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(54) ALUMINUM NITRIDE PASSIVATED PHOSPHORS FOR ELECTROLUMINESCENT DISPLAYS

PASSIVIERTER ALUMINIUMNITRID-PHOSPHOR FÜR ELEKTROLUMINESZENZANZEIGEN

PHOSPHORES PASSIVES PAR LE NITRURE D'ALUMINIUM POUR AFFICHEURS ELECTROLUMINESCENTS

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(73) Proprietor: **iFire IP Corporation**
Fort Saskatchewan AB T8L 3W4 (CA)

(72) Inventor: **LIU, Guo**
Brampton, Ontario L6Y 4Y2 (CA)

(74) Representative: **Howard, Paul Nicholas et al**
Carpmaels & Ransford
43-45 Bloomsbury Square
London WC1A 2RA (GB)

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- **PATENT ABSTRACTS OF JAPAN vol. 0135, no. 61 (E-859), 13 December 1989 (1989-12-13) & JP 1 232695 A (MATSUSHITA ELECTRIC IND CO LTD), 18 September 1989 (1989-09-18)**
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- **PATENT ABSTRACTS OF JAPAN vol. 0151, no. 47 (E-1055), 12 April 1991 (1991-04-12) & JP 3 022392 A (MATSUSHITA ELECTRIC IND CO LTD), 30 January 1991 (1991-01-30)**
- **PATENT ABSTRACTS OF JAPAN vol. 0143, no. 16 (E-0949), 6 July 1990 (1990-07-06) & JP 2 103894 A (RICOH CO LTD; others: 01), 16 April 1990 (1990-04-16)**
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- **PATENT ABSTRACTS OF JAPAN vol. 0170, no. 50 (E-1314), 29 January 1993 (1993-01-29) & JP 4 264392 A (CLARION CO LTD), 21 September 1992 (1992-09-21)**

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Description

Field of the Invention

[0001] The present invention relates to improving the luminance and the operating stability of phosphors used for full colour ac electroluminescent displays employing thick film dielectric layers with a high dielectric constant. More specifically, the invention provides aluminum nitride barrier layers in contact with the phosphor film in a thick film dielectric electroluminescent display to minimize or prevent reaction of the phosphor with oxygen and other deleterious species.

Background to the Invention

[0002] Thick film dielectric structures as exemplified by U.S. patent 5,432,015 (the entirety of which is incorporated herein by reference) are known and exhibit superior characteristics to that of traditional thin film electroluminescent (TFEL) displays. High performance red, green and blue phosphor materials have been developed for use with thick film dielectric structures to provide increased luminance performance. These phosphor materials include europium activated barium thioaluminate based materials for blue emission, terbium activated zinc sulfide, manganese activated magnesium zinc sulfide or europium activates, calcium thioaluminate based materials for green emission, as well as traditional manganese activated zinc sulfide that can be appropriately filtered for red emission.

[0003] A high luminosity full colour thick film dielectric electroluminescent display requires that the thin film phosphor materials used for the red, green and blue sub-pixels be patterned so that the emission spectrum for each colour of pixel is tailored to minimize the attenuation associated with the optical filters needed to achieve the required colour coordinates for each sub-pixel. For relatively low-resolution displays patterning can be achieved by depositing the phosphor materials through a shadow mask. However, for high resolution displays the shadow mask technique does not provide adequate accuracy requiring that photolithographic methods be employed. Photolithographic techniques, as exemplified in U.S. Patent Application serial number 09/540,288 require the deposition of photoresist films and the etching or lift-off of portions of the phosphor film to provide the required pattern. Deposition and removal of photoresist films and etching and or lift-off of phosphor films requires the use of solvent solutions that contain water or other protic solvents. Traces of these solutions remaining in the display structure following photolithographic processing together with reaction of moisture or oxygen present in the processing environment may react chemically with certain phosphor materials sensitive to oxidation or hydrolysis reactions to cause performance degradation of the completed display. Continued chemical reactions during operation of the display may cause continued performance degradation thereby shortening the life of the display.

[0004] To overcome such performance degradation problems, the use of various materials in conjunction with certain phosphor materials has been proposed. Silicon nitride has been proposed for use with terbium activated zinc sulfide and zinc magnesium sulfide phosphors (Mikami et al.; 2000 Proceedings of the 6th International Conference on the Science and Technology of Display Phosphors; J. Ohwaki et al., 1987, Review of the Electrical Communications Laboratories Vol. 35).

[0005] U.S. Patents 4,188,565, 4,721,631, 4,897,319 and 5,644,190 disclose the use of silicon nitride layers or silicon oxynitride layers in conjuction with a manganese activated zinc sulfide phosphor film using a plasma chemical vapour deposition method.

[0006] U.S. Patents 5,496,597 and 5,598,059 disclose the use of aluminum oxide in conjunction with a terbium doped zinc sulfide for electroluminescent displays. WO 00/70917 discloses an electroluminescent laminate that includes a rare earth activated zinc sulfide material having a diffusion barrier layer of zinc sulfide.

[0007] Aluminum nitride has also been proposed for use with EL emitting layers of alkali earth chalcogen compounds in thin film electroluminescent devices as described in U.S. 4,975,338 and JP 02103893. Aluminum nitride has also been used as an insulating thin film layer in organic electroluminescent elements/displays as described in JP 08288069, JP 10092580, U.S. 6,146,225, U.S. 6,383,048 and U.S. 6,416,888 as well as a moisture barrier layer in EL elements as described in U.S. 2002/0079836 and U.S. 2002/0031688. Aluminum nitride as a ceramic substrate has also been proposed as disclosed in U.S. 2002/0177008.

[0008] U.S. 2002/0125821 discloses the use of aluminum nitride as a semiconductor material interposed between a conventional manganese activated zinc sulfide phosphor film and a thick film dielectric layer. The device is constructed by annealing the phosphor film, applying a layer of aluminum nitride on top of the annealed phosphor and then screen printing and sintering a thick film dielectric layer thereon such that the aluminum nitride is placed between the phosphor film and the thick film dielectric layer.

[0009] While the aforementioned patents and patent applications may teach the use of certain insulator materials such as aluminum nitride in conjunction with conventional zinc sulfide phosphors or within thin film electroluminescent displays, there remains a need to provide specific improved phosphor materials for use within thick film dielectric electroluminescent displays that exhibit improved luminance and a long operating life with minimal degradation.

Summary of the Invention

[0010] The present invention is a passivating or barrier layer for use with a phosphor provided within a thick film dielectric electroluminescent device More specifically, the present invention is a passivating or barrier layer for use with a phosphor selected from: a rare earth activated alkaline thioaluminate; a rare earth or transition metal activated zinc selenide; and a rare earth or transition metal activated zinc sulfo-selenide. The phosphors are used within a thick film dielectric electroluminescent device as described for example in Applicant's U.S. Patent 5,432,015 and U.S. Patent Application Serial No. 60/341,790 filed December 21, 2002.

[0011] The barrier layer of the present invention helps to improve the luminance and operating life of the phosphor. The barrier layer is comprised of one or more aluminum nitride layers provided on the top (viewing side surface) of the phosphor film and optionally, also on the bottom side of the phosphor film. In a preferred aspect of the invention, the barrier layer is provided on the viewing side surface of the phosphor material.

[0012] The barrier layer of the invention acts to prevent or minimize the effect of any chemical species present within the device from reacting with the phosphor. Such chemical species may cause a reduction in the realizable luminance of the phosphor by reducing the efficiency with which electrons are injected into the phosphor during operation of the device by causing a reduction in the efficiency with which electrons interact with the activator species in the phosphor to emit light. Chemical species may also act to reduce the efficiency by which light generated in the phosphor is transmitted from the device to provide useful luminance.

[0013] In particular, phosphor degradation may involve reaction of oxygen or water with the phosphor to change the chemical composition of at least a portion of the phosphor. The aluminum nitride passivating layer of the present invention reduces the rate of these reactions by acting as a barrier for oxygen originating from outside of the phosphor layer, such as for example from within the thick dielectric structure of the device, residual species from chemicals used in the photolithographic processes used to pattern the phosphor or from adjacent thin film layers and/or the external environment.

[0014] The barrier layer material is selected such that it is not chemically reactive with adjacent layers, particularly with the phosphor material. The chemical reactivity during the fabrication processes for and during the operation of a display device is not readily determinable and therefore this makes the selection of usable material within the display device and in conjunction with the phosphor material difficult.

[0015] The present invention has several different embodiments. In one embodiment, a thin aluminum nitride film is provided in contact with the viewing side surface of the inorganic phosphor film within a thick film dielectric electroluminescent display. In another embodiment, an aluminum nitride thin film is provided in contact with both surfaces of an inorganic thin film phosphor within a thick film dielectric electroluminescent display. In yet a further embodiment of the invention, the phosphor film is selected from the group consisting of: (a) an europium or cerium activated alkaline earth thioaluminate, (b) a rare earth activated fine grained zinc sulfide, (c) a transition metal activated zinc sulfide, (d) a rare earth or transition metal activated zinc selenide and (e) a rare earth or transition metal activated zinc sulfo-selenide wherein the aluminum nitride film is provided in contact with the viewing-side surface of the phosphor film. In still a further embodiment of the invention, an aluminum nitride film is provided in contact with both surfaces of the phosphor film.

[0016] According to an aspect of the present invention is an improved phosphor film for a thick film dielectric electroluminescent display as defined in claim 1.

[0017] According to a further aspect of the present invention is a thick film dielectric electroluminescent device constructed on a glass or glass ceramic substrate as defined in claim 15.

