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PROTECTIVE GLASS FILM

Abstract

An electronic component includes a base body and a glass film which covers an outer surface of the base body. The glass film contains one or more elements selected from an alkali metal and an alkaline earth metal as an additive. The glass film has a thickness of 80 nm or more and 5000 nm or less. A ratio of an arithmetic average roughness of an outer surface of the glass film to an arithmetic average roughness of the outer surface of the base body is 0.0002 or more and 0.85 or less.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This application is a continuation of and claims priority to PCT/JP2023/027445, filed on Jul. 26, 2023. PCT/JP2023/027445 claims priority to JP 2022-180944, filed on Nov. 11, 2022. The content of both are hereby incorporated by reference in their entirety.

TECHNICAL FIELD
[0002] The present disclosure relates to an electronic component.
BACKGROUND
[0003] The electronic component described in Patent Document 1 includes a base body, a glass film, and an external electrode. The base body is made of ceramics. The external electrode covers both end surfaces of the base body. In addition, the glass film covers the side surface of the base body. The thickness of the glass film is as thin as about 0.05 to 0.2 μm. Therefore, the surface roughness of the outer surface of the glass film is substantially equal to the surface roughness of the outer surface of the base body.
PATENT DOCUMENT
[0004] Patent Document 1: Japanese Patent No. 5471586
SUMMARY
[0005] An electronic component according to the present disclosure includes a base body; and a glass film covering an outer surface of the base body, wherein the glass film contains one or more elements selected from an alkali metal and an alkaline earth metal as an additive, the glass film has a thickness of 80 nm or more and 5000 nm or less, and a ratio of an arithmetic average roughness of an outer surface of the glass film to an arithmetic average roughness of the outer surface of the base body is 0.0002 or more and 0.85 or less.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0006] FIG. **1** is a perspective view of an electronic component.
[0007] FIG. **2** is a side view of an electronic component.
[0008] FIG. **3** is a sectional view along the line **3-3** in FIG. **2**.
[0009] FIG. **4** is an enlarged sectional view of the outer surface of a base body and the outer surface of a glass film.
[0010] FIG. **5** is an enlarged sectional view of the vicinity of a recess of an electronic component.
[0011] FIG. **6** is an explanatory diagram illustrating the method for manufacturing an electronic component.
[0012] FIG. **7** is an explanatory diagram illustrating the method for manufacturing an electronic component.
[0013] FIG. **8** is an explanatory diagram illustrating the method for manufacturing an electronic component.
[0014] FIG. **9** is an explanatory diagram illustrating the method for manufacturing an electronic component.
[0015] FIG. **10** is an explanatory diagram illustrating the method for manufacturing an electronic

component.

[0016] FIG. **11** is an explanatory diagram illustrating the method for manufacturing an electronic component.

[0017] FIG. **12** is an explanatory diagram illustrating the method for manufacturing an electronic component.

[0018] FIG. **13** is a table showing comparison results of the electronic components between Examples and Comparative Examples.

DETAILED DESCRIPTION

[0019] In a conventional electronic component, a glass film is preferably as thin as possible from the viewpoint of, for example, ensuring conductivity between the internal electrode and the external electrode and reducing the dimension of the electronic component. However, when a thinned glass film is easily damaged, for example, cracked and chipped, when the electronic component is rubbed against another object.

[0020] The inventors have developed technology of the present disclosure to address issues with conventional electronic components. In accordance with the present disclosure, an outer surface of a glass film is smooth compared to an outer surface of a base body. Therefore, when the outer surface of the glass film is rubbed against another object, there is reduced frictional force on the outer surface of the glass film. Therefore, the glass film is less likely to be damaged, for example, cracked and chipped. On the other hand, the outer surface of the base body is rougher than the outer surface of the glass film. Therefore, sufficient adhesion force is obtained between the base body and the glass film.

[0021] When the glass film is thinned, the glass film is hardly damaged, and sufficient adhesion force is obtained between the base body and the glass film.

Electronic Component

[0022] Hereinafter, an electronic component will be described with reference to the drawings. It is to be noted that components may be shown in an enlarged manner for easy understanding in the drawings. In some cases, the dimension ratio of a component differs from an actual dimension ratio or a dimension ratio in another drawing.

Overall Configuration

[0023] As shown in FIG. **1**, an electronic component **10** is, for example, a surface-mount negative-characteristic thermistor component to be mounted on a circuit board or the like. The negative-characteristic thermistor component has a characteristic that the resistance value decreases as the temperature increases.

[0024] The electronic component **10** includes a base body **20**. The base body **20** has a substantially quadrangular prism shape and has a central axis CA. Hereinafter, an axis extending along the central axis CA is defined as a first axis X. In addition, one of axes that are orthogonal to the first axis X is defined as a second axis Y. Further, an axis that is orthogonal to the first axis X and the second axis Y is defined as a third axis Z. Furthermore, one of the directions along the first axis X is defined as a first positive direction X**1**, and the direction opposite to the first positive direction X**1**, of the directions along the first axis X, is defined as a first negative direction X**2**. In addition, one of the directions along the second axis Y is defined as a second positive direction Y**1**, and the direction opposite to the second positive direction Y**1**, of the directions along the second axis Y, is defined as a second negative direction Y**2**. Further, one of the directions along the third axis Z is defined as a third positive direction Z**1**, and a direction opposite to the third positive direction Z**1**, of the directions along the third axis Z, is defined as a third negative direction Z**2**.

[0025] An outer surface **21** of the base body **20** has six planar surfaces **22**. It is to be noted that the term “surface” of the base body **20** as used herein refers to a part that can be observed as a surface when the whole base body **20** is observed. That is, for example, if there are minute irregularities or steps that cannot be found unless a part of the base body **20** is enlarged and observed with a microscope or the like, the surface is expressed as a planar surface or a curved surface. The six planar surfaces **22** face in directions different from each other. The six planar surfaces **22** are roughly divided into a first end surface **22**A that faces in the first positive direction X**1**, a second end surface **22**B that faces in the first negative direction X**2**, and four side surfaces **22**C. The four side surfaces **22**C are a surface facing the third positive direction Z**1**, a surface facing the third negative direction Z**2**, a surface facing the second positive direction Y**1**, and a surface facing the second negative direction Y**2**, respectively.

[0026] In the outer surface **21** of the base body **20**, a boundary portion between two adjacent planar surfaces **22** and a boundary portion between three adjacent surfaces are curved surfaces. That is, the corners of the base body **20** are R-chamfered. It is to be noted that the outer surface **51** of a glass film **50** to be described later is designated by the same reference numerals as with the outer surface **21** of the base body **20** in FIGS. **1** and **2**.

