

明 細 書

発 明 の 名 称

電子部品とその製造方法

技 術 分 野

- 5 本発明は、例えば積層バリスタなどの電子部品とその製造方法に関するものである。

背 景 技 術

- 素体の外表面に少なくとも一対の電極を有する従来の電子部品は、この素体表面の電極非形成面のみに樹脂を含浸させた構成となっていた。
- 10

この構成によると、素体中に含浸された樹脂により耐湿性は向上するが、電極端部から水分などが浸入し、特性劣化を起こすという問題点を有していた。

発 明 の 開 示

- 15 そこで本発明は、電極端部を絶縁層で被覆することにより、電極端部からの水分などの浸入を防止できる電子部品を提供することを目的とするものである。

- そしてこの目的を達成するために、本発明の電子部品は、素体と、この素体の外表面に所定の間隔を設けて形成した少なくとも一対の電極と、前記素体表面の前記電極の非形成部分及び前記電極の端部を覆うように設けた絶縁層とを備え、前記絶縁層の少なくとも一部は、前記素体の内表面に含浸されているものである。この構成により、外表面に設けた絶縁層が電極端部を被覆しているので、電極端部の剥離を防ぐとともに電極端部
- 20
- 25 からの水分などの浸入を防止することができるものである。

図面の簡単な説明

第1図は本発明の一実施例における積層バリスタの断面図、
第2図は本発明の一実施例における積層バリスタの製造工程
図、第3図は本発明の一実施例におけるSiワニスに含浸後の
5 バリスタ素子の断面図、第4図は本発明の一実施例における遠
心分離工程後のバリスタ素子の断面図、第5図は本発明の一実
施例におけるトルエンに浸漬後のバリスタ素子の断面図、第6
図は本発明の一実施例におけるSi樹脂硬化後のバリスタ素子
の断面図、第7図は本発明の一実施例における研磨後のバリ
10 スタ素子の断面図である。

発明を実施するための最良の形態

以下、本発明の電子部品とその製造方法の一実施例について
図面を参照しながら詳細に説明する。

1はバリスタ素子で、内部にNiを主成分とする内部電極2
15 が複数設けられている。これらの内部電極2は、交互にバリ
スタ素子1の両端面に引き出され、その両端面において外部電
極3と電氣的に接続されている。外部電極3は少なくとも二重構
造となっており、内層3aはNiを主成分とし、外層3bはAg
を主成分としている。また、内部電極2間、及びその外側のセ
20 ラミックシート1aは、 SrTiO_3 を主成分とし、副成分と
して、 Nb_2O_5 、 SiO_2 等を含んでいる。30は内表面絶縁
層で、Si樹脂よりなり、バリスタ素子1内部の気孔表面を被
覆あるいは気孔に充填させて形成した層である。31は外表面
絶縁層で外部電極3の端部を被覆しており、Si樹脂で形成さ
25 れたものである。また外部電極3の表面にはNiメッキ4a、

3

半田メッキ 4 b よりなるメッキ層 4 を形成している。

第 2 図において、セラミックシート 1 a は (1 1) で示すごとく原料の混合、仮焼、粉碎、スラリー化、シート成形により作られる。次に、このセラミックシート 1 a と、内部電極 2 と
5 を積層 (1 2) し、それを切断 (1 3)、脱バイ (1 4)、面とり (1 5) し、端部を曲線状にする。次に、外部電極 3 の内層 3 a を塗布 (1 6) し、1 2 0 0 ~ 1 3 0 0 °C で還元焼成 (1 7) し、その後外層 3 b を塗布 (1 8) し、8 0 0 ~ 8 5 0 °C で再酸化のために加熱 (1 9) する。次に、完全に乾燥させた
10 バリスタ素子 1 を溶剤としてトルエン 7 5 % を含む S i ワニスに浸漬し (2 0)、バリスタ素子 1 に S i ワニスを含浸させる。

その後、バリスタ素子 1 を S i ワニスに浸漬したまま 6 ~ 1 5 0 0 kg / cm² に加圧し (2 1)、S i ワニスをさらにバリスタ素子 1 に含浸させるため、例えば 2 分間保持した後積層バリスタが使用される状態である大気圧にもどす。この時のバリスタ素子 1 は第 3 図に示すように表面全体が S i ワニス 5 に厚く覆われているとともに、バリスタ素子 1 及び外部電極 3 内にも S i ワニス 5 が含浸されている。この時の加圧力はバリスタ素子 1 の密度により決定する。つまり密度の大きいバリスタ素子 1 ほど加圧力も大きくして含浸させやすくする。例えば Z n O を主成分とするバリスタ素子の場合、密度が高いため 5 0 0 ~ 1 5 0 0 kg / cm² と加圧力を高くする。その後、S i ワニスよりバリスタ素子 1 を取り出し、金属製網かご (あるいはネット
20 等) に入れて、例えば内径 6 0 cm の遠心分離装置にセットし、
25

4

500 ~ 1500 r/minで作動させ（第2図の22）、第4図に示すようにバリスタ素子1の外表面に付着した不要なSiワニス5の大部分を除去する。さらに、金属製網かごとトルエンに浸漬し（23）、5 ~ 60秒間振動を与えた後取り出し、例えば60℃で速やかに加熱して、第5図に示すようにバリスタ素子1外表面に付着しているトルエンを除去する。またトルエンに浸漬させる代わりに、バリスタ素子1を金属製網かごと取り出し、Siワニス5と反応しない粉末であるSiO₂粉末をバリスタ素子1に接触させて、SiO₂粉末にバリスタ素子1外表面の不要なSiワニス5を吸い込ませた後、ふるい等を利用してバリスタ素子1を分離する方法をとっても良い。以上の方法により、バリスタ素子1表面上の不要なSiワニス5は除去される。その後バリスタ素子1を金属製網上に並べ、Siワニス5中に含まれるSi樹脂の硬化温度以上の温度（約125 ~ 200℃）でSi樹脂硬化のための加熱を行い（24）、この時、外部電極3及びバリスタ素子1内部に含浸されていたSi樹脂の一部が析出し、表面を覆い第6図に示すようなバリスタ素子1を得る。その後、例えばポリエチレンの容器にバリスタ素子1、SiC製研磨材、水を入れて密閉し、回転、振動等の機械的な方法で運動させることにより、表面研磨を行い（25）、第7図に示すように外部電極3表面上のSi樹脂をメッキ等の後工程に影響を及ぼさない程度まで除去する。この表面研磨（25）により、バリスタ素子1に加わる機械ストレス、及び硬化後のSi樹脂との接着強度が外部電極3よりもバリスタ素子1の方が優位なことにより、外部電極3外表面上のSi樹脂

5

を選択的に除去することができる。この時外部電極3の内表面には、Si樹脂は残っていても良く、このSi樹脂により外部電極3の電氣的接続が妨げられることはない。

次いでこのバリスタ素子1の外部電極3の表面にメッキ(26)5
を行い第1図に示すような積層バリスタを得る。

以上のように、バリスタ素子1内部にSi樹脂を含浸させた内表面絶縁層30を形成することにより耐湿性に優れ、且つ、外表面絶縁層31を形成することにより、外部電極3の端部の剥離が起きず、外部電極3において、メッキ(26)等の後工10
程に影響を及ぼさない積層バリスタを得ることが可能となる。

ここで、本実施例における積層バリスタ及びこの製造方法において、特徴となることを以下に示す。

I. 第1図に示すように外表面絶縁層31は、バリスタ素子1の側面にかかるように形成した外部電極3の端部を覆うよう15
に形成することにより、外部電極3とバリスタ素子1の境界からバリスタ素子1内部へのメッキ液、水分等の浸入を防ぐことができる。

II. 外表面絶縁層31、内表面絶縁層30は光沢を有しているので、積層バリスタ表面の光沢を確認することにより、内表面絶縁層30及び外表面絶縁層31を形成済みかどうかを視20
覚的に判断することができ、選別を容易に行うことができる。

III. 外表面絶縁層31、内表面絶縁層30の形成にSi樹脂を用いたが、硬化後、耐熱性を有し、絶縁性、撥水性が高く、25
吸水率が小さい樹脂であれば構わず、Si樹脂のほかに、エ

ポキシ系樹脂、アクリル系樹脂、ポリブタジエン系樹脂、フェノール系樹脂等があり、これらの中から一種類以上を用いても構わない。

5 また樹脂の代わりに、あるいは樹脂と混合して、シリコン、チタン、アルミニウム、ジルコニウム、イットリウム、マグネシウムから選ばれる少なくとも一種類以上の金属アルコキシドを用いても同様の効果が得られる。

10 金属アルコキシドを用いる場合は、アルコールなど金属アルコキシドが溶解することができる溶媒を用いて含浸液を製作する。

15 IV. 内表面絶縁層 30 の厚みは、積層バリスタとしての特性に影響を与えない範囲で出来るだけ大きい方が望ましく、さらには硬化後の Si 樹脂の内表面絶縁層 30 の厚みが一番薄いところで $10\ \mu\text{m}$ 以上となることが望ましい。これは、Siワニス 5 の粘度、溶剤率、加圧力の選択により調整することができる。