[0018] According to still a further aspect of the invention is a method for making a stabilized phosphor laminate for use in a thick film dielectric electroluminescent device as defined in claim 17.

[0019] in alternative embodiments, an additional layer of aluminum nitride may be provided on the substrate prior to deposition of the phosphor.

Brief Description of the Drawings

[0020] The present invention will become more fully understood from the description given herein, and from the accompanying drawings, which are given by way of illustration only and do not limit the intended scope of the invention.

Figure 1 shows a schematic drawing of the cross section of a thick film dielectric electroluminescent device showing the position of aluminum nitride layer (s) of the present invention.

Figure 2 is a graph showing the optical index of refraction of an aluminum oxynitride film was a function of the oxygen to nitrogen ratio in the film

Figure 3 is a graph showing the luminance of several thick film dielectric electroluminescent devices having a barium thioaluminate phosphor in contact with aluminum nitride and aluminum oxide films.

Figure 4 is a graph showing the luminance of several thick film dielectric devices having a terbium activated zinc sulfide phosphor in contact with aluminum nitride, aluminum oxynitride and aluminum oxide films.

Figure 5 is a graph showing the luminance of several thick film dielectric devices having a manganese activated zinc sulfide phosphor in contact with aluminum nitride and aluminum oxide films.

Figure 6 is a graph showing the luminance as a function of operating time for thick film dielectric electroluminescent devices having a europium activated barium thioaluminate phosphor in contact with aluminum nitride and aluminum oxide films.

Figure 7 is a graph showing the luminance as a function of operating time for thick film dielectric electroluminescent devices having a terbium activated zinc sulfide phosphor in contact with aluminum nitride and aluminum oxide films.

Detailed Description of the Invention

[0021] The present invention is a passivating or barrier layer for use with phosphor films in thick film dielectric electroluminescent displays. The passivating or barrier layer comprises aluminum nitride used in conjunction with a phosphor material selected from the group consisting of: (a) a rare earth activated alkaline earth thioaluminate, (b) a rare earth or transition metal activated zinc selenide, and (c) a rare earth or transition metal activated zinc sulfo-selenide. The aluminum nitride layer is provided in contact with one or both surfaces of the phosphor material which is preferably provided as a thin film within the thick film dielectric electroluminescent device. The aluminum nitride layer functions to improve the electrical and electrochemical stability of the phosphor film and its interface with the rest of the thick film dielectric electroluminescent device.

[0022] The aluminum nitride barrier layer helps to minimize migration of oxygen into the phosphor material during device operation as oxygen may react with the phosphor material to cause performance degradation. The aluminum nitride barrier layer acts as a barrier to oxygen migration and/or reacts with the oxygen to tie it up so that it is no longer available to react with the phosphor to an extent to cause a reduction in device luminance. The barrier layer also provides a more favourable interface at the phosphor surface to inhibit electrochemical reactions at these surfaces during device operation that may degrade the performance of the device.

[0023] The invention is particularly applicable to electroluminescent devices employing a thick dielectric layer having a high dielectric constant dielectric layer wherein -the thick film dielectric material is a composite material comprising two or more oxide compounds that may evolve chemical species that are deleterious to phosphor performance in response to thermal processing or device operation. Furthermore, the surface of the thick dielectric film is rough on the scale of the phosphor thickness resulting in cracks or pinholes through the device structure and contains voids that may contain or absorb deleterious chemical species thus contributing to a loss of luminance and operating efficiency over the operating life of the device. Suitable thick film dielectric devices for which the present invention may be used are described in Applicant's U.S. Patent 5,432,015 and U.S. Patent Application 60/341,790 filed December 21, 2002.

[0024] Figure 1 shows a schematic drawing of the cross section of a thick film dielectric electroluminescent device of the present invention generally indicated by reference numeral 10. The device 10 has a substrate 12 with a metal conductor layer 14 (ie. gold), a thick film dielectric layer 16 (i.e. PMT-PT) and a smoothing layer 18 (i.e. lead zirconate titanate) thereon. A variety of substrates may be used, as will be understood by persons skilled in the art. The preferred substrate is a substrate that is opaque in the visible and infrared regions of the electromagnetic spectrum. In particular, the substrate is a thick film dielectric layer on a ceramic substrate. Examples of such substrates include alumina, and metal ceramic composites. An aluminum nitride barrier layer 20 is shown to be present adjacent the phosphor layer 22. While the barrier layer 20 is shown on both sides of the phosphor, it is understood that only one such layer may be used. A thin film dielectric layer 24 and then an ITO transport electrode 26 are present above the phosphor- A hermetic enclosure 28 is shown disposed over the laminated structure which is enclosed by a sealing bead.

[0025] An important requirement in such a thick film dielectric electroluminescent display is to inhibit electrochemical reactions that may occur and cause device degradation at interfaces between different layers in the device when a voltage is applied across the device during operation. It is now demonstrated that aluminum nitride provides a stable interface with a variety of phosphor materials within the device in particular with thioaluminate phosphors and also with indium tin oxide layers used as optically transparent electrodes under these conditions.

[0026] The aluminum nitride layer is used with rare earth activated alkaline earth phosphors having one or more of the group consisting of Mg, Ca, Sr and Ba; one or more of the group consisting of Al, Ga and In; and one or more of the group consisting of S and Se which may also include oxygen at a relative atomic concentration that is less than 0.2 of the combined S and Se concentrations; and the rare earth activator species is selected from a rare earth activator species that generate the required light spectrum and is preferably Eu or Ce- The aluminum nitride barrier layer of the present invention is also suitable as a barrier layer for rare earth or transition metal activated zinc selenide phosphors and rare earth or transition metal activated zinc sulfo-selenide phosphors.

[0027] The zinc sulfo-selenide phosphor material may be represented by ZnS_xSe_{1-x}:A where $0<x<1$ and A is an activating element. The zinc selenide phosphor material may be represented by ZnSe:A where A is an activating element.

[0028] The present invention is particularly directed towards improving the operating life of rare earth activated alkaline earth thioaluminate phosphor materials, zinc selenide phosphor materials and zinc sulfo-selenide phosphor materials as described *supra.* The various phosphor materials being provided within a thick film dielectric electroluminescent display. While the detailed mechanism for stabilizing these phosphors is not understood and not being bound to any theory, preventing oxygen from reacting with the phosphors may help ensure that the rare earth activator species remain dissolved in the crystal lattice of the host thioaluminate compounds. Reaction of the phosphor with oxygen may cause precipitation of aluminum oxide from the phosphor, causing the remaining material to become more barium rich. While many different thioaluminate compounds exist with different ratios of alkaline earth elements to aluminum, not all of them are efficient phosphor hosts. Further, the rare earth species may come out of solution in the host thioaluminate to precipitate as oxysulfide species such as RE_2O_2S where RE represents a rare earth element. The formation of these compounds in a sulfur-bearing environment at very low oxygen partial pressure is well known, as for example described in an article by R. Akila et al, Metallurgical Transactions, Volume 18B (1987) pp. 163-8. The provision of the aluminum nitride layers of the present invention helps to minimize or prevent such undesirable reactions as described.

[0029] It is now demonstrated that aluminum nitride has several advantages compared to conventional thin film dielectric materials used in electroluminescent displays. The aluminum nitride barrier layers of the invention have an optical index of refraction closer to that of thioaluminate phosphor materials compared to traditional dielectric layers (such as aluminum oxide) in contact with the viewing-side surface of the phosphor film and through which light generated in the phosphor layer must pass. The improved matching of the optical index of refraction increases the light transmitted through the dielectric layer to improve overall luminosity Aluminum nitride is also stable against dielectric breakdown in the presence of high electric fields present during the operation of an ac thick film dielectric electroluminescent device. Furthermore, aluminum nitride, compared to the conventional thin film dielectric materials used in electroluminescent displays, have been found to include a relatively high dielectric constant of 13 to 15 as compared to 8 to 10 for silicon nitride and 7 to 8 for alumina. This minimizes the voltage drop across the dielectric layer, thereby reducing the display operating voltage, a relatively high dielectric breakdown strength of 0.5 to 1 megavolts per centimeter. In turn, this facilitates a stable interface between the phosphor layer and the adjacent aluminum nitride layer to provide stable charge injection into the phosphor layer, low residual film stress to prevent cracking or delamination of the film and a high optical index of refraction of about 2.0 that enhances light extraction from the phosphor.

[0030] The residual stress in aluminum nitride films can be minimized by appropriate control of the deposition atmosphere for reactive rf sputtering of aluminum nitride, in particular the nitrogen to argon ratio in the sputtering atmosphere. Typically, aluminum nitride films can be sputtered under an argon/nitrogen atmosphere at a pressure in the range of about 0.65 Pa to 3.5 Pa and with a nitrogen to argon ratio of about 0:50 to 20:50. The ratio should be close to about 5:50 to deposit low stress films on thioaluminate phosphor films. The rf power density applied to an aluminum nitride sputtering target for deposition may be in the range of about 2 watts per square centimeter to about 6 watts per square centimeter of active target area. The deposition substrate may be near ambient temperature during aluminum nitride deposition. The thickness of the aluminum nitride film is in aspects in the range of about 30 nanometers to about 50 nanometers and any sub range or ranges between 30 to 50 nanometers. The aluminum nitride can also be provided as one layer or two or more layers on each side of the phosphor material up to the desired thickness. The aluminum nitride sputtering rate tends to decrease as the pressure of the sputtering atmosphere is increased, as is the optical index of refraction, assumedly due to a concomitant increase in the partial pressure of oxygen contained as an impurity in the sputtering atmosphere. The optical index of refraction also decreases with a decreasing nitrogen partial pressure during sputtering, with the film becoming black as the nitrogen partial pressure is reduced to zero. This may be related to a nitrogen deficiency in the deposited film. The nitrogen and argon partial pressures may be set to achieve both a high optical index of refraction and a low residual stress in the deposited film. The residual stress in aluminum nitride films is significantly lower than that of silicon nitride films.