[0027] As illustrated in FIG. **2**, the base body **20** has a dimension in the direction along the first axis X larger than a dimension in the direction along the third axis Z. In addition, as shown in FIG. **1**, the base body **20** has a dimension in the direction along the first axis X larger than a dimension in the direction along the second axis Y. The material of the base body **20** is a ceramic obtained by firing a metal oxide containing one or more selected from Mn, Fe, Ni, Co, Ti, Ba, Al, and Zn as a component.

[0028] As shown in FIG. **3**, the electronic component **10** includes two first internal electrodes **41** and two second internal electrodes **42**. The first internal electrodes **41** and the second internal electrodes **42** are embedded in the base body **20**.

[0029] The material of the first internal electrode **41** is a conductive material. For example, the material of the first internal electrode **41** is palladium. The material of the second internal electrode **42** is the same as the material of the first internal electrode **41**.

[0030] The first internal electrode **41** has a rectangular plate shape. The first internal electrode **41** has a main surface that is orthogonal to the second axis Y. The second internal electrode **42** has the same rectangular plate shape as the first internal electrode **41**. The second internal electrode **42** has a main surface orthogonal to the second axis Y, as with the first internal electrode **41**.

[0031] The dimension of the first internal electrode **41** in the direction along the first axis X is smaller than the dimension of the base body **20** in the direction along the first axis X. In addition, as shown in FIG. **1**, the dimension of the first internal electrode **41** in the direction along the third axis Z is approximately ⅔ of the dimension of the base body **20** in the direction along the third axis Z. The dimension of the second internal electrode **42** in each of the directions is the same as that of the first internal electrode **41**.

[0032] As shown in FIG. **3**, the first internal electrodes **41** and the second internal electrodes **42** are located in a staggered manner in the direction along the second axis Y. That is, the first internal electrode **41**, the second internal electrode **42**, the first internal electrode **41**, and the second internal electrode **42** are arranged in this order from the side surface **22**C facing the second positive direction Y**1** toward the second negative direction Y**2**. Thus, the distances between the respective internal electrodes in the direction along the second axis Y are equal to each other.

[0033] As illustrated in FIG. **1**, the two first internal electrodes **41** and the two second internal electrodes **42** are both located at the center of the base body **20** in the direction along the third axis Z. On the other hand, as shown in FIG. **3**, the first internal electrodes **41** are located to be shifted in the first positive direction X**1**. The second internal electrodes **42** are located to be shifted in the first negative direction X**2**.

[0034] Specifically, the end of the first internal electrode **41** on the first positive direction X**1** side coincides with the end of the base body **20** on the first positive direction X**1** side. The end of the first internal electrode **41** on the first negative direction X**2** side is located inside the base body **20**, without reaching the end of the base body **20** on the first negative direction X**2** side. On the other hand, the end of the second internal electrode **42** on the first negative direction X**2** side coincides with the end of the base body **20** on the first negative direction X**2** side. The end of the second internal electrode **42** on the first positive direction X**1** side is located inside the base body **20**, without reaching the end of the base body **20** on the first positive direction X**1** side.

[0035] As illustrated in FIG. **3**, the electronic component **10** includes a glass film **50**. The glass film **50** covers the outer surface **21** of the base body **20**. That is, the glass film **50** covers the substantially whole region of the outer surface **21** of the base body **20**. The main material of the glass film **50** is insulating glass. Therefore, the glass film **50** contains silicon dioxide. In addition, the glass film **50** contains, as an additive, one or more elements selected from an alkali metal and an alkaline earth metal. Specifically, the glass film **50** contains potassium as an additive. The value of "K/Si", which is the ratio of potassium to silicon contained in the glass film **50**, is 0.5 atm % or more and 90 atm % or less. Specifically, the ratio of potassium to silicon contained in the glass film **50** is about 30 atm %.

[0036] The electronic component **10** includes a first external electrode **61** and a second external electrode **62**. The first external electrode **61** includes a first underlying electrode **61**A and a first metal layer **61**B. The first underlying electrode **61**A is stacked on the glass film **50** at a part of the outer surface **21** of the base body **20**, including the first end surface **22**A. Specifically, the first underlying electrode **61**A is a five-face electrode that covers the first end surface **22**A of the base body **20** and a portion of four side surfaces **22**C on the first positive direction X**1** side. The material of the first underlying electrode **61**A is silver and glass.

[0037] The first metal layer **61**B covers the first underlying electrode **61**A from the outside. Therefore, the first metal layer **61**B is stacked on the first underlying electrode **61**A. The first metal layer **61**B has a two-layer structure of a nickel layer and a tin layer in this order from the first underlying electrode **61**A side.

[0038] The second external electrode **62** includes a second underlying electrode **62**A and a second metal layer **62**B. The second underlying electrode **62**A is stacked on the glass film **50** at a part of the outer surface **21** of the base body **20**, including the second end surface **22**B. Specifically, the second underlying electrode **62**A is a five-face electrode that covers the second end surface **22**B of the base body **20** and a portion of four side surfaces **22**C on the first negative direction X**2** side. The material of the second underlying electrode **62**A is the same as the material of the first external electrode **61**, and is a mixture of silver and glass.

[0039] The second metal layer **62**B covers the second underlying electrode **62**A from the outside. More specifically, the second metal layer **62**B is stacked on the second underlying electrode **62**A. The second metal layer **62**B has, as with the first metal layer **61**B, a two-layer structure of nickel plating and tin plating in this order from the side of the base body **20**.

[0040] The second external electrode **62** is, without reaching the first external electrode **61** on the side surface **22**C, disposed away from the first external electrode **61** in the direction along the first axis X. Further, on the side surface **22**C of the base body **20**, the first external electrode **61** and the second external electrode **62** are not stacked with the glass film **50** exposed at the central part in the direction along the first axis X. It is to be noted that the first external electrode **61** and the second external electrode **62** are indicated by two-dot chain lines in FIGS. **1** to **3**.

[0041] As illustrated in FIG. **3**, the first external electrode **61** and the end of the first internal electrode **41** on the first positive direction X**1** side are connected via a first penetrating part **71** penetrating the glass film **50**. Although details will be described later, the first penetrating part **71** is formed by extension of palladium constituting the first internal electrode **41** toward the first external electrode **61** in the process of manufacturing the electronic component **10**.

[0042] The second external electrode **62** and the end of the second internal electrode **42** on the first negative direction X**2** side are connected via a second penetrating part **72** penetrating the glass film **50**. The second penetrating part **72** is also, as with the first penetrating part **71**, formed by extension of palladium constituting the second internal electrode **42** toward the second external electrode **62** in the process of manufacturing the electronic component **10**. While the first internal electrode **41** and the first penetrating part **71** are illustrated as separate members with a boundary in FIG. **3**, there is actually no clear boundary therebetween. In this respect, the same applies to the second penetrating part **72**.