V. バリスタ素子 1 を Siワニス 5 に含浸させて加圧する前に、大気圧よりも低くした状態を設けて、加圧の効果を高めてもよい。

20 VI. Siワニス 5 と反応しない粉末として SiO_2 を用いたが、バリスタ素子 1 に含浸させる含浸液と反応しない粉末であればよく、 ZrO_2 、 Al_2O_3 、 MgO やあるいはこれらを混合したものなども用いることができる。

25 VII. Siワニス 5 をバリスタ素子 1 に含浸させて硬化させる前に、Siワニス 5 に含まれる溶剤を、突沸しない温度に加熱

して十分に除去してから、S i 樹脂の硬化処理を行うことにより、密度の高い外表面絶縁層 3 1 を形成することができる。

5 Ⅷ. S i ワニス 5 への浸漬から表面研磨までを複数回、好ましくは 2 回繰り返すことにより、バリスタ素子 1 内部により S i 樹脂を含浸させることができるので、さらに耐湿特性を向上させることができる。

10 IX. 素体の端部は曲線状である方が望ましく、これにより外部電極 3 上の有機物を研磨により除去する場合、外部電極 3 の一部へのストレスの集中を緩和することができる。

なお、本実施例においてはチタン酸ストロンチウムを主成分とする積層バリスタを例に説明したが、酸化亜鉛を主成分とする積層バリスタはもちろん、セラミック素子を用いるものでも、サーミスタ、コンデンサ、抵抗等電子部品全般において同様の効果が得られる。また、形状も積層型だけでなく
15 ディスク型などどのような形状でも構わない。

産業上の利用可能性

20 以上本発明によると、内表面に含浸された絶縁層により耐湿特性が劣化を防ぐと共に、外表面の絶縁層により電極強度が向上するので、電極端部の剥離も防ぐことができる。また電極端部からの水分などの浸入を防ぐこともできるのでさらに耐湿特性が向上する。

請 求 の 範 囲

1. 素体と、この素体の外表面に所定の間隔を設けて形成した
少なくとも一対の電極と、前記素体表面の前記電極の非形
成部分及び前記電極の端部を覆うように設けた絶縁層とを
5 備え、前記絶縁層の少なくとも一部は、前記素体の内表面
に含浸されている電子部品。
2. 請求の範囲第1項において、絶縁層は、金属アルコキシド
または樹脂の少なくとも一方を用いて形成されたことを特
徴とする電子部品。
- 10 3. 請求の範囲第1項において、絶縁層を金属アルコキシドに
より形成し、この金属アルコキシドは、シリコン、チタ
ン、アルミニウム、ジルコニウム、イットリウム、マグネ
シウムから選ばれる少なくとも一種類以上の金属を有する
ことを特徴とする電子部品。
- 15 4. 請求の範囲第1項において、絶縁層を樹脂により形成し、
この樹脂は、シリコン系樹脂、エポキシ系樹脂、アクリル
系樹脂、ポリブタジエン系樹脂、フェノール系樹脂のう
ちの少なくとも一種類以上であることを特徴とする電子部品。
5. 請求の範囲第1項において、素体の内表面に含浸されてい
20 る絶縁層は、 $10\mu\text{m}$ 以上であることを特徴とする電子部
品。
6. 請求の範囲第1項において、素体外表面の絶縁層の厚み
は、この絶縁層に隣接する電極の最大の厚みよりも小さい
ことを特徴とする電子部品。
- 25 7. 請求の範囲第1項において、素体の端部は曲線状であるこ



とを特徴とする電子部品。

8. 素体と、この素体の外表面に所定の間隔を設けて形成した
少なくとも一対の電極と、前記素体の表面の少なくとも電
極の非形成部分に設けた絶縁層とを備え、前記素体外表面
5 は光沢を有することを特徴とする電子部品。
9. 素体の外表面に所定の間隔を設けて少なくとも一対の電極
を形成する工程と、次に前記素体の外表面を少なくとも有
機物を含む含浸液に接触させて前記含浸液で前記素体外表
面を被覆する工程と、次に前記素体外表面を被覆する含浸
10 液の一部を除去する工程と、次いで前記含浸液中の有機物
を硬化させる工程と、その後前記素体の前記電極外表面の
硬化した有機物を研磨により除去する工程とを有すること
を特徴とする電子部品の製造方法。
10. 請求の範囲第9項において、素体を含浸液に接触させる工
15 程を複数回繰り返すことを特徴とする電子部品の製造方法。
11. 請求の範囲第9項において、有機物は、金属アルコキシド
または樹脂の少なくとも一方を含んでいることを特徴とす
る電子部品の製造方法。
12. 請求の範囲第9項において、有機物は金属アルコキシドを
20 含み、この金属アルコキシドは、シリコン、チタン、アル
ミニウム、ジルコニウム、イットリウム、マグネシウムの
うちの少なくとも一種類以上の金属アルコキシドであるこ
とを特徴とする電子部品の製造方法。
13. 請求の範囲第9項において、有機物は樹脂を含み、この樹
25 脂は、シリコン系樹脂、エポキシ系樹脂、アクリル系樹



脂、ポリブタジエン系樹脂、フェノール系樹脂のうちの少なくとも一種類以上であることを特徴とする電子部品の製造方法。

- 5 14. 請求の範囲第9項において、素体を含浸液に接触させた状態で加圧することを特徴とする電子部品の製造方法。
15. 請求の範囲第9項において、素体外表面の有機物の除去は、遠心分離、有機物が可溶な液体による洗浄、含浸液と反応しない粉末との接触のうち少なくとも一つを用いて行うことを特徴とする電子部品の製造方法。
- 10 16. 請求の範囲第15項において、粉末は、 SiO_2 , ZrO_2 , Al_2O_3 , MgO のうち少なくとも一種類以上を含んでいることを特徴とする電子部品の製造方法。
- 15 17. 請求の範囲第9項において、研磨は、少なくとも素体と液体とを入れた容器を運動させて行うことを特徴とする電子部品の製造方法。
18. 請求の範囲第9項において、素体の端部を曲線状にしてから電極を形成することを特徴とする電子部品の製造方法。