[0031] In addition to sputtering, other methods may be used to deposit the aluminum nitride film as is understood by one of skill in the art. Atomic layer chemical vapour deposition (ALCVD) methods for depositing aluminum nitride films are known in the art. The use of ALCVD may provide a more conformal film of aluminum nitride. In a further aspect of the invention, oxygen may be added to the aluminum nitride film to change its optical index of refraction to match that of adjacent layers to minimize reflection at the interface between the layers. Figure 2 shows the dependence of the optical index of refraction on the nitrogen to oxygen ratio in the film as measured using energy dispersive x-ray analysis (EDX). The index varies from less than 1.6, corresponding to that of aluminum oxide, if the nitrogen to oxygen ratio is close to zero, to about 2.0 for nitrogen to oxygen ratios in the film greater than about 3:1. Typically, an optical index of refraction near 2 is desirable, providing a best match to the high optical index of refraction of the phosphor materials.

[0032] The use of thin film aluminum nitride layers in contact with phosphor films facilitates varying degrees of luminosity improvement, depending on the composition of the phosphor materials. For devices with a manganese activated zinc sulfide phosphor film, the improvement is in the range of about 10 to 15%, for a sputtered terbium activated zinc sulfide phosphor the improvement is in the range of about 10 to 30% and for a europium activated barium thioaluminate film as described in the present invention, the improvement is in the range of about 30 to 40%.

[0033] One embodiment of the present invention is the provision of a thin film aluminum nitride layer deposited on top of a phosphor film selected from the group consisting of: a rare earth activated barium thioaluminate wherein the ratio of aluminum to barium is between 2 and 4; a rare earth or transition metal activated zinc selenide; and a rare earth or transition metal activated zinc sulfoselenide. This structure is provided within a thick film dielectric electroluminescent device as described herein. An indium tin oxide transparent conductor film is deposited on the aluminum nitride layer.

[0034] A second embodiment of the invention is an ac thick film dielectric electroluminescent device having: a thick dielectric layer; a phosphor film selected from the group consisting of a rare earth activated barium thioaluminate wherein the ratio of aluminum to barium is between 2 and 4; ; a rare earth or transition metal activated zinc selenide; and a rare earth or transition metal activated zinc sulfo-selenide; a thin film aluminum nitride layer deposited on the phosphor film; a second thin film dielectric layer of a different composition deposited on the aluminum nitride layer; and an indium tin oxide transparent conductor film deposited on the second dielectric layer.

[0035] A third embodiment of the present invention is an ac thick film dielectric electroluminescent device having a thick dielectric layer and a phosphor film selected from the group consisting of a rare earth activated barium thioaluminate wherein the ratio of aluminum to barium is between 2 and 4; a rare earth or transition metal activated zinc selenide; and a rare earth or transition metal activated zinc sulfo-selenide and having a thin film aluminum nitride layer in contact with both surfaces of the phosphor film.

[0036] A fourth embodiment of the present invention is an ac thick film dielectric electroluminescent device of any of the first through third embodiments described *supra,* in which the phosphor composition includes magnesium with the ratio of the atomic concentration of magnesium to barium plus magnesium being in the range of about 0.001 to 0.2.

[0037] A fifth embodiment of the invention is an ac thick film dielectric electroluminescent device of any of the first to fourth embodiments where the phosphor is activated with trivalent europium or cerium, and preferably europium, and the atomic ratio of europium or cerium to barium or barium plus magnesium is in the range of about 0.005 to 0.04 and preferably in the range of about 0.015 to 0.03.

[0038] The above disclosure generally describes the present invention. A more complete understanding can be obtained by reference to the following specific Examples. These Examples are described solely for purposes of illustration and are not intended to limit the scope of the invention. Changes in form and substitution of equivalents are contemplated as circumstances may suggest or render expedient. Although specific terms have been employed herein, such terms are intended in a descriptive sense and not for purposes of limitation.

Examples

Example 1

[0039] A thick film dielectric electroluminescent device incorporating thin film phosphor layers comprising barium thioaluminate activated with europium was constructed. The thick film substrate comprised a 5cm by 5cm alumina substrate having a thickness of about 0.1 cm. A gold electrode was deposited on the substrate, followed with a thick film high dielectric constant dielectric layer in accordance with the methods exemplified in Applicant's co-pending international application PCT CA00/00561 filed May 12, 2000 . A thin film dielectric layer consisting of barium titanate, with a thickness of about 100-200 nanometers, was deposited on top of the thick film dielectric layer using the sol gel technique described in Applicant's co-pending U.S. Patent Application 09/761,971 filed January 17, 2001. A 400nm thick barium magnesium thioaluminate phosphor film activated with about 3 atomic percent of europium with respect to barium was electron beam deposited on the barium titanate layer according to the methods of the Applicant's U.S, Patent Application 09/747,315. Following deposition the deposited phosphor was annealed under nitrogen in a belt furnace with a peak temperature of about 700°C for 12 minutes.

[0040] A 50nm thick aluminum nitride layer was then sputter-deposited using a 38cm by 12cm by 0.64cm thick rectangular target. The sputtering atmosphere was maintained by injecting nitrogen at a rate of 5 sccm and argon at 50 sccm into the sputtering chamber to maintain a pressure of about 0.7 Pa. The substrate was at ambient temperature prior to the deposition. The rf power to the sputtering target was about 2000 watts. The deposition rate was about 4 to 6 Angstroms per second. Energy-dispersive x-ray spectroscopic analysis of the film showed that it contained an atomic ratio of oxygen to nitrogen of less than 0.2. X-ray diffraction analysis of aluminum nitride films sputtered on to a silicon wafer under similar conditions showed that the as-deposited film had a largely amorphous structure with a small fraction of crystalline aluminum nitride and that a similar film subsequently annealed at 450°C was substantially crystallized with a hexagonal crystal structure and with the crystallographic c-axis oriented preferentially in a direction perpendicular to the film surface. The preferred orientation was measured using an x-ray diffractometer fitted with an area detector.

[0041] An indium tin oxide upper conductor film was next deposited according to the methods of Applicants co-pending international application PCT CA00/00561 and the completed device was annealed in air at about 550°C and then annealed under nitrogen at about 550°C following deposition of the indium tin oxide and prior to testing.

[0042] The device was tested by applying a 240 Hz alternating polarity square wave voltage waveform with a pulse width of 30 nanoseconds and an of amplitude 60 volts about the optical threshold voltage. Figure 3 shows the luminance as a function of applied voltage for the device. As can be seen from the data the luminance at 60 volts above the threshold voltage of 145 volts was about 180 candelas per square meter.

Example 2

[0043] A device was constructed similar to that of example 1, except that the aluminum nitride dielectric layer was replaced by an alumina layer of similar thickness. The luminance data for this device is also shown in Figure 3 and shows a luminance of about 120 candelas per square meter at 60 volts above its threshold voltage of 160 volts. The lower threshold voltage of the device with the aluminum nitride layer is attributed to the higher dielectric constant for aluminum nitride as compared to alumina. The luminance at 60 volts above the threshold voltage for the device with the aluminum nitride layer is about 40% higher than that for the device with the aluminum oxide layer.

Comparative Example 3

[0044] A device was constructed similar to that of example 1, except that the phosphor layer was sputtered terbium activated zinc sulfide rather than europium activated barium thioaluminate, with a thickness of about 700 nanometers. The luminance as a function of voltage for this device under the same test conditions is shown in Figure 4. As can be seen from the data the luminance at 60 volts above the threshold voltage of 170 volts was about 3000 candelas per square meter.

Comparative Example 4

[0045] A device similar to that of example 3, except that the aluminum nitride dielectric layer was replaced by an alumina layer of similar thickness. The luminance data for this device under the same test conditions is also shown In Figure 4 and shows a luminance of about 2100 candelas per square meter at 60 volts above its threshold voltage of 180 volts. As with the devices with the europium activated barium thioaluminate phosphor, the device of this example has a higher threshold voltage than the device of example 3 with the aluminum nitride layer, again attributed to the higher dielectric constant for aluminum nitride as compared to alumina. The luminance at 60 volts above the threshold voltage for the device with the aluminum nitride layer is about 40% higher than the corresponding luminance for the device with the alumina layer.

Example 5

[0046] A device similar to that of example 3, except that the aluminum nitride layer was doped with oxygen to form aluminum oxynitride. As shown in Figure 4, the threshold voltage and luminance values are between those for devices with pure aluminum nitride and alumina layers.

Reference Example 1

[0047] A device was constructed similar to that of example 1, except that the phosphor layer was manganese activated zinc sulfide rather than europium activated barium thioaluminate ,with a thickness of about 860 nanometers. The luminance as a function of voltage for this device under the same test conditions is shown in Figure 5. As can be seen from the data the luminance at 60 volts above the threshold voltage of 155 volts was about 4000 candelas per square meter.

Reference Example 2.

[0048] A device similar to that of Reference example 1, except that the aluminum nitride dielectric layer was replaced by an alumina layer of similar thickness. The luminance data for this device under the same test conditions is also shown in Figure 5 and shows a luminance of about 3700 candelas per square meter at 60 volts above its threshold voltage of 160 volts, As with the devices with the europium activated barium thioaluminate phosphor, the device of this example has a higher threshold voltage than the device of example 3 with the aluminum nitride layer, although the difference is smaller for these examples. The luminance at 60 volts above the threshold voltage for the device with the aluminum nitride layer is about 10% higher than the corresponding luminance for the device with the alumina layer.