Thickness of Glass Film

[0043] As illustrated in FIG. **4**, the shortest distance from the outer surface **21** of the base body **20** to the outer surface **51** of the glass film **50** is defined as the thickness TG of the glass film **50**. The average value of the thickness TG of the glass film **50** is 80 nm or more and 5000 nm or less. Specifically, the average value of the thickness TG of the glass film **50** is 1200 nm. The average value of the thickness TG of the glass film **50** is calculated as follows.

[0044] First, in the outer surface **21** of the base body **20**, a portion where there is no recess **23** caused by falling off of ceramic grains, cracking and chipping of the base body **20**, and the like is specified. Next, the section of the base body **20** at the portion is captured with an electron microscope. For this captured image, a range of at least 10 μm or more in a direction along the outer surface **51** of the glass film **50** is defined as a measurement range. Then, the sectional area of the glass film **50** in the measurement range is calculated by image processing. Then, by dividing the sectional area of the glass film **50** in the measurement range by the length of the measurement range in the direction along the outer surface **51** of the glass film **50**, the average value of the thickness TG of the glass film **50** is calculated. That is, the average value of the thickness TG of the glass film **50** is an average value of the thickness TG in the measurement range.

[0045] The recess **23** having a maximum depth H that is 10 times or more the arithmetic average roughness of the outer surface **21** of the base body **20** is defined as the above-described recess **23** caused by falling off of ceramic grains, cracking and chipping of the base body **20**, and the like. The maximum depth H of the recess **23** is calculated as follows. First, the base body **20** is ground in a direction orthogonal to the outer surface **21** by focused ion beam processing. The ground section of the base body **20** is captured. Then, as illustrated in FIG. **5**, on the section, a tangent line CL is drawn so that the tangent line CL is circumscribed to both of the outer surfaces **21**, which sandwich the recess **23** and are present on both sides thereof. At this time, a part of the tangent line CL may coincide with the outer surface **21**. At this time, the depth of the recess **23** is the length from the tangent line CL to the inner surface of the recess **23** in the direction orthogonal to the tangent line CL circumscribing the outer surface **21**.

[0046] Next, by focused ion beam processing, the base body **20** is ground from the above ground section by a predetermined capturing pitch. The capturing pitch of the focused ion beam processing is, for example, 10 nm. Then, the new ground section of the base body **20** is captured, and the maximum depth of the same recess **23** is measured on the new section. In this way, grinding and measuring the maximum depth of the recess **23** are repeated. Among the maximum depths in each ground section obtained in this manner, the largest value is defined as the maximum depth H in the entire recess **23**. That is, the maximum depth H of the recess **23** herein is the depth at the deepest portion of the recess **23**.

Arithmetic Average Roughness of Each Outer Surface of Glass Film and Base Body

[0047] The arithmetic average roughness of the outer surface **51** of the glass film **50** is 0.1 nm or more and 5 nm or less. Specifically, the arithmetic average roughness of the outer surface **51** of glass film **50** is 5 nm. The arithmetic average roughness of the outer surface **51** of the glass film **50** is calculated as follows. First, by the above-described method, in the outer surface **21** of the base body **20**, a portion where there is no recess **23** caused by falling off of ceramic grains, cracking and chipping of the base body **20**, and the like is specified. In the portion, a range of at least 10 μm or more in a linear direction along the outer surface **21** of the base body **20** is defined as a measurement range. For the measurement range, the arithmetic average roughness of the glass film **50** is measured using a laser microscope.

[0048] The arithmetic average roughness of the outer surface **21** of the base body **20** is 5.9 nm or more and 500 nm or less. Specifically, the arithmetic average roughness of the outer surface **21** of the base body **20** is 70 nm. The arithmetic average roughness of the outer surface **21** of the base body **20** is calculated as follows. First, the glass film **50** is removed from the electronic component **10** using an alkaline aqueous solution or the like that dissolves the glass film **50** and does not dissolve the base body **20**. Then, similarly to the measurement of the arithmetic average roughness of the outer surface **51** of the glass film **50**, a portion where there is no recess **23** caused by falling off of ceramic grains, cracking and chipping of the base body **20**, and the like is specified. In the portion, a range of at least 10 μm or more in a linear direction along the outer surface **21** of the base body **20** is defined as a measurement range. For the measurement range, the arithmetic average roughness of the base body **20** is measured using a laser microscope. The base body **20** is formed by barrel polishing in the R chamfering step S**12** described later. Therefore, the roughness is substantially constant in the entire outer surface **21** of the base body **20**, excluding the recess **23** caused by falling off of ceramic grains, cracking and chipping of the base body **20**, and the like.

[0049] The ratio of the arithmetic average roughness of the outer surface **51** of the glass film **50** is 0.0002 or more and 0.85 or less with respect to the arithmetic average roughness of the outer surface **21** of the base body **20**. Specifically, the ratio is about **0.07**.

Method for Manufacturing Electronic Component

[0050] Next, the method for manufacturing the electronic component **10** will be described.

[0051] As illustrated in FIG. **6**, the method for manufacturing the electronic component **10** includes a stacked body preparing step S**11**, a R chamfering step S**12**, a solvent charging step S**13**, a catalyst charging step S**14**, a base body charging step S**15**, a polymer charging step S**16**, and a metal alkoxide charging step S**17**. In addition, the method for manufacturing the electronic component **10** further includes a film forming step S**18**, a first drying step S**19**, an immersing step S**20**, a second drying step S**21**, a conductor applying step S**22**, a curing step S**23**, and a plating step S**24**.

[0052] First, in forming the base body **20**, a stacked body that is a cuboid base body **20** having six planar surfaces **22** is prepared in the stacked body preparing step S**11**. That is, the stacked body at this stage is in a state before R chamfering. For example, first, a plurality of ceramic sheets to serve as the base body **20** are provided. The sheet has a thin plate shape. On the sheet, a conductive paste to serve as the first internal electrode **41** is stacked. On the stacked paste, the ceramic sheet to serve as the base body **20** is stacked. On the sheet, a conductive paste to serve as the second internal electrode **42** is stacked. In this manner, the ceramic sheet and the conductive paste are stacked. Then, an unfired stacked body is formed by cutting into a predetermined size. Thereafter, the unfired stacked body is subjected to firing at a high temperature to provide a stacked body.

