothers to apply the technology described in Cited Document 2 that has a completely different problem to be solved and completely different technological demands.

However, Cited Document 2 is one that cites a technology to make, in a capacitor including a laminated body constituted of dielectric layers and electrodes, the thickness of the dielectric and the internal electrode be predetermined values, and it is not acknowledged that both of the problems to be solved of Cited Document 1 and Cited Document 2 are ones that interfere with application of the technology described in Cited Document 2 to Cited Invention, and thus it is recognized that the technology

Described in Cited Document 2 can be applied to Cited Invention.

In addition, in the same written opinion, the Appellant alleges that it can be thought that the thin film capacitor 100 of Cited Document 2 does not include an internal electrode having a function and constitution equivalent to those of the internal electrode layers 12 described in Cited Document 1, and, therefore, it is unreasonable to simply apply the technology related to the thickness of the internal electrode 8 of Cited Document 2 to the thickness of the internal electrode layers 12 of Cited Document 1.

However, both Cited Document 1 and Cited Document 2 are of capacitors having a laminated body constituted of a dielectric layer and a plurality of electrodes (the internal electrode layers 12 of Cited Document 1, and the internal electrode 8 and the upper electrode 10 of Cited Document 2), and are ones provided with an internal electrode having similar constitution, and, therefore, the capacitor of Cited Document 1 and the capacitor of Cited Document 2 are not ones that do not include an internal electrode having an equivalent function and constitution.

Therefore, it cannot be said that it is unreasonable to apply the technology related to the thickness of the internal electrode 8 of Cited Document 2 to the thickness of the internal electrode layers 12 of Cited Document 1.

Further, in the same written opinion, the Appellant alleges to the effect that the thin film capacitor 100 described in Cited Document 2 has a different burning temperature from that of the multilayer ceramic capacitor 2 described in Cited Document 1; that is, the thin film capacitor 100 described in Cited Document 2 is one that is formed by being burned at the temperature that cannot be adopted in Cited Document 1, and, therefore, it is technically unreasonable to try to apply such technology related to the thin film capacitor 100 to the multilayer ceramic capacitor 2 of Cited Document 1, and, in addition, as a result of the effect that the internal electrode layers 12 described in Cited Document 1 are formed by transcribing a film for an internal electrode layer on a surface of a greensheet, handling problems are liable to occur when the film is made to be thinner, and, therefore, it cannot be thought that the technology described in Cited Document 2 to make the thickness of internal electrode be 100 or 200 nm can be simply applied thereto.

Here, it is understood that the Appellant's allegation is that, since the multilayer ceramic capacitor described in Cited Document 1 and the thin film capacitor described in Cited Document 2 are different from each other in their fabrication methods, the technology related to the thickness of the internal electrode described in

Cited Document 2 cannot be applied to the multilayer ceramic capacitor described in Cited Document 1.

However, it was a matter of well-known art before the application of the present application to make both a dielectric layer and an internal electrode layer be a few hundred nm or less also in a multilayer ceramic capacitor made by laminating and burning a ceramic greensheet on which an internal electrode layer is formed by printing or transcription (if necessary, refer to: Japanese Unexamined Patent Application Publication No. 2014-22714 (in particular, recitations of [Claim 2] and [Claim 10], and descriptions of [0031], [0105]); Japanese Unexamined Patent Application Publication No. 2014-82435 (in particular, recitations and descriptions of [Claim 2], [Claim 3], [0022], [0040], [0134]); and Japanese Unexamined Patent Application Publication No. 2003-234242 (descriptions of [0001] and [0053], and descriptions of Sample Number 1 of [Table 2])).

Therefore, also in a multilayer ceramic capacitor having an internal electrode formed on a greensheet by transcription as described in Cited Document 1, both a dielectric layer and an internal electrode layer can be made to be of a thickness of a few hundred nm or less, and, therefore, it is recognized that the technology related to the thickness of the internal electrode described in Cited Document 2 can be applied to the multilayer ceramic capacitor described in Cited Document 1.

Therefore, the Appellant's allegation cannot be adopted.

No. 7 Closing

As above, the invention according to Claim 1 of the present application is one for which the Appellant should not be granted a patent in accordance with the provision of Article 29(2) of the Patent Act, and, therefore, without examining the inventions according to the other claims, the present application should be rejected.

Therefore, the appeal decision shall be made as described in the conclusion.

March 24, 2020

Chief administrative judge: SAKAI, Tomohiro
Administrative judge: YAMADA, Masafumi
Administrative judge: YAMASAWA, Hiroshi