Example 6

[0049] Two devices similar to those of examples 1 and 2 were constructed and subjected to life testing under the same driving conditions. Figure 6 shows comparative life data for electroluminescent devices with aluminum nitride and with alumina upper dielectric layers showing that aluminum nitride films deposited on top of thioaluminate phosphor films has a stabilizing effect on the thioaluminate phosphor. The data shows that the luminance dropped to zero after 200 hours for the device with the alumina upper dielectric layer, but decreased much more slowly following an initial burn-in period for the device with the aluminum nitride layer.

Reference Example 3

[0050] Four devices having a terbium activated zinc sulfide phosphor, two similar to those of example 3 with an aluminum nitride upper dielectric layer and two similar to those of example 4 with an alumina upper dielectric layer were constructed and subjected to life testing at a drive frequency of 600 Hz under the same driving conditions. Figure 7 shows comparative life data for electroluminescent devices with the aluminum nitride and with the alumina upper dielectric layers showing that aluminum nitride films has a stabilizing effect on the zinc sulfide phosphor. The data shows that the initial luminance for the former devices was more than 2700 candelas per square meter with no substantial change over 850 operating hours whereas the latter devices had a similar initial luminance, but a sharp initial drop to about 2200 candelas per square meter, and a steady decline following the initial drop to around 1500 candelas per square meters after 850 hours of testing.

Claims

1. An improved phosphor film for a thick film dielectric electroluminescent displays, said phosphor film selected from the group consisting of:

(a) a rare earth activated alkaline earth phosphor having one or more of the group consisting of Mg, Ca, Sr and Ba; one or more of the group consisting of Al, Ga and In; and one or more of the group consisting of S and Se;
(b) a rare earth or transition metal activated zinc selenide; and
(c) a rare earth or transition metal activated zinc sulfo-selenide,

- wherein said phosphor film of (a), (b) and (c) is provided with an aluminum nitride barrier layer on at top and/or bottom side of the phosphor film; and wherein when said phosphor film is (a), the aluminium nitride barrier layer has a thickness in the range from 30 to 50 nm.

2. The phosphor film of claim 1, which may also include oxygen at a relative atomic concentration that is less than 0.2 of the combined S and Se concentrations.

3. The phosphor film of claim 1, wherein the rare earth activator species is selected from the group consisting of Eu and Ce.

4. The phosphor film of claim 1, wherein said aluminum nitride barrier layer is provided on top of said phosphor of (a) to (c).

5. The phosphor film of claim 1, wherein said aluminum nitride barrier layer is provided on the bottom of said phosphor of (a), (b) and (c).

6. The phosphor of claim 1, wherein said aluminum nitride barrier layer is provided on the top and bottom of said phosphor of (a) to (c).

7. The phosphor of claim 1, wherein said aluminum nitride barrier layer is about 30nm to about 50nm thick.

8. The phosphor of claim 7, wherein said aluminum nitride barrier layer is deposited by sputtering.

9. The phosphor of claim 8, wherein said sputtering is conducted in a sputtering atmosphere of gases at a pressure of about 0.65Pa to 3.5Pa having a nitrogen to argon ratio of about 0:50 to 20:50 and a power density of about 2 to 6 watts per square centimeter.

10. The phosphor of claim 9, wherein oxygen is added to said sputtering atmosphere.

11. The phosphor of claim 7, wherein said aluminum nitride barrier layer is deposited by atomic layer chemical vapour deposition.

12. The phosphor of claim 7, wherein said aluminum nitride barrier layer has a optical index of refraction of up to about 2.0.

13. The phosphor of claim 1, wherein said zinc sulfoselenide is represented by the formula ZnS_xSe_{1-x}:A where 0<x<1 and A is an activating element.

14. The phosphor of claim 1, wherein said zinc selenide phosphor material is represented by ZnSe:A where A is an activating element.

15. A thick film dielectric electroluminescent device constructed on a glass or glass ceramic substrate and comprising a phosphor selected from the group consisting of;

(a) a rare earth activated alkaline earth phosphor as defined in claim 1;
(b) a rare earth or transition metal activated zinc selenide; and
(c) a rare earth or transition metal activated zinc sulfo-selenide,

- wherein said phosphor film of (a), (b) and (c) is provided with an aluminum nitride barrier layer on a top and/or bottom side of the phosphore film; and wherein when said phosphor film is (a), the aluminium nitride barrier layer has a thickness in the range from 30 to 50nm.

16. The device of claim 15, wherein said aluminum nitride barrier layer has a thickness of about 30nm to about 50nm.

17. A method for making a stabilized phosphor laminate for use in a thick film dielectric electroluminescent device, said method comprising;

i) deposition of a phosphor selected from the group consisting of:

(a) a rare earth activated alkaline earth a phosphor as defined in claim 1;
(b) a rare earth or transition metal activated zinc selenide; and
(c) a rare earth or transition metal activated zinc sulfo-selenide,

onto a glass or glass ceramic substrate incorporating a first set of address lines and a dielectric layer,
ii) deposition of a layer of aluminum nitride on top of said phosphor film of (a)-(c) wherein when said phosphor film (a), the aluminium nitride layer is deposited to a tnickness in the range from 30 to 50 nm; and
iii) annealing said phosphor film at a temperature of up to about 1100°C.

18. The method of claim 17, wherein said method further comprises deposition of a layer of aluminum nitride on the bottom of said phosphor film of (a), (b) and (c).

19. The method of claim 18, wherein said alumium nitride has a thickness of about 30nm to about 50nm.

20. The method of claim 18 or 19, wherein said aluminum nitride barrier layer is deposited by sputtering.

21. The method of claim 20, wherein said sputtering is conducted in a sputtering atmosphere of gases at a pressure of about 0.65Pa to 3.5Pa, having as nitrogen to argon ratio of about 0:50 to 20:50 and a power density of about 2 to 6 watts per square centimeter.

22. The method of claim 21 wherein oxygen is added to said sputtering atmosphere.

23. The method of claim 18, or 19, wherein said aluminum nitride, barrier layer is deposited by atomic layer chemical vapour deposition.

Patentansprüche

1. Verbesserter Phosphorfilm für eine dielektrische Elektrolumineszenz-Dickfilmvorrichtung, wobei der Phosphorfilm aus der Gruppe, bestehend aus :

(a) einem Seltenerd-aktivierten Erdalkaliphosphor mit einem oder mehreren von der Gruppe, bestehend aus Mg, Ca, Sr und Ba, einem oder mehreren von der Gruppe, bestehend aus Al, Ga und In, und einem oder mehreren von der Gruppe, bestehend aus S und Si,
(b) einem Seltenerd- oder Übergangsmetall-aktivierten Zinkselenid, und
(c) einem Seltenerd- oder Übergangsmetall-aktivierten Zinksulfoselenid, ausgewählt ist,

wobei der Phosphorfilm von (a), (b) und (c) mit einer Aluminiumnitrid-Sperrschicht auf einer Ober- und/ oder Unterseite des Phosphorfilms versehen ist, und wobei, wenn der Phosphorfilm (a) ist, die Aluminiumnitrid-Sperrschicht eine Dicke in dem Bereich von 30 bis 50 nm aufweist.

2. Phosphorfilm gemäß Anspruch 1, welcher auch Sauerstoff mit einer relativen Atomkonzentration, die weniger als 0,2 der kombinierten S- und Se-Konzentrationen beträgt, einschließen kann.

3. Phosphorfilm gemäß Anspruch 1, wobei die Seltenerd-Aktivatorspezies aus der Gruppe, bestehend aus Eu und Ce, ausgewählt ist.

4. Phosphorfilm gemäß Anspruch 1, wobei die Aluminiumnitrid-Sperrschicht auf der Oberseite des Phosphors von (a) bis (c) angeordnet ist.

5. Phosphorfilm gemäß Anspruch 1, wobei die Aluminiumnitrid-Sperrschicht auf der Unterseite des Phosphors von (a), (b) und (c) angeordnet ist.

6. Phosphor gemäß Anspruch 1, wobei die Aluminiumnitrid-Sperrschicht auf der Oberseite und Unterseite des Phosphors von (a) bis (c) angeordnet ist.

7. Phosphor gemäß Anspruch 1, wobei die Aluminiumnitrid-Sperrschicht etwa 30 nm bis etwa 50 nm dick ist.

8. Phosphor gemäß Anspruch 7, wobei die Aluminiumnitrid-Sperrschicht durch Sputtern abgeschieden worden ist.

9. Phosphor gemäß Anspruch 8, wobei das Sputtern in einer Sputtergasatmosphäre bei einem Druck von etwa 0,65 Pa bis 3,5 Pa mit einem Stickstoff-zu Argonverhältnis von etwa 0:50 bis 20:50 und einer Leistungsdichte von etwa 2 bis 6 Watt pro Quadratzentimeter durchgeführt wird.

10. Phosphor gemäß Anspruch 9, wobei Sauerstoff zu der Sputteratmosphäre zugefügt wird.

11. Phosphor gemäß Anspruch 7, wobei die Aluminiumnitrid-Sperrschicht durch chemische Atomlagen-Dampfabscheidung abgeschieden wird.

12. Phosphor gemäß Anspruch 7, wobei die Aluminiumnitrid-Sperrschicht einen optischen Brechungsindex von bis zu etwa 2,0 aufweist.

13. Phosphor gemäß Anspruch 1, wobei das Zinksulfoselenid durch die Formel ZnS_xSe_{1-x}:A dargestellt wird, worin $0<x<1$ und A ein aktivierendes Element ist.