[0053] Next, as illustrated in FIG. **6**, the R chamfering step S**12** is performed. In the R chamfering step S**12**, a curved surface is formed at a boundary portion between two adjacent planar surfaces **22** and a boundary portion between three adjacent planar surfaces **22** of the stacked body prepared in the stacked body preparing step S**11**. For example, the corner of the stacked body is subjected to R chamfering by barrel polishing, whereby a curved surface is formed at the boundary portion.

[0054] Next, as shown in FIG. **6**, the solvent charging step S**13** is performed. As illustrated in FIG. **7**, in the solvent charging step S**13**, 2-propanol is charged as a solvent **82** into a reaction vessel **81**.

[0055] Next, as shown in FIG. **6**, the catalyst charging step S**14** is performed. As illustrated in FIG. **8**, in the catalyst charging step S**14**, first, stirring of the solvent **82** in the reaction vessel **81** is started. Then, ammonia water is charged into the reaction vessel **81** as an aqueous solution **83** containing the catalyst. The catalyst, which is a hydroxide ion, functions as a catalyst that promotes hydrolysis of a metal alkoxide **85** described later.

[0056] Next, as illustrated in FIG. **6**, the base body charging step S**15** is performed. As illustrated in FIG. **9**, in the base body charging step S**15**, the plurality of base bodies **20** formed in advance in the R chamfering step S**12** as described above are charged into the reaction vessel **81**.

[0057] Next, as illustrated in FIG. **6**, the polymer charging step S**16** is performed. As illustrated in FIG. **10**, in the polymer charging step S**16**, polyvinylpyrrolidone is charged as a polymer **84** into the reaction vessel **81**. Thus, the polymer **84** put into the reaction vessel **81** adsorbs to the outer surfaces **21** of the base bodies **20**.

[0058] Next, as illustrated in FIG. **6**, the metal alkoxide charging step S**17** is performed. As illustrated in FIG. **11**, in the metal alkoxide charging step S**17**, tetraethyl orthosilicate in a liquid state is charged as the metal alkoxide **85** into the reaction vessel **81**. Tetraethyl orthosilicate is sometimes referred to as tetraethoxysilane. The amount of the metal alkoxide **85** to be charged in the metal alkoxide charging step S**17** is calculated based on the area of the outer surface **21** of the base bodies **20** charged in the base body charging step S**15**. Specifically, the calculation is performed by multiplying the amount of the metal alkoxide **85** per base body **20**, required for forming the glass film **50** covering the outer surface **21** of the base body **20**, by the number of base bodies **20**.
[0059] Next, as illustrated in FIG. **6**, the film forming step S**18** is performed. In the film forming step S**18**, the stirring of the solvent **82** started in the solvent charging step S**13** described above is continued for a predetermined time after the metal alkoxide **85** is charged into the reaction vessel **81** in the metal alkoxide charging step S**17**. Thus, the metal alkoxide **85** is hydrolyzed with the hydroxide ion as a catalyst. When the metal alkoxide **85** is hydrolyzed, the hydrolyzed metal alkoxide **85** adheres to the surfaces of the base bodies **20**. Then, the metal alkoxides **85** adhering to the surfaces of the base bodies **20** are dehydrated and condensed to form the glass film **50**. In the film forming step S**18**, the glass film **50** in a sol form is formed by a liquid phase reaction in the reaction vessel **81**.
[0060] Next, as shown in FIG. **6**, the first drying step S**19** is performed. In the first drying step S**19**, the base bodies **20** are, after the film forming step S**18**, taken out from the reaction vessel **81** and then dried. Thus, the glass film **50** in a sol form is dried to become a glass film **50** in a gel form.
[0061] Next, as shown in FIG. **6**, the immersing step S**20** is performed. As shown in FIG. **12**, in the immersing step S**20**, first, a solution **87** containing, as an additive, at least one element selected from an alkali metal and an alkaline earth metal is placed in advance in a reaction vessel **86** that is different from the reaction vessel **81** used up to the film forming step S**18**. The solution **87** is an aqueous solution containing a potassium oxide precursor. Then, the base bodies **20** with the glass film **50** in a gel form is immersed in the solution **87**. Thus, the solution **87** adheres to the surface of the glass film **50**.
[0062] Next, as shown in FIG. **6**, the second drying step S**21** is performed. In the second drying step S**21**, the base bodies **20** immersed in the solution **87** in the immersing step S**20** are taken out from the reaction vessel **86** and then dried. Thus, the water of the solution **87** adhering to the surface of the glass film **50** is volatilized. In contrast, the potassium oxide precursor contained in the solution **87** is deposited on the outer surface **51** of the glass film **50**.
[0063] Next, the conductor applying step S**22** is performed. In the conductor applying step S**22**, a conductor paste is applied to two parts of the surface of the glass film **50**: a part including a part that covers the first end surface **22**A of the base body **20**; and a part including a part that covers the second end surface **22**B of the base body **20**. Specifically, the conductor paste is applied so as to cover the glass film **50** on the whole region of the first end surface **22**A and parts of the four side surfaces **22**C. In addition, the conductor paste is applied so as to cover the glass film **50** on the whole region of the second end surface **22**B and parts of the four side surfaces **22**C.
[0064] Next, the curing step S**23** is performed. Specifically, the base bodies **20** with the glass film **50** and conductor paste applied thereto are heated in the curing step S**23**. Thus, the deposited potassium oxide precursor becomes potassium oxide. The potassium oxide diffuses into the glass film **50** covering the outer surface **21** of the base body **20**. Then, the vaporization of water and the polymer **84** from the glass film **50** in a gel form causes the glass film **50** covering the outer surface **21** of the base body **20** to be fired and cured. Furthermore, in the curing step S**23**, the conductor paste applied in the conductor applying step S**22** is fired to form the first underlying electrode **61**A and the second underlying electrode **62**A.
[0065] At the time of heating in the curing step S**23**, palladium contained on the side with the first internal electrodes **41** is attracted toward the side with the first underlying electrode **61**A containing

silver by the Kirkendall effect caused from the difference in diffusion rate between the first internal electrodes **41** and the first underlying electrode **61**A. Thus, the first penetrating parts **71** penetrate and extend through the glass film **50** from the first internal electrodes **41** toward the first underlying electrode **61**A, thereby connecting the first internal electrodes **41** and the first underlying electrode **61**A to each other. In this respect, the same applies to the second penetrating parts **72** that connect the second internal electrodes **42** and the second underlying electrode **62**A to each other.

