

Description

This invention relates to a vacuum electron tube or an electron gun therefor, comprising an oxide cathode. The oxide cathode may be used in an electron tube such as a vacuum diode, a vacuum triode, or a cathode-ray tube.

Most vacuum electron tubes employ at least one thermionic oxide cathode as a source of electrons. A typical cathode comprises a nickel metal substrate, a layer consisting essentially of barium oxide and one or more other alkaline earth oxides on one surface of the substrate, and means opposite the other surface for maintaining the operating temperature of the substrate at about 950° to 1100° K. The substrate contains minor amounts of reducing agents which progressively migrate at different rates into the oxide layer at the operating temperature and reduce the barium oxide in the oxide layer to barium metal. The barium metal produces a low work function surface on the oxide layer for the efficient emission of electrons at the operating temperature. An article by A. M. Bounds et al., "Nickel Alloys for Oxide-Coated Cathodes," Proceedings of the I.R.E., vol. 39, pp. 788-799 (1951), discloses that the commonly-used reducing agents in the substrate are elemental aluminum, carbon, magnesium, manganese, silicon, titanium and tungsten.

Minor amounts of elemental silicon are alloyed with nickel in the substrates of all commercial oxide cathodes, even though a resistive interfacial layer of barium orthosilicate is known to form between the substrate and the oxide layer during the operation of the cathode. To limit the formation of this interfacial layer and thereby extend the life of the cathode, the concentration of silicon in the substrate is usually less than 0.1 weight percent and never more than 0.25 weight percent. The other reducing agents mentioned above are similarly limited in concentrations in the substrate.

Chromium metal, which has been reported as a reducing agent, is never intentionally present in significant quantities in the substrate, because it is reported to form a heavy black interfacial layer between the substrate and the oxide layer which interferes with the operation of the cathode, and because it is believed that chromium metal sublimes too rapidly at the operating temperatures of oxide cathodes to be practical. U. S. Pat. No. 4,370,588, issued January 25, 1983 to K. Takahashi, also points out that chromium that is diffused into the oxide layer will shorten the emissive life of the cathode.

Document GB-A-1076 229 discloses a cathode for electron tubes wherein the substrate comprises by weight, among others, 1% chromium and 0.005% silicon.

The present invention provides a vacuum electron tube as disclosed in claim 1.

Usually, the chromium concentration is about 5 to 20 weight percent. Tests have demonstrated that the cathodes, when properly made, have long operating lives with little or no adverse effects from interfacial layers or rapid sublimation.

The oxide cathode is employed in a vacuum electron tube such as a diode, triode or cathode-ray tube. As in prior oxide cathodes, the present oxide cathode comprises a metal base or substrate, preferably of nickel metal, means for heating the cathode to, and maintaining the cathode at, its operating temperature, and an oxide layer consisting essentially of alkaline-earth-metal oxide on the base. Unlike prior oxide cathodes, the substrate is essentially free from silicon and contains operative proportions of chromium metal for progressively reducing the oxide to yield controlled amounts of alkaline earth metal in the oxide layer during the operating life of the cathode.

The cathode may be directly or indirectly heated. Elemental chromium may be present in the substrate prior to assembling the present cathode, but is preferably introduced into the substrate by thermal migration from a contiguous source of chromium after assembling the cathode into an electron tube. Other reducing agents, such as elemental magnesium, may also be present in the substrate.

In the drawing:

FIG. 1 is a symbolic representation of a cathode-ray tube comprising a cathode in accordance with the present invention.

FIGS. 2A to 2D are a family of graphs representing the concentrations of chromium in a bimetal after 0, 10, 500 and more than 1,000 hours of heating at about 1050° K.

FIGS. 3, 4, 5 and 6 are partially broken-away elevational views of four different embodiments of the cathode.