14. Phosphor gemäß Anspruch 1, wobei das Zinkselenid-Phosphormaterial durch ZnSe:A dargestellt wird, worin A ein aktivierendes Element ist.

15. Dielektrische Elektrolumineszenz-Dickfilmvorrichtung, aufgebaut auf einem Glas- oder Glaskeramiksubstrat und umfassend einen Phosphor, ausgewählt aus der Gruppe, bestehend aus:

(a) einem Seltenerd-aktivierten Erdalkaliphosphor, wie in Anspruch 1 definiert,
(b) einem Seltenerd- oder Übergangsmetall-aktivierten Zinkselenid und
(c) einem Seltenerd- oder Übergangsmetall-aktivierten Zinksulfoselenid,

wobei der Phosphorfilm von (a), (b) und (c) mit einer Aluminiumnitrid-Sperrschicht auf einer Ober- und/oder Unterseite des Phosphorfilms versehen ist, und wobei, wenn der Phosphorfilm (a) ist, die Aluminiumnitrid-Sperrschicht eine Dicke in dem Bereich von 30 bis 50 nm aufweist.

16. Vorrichtung gemäß Anspruch 15, wobei die Aluminiumnitrid-Sperrschicht eine Dicke von etwa 30 nm bis etwa 50 nm aufweist.

17. Verfahren zur Herstellung eines stabilisierten Phosphorlaminats zur Verwendung in einer dielektrischen Elektrolumineszenz-Dickfilmvorrichtung, wobei das Verfahren umfaßt:

i) Abscheidung eines Phosphors, ausgewählt aus der Gruppe, bestehend aus:

(a) einem Seltenerd-aktivierten Erdalkaliphosphor, wie in Anspruch 1 definiert,
(b) einem Seltenerd- oder Übergangsmetall-aktivierten Zinkselenid und
(c) einem Seltenerd- oder Übergangsmetall-aktivierten Zinksulfoselenid, auf einem Glas- oder Glaskeramiksubstrat, einbringend ein erstes Set von Adresslinien und eine dielektrische Schicht,

ii) Abscheidung einer Schicht von Aluminiumnitrid auf der Oberseite des Phosphorfilms von (a)-(c), wobei, wenn der Phosphorfilm (a) ist, die Aluminiumnitrid-Schicht mit einer Dicke in dem Bereich von 30 bis 50 nm abgeschieden wird, und
iii) Tempern des Phosphorfilms bei einer Temperatur von bis zu etwa 1100°C.

18. Verfahren gemäß Anspruch 17, wobei das Verfahren weiter die Abscheidung einer Schicht von Aluminiumnitrid auf der Unterseite des Phosphorfilms von (a), (b) und (c) umfaßt.

19. Verfahren gemäß Anspruch 18, wobei das Aluminiumnitrid eine Dicke von etwa 30 nm bis etwa 50 nm aufweist.

20. Verfahren gemäß Anspruch 18 oder 19, wobei die Aluminiumnitrid-Sperrschicht durch Sputtern abgeschieden wird.

21. Verfahren gemäß Anspruch 20, wobei das Sputtern in einer Sputtergasatmosphäre bei einem Druck von 0,65 Pa bis 3,5 Pa mit einem Stickstoff- zu Argonverhältnis von etwa 0:50 bis 20:50 und einer Leistungsdichte von etwa 2 bis 6 Watt pro Quadratzentimeter durchgeführt wird.

22. Verfahren gemäß Anspruch 21, wobei Sauerstoff zu der Sputteratmosphäre zugefügt wird.

23. Verfahren gemäß Anspruch 18 oder 19, wobei die Aluminiumnitrid-Sperrschicht durch chemische Atomlagen-Dampfabscheidung abgeschieden wird.

Revendications

1. Film de phosphore amélioré pour un dispositif d'affichage électroluminescent diélectrique à film épais, ledit film de phosphore étant choisi dans le groupe constitué par :

(a) un phosphore terreux alcalin activé par une terre rare, présentant :

un ou plusieurs éléments du groupe constitué par Mg, Ca, Sr et Ba ;
un ou plusieurs éléments du groupe constitué par Al, Ga et In ; et
un ou plusieurs éléments du groupe constitué par S et Se ;

(b) un séléniure de zinc activé par une terre rare ou un métal de transition ; et
(c) un sulfo-sélénure de zinc activé par une terre rare ou un métal de transition,

- dans lequel ledit film de phosphore constitué de (a), (b) et (c) est pourvu d'une couche barrière de nitrure d'aluminium du côté supérieur et/ou du côté inférieur du film de phosphore ; et dans lequel lorsque ledit film de phosphore est constitué de (a), la couche barrière de nitrure d'aluminium présente une épaisseur située dans l'intervalle de 30 à 50 nm.

2. Film de phosphore selon la revendication 1, qui peut comprendre également de l'oxygène à une concentration atomique relative qui est inférieure à 0,2 des concentrations combinées de S et Se.

3. Film de phosphore selon la revendication 1, dans lequel le type de l'activateur de terre rare est choisi dans le groupe constitué par Eu et Ce.

4. Film de phosphore selon la revendication 1, dans lequel ladite couche barrière de nitrure d'aluminium est fournie du côté supérieur dudit phosphore (a) à (c).

5. Film de phosphore selon la revendication 1, dans lequel ladite couche barrière de nitrure d'aluminium est fournie au fond dudit phosphore (a), (b) et (c).

6. Phosphore selon la revendication 1, dans lequel ladite couche barrière de nitrure d'aluminium est fournie du côté supérieur et du côté inférieur dudit phosphore (a) à (c).

7. Phosphore selon la revendication 1, dans lequel ladite couche barrière de nitrure d'aluminium présente une épaisseur d'environ 30 nm à environ 50 nm.

8. Phosphore selon la revendication 7, dans lequel ladite couche barrière de nitrure d'aluminium est déposée par pulvérisation.

9. Phosphore selon la revendication 8, dans lequel ladite pulvérisation est conduite sous une atmosphère de pulvérisation de gaz à une pression d'environ 0,65 Pa à 3,5 Pa, avec un rapport de l'azote à l'argon d'environ 0:50 à 20:50 et une densité de puissance d'environ 2 à 6 watts par centimètre carré.

10. Phosphore selon la revendication 9, dans lequel de l'oxygène est ajouté à ladite atmosphère de pulvérisation.

11. Phosphore selon la revendication 7, dans lequel ladite couche barrière de nitrure d'aluminium est déposée par dépôt de vapeur chimique en couche atomique.

12. Phosphore selon la revendication 7, dans lequel ladite couche barrière de nitrure d'aluminium présente un indice de réfraction optique pouvant atteindre environ 2,0.

13. Phosphore selon la revendication 1, dans lequel ledit sulfo-séléniure de zinc est représenté par la formule ZnS_xSe_{1-x}:A dans laquelle $0<x<1$ et A est un élément activateur.

14. Phosphore selon la revendication 1, dans lequel ledit matériau phosphoré de séléniure de zinc est représenté par ZnSe:A où A est un élément activateur.

15. Dispositif électroluminescent diélectrique sous forme d'un film épais construit sur du verre ou sur un substrat céramique de verre, et comprenant un phosphore choisi dans le groupe constitué par :

(a) un phosphore de terre alcaline activé par une terre rare tel que défini dans la revendication 1 ;
(b) un séléniure de zinc activé par une terre rare ou un métal de transition ; et
(c) un sulfo-séléniure de zinc activé par une terre rare ou un métal de transition ;

- dans lequel ledit film de phosphore constitué de (a), (b) et (c) est pourvu d'une couche barrière de nitrure d'aluminium du côté supérieur et/ou du côté inférieur du film de phosphore ; et dans lequel, lorsque ledit film de phosphore est constitué de (a), la couche barrière de nitrure d'aluminium a une épaisseur située dans l'intervalle de 30 à 50 nm.

16. Dispositif selon la revendication 15, dans lequel ladite couche barrière de nitrure d'aluminium a une épaisseur d'environ 30 nm à environ 50 nm.

17. Procédé de préparation d'un stratifié de phosphore stabilisé à utiliser dans un dispositif électroluminescent diélectrique sous forme d'un film épais, ledit procédé comprenant :

i) le dépôt d'un phosphore choisi dans le groupe constitué par :

(a) un phosphore de terre rare alcaline activé par une terre rare tel que défini dans la revendication 1 ;
(b) un séléniure de zinc activé par une terre rare ou un métal de transition ; et
(c) un sulfo-sélénure de zinc activé par une terre rare ou un métal de transition,

sur un substrat de verre ou de céramique de verre incorporant un premier ensemble de lignes d'adresse et une couche diélectrique ;
ii) le dépôt d'une couche de nitrure d'aluminium au-dessus dudit film de phosphore constitué de (a) - (c), dans lequel, lorsqu'il s'agit dudit film de phosphore (a), la couche de nitrure d'aluminium est déposée en une épaisseur située dans l'in-

tervalle de 30 à 50 nm ; et

iii) le recuit dudit film de phosphore à une température pouvant atteindre environ 1100 °C.

18. Procédé selon la revendication 17, dans lequel ledit procédé comprend en outre le dépôt d'une couche de nitrure d'aluminium au fond dudit film de phosphore constitué de (a), (b) et (c).

19. Procédé selon la revendication 18, dans lequel ledit nitrure d'aluminium a une épaisseur d'environ 30 nm à environ 50 nm.

20. Procédé selon la revendication 18 ou 19, dans lequel ladite couche barrière de nitrure d'aluminium est déposée par pulvérisation.