Fig. 1

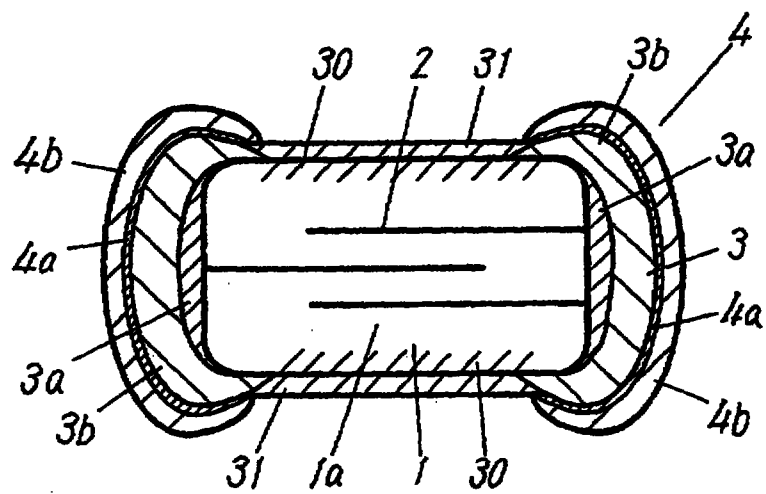


Fig. 2

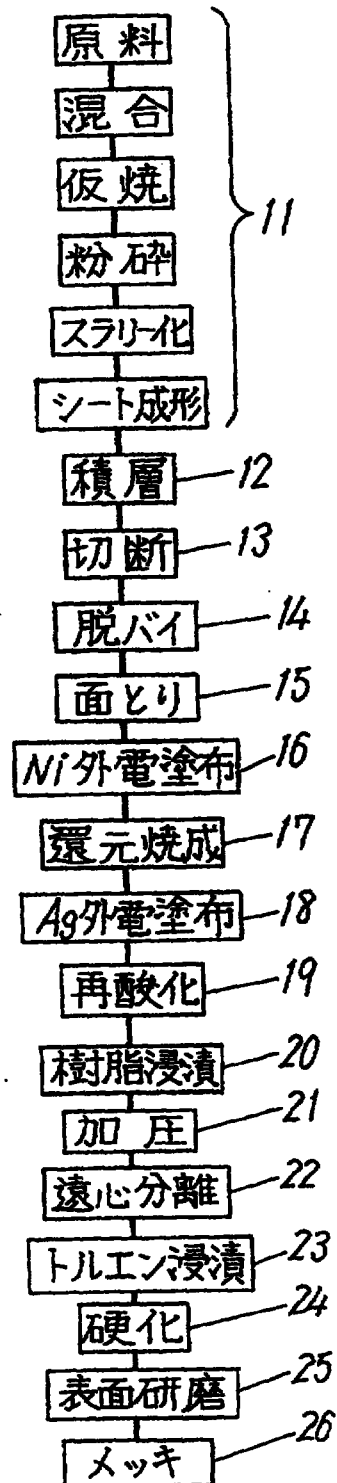


Fig. 3

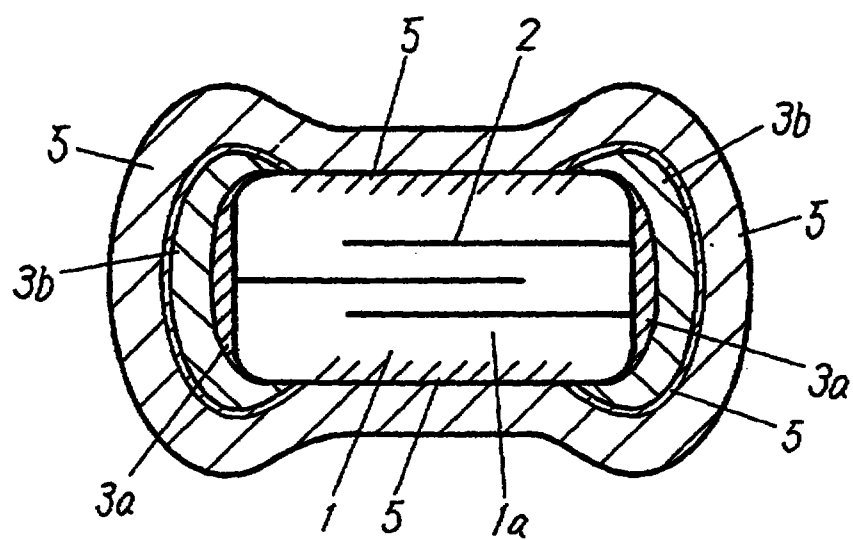


Fig. 4

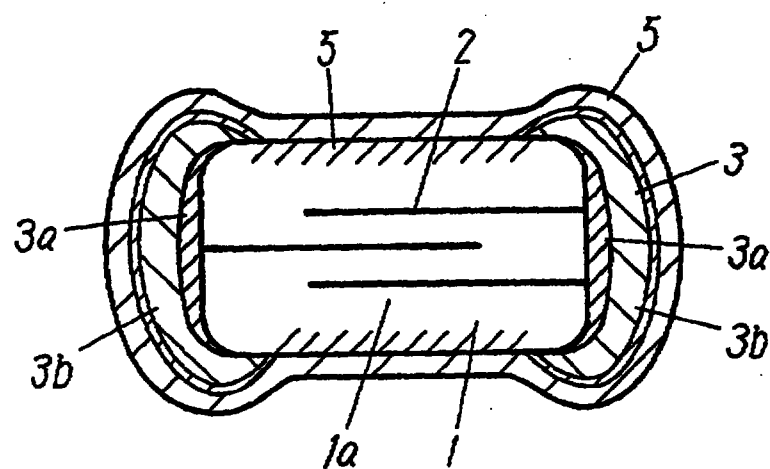


Fig. 5

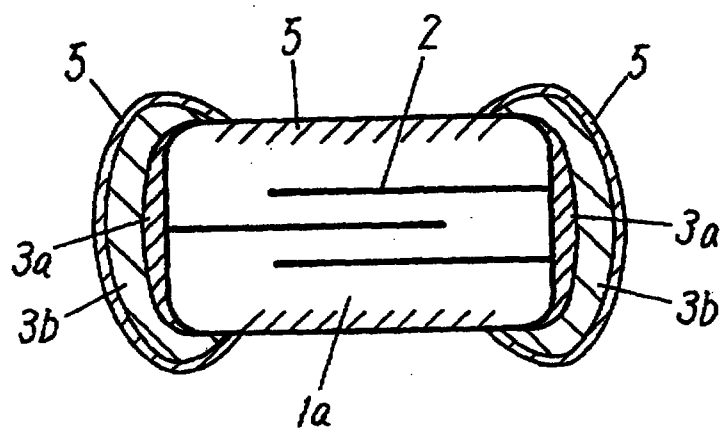


Fig. 6

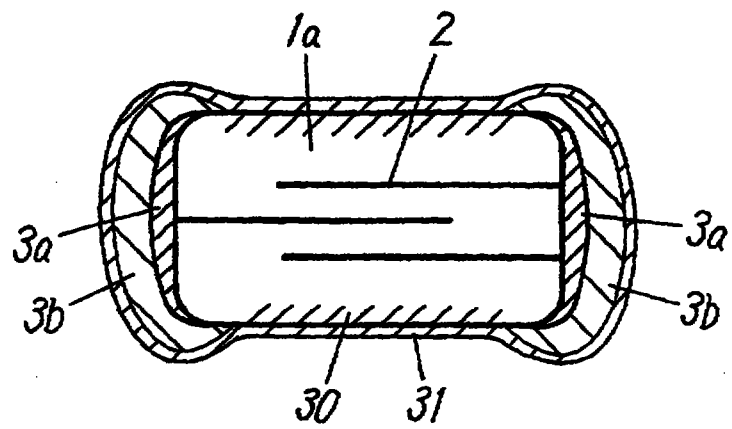
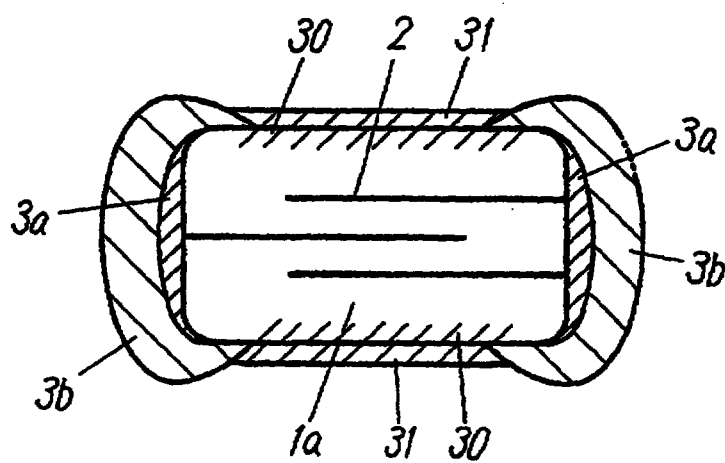


Fig. 7



8/8

図面の参照符号の一覧表

	1	… …	バリスタ素子
	2	… …	内部電極
	3	… …	外部電極
5	3 a	… …	内層
	3 b	… …	外層
	4	… …	メッキ層
	4 a	… …	N i メッキ
	4 b	… …	半田メッキ
10	5	… …	S i ワニス
	3 0	… …	内表面絶縁層
	3 1	… …	外表面絶縁層

SPECIFICATION

TITLE OF THE INVENTION

Electronic Component and Method of Manufacture Therefor

TECHNICAL FIELD

The present invention relates to electronic components such as a multilayer varistor etc., and a method of manufacturing the same.

BACKGROUND ART

A conventional electronic component having at least a pair of electrodes on the surface of body is impregnated with resin on the surface only in an area where the electrodes are not formed.

The water-resisting quality may be improved by the resin impregnated in the body. However, there is a problem in the above described structure that the water etc. sneaks into through the edge of electrode causing deteriorated characteristics.

DISCLOSURE OF THE INVENTION

The present invention aims to present an electronic component with which the sneaking of water etc. through the electrode edge is prevented by covering the electrode edge with an insulating layer.

An electronic component according to the present invention comprises a body, at least a pair of electrodes formed on the surface of the body at a specified gap, and an insulation layer provided for covering the surface of the body in an area where the electrodes are not formed and the edge of the electrode, wherein at least a part of the insulation layer is formed by impregnating an insulation material into within-the-surface of the body. With the above described structure in which an insulation layer provided on the surface covers

This Sheet Has Been Replaced



the edge of electrodes, peeling-off at the edge of electrode is prevented, at the same time the sneaking of water through the electrode edge is also avoided.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig.1 is a cross sectional view showing a multilayer varistor according to an embodiment of the present invention. Fig.2 is a chart showing manufacturing process steps of a multilayer varistor according to an embodiment of the present invention. Fig.3 is a cross sectional view showing a varistor after silicone varnish impregnation according to an embodiment of the present invention. Fig.4 is a cross sectional view showing a varistor after centrifugal processing according to an embodiment of the present invention. Fig.5 is a cross sectional view showing a varistor after toluene impregnation according to an embodiment of the present invention. Fig.6 is a cross sectional view showing a varistor after silicone resin curing according to an embodiment of the present invention. Fig.7 is a cross sectional view showing a varistor after grinding according to an embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

In the following, an electronic component according to the present invention and a method of manufacturing the same is described in detail referring to drawings.