[0066] Next, the plating step S**24** is performed. The parts of the first underlying electrode **61**A and second underlying electrode **62**A are subjected to electroplating. Thus, the first metal layer **61**B is formed on the surface of the first underlying electrode **61**A. In addition, the second metal layer **62**B is formed on the surface of the second underlying electrode **62**A. The first metal layer **61**B and the second metal layer **62**B each have a two-layer structure electroplated with two types: nickel and tin. In this manner, the electronic component **10** is formed.

Results of Comparative Test

[0067] The electronic components **10** of Examples 1 to 3 and the electronic component of Comparative Example were subjected to a micro-scratch test.

[0068] The electronic component **10** of Example 1 has been described in the above discussion. That is, the average value of the thickness TG of the glass film **50** is 1200 nm. The arithmetic average roughness of the outer surface **21** of the base body **20** is 70 nm. The arithmetic average roughness of the outer surface **51** of the glass film **50** is 5 nm. The ratio of the arithmetic average roughness of the outer surface **51** of the glass film **50** is about 0.07 with respect to the arithmetic average roughness of the outer surface **21** of the base body **20**.

[0069] The structure of the electronic component **10** of Examples 2 and 3 is similar to those described in the above-described Example 1. However, the thickness TG of the glass film **50**, the arithmetic average roughness of the outer surface **21** of the base body **20**, and the arithmetic average roughness of the outer surface **51** of the glass film **50** are different.

[0070] Specifically, in the electronic component **10** of Example 2, the average value of the thicknesses TG of the glass film **50** is 80 nm. The arithmetic average roughness of the outer surface **21** of the base body **20** is 5.9 nm. The arithmetic average roughness of the outer surface **51** of the glass film **50** is 5 nm. The ratio of the arithmetic average roughness of the outer surface **51** of the glass film **50** is about 0.85 with respect to the arithmetic average roughness of the outer surface **21** of the base body **20**.

[0071] In the electronic component **10** of Example 3, the average value of the thickness TG of the glass film **50** is 5000 nm. The arithmetic average roughness of the outer surface **21** of the base body **20** is 500 nm. The arithmetic average roughness of the outer surface **51** of the glass film **50** is 0.1 nm. The ratio of the arithmetic average roughness of the outer surface **51** of the glass film **50** is about 0.0002 with respect to the arithmetic average roughness of the outer surface **21** of the base body **20**.

[0072] The arithmetic average roughness of the outer surface **21** of the base body **20** can be adjusted by changing the conditions of the R chamfering step S**12** of the manufacturing method described above. In addition, the thickness TG of the glass film **50** and the arithmetic average roughness of the outer surface **51** can be adjusted as in each Example by changing the time conditions of the film forming step S**18**, the concentration of the additive in the immersing step S**20**, and the like.

[0073] The structure of the electronic component of Comparative Example is similar to those described in the above-described examples. However, the thickness TG of the glass film **50**, the arithmetic average roughness of the outer surface **21** of the base body **20**, and the arithmetic average roughness of the outer surface **51** of the glass film **50** are different.

[0074] Specifically, in the electronic component of Comparative Example, the average value of the thickness TG of the glass film **50** is 80 nm. The arithmetic average roughness of the outer surface

21 of the base body **20** is 10 nm. The arithmetic average roughness of the outer surface **51** of the glass film **50** is 10 nm. The ratio of the arithmetic average roughness of the outer surface **51** of the glass film **50** is 1 with respect to the arithmetic average roughness of the outer surface **21** of the base body **20**.

[0075] The electronic component of Comparative Example was manufactured without performing the immersing step S**20** and the second drying step S**21** in the above-described manufacturing method. That is, the glass film **50** of the electronic component of Comparative Example contains neither an alkali metal nor an alkaline earth metal as an additive.

[0076] For the electronic components **10** of Examples 1 to 3 and the electronic component of Comparative Example, the durability of the glass film **50** was evaluated by a micro-scratch test. In the evaluation of the micro-scratch test, 400 μm scanning is performed with a load of 100 mN using a diamond needle whose tip has a curvature radius of 25 μm. When no scratch was made, it was determined as pass, and when a scratch was made, it was determined as fail. In FIG. **13**, "o" indicates pass, and "x" indicates fail.

[0077] As shown in FIG. **13**, the electronic components **10** of Examples 1 to 3 were evaluated as pass in the micro-scratch test. On the other hand, the electronic component of Comparative Example was evaluated as fail in the micro-scratch test. From the test results, it has been found that the arithmetic average roughness of the outer surface **51** of the glass film **50** is preferably smaller than the arithmetic average roughness of the outer surface **21** of the base body **20** from the viewpoint of the durability of the glass film **50**. In particular, it has been found that the micro-scratch test can be passed when the ratio of the arithmetic average roughness of the outer surface **51** of the glass film **50** is 0.0002 or more and 0.85 or less with respect to the arithmetic average roughness of the outer surface **21** of the base body **20**. In addition, it has been found that the micro-scratch test can be passed when the average value of the thickness TG of the glass film **50** is as thin as less than 5000 nm, as long as the condition of arithmetic average roughness is satisfied.

Technical Effects

[0078] (1) A ratio of the arithmetic average roughness of the outer surface **51** of the glass film **50** to the arithmetic average roughness of the outer surface **21** of the base body **20** is 0.0002 or more and 0.85 or less. That is, the outer surface **51** of the glass film **50** is smooth compared to the outer surface **21** of the base body **20**. Therefore, when the outer surface **51** of the glass film **50** is rubbed against another object, it is possible to reduce frictional force to be generated on the outer surface **51** of the glass film **50**. Therefore, the glass film **50** is less likely to be damaged, for example, cracked and chipped. On the other hand, the outer surface **21** of the base body **20** is rougher than the outer surface **51** of the glass film **50**. Therefore, sufficient adhesion force is obtained between the base body **20** and the glass film **50**. [0079] (2) The thickness TG of the glass film **50** is 80 nm or more and 5000 nm or less. When the thickness TG of the glass film **50** is thin as described above, interface stress is less likely to occur between the base body **20** and the glass film **50**. Therefore, the glass film **50** is hardly peeled off from the base body **20**. [0080] (3) The arithmetic average roughness of the outer surface **51** of the glass film **50** is 0.1 nm or more and 5 nm or less. That is, the outer surface **51** of the glass film **50** is considerably smooth. As a result, frictional force to be generated on the outer surface **51** of the glass film **50** is reduced. Therefore, the outer surface **51** of the glass film **50** is less likely to be scratched. [0081] (4) The arithmetic average roughness of the outer surface **21** of the base body **20** is 5.9 nm or more and 500 nm or less. When the outer surface **21** of the base body **20** has unevenness to some extent as described above, an anchor effect is generated between the base body **20** and the glass film **50**. Therefore, adhesiveness between the base body **20** and the glass film **50** is enhanced. [0082] (5) Since the first underlying electrode **61**A contains glass, the glass component of the first underlying electrode **61**A is diffused into and integrated with the glass film **50**. As a result, while the outer surface **51** of the glass film **50** is smooth, adhesion to the first underlying electrode **61**A can also be secured. In this respect, the same applies to the second underlying electrode **62**A. [0083] (6) The glass film **50** contains, as an additive, one or more elements selected from an alkali metal and an alkaline earth metal, and the ratio of the additive to Si contained in the glass film **50** is 0.5 atm % or more and 90 atm % or less. When the additive is contained within the range of this ratio, a part of the recess **23** present in the outer surface **21** of the base body **20** is filled with the glass film **50**. Consequently, the outer surface **51** of the glass film **50** becomes smoother.