21. Procédé selon la revendication 20, dans lequel ladite pulvérisation est conduite dans une atmosphère de pulvérisation de gaz à une pression d'environ 0,65 Pa à 3,5 Pa, avec un rapport de l'azote à l'argon d'environ 0:50 à 20:50, et une densité de puissance d'environ 2 à 6 watts par centimètre carré.

22. Procédé selon la revendication 21, dans lequel de l'oxygène est ajouté à ladite atmosphère de pulvérisation.

23. Procédé selon la revendication 18 ou 19, dans lequel ladite couche barrière de nitrure d'aluminium est déposée par dépôt de vapeur chimique en couche atomique.

Figure 1

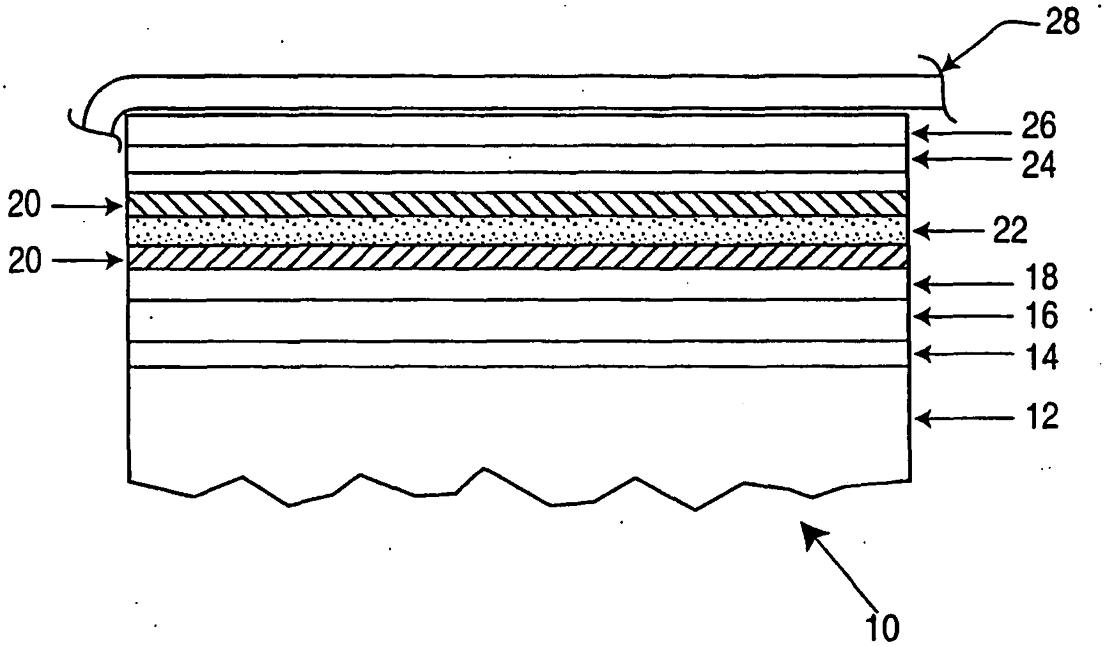


Figure 2

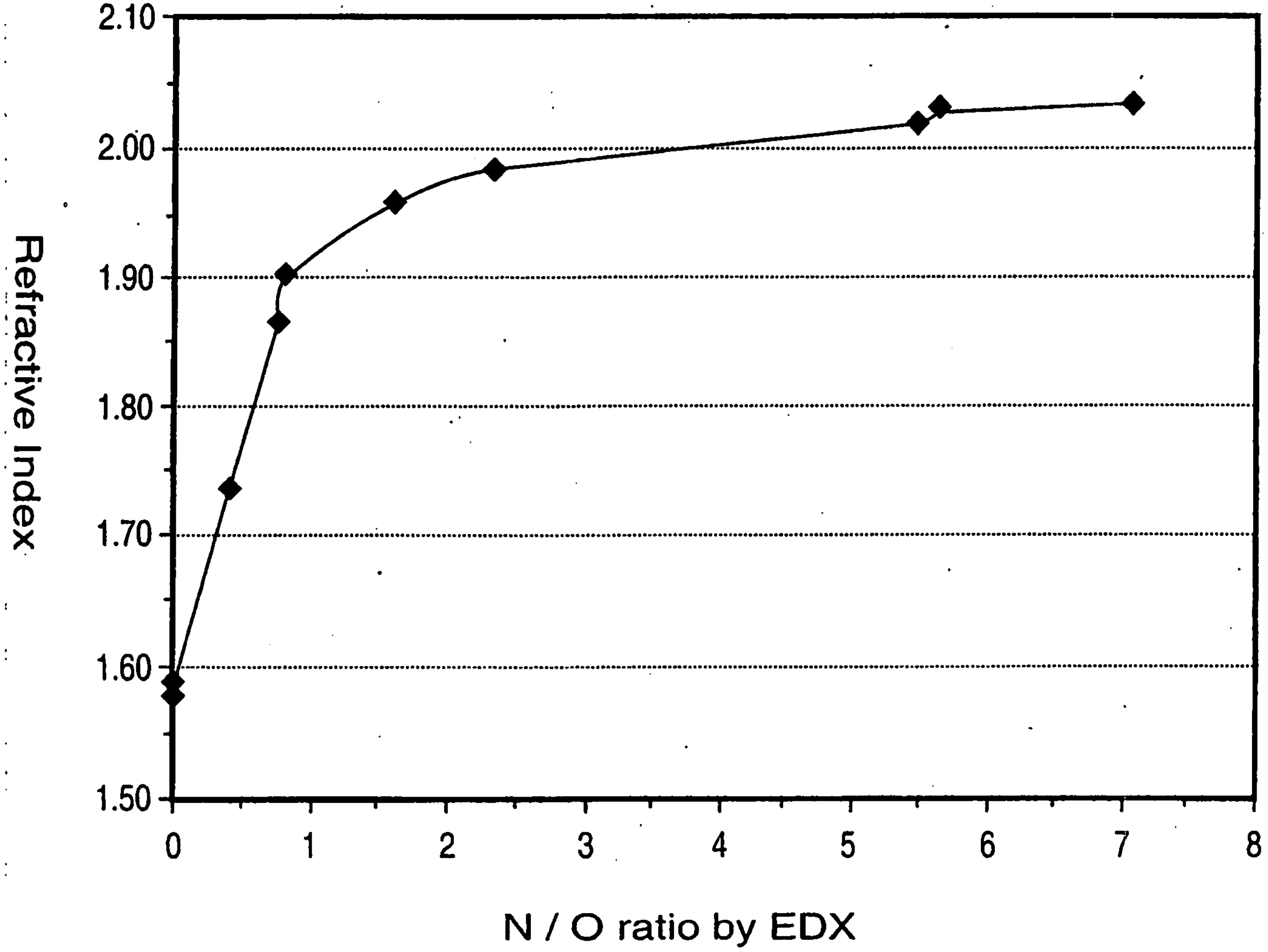

2.10
2.00
1.90
1.80
1.70
1.60
1.50
Refractive Index
0
1
2
3
4
5
6
7
8
N / O ratio by EDX