The single-gun cathode-ray tube 11 shown symbolically in FIG. 1 comprises an evacuated glass envelope 12 having a luminescent screen 13 at one end, an anode 14 coated on its sides, an oxide cathode 15 at its other end, and beam-forming grids 16 and 17 between the cathode 15 and the anode. The cathode 15 comprises a substrate 18 carrying an oxide layer 19 on its outer surface, a resistance heater 20 opposite its inner surface, and a metallic sleeve 21 around the heater. The physical construction of the cathode 15 may be the construction shown in FIG. 3. The electron tube may include more than one cathode, as is common for color display and entertainment tubes. It is also common for the cathode, and usually one or more beam-forming grids to be preassembled as an integrated gun structure in-

serted into the neck of the tube. Also, the substrate 18 and sleeve 21 may be one integral piece or may be two pieces that are welded together.

In each of the following descriptions of embodiments, the oxide cathode consists essentially of a coating of triple (barium, strontium and calcium) carbonates, (Ba,Sr,Ca) CO₃, spray coated onto a substrate of nickel metal which contains minor amounts of reducing agents. One or more compounds which decompose upon heating to oxides of one or more alkaline earth metals, including barium, may be used in the coating. Unlike prior oxide cathodes, the substrate of the cathode is essentially free from silicon and contains preferably more than 1.0 weight percent chromium metal as an essential reducing agent, although other reducing agents may be present. By "essentially free from silicon" is meant that any content of silicon does not function as a reducing agent for the oxide layer, and does not form an interfacial layer between the substrate and the oxide layer.

After the cathode is installed in a vacuum tube, the tube is thermally processed by energizing the heating means of the cathode, whereby carbonates of the coating decompose under the influence of the heat, producing an oxide layer on the substrate. Some purposes of the nickel substrate are to support the carbonate coating and oxide layer, to conduct heat to the carbonate coating and oxide layer, to conduct electric current to the oxide layer and to provide reducing agents that can thermally migrate to the oxide layer.

Electron emission from the present cathode, as in prior oxide cathodes, depends on the presence of free barium metal in the oxide layer, which produces a low-work-function surface on the oxide layer. Reducing agents in the nickel substrate diffuse progressively into the oxide layer during thermal processing and during operating life of the cathode, and react with barium oxide, producing free barium metal and compounds of the reducing agent. The depletion and/or loss of mobility of the reducing agents in the substrate is a primary cause of the fall off of electron emission from the cathode with use.

In the preferred oxide cathode, elemental chromium is present in the substrate in concentrations greater than 1.0 weight percent, and usually 5 to 20 weight percent. This is contrary to prior practice, which taught that chromium in any form is undesirable in an oxide cathode, and that even traces of chromium are to be avoided. Also, prior practice taught that the concentrations of reducing agents in the substrate should be carefully controlled to values not greater than 1.0 weight percent.

Undesirable effects resulting from the presence of chromium in the substrate have been confirmed. These undesirable effects are the result of the

formation of chromium oxides at the interface between the substrate and the oxide layer, which results in poor adherence of the oxide layer to the substrate. However, when little or no chromium oxides are formed at that interface with a chromium-containing substrate, efficient oxide cathodes with long operating lives can be produced.

In the cathodes here, chromium-oxygen bonds are suppressed or avoided, and the usual nickel-oxygen bonds are formed on the substrate surface prior to assembling the cathode. The usual nickel-oxygen-barium bonds are formed at the substrate-layer interface during thermal processing after the cathode is assembled into a vacuum electron tube. This can be achieved in several ways. A nickel-chromium alloy substrate can be carefully processed to suppress the formation of chromium-oxide bonds on the surface of the substrate.