As shown in Fig. 1, there are plural internal electrodes 2 made mainly of nickel (Ni), inside varistor 1. These internal electrodes 2 are alternately pulled out to respective ends of varistor 1 to be electrically connected with external electrodes 3. The external electrode 3 is comprised of at least two layers; an inner layer 3a is made mainly of Ni, an outer layer 3b is made mainly of silver (Ag).



A ceramic sheet 1a existing between and outside the internal electrodes 2 is made mainly of SrTiO_3 , containing Nb_2O_5 , SiO_2 etc. as subordinate component. A within-the-surface insulation layer 30 is a layer formed by covering the porous surface inside the varistor 1 or filling the pore with silicone resin. An outside-the-surface insulation layer 31 is a layer of silicone resin covering the edge of external electrode 3. On the surface of external electrode 3 is a layer of plating 4, comprised of Ni layer 4a and solder layer 4b.

As shown in Fig. 2, the ceramic sheet 1a is manufactured through the process (11); mixing of raw materials, calcination, crashing, slurring and forming in a sheet form. The ceramic sheet 1a and internal electrodes 2 are laminated (12), cut (13), binder is removed (14), chamfered (15), and the edge is curved. Inner layer 3a of external electrode 3 is formed through coating (16) and sintering (17) at $1200 - 1300^\circ\text{C}$ in reducing atmosphere. Then, outer layer 3b is formed through coating (18) and heating (19) at $800 - 850^\circ\text{C}$ for reoxidizing. A completely dried varistor 1 is immersed (20) in silicone varnish containing 75% toluene as solvent to have the varistor 1 impregnated with silicone varnish.

Varistor 1 is pressurized (21) by $6 - 1500\text{kg/cm}^2$ for e.g. 2 minutes while being immersed in the silicone varnish in order to have the varistor 1 impregnated further with the silicone varnish, and then restored to the normal atmospheric pressure, at which the multilayer varistor is put on service. The varistor 1 at this stage is covered thick with silicone varnish 5 for the entire surface, with the varistor 1 and the external electrodes 3 impregnated with silicone varnish 5, as shown in Fig. 3. The pressurizing force may be determined according to the density of varistor 1; namely, varistor 1 of a higher density may be pressurized with a higher force for the easier impregnation. In the case of a varistor whose main component

is ZnO , the density of which is high and the pressurizing force may be raised to $500 - 1500 \text{ kg/cm}^2$.

The varistor 1 is taken out of the silicone varnish, and put into a metal basket (or metal net etc.) to be set on a centrifugal separator having inner diameter of e.g. 60cm running at $500 - 1500 \text{ r/min}$. (22 in Fig. 2) for removing most portion of unnecessary silicone varnish sticking on the surface of varistor 1, as shown in Fig. 4. Then, the metal basket containing the varistor is immersed in toluene (23), vibrated for $5 - 60 \text{ sec.}$, taken out, and quickly heated at e.g. 60°C for removing the toluene sticking on the surface of varistor 1, as shown in Fig. 5. Instead of immersing in toluene, varistor 1 may be taken out of the metal basket to be put in SiO_2 powder, which is inert to the silicone varnish, to have unnecessary silicone varnish 5 sticking on the surface of varistor 1 absorbed, and then separating the varistor 1 using a sieve or such other devices. Through the above described procedure, unnecessary portion of silicone varnish 5 sticking on the surface of varistor 1 is removed.

And then, varistor 1 is put on a metal net to be heated at a temperature (approximately $125 - 200^\circ\text{C}$) higher than the curing temperature of silicone resin contained in the silicone varnish 5 for curing (24) the silicone resin. When, a part of the silicone resin impregnated within external electrodes 3 and inside of varistor 1 is separated out to cover the surface, and a varistor 1 as shown in Fig. 6 is obtained. After this, varistor 1 is put into a container of e.g. polyethylene together with an abrasive of SiC and water, the container sealed, and provided with mechanical movement such as revolution, vibration etc. for grinding (25) the surface, in order to remove the silicone resin covering the surface of external electrodes 3 to a degree so as plating and other succeeding process steps are not ill-affected. During the surface grinding (25), the silicone

resin on the surface of external electrodes 3 is selectively removed by a mechanical stress given to varistor 1 due to a fact that the adhesion strength of silicone resin after curing is stronger with respect to varistor 1 than with the surface of external electrode 3. Some of the silicone resin may remain in the inner surface of external electrode 3, the electrical contact of external electrode 3 is not affected by the silicone resin.

The surface of external electrode 3 of varistor 1 is plated (26) to obtain a multilayer varistor as illustrated in Fig. 1.

As described in the above, a multilayer varistor having enhanced water-resisting property is implemented by the formation of a silicone resin-impregnated within-the-surface insulation layer 30 inside the varistor 1, with which multilayer varistor the peeling-off at the edge of external electrode 3 is also prevented by the formation of an outside-the-surface insulation layer 31, and the external electrode 3 does not ill-affect plating (26) and other post processes.

Now in the following, description will be made on some of the noticeable items regarding a multilayer varistor according to the present embodiment and its manufacturing method.

Referring to Fig. 1, by forming an outside-the-surface insulation layer 31 so as it covers the edge of external electrodes 3 formed at the ends of varistor 1 covering a part of the side surface, the sneaking of plating liquid, water etc. into inside of varistor 1 through the boundary between external electrode 3 and varistor 1 is prevented.

As an outside-the-surface insulation layer 31 and a within-the-surface insulation layer 30 have glossy surface, whether or not the within-the-surface insulation layer 30 and the outside-the-surface insulation layer 31 are formed can be visually identified by inspecting the surface of a multilayer varistor. This makes the selection work easier.

Although silicone resin has been exemplified as the insulation material for forming the outside-the-surface insulation layer 31 and the within-the-surface insulation layer 30, other resins may of course be used provided that they satisfy a certain heat resistivity, insulating property, water-repellent property, and low water-absorbing property; either one, or more than one, of epoxy resin, acrylic resin, polybutadiene resin, phenolic resin, etc. may be used for the purpose, besides the silicone resin.

Instead of the resin, or in mixture with the resin, at least one kind of metal alkoxide selected from the group of silicon, titanium, aluminium, zirconium, yttrium and magnesium may be used to obtain a same effect.

When the metal alkoxide is used, the impregnating solution is made with alcohol or other such solvents that dissolve metal alkoxide.

The within-the-surface insulation layer 30 has preferably a greatest possible thickness in so far as the characteristics of a multilayer varistor is not affected, at the same time the thinnest part of the within-the-surface insulation layer 30 of silicone resin after curing is preferably equal to or thicker than $10\mu\text{m}$. This is adjustable through the selection of the viscosity of silicone varnish 5, the rate of solvent and the pressurizing force.

The effect of pressurizing is enhanced by providing a state where the pressure is lower than the normal atmospheric pressure prior to the step of pressurizing for impregnation of silicone varnish 5 into varistor 1.

Besides SiO_2 exemplified as the powder inert to silicone varnish 5, other powders may also be used provided that they do not react with the impregnation solution to be impregnated into varistor 1; either one, or a mixture, of ZrO_2 , Al_2O_3 , MgO may serve a same purpose.

A harder outside-the-surface insulation layer 31 is formed by

thoroughly removing a solvent contained in silicone varnish 5 impregnated into varistor 1 by heating, prior to curing, at a temperature lower than boiling point.

The moisture-resisting property may be improved further by repeating the process steps from the immersion in silicone varnish 5 through the surface grinding for plural times, preferably twice. By so doing, the silicone resin is impregnated further into inside of varistor 1.

It is preferred that the edge of body has a curved shape. This shape alleviates the concentration of stress to one part of external electrode 3 when removing organic substance on external electrode 3 by grinding.

Although in the present embodiment a multilayer varistor using strontium titanium oxide as the main component is exemplified, the same effects are implementable also with a multilayer varistor using zinc oxide as the main component, as well as ceramic thermistors, capacitors, resistors and other electronic components in general. Not only in the multilayer type electronic components, the present invention implements the same effects in electronic components of any shapes, for example a disk shape electronic component.

INDUSTRIAL APPLICABILITY

The insulation layer formed by impregnation into inside of the surface prevents deterioration of the moisture-resisting property, and the insulation layer formed on the surface enhances the strength of electrode preventing the peeling-off at the edge of electrode. Furthermore, this contributes to prevent the sneaking of moisture etc. into the inside through the edge of electrode. The moisture-resisting property is enhanced a step further.