Modification

[0084] The above-mentioned examples and the following modifications can be implemented in combination within a range that is not technically contradictory. [0085] The electronic component **10** is not limited to any negative-characteristic thermistor component. For example, the electronic component **10** may be a thermistor component other than those that have negative characteristics, or may be a multilayer capacitor component or an inductor component, as long as the electronic component **10** includes some wiring inside the base body **20**. [0086] The material of the base body **20** is not limited to the above example. The material of the base body **20** may be a composite of a resin and a metal powder. [0087] The shape of the base body **20** is not limited to the above example. For example, the base body **20** may have a polygonal columnar shape, other than a quadrangular columnar shape, having a central axis CA. Furthermore, the base body **20** may be the core of a wire-wound inductor component. For example, the core may have what is called a drum core shape. Specifically, the core may have a columnar winding core portion and a flange portion provided at each end of the winding core portion. [0088] In the outer surface **21** of the base body **20**, a boundary portion between the adjacent planar surfaces **22** does not necessarily have a chamfered shape. In this case, there is no curved surface at the boundary portion. [0089] The shape of the first internal electrode **41** and the second internal electrode **42** is not limited as long as it can ensure electrical conduction with the corresponding first external electrode **61** and second external electrode **62**. In addition, the number of the first internal electrode **41** and the number of the second internal electrode **42** are not limited, and the number of the internal electrode may be one or may be three or more. [0090] The configuration of the first external electrode **61** is not limited to the example mentioned above. For example, the first external electrode **61** may include only the first underlying electrode **61**A, or the first metal layer **61**B may have no two-layer structure. In this respect, the same applies to the second external electrode **62**. [0091] The first underlying electrode **61**A is only electrically conductive with the first internal electrode **41**, and may contain no glass. Similarly, the second underlying electrode **62**A is only electrically conductive with the second internal electrode **42**, and may contain no glass. [0092] The material combination of the first internal electrode **41** and the first underlying electrode **61**A is not limited to the combination of palladium and silver. The combination may be, for example, a combination of copper and nickel, copper and silver, silver and gold, nickel and cobalt, or nickel and gold. For example, one may be silver, and the other may be a combination of silver and palladium. For example, one may be palladium, and the other may be a combination of silver and palladium. Alternatively, one may be copper, and the other may be a combination of silver and palladium. For example, one may be gold, and the other may be a combination of silver and palladium. [0093] Depending on the combination of the first internal electrode **41** and the first underlying electrode **61**A, no Kirkendall effect may be achieved. In this case, the first internal electrode **41** may be processed to be exposed before the external electrode forming step. For example, a part of the glass film **50** may be physically removed by polishing the first end surface **22**A side of the base body **20**. Thereafter, the first internal electrode **41** and the first underlying electrode **61**A can be connected by performing the underlying electrode forming step. Alternatively, for example, after the first underlying electrode **61**A is formed, the glass film **50** is formed on a region including the surface of the first underlying electrode **61**A, and the glass film **50** covering the surface of the first underlying electrode **61**A is removed. In this respect, the same applies to the combination of the materials of the second internal electrode **42** and the second underlying electrode **62**A. [0094] The arrangement place of the first external electrode **61** is not limited to the above example. For example, the first external electrode

61 may be disposed only on the first end surface **22**A and one of the side surfaces **22**C. In this respect, the same applies to the second external electrode **62**. [0095] The glass film **50** does not have to cover substantially the entire region of the outer surface **21** of the base body **20**. The range covered by the glass film **50** may be changed appropriately in accordance with the shape of the base body **20**, the positions of the first external electrode **61** and the second external electrode **62**, and the like. [0096] As for the part of the glass film **50** covered with the first underlying electrode **61**A, the glass in the glass film **50** may be diffused into and thus integrated with the glass in the first underlying electrode **61**A. [0097] When the glass film **50** contains, as an additive, one or more elements selected from an alkali metal and an alkaline earth metal, the ratio of the additive may be less than 0.5 atm %, or may be more than 90 atm %, with respect to Si contained in the glass film **50**. [0098] The material of the glass film **50** is not limited to the above example. For example, the glass is not limited to any silicon dioxide, and may be a multicomponent oxide containing Si, such as a B—Si-based, Si—Zn-based, Zr—Si-based, or Al—Si-based oxide. In addition, the glass may be a multicomponent oxide containing an alkali metal and Si, such as an Al—Si-based, Na—Si-based, or Li—Si-based oxide. Furthermore, the glass may be a multicomponent oxide containing an alkaline earth metal and Si, such as a Mg—Si-based, Ca—Si-based, Ba—Si-based, or Sr—Si-based oxide. The glass does not have to contain Si, and may be a mixture thereof.

[0099] The material of the glass film **50** may contain, in addition to glass, a pigment, a silicone-based flame retardant, a surface treatment agent such as a silane coupling agent and a titanate coupling agent, or an antistatic agent.

[0100] More specifically, the glass film **50** may contain, in addition to the glass, additives of fine particles and nanoparticles of organic acid salts, oxides, inorganic salts, organic salts, and other metal oxides. In addition, the additive contained in the solution **87** is not limited to the potassium oxide precursor.

[0101] Examples of the organic acid salt include salts of oxo acids such as soda ash, sodium carbonate, sodium hydrogen carbonate, sodium percarbonate, sodium sulfite, sodium hydrogen sulfite, sodium sulfate, sodium thiosulfate, sodium nitrate, and sodium sulfite, and halogen compounds such as sodium fluoride, sodium chloride, sodium bromide, and sodium iodide.

[0102] Examples of the oxide include sodium peroxide, and examples of the hydroxide include sodium hydroxide.

[0103] Examples of the inorganic salt include sodium hydride, sodium sulfide, sodium hydrogen sulfide, sodium silicate, trisodium phosphate, sodium borate, sodium borohydride, sodium cyanide, sodium cyanate, and sodium tetrachloroaurate.