By another method, a cathode with a nickel substrate free from chromium can be assembled into a vacuum tube. Then, chromium from a contiguous source can be made to migrate into the substrate when the cathode is heated for at least 10 hours at about 1030 to 1080° K in the usual way for operating the vacuum tube. Sufficient migration of chromium may require several weeks of operation of the cathode. Faster-acting reducing agents, such as elemental magnesium, may be present in the substrate to enhance electron emission by the cathode until sufficient concentrations of chromium have migrated into the substrate. FIGS. 2A to 2D are graphs showing the concentration profiles of chromium in a starting bonded bimetal about 3.0 mils (76μm) thick, consisting of 2.0-mil (51-μm)-thick nickel strip 22 and 1.0-mil (25-μm)-thick nichrome alloy (20% chromium - 80% nickel) strip 23, after heating at about 1050° K for 0, 10, 500 and 1,000 hours, respectively. This data shows that substantial amounts of chromium migrate to the external nickel surface 24 during the first 500 hours of operation of the cathode. After more than 1,000 hours of heating, the concentration of chromium in the nickel strip 22 averages about 6 weight %. If this surface carries an adherent oxide layer, then chromium atoms migrate by vapor transport to the oxide layer, where they react with and reduce barium oxide to form elemental barium and barium chromate, by a reaction such as



At normal cathode operating temperatures of about 1030 to 1080° K, the vapor pressure of elemental chromium is about 5.0×10^{-11} atmos. Elemental barium is produced progressively, and relatively high levels of electron emission are maintained by the cathode over a long period of operation. The reaction products do not concentrate as an inter-

facial layer at the interface between the substrate and the oxide layer. In comparison, the vapor pressure of elemental silicon (which is present in all commercial oxide cathodes, but is specifically excluded in operative concentrations from the present cathode) at the same temperature is about 4.7×10^{-13} atmos, which is about two orders of magnitude lower. Elemental silicon in the substrate tends to form a resistive interfacial layer of barium orthosilicate at the interface between the substrate and the oxide layer.

FIG. 3 shows a preferred first embodiment of the present cathode. The substrate is prepared by the method disclosed in U. S. Pat. No. 4,376,009, issued March 8, 1983 to P. J. Kunz. By that method a bimetal of 1-mil (25- μ m)-thick nichrome and 2-mil (51- μ m)-thick cathode nickel is drawn into a tube or sleeve 25 that is closed at one end by an endwall 26. Then the outer layer of cathode nickel is selectively etched, leaving a bonded substrate or cap 27 of nickel metal on the closed endwall and adjacent sidewall of the sleeve 25. In this case, the sleeve 25, which is the inner layer of the drawn bimetal, contains about 20 weight % chromium and about 80 weight % nickel. The cap 27 contains more than 95 weight % nickel and less than 5 weight % of other constituents including about 0.1 weight % magnesium and 4.0 weight % tungsten. Neither layer contains any significant amount of silicon; that is, the silicon content is less than 0.001 weight %. The initial distribution of chromium in the bimetal is shown in FIG. 2A. An oxide layer 28 resides on the outer surface of the cap 27, and a heater 29 is located within the sleeve 25 with legs 31 extending out of the open end of the sleeve 25. The heater carries an electrically insulating coating 33 on its surfaces within the sleeve 25. After the substrate or cap 27 is drawn and etched, a coating of triple carbonates is sprayed on the endwall of the cap 27. Then, the cap and sleeve with the coating thereon are mounted in an electron tube. The resistance heater 29 is inserted into the sleeve 25, and the heater legs 31 are welded to electrical contacts (not shown). An insulating layer 33 resides on the surface of the heater 29. Assembly of the tube is completed, and then the tube is evacuated to low pressure and sealed. Then, voltage (ordinarily about 6.2 volts DC) is applied across the legs 31, causing the heater 29 to heat and raising the temperature of the substrate 27 to about 1050° K. Above 600° K, carbonates of the coating on the cap 27 decompose to form oxides forming an oxide layer, and the reducing agents in the cap 21 migrate over a period of time into the oxide layer and react, forming free elemental barium. Also, chromium in the endwall of the sleeve 25 migrates into the cap 27, as shown in FIGS. 2B, 2C and 2D, and finally into the oxide layer 28.