Figure 3

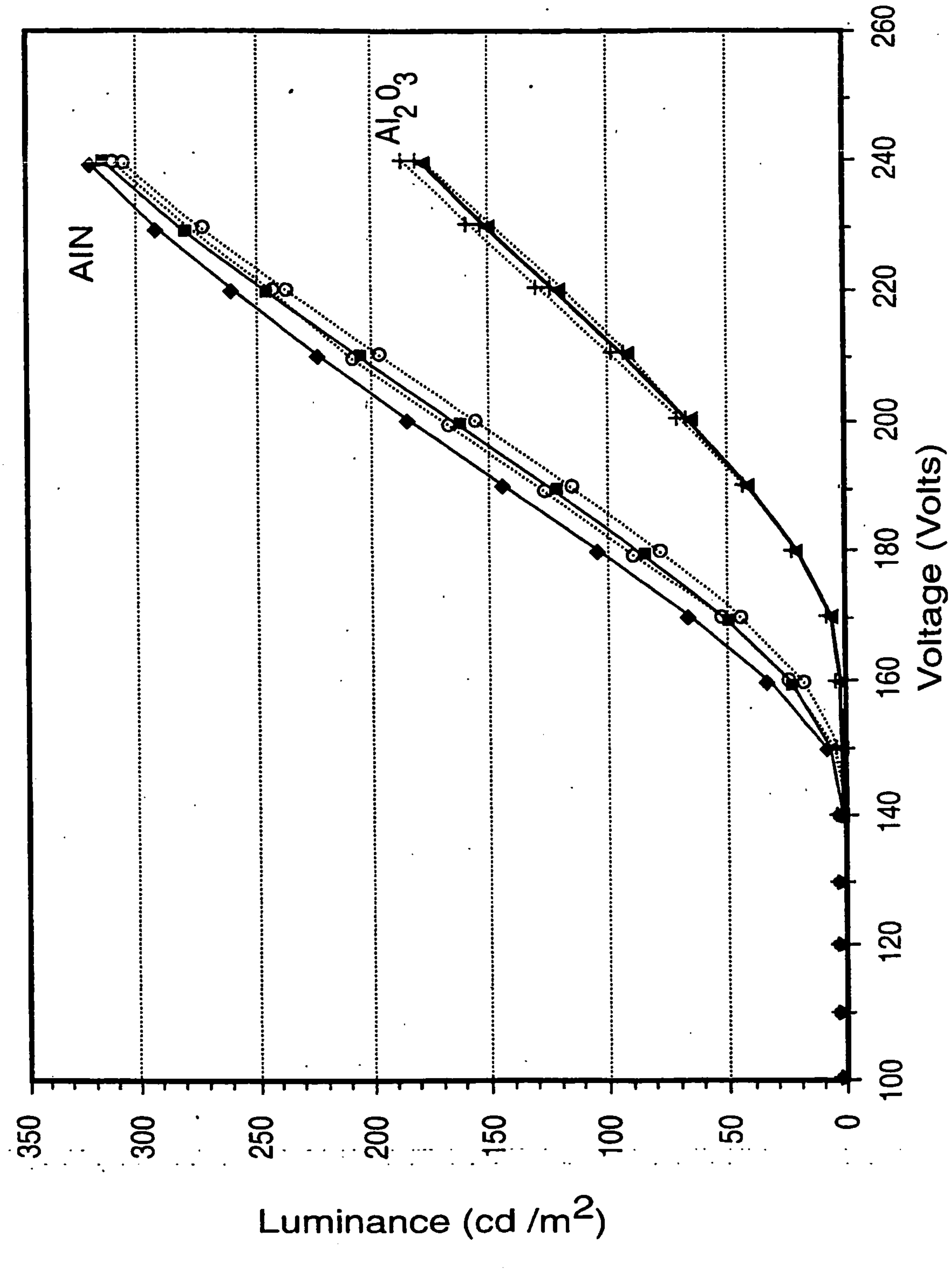

AlN
Al_2O_3
Luminance (cd /m^2)
350
300
250
200
150
100
50
0
Voltage (Volts)
100
120
140
160
180
200
220
240
260

Figure 4

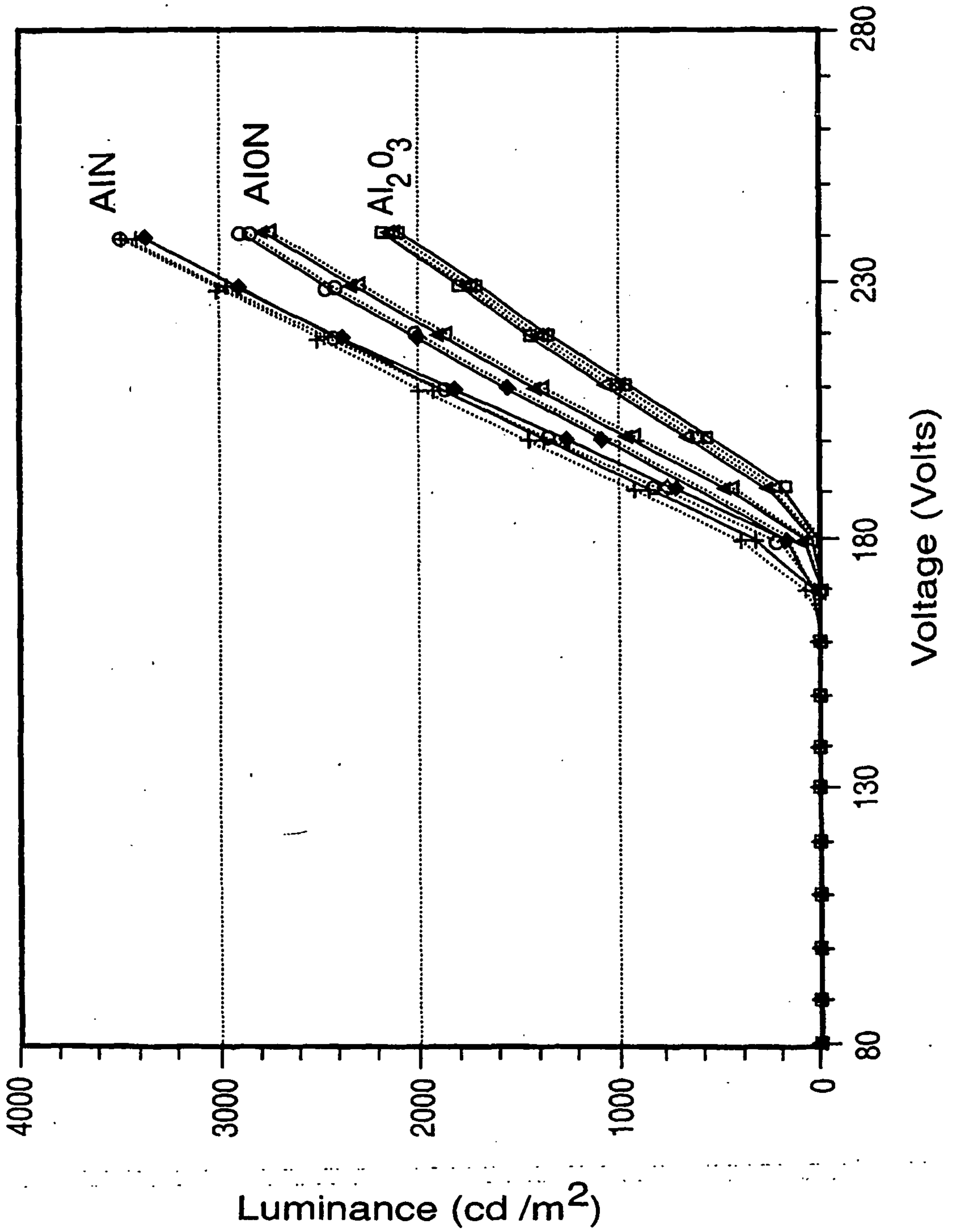

AlN
AlON
Al_2O_3
0
1000
2000
3000
4000
Luminance (cd /m^2)
80
130
180
230
280
Voltage (Volts)

Figure 5

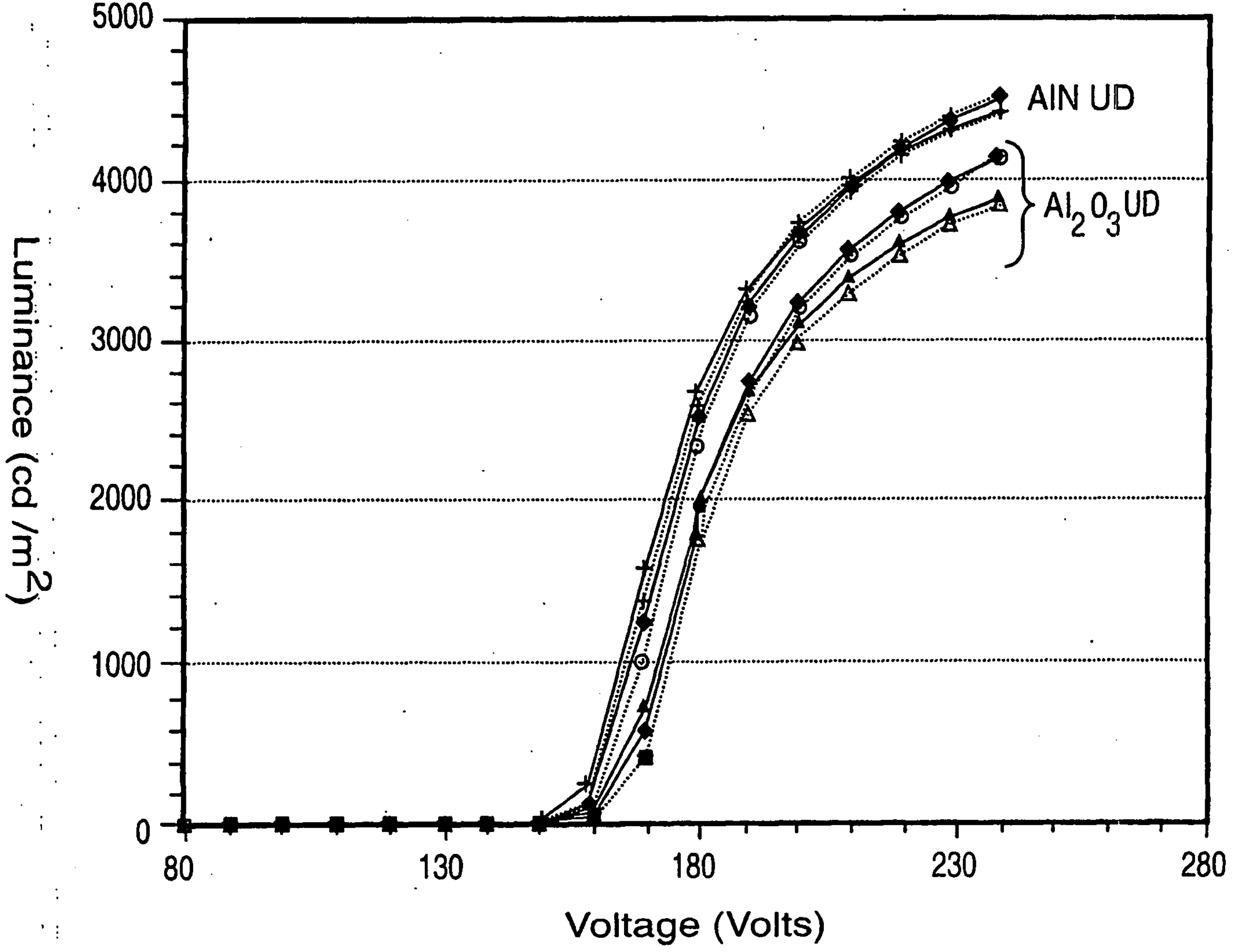

5000
4000
3000
2000
1000
0
Luminance (cd /m^2)
80
130
180
230
280
Voltage (Volts)
AlN UD
Al_2O_3UD