[0104] Examples of the inorganic salt include calcium peroxide, calcium hydroxide, calcium fluoride, calcium chloride, calcium bromide, calcium iodide, calcium hydride, calcium carbide, and calcium phosphide.

[0105] The additive may be an oxoacid salt such as calcium carbonate, calcium hydrogen carbonate, calcium nitrate, calcium sulfate, calcium sulfite, calcium silicate, calcium phosphate, calcium pyrophosphate, calcium hypochlorite, calcium chlorate, calcium perchlorate, calcium bromate, calcium iodate, calcium arsenite, calcium chromate, calcium tungstate, calcium molybdate, calcium magnesium carbonate, or hydroxyapatite. Examples of the additive include calcium acetate, calcium gluconate, calcium citrate, calcium malate, calcium lactate, calcium benzoate, calcium stearate, and calcium aspartate.

[0106] For example, the additive may be lithium carbonate, lithium chloride, lithium titanate, lithium nitride, lithium peroxide, lithium citrate, lithium fluoride, lithium hexafluorophosphate, lithium acetate, lithium iodide, lithium hypochlorite, lithium tetraborate, lithium bromide, lithium nitrate, lithium hydroxide, lithium aluminum hydride, lithium triethylborohydride, lithium hydride, lithium amide, lithium imide, lithium diisopropylamide, lithium tetramethylpiperidide, lithium sulfide, lithium sulfate, lithium thiophenolate, or lithium phenoxide.

[0107] For example, the additive may be boron triiodide, sodium cyanoborohydride, sodium

borohydride, tetrafluoroboric acid, triethylborane, borax, or boric acid.
[0108] For example, the additive may be barium sulfite, barium chloride, barium chlorate, barium perchlorate, barium peroxide, barium chromate, barium acetate, barium cyanide, barium bromide, barium oxalate, barium nitrate, barium hydroxide, barium hydride, barium carbonate, barium iodide, barium sulfide, or barium sulfate. In addition, the additive may be sodium acetate or sodium citrate.
[0109] The additive may be fine particles or nanoparticles of a metal oxide, and examples of the metal oxide include sodium oxide, calcium oxide, lithium oxide, boron oxide, barium oxide, silicon oxide, titanium oxide, zircon oxide, aluminum oxide, zinc oxide, and magnesium oxide.
[0110] In addition, as mentioned above, examples of the potassium oxide precursor include potassium arsenide, potassium bromide, potassium carbide, potassium chloride, potassium fluoride, potassium hydride, potassium iodide, potassium triiodide, potassium azide, potassium nitride, potassium superoxide, potassium ozonide, potassium peroxide, potassium phosphide, potassium sulfide, potassium selenide, potassium telluride, potassium tetrafluoroaluminate, potassium tetrafluoroborate, potassium tetrahydroborate, potassium methanide, potassium cyanide, potassium formate, potassium hydrogen fluoride, potassium tetraiodomercurate (II), potassium hydrogen sulfide, potassium octachlorodimolybdate (II), potassium amide, potassium hydroxide, potassium hexafluorophosphate, potassium carbonate, potassium tetrachloroplatinate (II), potassium hexachloroplatinate (IV), potassium nonahydridorhenate (VII), potassium sulfate, potassium acetate, gold (I) potassium cyanide, potassium hexanitritocobaltate (III), potassium hexacyanoferrate (III), potassium hexacyanoferrate (II), potassium methoxide, potassium ethoxide, potassium tert-butoxide, potassium cyanate, potassium fulminate, potassium thiocyanate, potassium aluminum sulfate, potassium aluminate, potassium arsenate, potassium bromate, potassium hypochlorite, potassium chlorite, potassium chlorate, potassium perchlorate, potassium carbonate, potassium chromate, potassium dichromate, potassium tetrakis (peroxo) chromate (V), potassium cuprate (III), potassium ferrate, potassium iodate, potassium periodate, potassium permanganate, potassium manganate, potassium hypomanganate, potassium molybdate, potassium nitrite, potassium nitrate, tripotassium phosphate, potassium perrhenate, potassium selenate, potassium silicate, potassium sulfite, potassium sulfate, potassium thiosulfate, potassium disulfite, potassium dithionate, potassium disulfate, potassium peroxodisulfate, potassium dihydrogenarsenate, dipotassium hydrogen arsenate, potassium hydrogen carbonate, potassium dihydrogen phosphate, dipotassium hydrogen phosphate, potassium hydrogen selenate, potassium hydrogen sulfite, potassium hydrogen sulfate, and potassium hydrogen peroxosulfate.
[0111] The metal alkoxide **85** may be, for example, sodium methoxide, sodium ethoxide, calcium diethoxide, lithium isopropoxide, lithium ethoxide, lithium tert-butoxide, lithium methoxide, boron alkoxide, potassium t-butoxide, tetraethyl orthosilicate, allyltrimethoxysilane, isobutyl(trimethoxy)silane, tetrapropyl orthosilicate, tetramethyl orthosilicate, [3-(diethylamino)propyl]trimethoxysilane, triethoxy(octyl)silane, triethoxyvinylsilane, triethoxyphenylsilane, trimethoxyphenylsilane, trimethoxymethylsilane, butyltrichlorosilane, n-propyltriethoxysilane, methyltrichlorosilane, dimethoxy(methyl)octylsilane, dimethoxydimethylsilane, tris(tert-butoxy)silanol, tris(tert-pentoxy)silanol, hexadecyltrimethoxysilane, dipotassium tris(1,2-benzenediolato-O,O′) silicate, tetrabutyl orthosilicate, aluminum silicate, calcium silicate, a tetramethylammonium silicate solution, chlorotriisopropoxytitanium (IV), titanium (IV) isopropoxide, titanium (IV) 2-ethylhexyl oxide, titanium (IV) ethoxide, titanium (IV) butoxide, titanium (IV) tert-butoxide, titanium (IV) propoxide, titanium (IV) methoxide, zirconium (IV) bis (diethyl citrato) dipropoxide, zirconium (IV) dibutoxide (bis-2,4-pentanedionate), zirconium (IV) 2-ethylhexanoate, a zirconium (IV) isopropoxide isopropanol complex, zirconium (IV) ethoxide, zirconium (IV) butoxide, zirconium (IV) tert-butoxide, zirconium (IV) propoxide, aluminum tert-butoxide, aluminum isopropoxide, aluminum ethoxide, aluminum-tri-sec-butoxide, or aluminum phenoxide. [0112] The arithmetic