FIG. 4 shows a second embodiment of the oxide cathode. The substrate of 2-mil (51- μ m)-thick cathode nickel comprises a sleeve 41 closed at one end by an endwall 43. The inner surface of the endwall 43 carries a layer 45 of chromium metal, and the outer surface of the endwall 43 carries an oxide layer 47. A resistance heater 49 resides inside the sleeve 41 with the legs 51 thereof extending out of the open end of the sleeve. An insulating layer 53 is present on the heater 49. This second embodiment may be prepared in a manner similar to that described for the first embodiment.

FIG. 5 shows a third embodiment of the oxide cathode. The substrate of 1-mil (25- μ m)-thick nichrome comprises a sleeve 61 closed at one end by an endwall 63, which functions as the substrate. The outer surface of the endwall 63 carries an oxide layer 65. A resistance heater 67 resides inside the sleeve 61 with the legs 69 thereof extending out of the open end of the sleeve 61. An insulating layer 71 is present on the heater 67. In preparing this embodiment, all oxides are removed from the external surface of the endwall 63 prior to depositing a triple-carbonates coating thereon. Then, throughout the subsequent processing, that surface is protected from oxidation. In so doing, chromium oxides are discouraged from forming. Subsequently, during thermal processing at elevated temperatures, nickel-oxygen-barium bonds are formed predominantly at the interface between the endwall 63 (substrate) and the oxide layer 65, thereby providing adequate bonding of the oxide layer 65 to the endwall 63.

FIG. 6 shows a fourth embodiment of the oxide cathode, comprising a 1-mil (25- μ m)-thick nichrome sleeve 73 and a 2-mil (51- μ m)-thick cap 75 of nickel welded to one end of the sleeve 73. The sleeve 73 and the cap 75 have compositions similar to the sleeve and cap of the first embodiment. An oxide layer 77 resides on the outer surface of the cap 75. The inner surface of the endwall of the cap 75 carries a layer 79 of chromium metal. A resistance heater 81 resides inside the sleeve 73 with the legs 83 thereof extending out of the open end of the sleeve 73. An insulating layer 85 is present on the heater.

Claims

1. A vacuum electron tube having an oxide cathode (15) comprising a metal alloy substrate (18), a sleeve (21) adjacent to said substrate, means (20) within said sleeve for heating said substrate to its operating temperature, and a layer (19) consisting essentially of alkaline-earth-metal oxide on said substrate; characterized in that said substrate is essentially free from silicon which means that any content of



facial layer at the interface between the substrate and the oxide layer. In comparison, the vapor pressure of elemental silicon (which is present in all commercial oxide cathodes, but is specifically excluded in operative concentrations from the present cathode) at the same temperature is about 4.7×10^{-13} atmos, which is about two orders of magnitude lower. Elemental silicon in the substrate tends to form a resistive interfacial layer of barium orthosilicate at the interface between the substrate and the oxide layer.

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FIG. 6 shows a fourth embodiment of the oxide cathode, comprising a 1-mil (25- μ m)-thick nichrome sleeve 73 and a 2-mil (51- μ m)-thick cap 75 of nickel welded to one end of the sleeve 73. The sleeve 73 and the cap 75 have compositions similar to the sleeve and cap of the first embodiment. An oxide layer 77 resides on the outer surface of the cap 75. The inner surface of the endwall of the cap 75 carries a layer 79 of chromium metal. A resistance heater 81 resides inside the sleeve 73 with the legs 83 thereof extending out of the open end of the sleeve 73. An insulating layer 85 is present on the heater.