CLAIMS

1. An electronic component comprising:
a body;
at least a pair of electrodes formed on the surface of said body at a specified clearance; and
an insulation layer formed on the surface of said body covering an area where the pair of electrodes is not formed and the edge part of the pair of electrodes,
wherein at least a part of said insulation layer is formed by impregnating within-the-surface of said body with an insulation material.
2. An electronic component of Claim 1, wherein the insulation layer is formed with at least one of metal alkoxide and resin.
3. An electronic component of Claim 1, wherein the insulation layer is formed with metal alkoxide, the metal alkoxide comprising at least one selected from the group consisting of silicon alkoxide, titanium alkoxide, aluminium alkoxide, zirconium alkoxide, yttrium alkoxide and magnesium alkoxide.
4. An electronic component of Claim 1, wherein the insulation layer is formed with resin, the resin being at least one selected from the group consisting of silicone resin, epoxy resin, acrylic resin, polybutadiene resin and phenolic resin.
5. An electronic component of Claim 1, wherein the thickness of insulation layer impregnated into within-the-surface of the body is not less than $10\mu\text{m}$.
6. An electronic component of Claim 1, wherein the thickness of insulation layer on outside-the-surface of the body is less than the greatest thickness of the pair of electrodes contacting the insulation layer.



7. An electronic component of Claim 1, wherein the end of the body has a curved shape.

8. An electronic component comprising:

a body;

at least a pair of electrodes formed on the surface of said body at a specified clearance; and

an insulation layer formed on the surface of said body covering an area where the pair of electrodes is not formed and the edge part of the pair of electrodes,

wherein the surface of said body is glossy.

9. A method of manufacturing an electronic component comprising the steps of:

forming at least a pair of electrodes on the surface of a body at a specified clearance;

contacting the surface of said body with an impregnating solution containing at least an organic substance for covering the surface of said body with said impregnating solution;

removing a part of the impregnating solution covering the surface of said body;

hardening the organic substance contained in said impregnating solution; and

removing the hardened organic substance on the surface of the pair of electrodes by grinding.

10. A method of manufacturing an electronic component of Claim 9, wherein the step of contacting the body with an impregnating solution is repeated for plural times.

11. A method of manufacturing an electronic component of Claim 9, wherein the organic substance contains at least one of metal alkoxide and resin.



* C L M S *

This Sheet Has Been Replaced



12. A method of manufacturing an electronic component of Claim 9, wherein the organic substance contains metal alkoxide, the metal alkoxide comprising at least one selected from the group consisting of silicon alkoxide, titanium alkoxide, aluminium alkoxide, zirconium alkoxide, yttrium alkoxide and magnesium alkoxide.

13. A method of manufacturing an electronic component of Claim 9, wherein the organic substance contains resin, the resin being at least one selected from the group consisting of silicone resin, epoxy resin, acrylic resin, polybutadiene resin and phenolic resin.

14. A method of manufacturing an electronic component of Claim 9, wherein the body is pressurized while being contacted with an impregnating solution.

15. A method of manufacturing an electronic component of Claim 9, wherein the organic substance on the surface of the body is removed by at least one means of centrifugal separation, washing with an organics-dissolving liquid, and contacting with a powder inert to impregnating solution.

16. A method of manufacturing an electronic component of Claim 15, wherein the powder contains at least one selected from the group consisting of SiO_2 , ZrO_2 , Al_2O_3 and MgO .

17. A method of manufacturing an electronic component of Claim 9, wherein the grinding is conducted at least by moving a container in which the body and a liquid are contained.

18. A method of manufacturing an electronic component of Claim 9, wherein the pair of electrodes is formed after the edge of the body is made to have a curved shape.



This Sheet Has Been Replaced



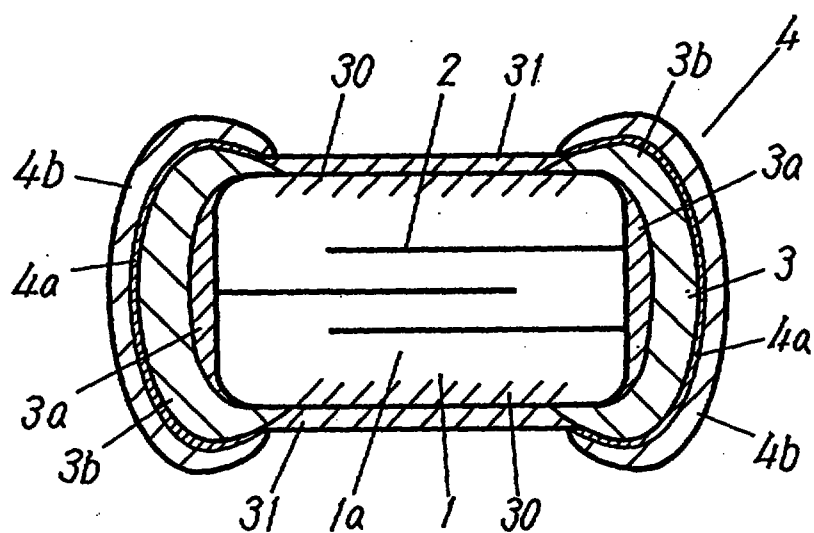
ABSTRACT

The present invention aims to present an electronic component which is free from the fear of sneaking-in of water etc. from the edge of electrode, by covering the electrode edge with resin. For the purpose, external electrodes (3) are formed at both ends of varistor (1) comprised of ceramic sheet (1a) and internal electrode (2) laminated alternately, and then, a within-the-surface insulation layer (30) is formed by covering the porous surface inside the varistor (1), or filling the porosity, with silicone resin, and an outside-the-surface insulation layer (31) is formed covering the surface of varistor (1) and the edge of external electrode (3).