Figure 6

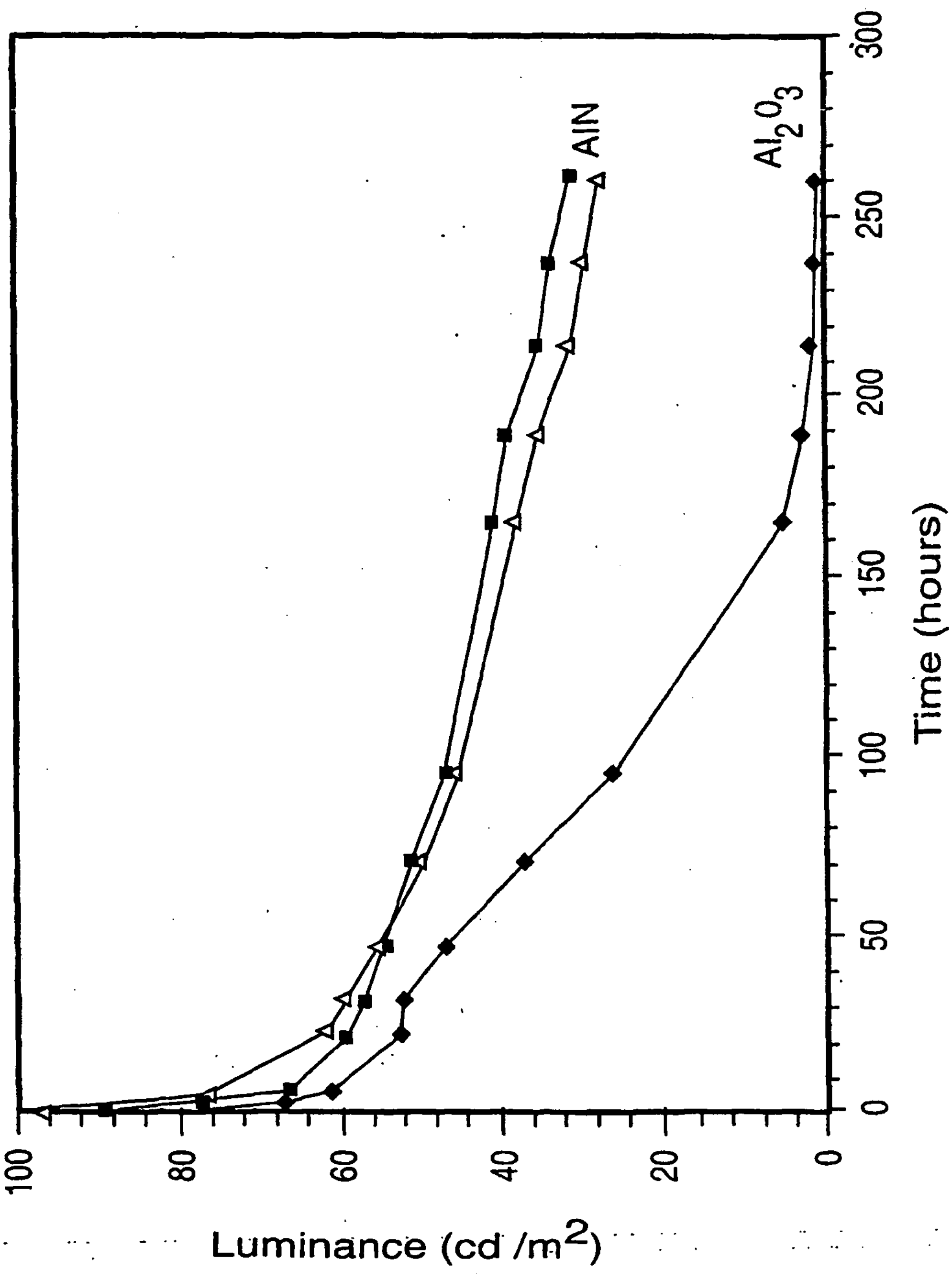
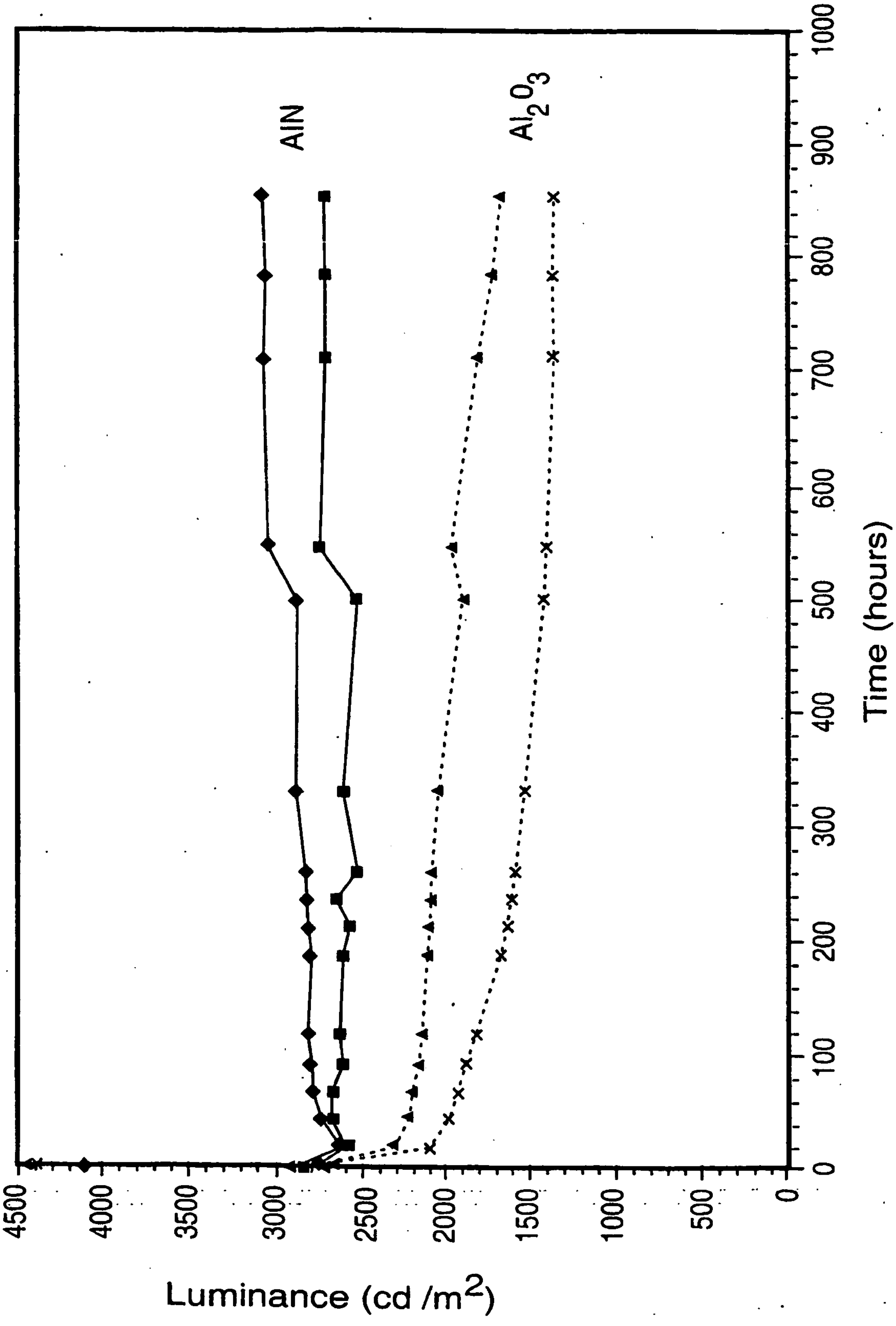

Luminance (cd /m^2)
100
80
60
40
20
0
0
50
100
150
200
250
300
Time (hours)
AlN
Al$_2$O$_3$

Figure 7


AlN
Al_2O_3
Luminance (cd /m^2)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Time (hours)
0
100
200
300
400
500
600
700
800
900
1000

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- **R. AKILA et al.** *Metallurgical Transactions,* 1987, vol. 18B, 163-8 **[0028]**

专利名称(译)	用于电致发光显示器的氮化铝钝化磷光体		
公开(公告)号	EP1574114B1	公开(公告)日	2008-08-20
申请号	EP2003779617	申请日	2003-12-05
[标]申请(专利权)人(译)	伊菲雷技术公司		
申请(专利权)人(译)	IFIRE科技股份有限公司.		
当前申请(专利权)人(译)	IFIRE IP CORPORATION		
[标]发明人	LIU GUO		
发明人	LIU, GUO		
IPC分类号	H05B33/14 H05B33/22 H05B33/10 C09K11/84 C09K11/88 B32B9/00 C09K11/02 C09K11/57 C09K11/77 H05B33/12		
CPC分类号	C09K11/02 C09K11/574 C09K11/7702 C09K11/7703 C09K11/7706 C09K11/7718 C09K11/7721 C09K11/773 C09K11/7731 C09K11/7734 C09K11/7745 C09K11/883 C09K11/886 H05B33/10 H05B33/14 H05B33/22 Y10S428/917 Y10T428/26		
优先权	60/434639 2002-12-20 US		
其他公开文献	EP1574114A1		
外部链接	Espacenet		

摘要(译)

提供了一种新颖的结构，以改善交流厚膜电介质电致发光显示器中使用的磷光体的亮度和操作稳定性。该新颖结构包括与磷光体膜接触的氮化铝阻挡层，以防止由于与氧反应而导致的磷光体降解。可以使用与用于沉积和退火磷光体膜的工艺兼容的真空沉积工艺来沉积阻挡层。本发明特别适用于电致发光显示器中使用的磷光体，其采用经受高处理温度的厚介电层以形成和激活磷光体膜。

Figure 1