Claims

1. A vacuum electron tube having an oxide cathode (15) comprising a metal alloy substrate (18), a sleeve (21) adjacent to said substrate, means (20) within said sleeve for heating said substrate to its operating temperature, and a layer (19) consisting essentially of alkaline-earth-metal oxide on said substrate; characterized in that said substrate is essentially free from silicon which means that any content of



- silicon does not function as a reducing agent for the oxide layer and contains operative concentrations greater than 1.0 weight percent of chromium metal for progressively reducing said oxide to yield alkaline earth metal.
2. A tube or gun according to claim 1, characterized in that said chromium is present in said substrate (18) in concentrations in the range of 5 to 20 weight percent.
 3. A tube or gun according to claim 1, characterized in that chromium metal in said substrate (18) in concentrations averaging about 6.0 weight percent.
 4. A tube or gun according to any preceding claim, characterized in that substrate (18) contains operative proportions of at least one reducing agent in addition to said chromium metal.
 5. A tube or gun according to any of claims 1-3 characterized in that said metal substrate (18) consists essentially of a major proportion of nickel metal and a minor proportion of a plurality of metallic reducing agents including (a) said chromium metal and (b) at least one fast-acting metallic reducing agent for reducing said oxide layer (19), and said oxide layer includes barium oxide.
 6. A tube or gun according to claim 5, characterized in that said one fast-acting metallic reducing agent is magnesium metal.
 7. A tube or gun according to claim 1 wherein said layer on said substrate includes an oxidic compound of barium as an essential ingredient; characterized in that said substrate (18) consists essentially of a major proportion of nickel metal and a minor proportion greater than 1.0 weight percent of said chromium metal as an essential reducing agent for the barium oxide.
 8. A tube or gun according to any preceding claim characterized by a source of chromium disposed contiguously to said substrate (18) for thermal migration of chromium from said source into the substrate.
 9. A tube or gun according to claim 8 characterized in that said contiguous source is a layer (45,79) of chromium metal applied to a surface of said substrate (18) opposite the surface thereof coated by said oxide layer (47,77).
 10. A tube or gun according to claim 8 characterized in that said contiguous source is a body (25) of nickel-chromium alloy bonded to a surface of said substrate (18) opposite the surface thereof coated by an oxide layer (28,65).
 11. A method of making a tube or gun according to claim 8,9 or 10 characterized in that said substrate (18) is prepared by bonding together a metal base layer (22) that is essentially free from both chromium and silicon to a metal auxiliary layer (23) (constituting said contiguous source) that contains substantial proportions of chromium metal and is free from silicon, coating the surface of said metal base layer with material that is thermally-decomposable to said oxide layer (19), and then heating said coated and bonded metal layers at temperatures at which operative proportions of chromium in said auxiliary layer progressively migrate into said base layer and said coating.
 12. The method of claim 11, characterized in that coated and bonded metal layers are heated at temperatures in the range of 1030 to 1080°K for at least 50 hours.

Revendications

1. Tube électronique sous vide ayant une cathode à oxyde (15) comprenant un substrat en alliage métal (18), un manchon (21) adjacent audit substrat, des moyens (20) dans ledit manchon pour chauffer ledit substrat à sa température de fonctionnement, et une couche (19) consistant essentiellement en oxyde de métal alcalino-terreux sur ledit substrat, caractérisé en ce que ledit substrat est essentiellement dépourvu de silicium, ce qui signifie qu'une teneur quelconque de silicium n'agit pas comme un agent réducteur pour la couche d'oxyde et contient des concentrations de fonctionnement supérieures à 1,0 pour cent en poids de métal chrome pour réduire progressivement ledit oxyde afin de produire un métal alcalino-terreux.
2. Tube ou canon selon la revendication 1, caractérisé en ce que ledit chrome est présent dans ledit substrat (18) suivant des concentrations comprises entre 5 et 20 pour cent en poids.
3. Tube ou canon selon la revendication 1, caractérisé en ce que le métal chrome représente en moyenne des concentrations d'environ 6% en poids dans ledit substrat (18).



4. Tube ou canon selon l'une quelconque des revendications précédentes, caractérisé en ce que ledit substrat (18) contient des proportions de fonctionnement d'au moins un agent de réduction en plus dudit métal chrome.