This Sheet Has Been Replaced



Fig. 1



2/8

FIG. 2

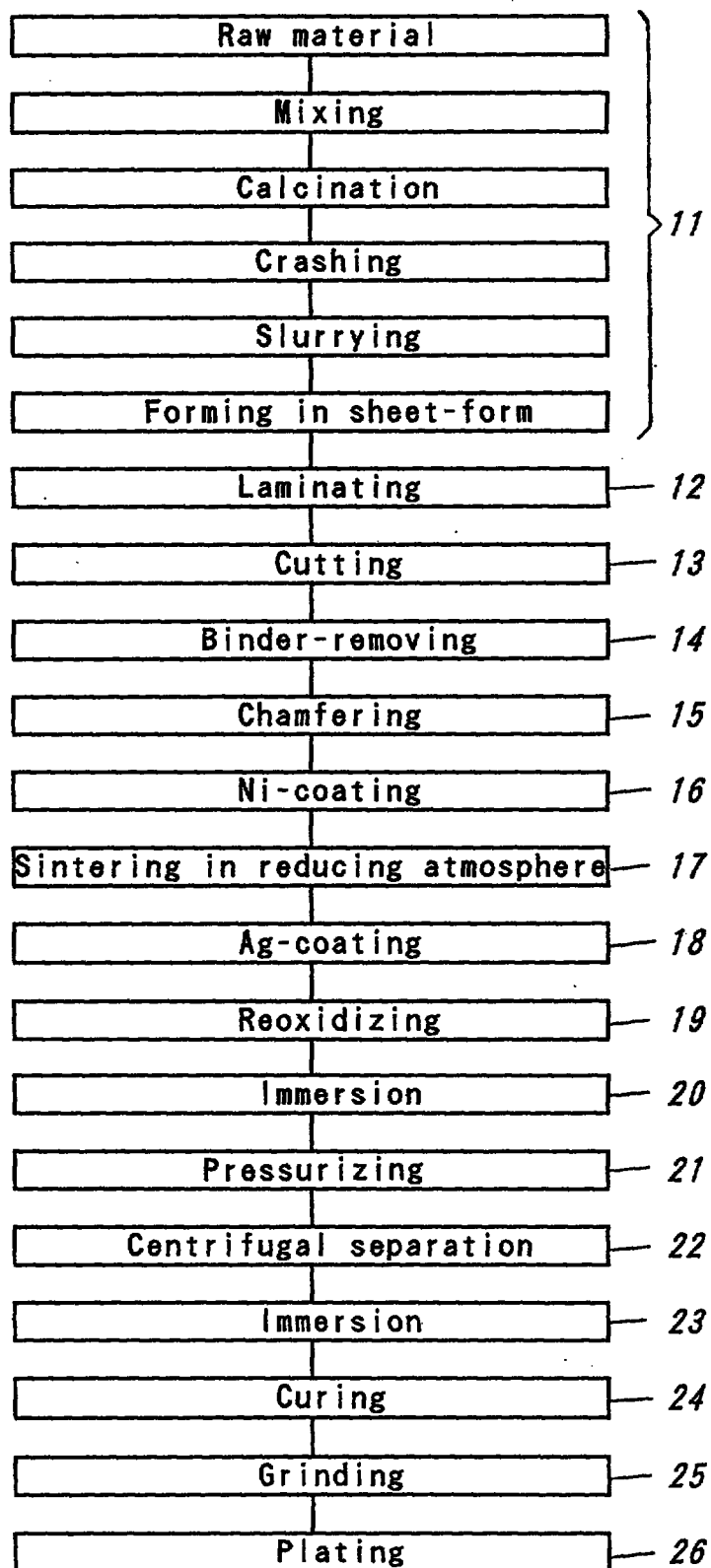


Fig. 3

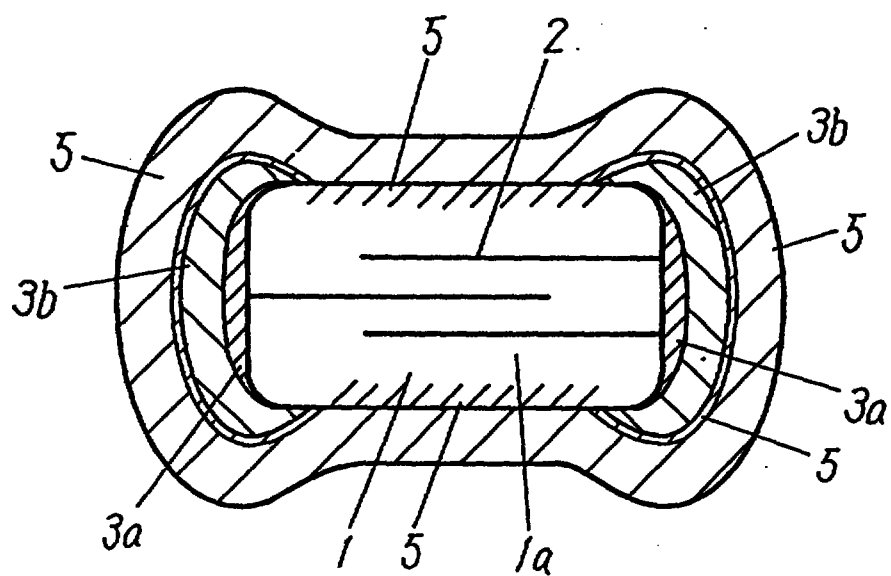


Fig.4

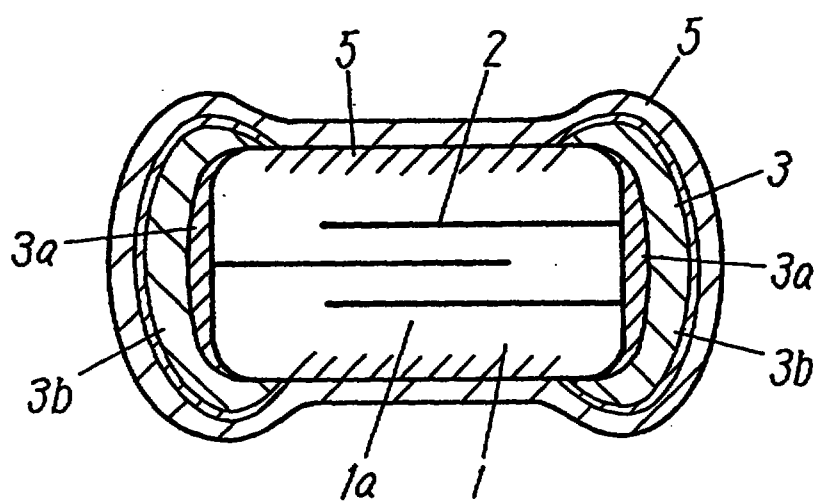


Fig. 5

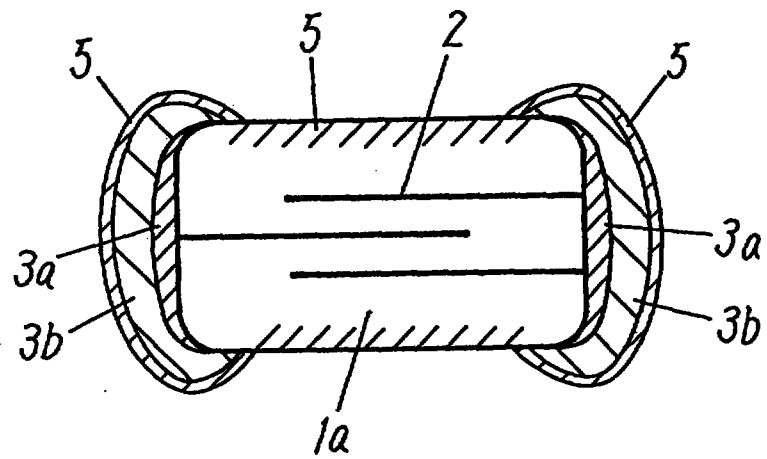


Fig. 6

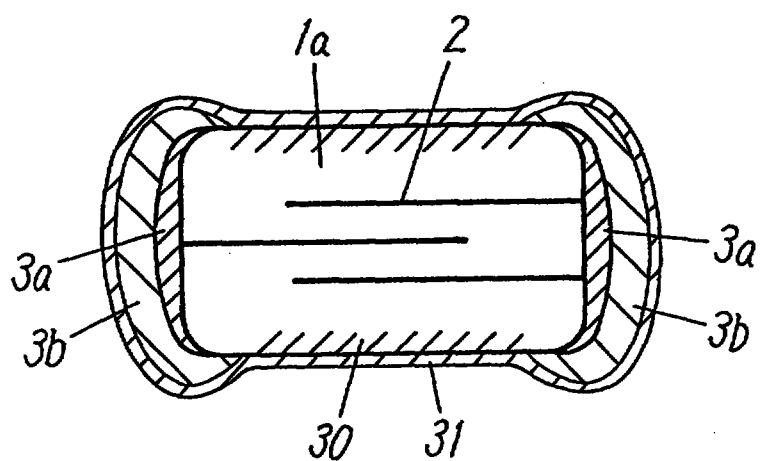
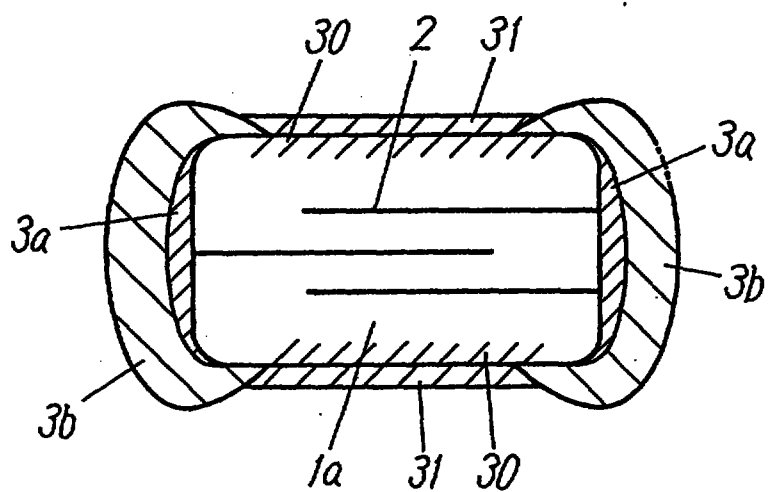


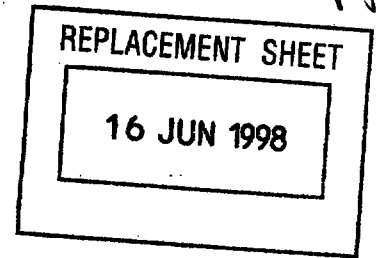
Fig. 7



EXPLANATION OF THE NOTATIONS OF THE DRAWINGS

- 1 Varistor
- 2 Internal electrode
- 3 External electrode
- 3a Inner layer
- 3b Outer layer
- 4 Plating layer
- 4a Ni plating
- 4b Solder plating
- 5 Silicone varnish
- 30 Within-the-surface insulation layer
- 31 Outside-the-surface insulation layer

SPECIFICATION



TITLE OF THE INVENTION

Electronic Component and method of Manufacture Therefor

TECHNICAL FIELD

The present invention relates to electronic components such as a multilayer varistor etc., and a method of manufacturing the same.

BACKGROUND ART

A conventional electronic component having at least a pair of electrodes on the surface of body is impregnated with resin on the surface only in an area where the electrodes are not formed.

The water-resisting quality may be improved by the resin impregnated in the body. However, there is a problem in the above described structure that the water etc. sneaks into through the edge of electrode causing deteriorated characteristics.

DISCLOSURE OF THE INVENTION

The present invention aims to present an electronic component with which the sneaking of water etc. through the electrode edge is prevented by covering the electrode edge with an insulating layer.

According to one aspect of the present invention there is provided an electronic component comprising: a body; at least a pair of electrodes formed on an outside surface of said body with a predetermined distance; and an outer insulation layer formed on an exposed area of the outside surface and an edge of each of said pair of electrodes, wherein an inner insulation layer is formed on an inside surface of said body, being impregnated with an insulation material.