average roughness of the outer surface **51** of the glass film **50** may be less than 0.1 nm. That is, the outer surface **51** of the glass film **50** may be smoother than the example described above. The arithmetic average roughness of the outer surface **51** of the glass film **50** may be larger than 5 nm. The present disclosure makes it possible to reduce the arithmetic average roughness of the outer surface **51** of the glass film **50** with respect to the arithmetic average roughness of the outer surface **21** of the base body **20**, compared to the case where the glass film **50** contains no additive. Thereby, the effect described in (1) can be obtained. [0113] The arithmetic average roughness of the outer surface **21** of the base body **20** may be less than 5.9 nm or may be greater than 500 nm. When the outer surface **51** of the glass film **50** is sufficiently smooth compared to the roughness of the outer surface **21** of the base body **20**, the effect described in (1) can be obtained. [0114] The method for measuring the arithmetic average roughness of the outer surface **51** of the glass film **50** and the arithmetic average roughness of the outer surface **21** of the base body **20** is not limited to the above example. For example, each arithmetic average roughness may be obtained as follows: the section of the base body **20** is captured with an electron microscope, and the captured image is subjected to image analysis within a range of at least 10 μm or more in a direction along the outer surface **51** of the glass film **50**. When the roughness of the outer surface **21** of the base body **20** is not substantially constant as a whole, the outer surface **51** of the glass film **50** and the outer surface **21** of the base body **20** may be measured at substantially the same portion to obtain each arithmetic average roughness by the above method. [0115] When the arithmetic average roughness of the outer surface **51** of the glass film **50** and the arithmetic average roughness of the outer surface **21** of the base body **20** are measured, instruments such as a white interferometer, an atomic force microscope, and a stylus profiling system may be used instead of a laser microscope. In addition, the instrument to measure the arithmetic average roughness of the outer surface **51** of the glass film **50** and the instrument to measure the arithmetic average roughness of the outer surface **21** of the base body **20** may be non-identical to each other. For example, the arithmetic average roughness of the outer surface **51** of the glass film **50** is measured using a white interferometer, and the arithmetic average roughness of the outer surface **21** of the base body **20** is measured using a laser microscope.

Supplementary Note

[0116] Technical ideas that can be derived from the above discussion and modifications will be described below.

[1]

[0117] An electronic component including: a base body; and a glass film covering an outer surface of the base body, wherein [0118] the glass film contains one or more elements selected from an alkali metal and an alkaline earth metal as an additive, [0119] the glass film has a thickness of, as an average value, 80 nm or more and 5000 nm or less, and [0120] a ratio of an arithmetic average roughness of an outer surface of the glass film to an arithmetic average roughness of an outer surface of the base body is 0.0002 or more and 0.85 or less.

[2]

[0121] The electronic component according to [1], wherein the arithmetic average roughness of the outer surface of the glass film is 0.1 nm or more and 5 nm or less.

[3]

[0122] The electronic component according to [1] or [2], wherein the arithmetic average roughness of the outer surface of the base body is 5.9 nm or more and 500 nm or less.

[4]

[0123] The electronic component according to any one of [1] to [3], further including an underlying electrode partly covering the glass film, wherein [0124] the underlying electrode contains glass.

[5]

[0125] The electronic component according to any one of [1] to [4], wherein a ratio of the additive to Si contained in the glass film is 0.5 atm % or more and 90 atm % or less.

DESCRIPTION OF REFERENCE SYMBOLS

[0126] **10**: Electronic component [0127] **20**: Base body [0128] **50**: Glass film [0129] **51**: Outer surface [0130] TG: Thickness

Claims

1. An electronic component, comprising: a base body; and a glass film covering an outer surface of the base body, wherein the glass film contains one or more elements selected from an alkali metal and an alkaline earth metal as an additive, the glass film has a thickness of 80 nm or more and 5000 nm or less, and a ratio of an arithmetic average roughness of an outer surface of the glass film to an arithmetic average roughness of the outer surface of the base body is 0.0002 or more and 0.85 or less.
2. The electronic component according to claim 1, wherein the arithmetic average roughness of the outer surface of the glass film is 0.1 nm or more and 5 nm or less.
3. The electronic component according to claim 1, wherein the arithmetic average roughness of the outer surface of the base body is 5.9 nm or more and 500 nm or less.
4. The electronic component according to claim 2, wherein the arithmetic average roughness of the outer surface of the base body is 5.9 nm or more and 500 nm or less.
5. The electronic component according to claim 1, further comprising: an underlying electrode at least partly covering the glass film, wherein the underlying electrode contains glass.
6. The electronic component according to claim 2, further comprising: an underlying electrode at least partly covering the glass film, wherein the underlying electrode contains glass.
7. The electronic component according to claim 3, further comprising: an underlying electrode at least partly covering the glass film, wherein the underlying electrode contains glass.
8. The electronic component according to claim 1, wherein the glass film contains Si, and a ratio of the additive to the Si contained in the glass film is 0.5 atm % or more and 90 atm % or less.
9. The electronic component according to claim 2, wherein the glass film contains Si, and a ratio of the additive to the Si contained in the glass film is 0.5 atm % or more and 90 atm % or less.
10. The electronic component according to claim 3, wherein the glass film contains Si, and a ratio of the additive to the Si contained in the glass film is 0.5 atm % or more and 90 atm % or less.
11. The electronic component according to claim 5, wherein the glass film contains Si, and a ratio of the additive to the Si contained in the glass film is 0.5 atm % or more and 90 atm % or less.
12. The electronic component according to claim 1, wherein the thickness of the glass film is an average value thickness of 80 nm or more and 5000 nm or less.
13. A thermistor, comprising: the electronic component according to claim 1, wherein a resistance value of the thermistor decreases as a temperature of the thermistor increases.
14. A thermistor, comprising the electronic component according to claim 1.
15. An inductor, comprising: a wiring; and the electronic component according to claim 1, wherein the wiring is inside of the base body.
16. The electronic component according to claim 1, wherein the base body is composed of a resin and a metal powder.
17. The electronic component according to claim 5, wherein the glass film is diffused into and integrated with the underlying electrode.
18. The electronic component according to claim 1, wherein the glass film is a multicomponent oxide containing Si, such as a B—Si-based, Si—Zn-based, Zr—Si-based, or Al—Si-based oxide.
19. The electronic component according to claim 1, wherein the glass film is a multicomponent oxide containing an alkali metal and Si, such as an Al—Si-based, Na—Si-based, or Li—Si-based oxide.
20. The electronic component according to claim 1, wherein the glass film is a multicomponent

oxide containing an alkaline earth metal and Si, such as a Mg—Si-based, Ca—Si-based, Ba—Si-based, or Sr—Si-based oxide.