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5. Tube ou canon selon l'une quelconque des revendications 1 à 3, caractérisé en ce que ledit substrat en métal (18) consiste essentiellement en une proportion majeure de métal nickel et d'une proportion mineure d'une pluralité d'agents de réduction métalliques incluant

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(a) ledit métal chrome et

(b) au moins un agent de réduction métallique agissant rapidement pour la réduction de ladite couche d'oxyde (19), et ladite couche d'oxyde comprend de l'oxyde de baryum.

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6. Tube ou canon selon la revendication 5, caractérisé en ce que ledit agent de réduction métallique agissant rapidement est du métal magnésium.

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7. Tube ou canon selon la revendication 1, où ladite couche dudit substrat comprend un composé oxydé de baryum comme ingrédient essentiel; caractérisé en ce que ledit substrat (18) consiste essentiellement en une proportion majeure de métal nickel et en une proportion mineure supérieure à 1 pour cent en poids dudit métal chrome comme agent de réduction essentiel pour l'oxyde de baryum.

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8. Tube ou canon selon l'une quelconque des revendications précédentes, caractérisé en ce qu'une source de chrome est disposée de façon contigue audit substrat (18) pour la migration thermique du chrome à partir de ladite source dans ledit substrat.

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9. Tube ou canon selon la revendication 8, caractérisé en ce que ladite source contigue est une couche (45,79) de métal chrome appliquée sur une surface dudit substrat (18) opposée à la surface de celui-ci revêtue par ladite couche d'oxyde (47,77).

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10. Tube ou canon selon la revendication 8, caractérisé en ce que ladite source contigue est un corps (25) d'alliage chrome-nickel lié à une surface dudit substrat (18) opposée à la surface de celui-ci revêtue par une couche d'oxyde (28,65).

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11. Procédé de fabrication d'un tube ou d'un canon selon la revendication 8,9 ou 10, caractérisé en ce que ledit substrat (18) est préparé en liant ensemble une couche de base en métal

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(22) qui est essentiellement dépourvue à la fois de chrome et de silicium à une couche auxiliaire en métal (23) (constituant ladite source contigue) qui contient des proportions substantielles de métal chrome et qui est dépourvue de silicium, en revêtant la source de ladite couche de base en métal avec un matériau qui est décomposable thermiquement à ladite couche d'oxyde (19), et en chauffant ensuite lesdites couches de métal liées et revêtues à des températures auxquelles des proportions de fonctionnement de chrome dans ladite couche auxiliaire migrent progressivement dans ladite couche de base et ledit revêtement.

12. Procédé selon la revendication 11, caractérisé en ce que les couches de métal liées et revêtues sont chauffées à des température comprises entre 1030 et 1080° K pendant au moins 50 heures.

Patentansprüche

1. Vakuum-Elektronenröhre mit einer Oxidkathode (15), die ein Substrat (18) aus einer Metalllegierung, eine an das Substrat angrenzende Hülse (21), eine innerhalb der Hülse befindliche Einrichtung (20) zum Aufheizen des Substrats auf seine Betriebstemperatur und eine Schicht (19) auf dem Substrat aufweist, die im wesentlichen aus einem Erdalkalimetalloxid besteht, dadurch gekennzeichnet, daß das Substrat im wesentlichen frei von Silizium ist, das heißt, daß ein etwaiger Gehalt an Silizium nicht als ein Reduktionsmittel für die Oxidschicht wirkt, und daß das Substrat wirksame Konzentrationen von mehr als 1,0 Gewichtsprozent an Chrommetall enthält, um das Oxid zur Freigabe von Erdalkalimetall zu reduzieren.

2. Röhre oder Strahlsystem nach Anspruch 1, dadurch gekennzeichnet, daß das Chrom im Substrat (19) in Konzentrationen im Bereich von 5 bis 20 Gewichtsprozent vorhanden ist.