According to another aspect of the present invention there is provided a method of manufacturing an electronic component comprising the steps of: forming at least a pair of electrodes on an outside surface of a body with a predetermined distance; contacting said outside surface with an impregnating solution containing at least an organic substance to impregnate an inside surface of said body with said impregnating solution and cover said outside surface with said impregnating solution; removing a part of said

impregnating solution covering said outside surface; hardening said organic substance contained in said impregnating solution; and removing the hardened organic substance on a surface of said pair of electrodes by grinding.

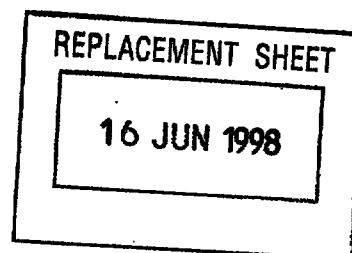
BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross sectional view showing a multilayer varistor according to an embodiment of the present invention. Fig. 2 is a chart showing manufacturing process steps of a multilayer varistor according to an embodiment of the present invention. Fig. 3 is a cross sectional view showing a varistor after silicone varnish impregnation according to an embodiment of the present invention. Fig. 4 is a cross sectional view showing a varistor after centrifugal processing according to an embodiment of the present invention. Fig. 5 is a cross sectional view showing a varistor after toluene impregnation according to an embodiment of the present invention. Fig. 6 is a cross sectional view showing a varistor after silicone resin curing according to an embodiment of the present invention. Fig. 7 is a cross sectional view showing a varistor after grinding according to an embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

In the following, an electronic component according to the present invention and a method of manufacturing the same is described in detail referring to drawings.

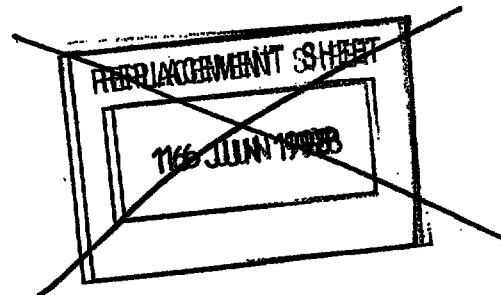
As shown in Fig. 1, there are plural internal electrodes 2 made mainly of nickel (Ni), inside varistor 1. These internal electrodes 2 are alternately pulled out to respective ends of varistor 1 to be electrically connected with external electrodes 3. The external electrode 3 is comprised of at least two layers; an inner layer 3a is made mainly of Ni, an outer layer 3b is made mainly of silver (Ag).



16 JUN 1998

-8-

CLAIMS



1. An electronic component comprising:
a body;
at least a pair of electrodes formed on an outside surface of said body with a predetermined distance; and
an outer insulation layer formed on an exposed area of the outside surface and an edge of each of said pair of electrodes,
wherein an inner insulation layer is formed on an inside surface of said body, being impregnated with an insulation material.
2. An electronic component of claim 1, wherein said insulation material comprises one of metal alkoxide and resin.
3. An electronic component of claim 1, wherein said insulation material comprises at least one selected from the group consisting of silicon alkoxide, titanium alkoxide, aluminum alkoxide, zirconium alkoxide, yttrium alkoxide and magnesium alkoxide.
4. An electronic component of claim 1, wherein said insulation material comprises at least one selected from the group consisting of silicone resin, epoxy resin, acrylic resin, polybutadiene resin and phenolic resin.
5. An electronic component of claim 1, wherein a thickness of said inner insulation layer is not less than 10 μ m.
6. An electronic component of claim 1, wherein a thickness of said outer insulation layer is thinner than a greatest thickness of said pair of electrodes.
7. An electronic component of claim 1, wherein an edge of said body has a curved shape.
8. An electronic component comprising:
a body;
at least a pair of electrodes formed on an outside surface of said body with a predetermined distance; and
an outer insulation layer formed on an exposed area of the outside surface and an edge of each of said pair of electrodes,
wherein the outside surface of said body is glossy.
9. A method of manufacturing an electronic component comprising the steps of:
forming at least a pair of electrodes on an outside surface of a body with a predetermined distance;
contacting said outside surface with an impregnating solution containng at least an organic substance to impregnate an inside surface of said body with said impregnating solution and cover said outside surface with said impregnating solution;
removing a part of said impregnating solution covering said outside surface;
hardening said organic substance contained in said impregnating solution; and



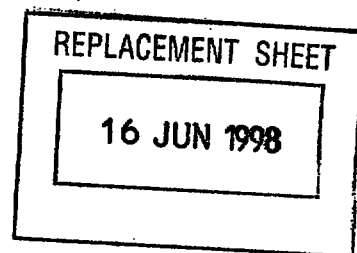
* C L M S *

This Sheet Has Been Replaced



removing the hardened organic substance on a surface of said pair of electrodes by grinding.

10. A method of claim 9, wherein the contacting step is repeated.
11. A method of claim 9, wherein said organic substance contains one of metal alkoxide and resin.
12. A method of claim 9, wherein said organic substance contains at least one selected from the group consisting of silicon alkoxide, titanium alkoxide, aluminum alkoxide, zirconium alkoxide, yttrium alkoxide and magnesium alkoxide.
13. A method of claim 9, wherein said organic substance contains at least one selected from the group consisting of silicone resin, epoxy resin, acrylic resin, polybutadiene resin and phenolic resin.
14. A method of claim 9, wherein said body is pressurized while being contacted with said impregnating solution.
15. A method of claim 9, wherein the step of removing a part of said impregnating solution is conducted by one means of centrifugal separation, washing with an organics-dissolving liquid, and contacting with a powder inert to impregnating solution.
16. A method of claim 15, wherein said powder contains at least one selected from the group consisting of SiO_2 , ZrO_2 , Al_2O_3 and MgO .
17. A method of claim 9, wherein the grinding process is conducted by moving a container in which at least said body and a liquid are contained.
18. A method of claim 9, wherein an edge of said body has a curved shape.



This Sheet Has Been Replaced



A B S T R A C T

The present invention aims to present an electronic component which is free from the fear of sneaking-in of water etc. from the edge of electrode, by covering the electrode edge with resin. For the purpose, external electrodes (3) are formed at both ends of varistor (1) comprised of ceramic sheet (1a) and internal electrode (2) laminated alternately, and then, a within-the-surface insulation layer (30) is formed by covering the porous surface inside the varistor (1), or filling the porosity, with silicone resin, and an outside-the-surface insulation layer (31) is formed covering the surface of varistor (1) and the edge of external electrode (3).

REPLACEMENT SHEET

16 JUN 1998



CLAIMS

1. An electronic component comprising:
a body;
at least a pair of electrodes formed on an outside surface of said body with a predetermined distance; and
an outer insulation layer formed on an exposed area of the outside surface and an edge of each of said pair of electrodes,
wherein an inner insulation layer is formed on an inside surface of said body, being impregnated with an insulation material.
2. An electronic component as claimed in claim 1, wherein said insulation material comprises a metal alkoxide or a resin or a mixture thereof.
3. An electronic component as claimed in claim 2, wherein said metal alkoxide is selected from the group consisting of silicon alkoxide, titanium alkoxide, aluminum alkoxide, zirconium alkoxide, yttrium alkoxide and magnesium alkoxide.
4. An electronic component as claimed in claim 2 or 3 wherein said resin is selected from the group consisting of silicon resin, epoxy resin, acrylic resin, polybutadiene resin and phenolic resin.
5. An electronic component as claimed in any of claims 1-4, wherein said inner insulation layer has a thickness not less than 10 μ m.
6. An electronic component as claimed in claims 1-5, wherein said outer insulation layer is thinner than the greatest thickness of said pair of electrodes.
7. An electronic component as claimed in claims 1-6, wherein said body has curved edges.
8. An electronic component as claimed in claims 1-7, wherein the outside surface of said body is glossy.
9. An electronic component wherein said inner and outer insulation layer are substantially the same.
10. A method of manufacturing an electronic component comprising the steps of:
forming at least a pair of electrodes on an outside surface of a body with a predetermined distance;
contacting said outside surface with an impregnating solution containing at least an organic substance to impregnate an inside surface of said body with said impregnating solution and cover said outside surface with said impregnating solution;
removing a part of said impregnating solution covering said outside surface;
hardening said organic substance contained in said impregnating solution; and
removing the hardened organic substance on a surface of said pair of electrodes by grinding.



REPLACEMENT SHEET

30 OCT 1998



11. A method as claimed in claim 10, wherein the contacting step is repeated.
12. A method as claimed in claim 10 or 11, wherein said organic substance contains a metal alkoxide or a resin or a mixture thereof.
13. A method as claimed in claim 12, wherein said metal alkoxide is selected from the group consisting of silicon alkoxide, titanium alkoxide, aluminum alkoxide, zirconium alkoxide, yttrium alkoxide and magnesium alkoxide.
14. A method as claimed in claim 12 or 13, wherein said resin is selected from the group consisting of silicone resin, epoxy resin, acrylic resin, polybutadiene resin and phenolic resin.
15. A method as claimed in any one of claims 10-14 wherein said body is pressurized while being contacted with said impregnating solution.
16. A method as claimed in any one of claims 10-15 wherein the step of removing a part of said impregnating solution is conducted by either centrifugal separation, or washing with an organics-dissolving liquid, or contacting with a powder inert to impregnating solution.
17. A method as claimed in claim 16, wherein said powder is selected from the group consisting of SiO_2 , ZrO_2 , Al_2O_3 and MgO or mixtures thereof.
18. A method as claimed in any one of claims 10-17, wherein the grinding process is conducted by moving a container in which at least said body and a liquid are contained.
19. A method as claimed in any one of claim 10-18, wherein said body has curved edges.
20. A method as claimed in any one of claims 10-19, wherein said hardened organic substance is glossy.



REPLACEMENT SHEET

30 OCT 1998

CLAIMS

1. An electronic component comprising:
a body;
at least a pair of electrodes formed on an outside surface of said body with a predetermined distance; and
an outer insulation layer formed on an exposed area of the outside surface and an edge of each of said pair of electrodes,
wherein an inner insulation layer is formed on an inside surface of said body, being impregnated with an insulation material.
2. An electronic component as claimed in claim 1, wherein said insulation material comprises a metal alkoxide or a resin or a mixture thereof.
3. An electronic component as claimed in claim 2, wherein said metal alkoxide is selected from the group consisting of silicon alkoxide, titanium alkoxide, aluminum alkoxide, zirconium alkoxide, yttrium alkoxide and magnesium alkoxide.
4. An electronic component as claimed in claim 2 or 3, wherein said resin is selected from the group consisting of silicone resin, epoxy resin, acrylic resin, polybutadiene resin and phenolic resin.
5. An electronic component as claimed in any one of claims 1-4, wherein said inner insulation layer has a thickness of not less than 10 μ m.
6. An electronic component as claimed in any one of claims 1-5, wherein said outer insulation layer is thinner than the greatest thickness of said pair of electrodes.
7. An electronic component as claimed in any one of claims 1-6, wherein said body has curved edges.
8. An electronic component as claimed in any one of claims 1-7 wherein the outside surface of said body is glossy.
9. A method of manufacturing an electronic component comprising the steps of:
forming at least a pair of electrodes on an outside surface of a body with a predetermined distance;
contacting said outside surface with an impregnating solution containing at least an organic substance to impregnate an inside surface of said body with said impregnating solution and cover said outside surface with said impregnating solution;
removing a part of said impregnating solution covering said outside surface;
hardening said organic substance contained in said impregnating solution; and
removing the hardened organic substance on a surface of said pair of electrodes by grinding.
10. A method as claimed in claim 10, wherein the contacting step is repeated.
11. A method as claimed in claim 9 or 10, wherein said organic substance contains a metal alkoxide or a resin or a mixture thereof.

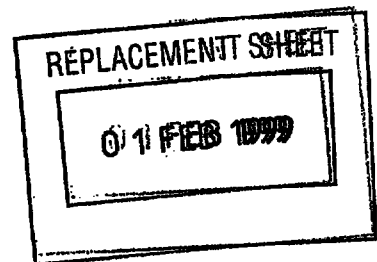


* C L M S *

REPLACEMENT SHEET

01 FEB 1999

12. A method as claimed in claim 11, wherein said metal alkoxide is selected from the group consisting of silicon alkoxide, titanium alkoxide, aluminum alkoxide, zirconium alkoxide, yttrium alkoxide and magnesium alkoxide.
13. A method as claimed in claim 11 or 12, wherein said resin is selected from the group consisting of silicone resin, epoxy resin, acrylic resin, polybutadiene resin and phenolic resin.
14. A method as claimed in any one of claims 9-13, wherein said body is pressurized while being contacted with said impregnating solution.
15. A method as claimed in any one of claims 9-14, wherein the step of removing a part of said impregnating solution is conducted by either centrifugal separation, or washing with an organics-dissolving liquid, or contacting with a powder inert to said impregnating solution.
16. A method as claimed in claim 15, wherein said powder is selected from the group consisting of SiO_2 , ZrO_2 , Al_2O_3 and MgO or mixtures thereof.
17. A method as claimed in any one of claims 9-16, wherein the grinding process is conducted by moving a container in which at least said body and a liquid are contained.
18. A method as claimed in any one of claims 9-17, wherein said body has curved edges.



9704190-9.

RWP's

copy!



世界知的所有権機関
国際事務局

PCT

特許協力条約に基づいて公開された国際出願

(51) 国際特許分類6 H01C 7/10, 7/02, 7/04, H01G 2/10	A1	(11) 国際公開番号 ✓ WO97/27598 (43) 国際公開日 1997年7月31日(31.07.97)
(21) 国際出願番号 ✓ PCT/JP97/00146 (22) 国際出願日 ✓ 1997年1月23日(23.01.97) (30) 優先権データ 特願平8/9773 ✓ 1996年1月24日(24.01.96) JP (71) 出願人 (米国を除くすべての指定国について) 松下電器産業株式会社 (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.)(JP/JP) 〒571 大阪府門真市大字門真1006番地 Osaka, (JP) (72) 発明者: および (75) 発明者/出願人 (米国についてのみ) 神野理穂(JINNO, Riho)(JP/JP) 〒570 大阪府守口市西郷通1丁目24-11-419 Osaka, (JP) 中村和幸(NAKAMURA, Kazuyuki)(JP/JP) 〒061-14 北海道恵庭市福住町2-7-3 Hokkaido, (JP) (74) 代理人 弁理士 滝本智之, 外(TAKIMOTO, Tomoyuki et al.) 〒571 大阪府門真市大字門真1006番地 松下電器産業株式会社内 Osaka, (JP)		(81) 指定国 CA, CN, KR, SG, US, 欧州特許 (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). 添付公開書類 国際調査報告書
(54) Title: ELECTRONIC PARTS AND METHOD FOR MANUFACTURING THE SAME (54) 発明の名称 電子部品とその製造方法 (57) Abstract An electronic part having electrodes whose ends are covered with resin for preventing moisture from entering into the part. The part comprises external electrodes (3) formed on both end faces of a varistor element (1) constituted by alternating ceramic sheets (1a) and internal electrodes (2), an internal insulating layer (30) formed by covering or filling up pores in the element (1) with an Si resin, and an external-surface insulating layer (31) formed so as to coat the external surface of the element (1) and the end sections of the electrodes (3).		

(57) 要約

本発明は、電極端部を樹脂で被覆することにより、電極端部からの水分などの浸入のおそれのない電子部品を提供することを目的とするものである。

そして、この目的を達成するために、本発明の電子部品は、まずセラミックシート（1a）と内部電極（2）とを交互に積層したバリスタ素子（1）の両端面に外部電極（3）を形成し、次にバリスタ素子（1）内部の気孔表面を被覆あるいは気孔にS i樹脂を充填させて内表面絶縁層（30）を、またバリスタ素子（1）外表面と外部電極（3）の端部を被覆するように外表面絶縁層（31）を形成したものである。

情報としての用途のみ

PCTに基づいて公開される国際出願をパンフレット第一頁にPCT加盟国を特定するために使用されるコード

AL	アルバニア	EE	エストニア	LR	リベリア	RU	ロシア連邦
AM	アルメニア	ES	スペイン	LS	レソト	SD	スーダン
AU	オーストラリア	FI	フィンランド	LT	リトアニア	SE	スウェーデン
AZ	アゼルバイジャン	FR	フランス	LU	ルクセンブルグ	SG	シンガポール
BB	バルバドス	GB	イギリス	LV	ラトヴィア	SK	スロバキア共和国
BE	ベルギー	GE	グルジア	MC	モナコ	SN	セネガル
BG	ブルガリア	GH	ガーナ	MD	モルドバ	SZ	スワジランド
BR	ブラジル	GN	ギニア	MG	マダガスカル	TD	チャド
BY	ベラルーシ	GR	ギリシャ	MK	マケドニア	TG	トーゴ
CC	カナダ	HU	ハンガリー	ML	マリ	TM	タジキスタン
CF	中央アフリカ共和国	IE	アイルランド	MN	モンゴル	TR	トルコ
CG	コンゴ	IT	イタリア	MR	モーリタニア	TT	トリニダード・トバゴ
CH	スイス	JP	日本	MW	マラウイ	UA	ウクライナ
CI	コート・ジボアール	KE	ケニア	MX	メキシコ	UG	ウガンダ
CM	カメルーン	KR	韓国	NE	ニジェール	US	米国
CN	中国	KZ	中央アジア諸国	NL	オランダ	UZ	ウズベキスタン共和国
CO	コロンビア	LI	リヒテンシュタイン	NZ	ニュージーランド	VN	ベトナム
DE	ドイツ	LU	ルクセンブルグ	PT	ポルトガル	YU	ユーゴスラビア
DK	デンマーク	LK	スリランカ	RO	ルーマニア		