3. Röhre oder Strahlsystem nach Anspruch 1, dadurch gekennzeichnet, daß das Chrommetall im Substrat (18) in Konzentrationen vorhanden ist, die im Mittel etwa 6,0 Gewichtsprozent betragen.

4. Röhre oder Strahlsystem nach irgendeinem vorhergehenden Anspruch, dadurch gekennzeichnet, daß das Substrat (18) wirksame Anteile von mindestens einem Reduktionsmittel zusätzlich zum Chrommetall enthält.

5. Röhre oder Strahlsystem nach irgendeinem

der Ansprüche 1-3, dadurch gekennzeichnet, daß das Metallsubstrat (18) im wesentlichen aus einem größeren Anteil an Nickelmetall und einem kleineren Anteil einer Mehrzahl metallischer Reduktionsmittel besteht, die (a) das Chrommetall und (b) mindestens ein schnellreagierendes metallisches Reduktionsmittel zur Reduzierung der Oxidschicht (19) enthalten, und daß die Oxidschicht Bariumoxid enthält.

6. Röhre oder Strahlsystem nach Anspruch 5, dadurch gekennzeichnet, daß das besagte eine schnellreagierende metallische Reduktionsmittel Magnesiummetall ist.

7. Röhre oder Strahlsystem nach Anspruch 1, worin die besagte Schicht auf dem Substrat als einen wesentlichen Bestandteil eine oxidische Verbindung von Barium enthält, dadurch gekennzeichnet, daß das Substrat (18) im wesentlichen aus einem größeren Anteil von Nickelmetall und einem kleineren Anteil von mehr als 1,0 Gewichtsprozent des Chrommetalls als ein wesentliches Reduktionsmittel für das Bariumoxid besteht.

8. Röhre oder Strahlsystem nach irgendeinem vorhergehenden Anspruch, gekennzeichnet durch eine Chromquelle, die an das Substrat (18) angrenzend angeordnet ist für thermische Migration des Chroms von der Quelle in das Substrat.

9. Röhre oder Strahlsystem nach Anspruch 8, dadurch gekennzeichnet, daß die angrenzende Quelle eine Schicht (45, 79) aus Chrommetall ist, die auf eine Oberfläche des Substrats (18) aufgebracht ist, welche zu der von der Oxidschicht (47, 77) beschichteten Oberfläche des Substrats entgegengesetzt ist.

10. Röhre oder Strahlsystem nach Anspruch 8, dadurch gekennzeichnet, daß die angrenzende Quelle ein Körper (25) einer Nickel-Chrom-Legierung ist, der haftend auf eine Oberfläche des Substrats (18) aufgebracht ist, die zu der von einer Oxidschicht (28, 65) belegten Substratoberfläche entgegengesetzt ist.

11. Verfahren zur Herstellung einer Röhre oder eines Strahlsystems nach Anspruch 8, 9 oder 10, dadurch gekennzeichnet, daß das Substrat (18) hergestellt wird durch Zusammenheften einer metallenen Grundsicht (22), die im wesentlichen frei von Chrom und Silizium ist, mit einer metallenen Hilfsschicht (23) (welche die angrenzende Quelle bildet), die wesentliche Anteile an Chrommetall enthält und frei von

Silizium ist, Beschichten der Oberfläche der metallenen Grundsicht mit Material, das in die besagte Oxidschicht (19) thermisch abbaubar ist, und anschließende Erhitzung der beschichteten und zusammengehefteten Metallschichten auf Temperaturen, bei denen wirksame Anteile des in der Hilfsschicht enthaltenen Chroms fortschreitend in die Grundsicht und die Beschichtung wandern.

12. Verfahren nach Anspruch 11, dadurch gekennzeichnet, daß die beschichteten und zusammengehefteten Metallschichten auf Temperaturen im Bereich von 1030 bis 1080 °K für mindestens 50 Stunden aufgeheizt werden.



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