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(19) **HU**(11) Lajstromszám: **E 030 851**(13) **T2****MAGYARORSZÁG****Szellemi Tulajdon Nemzeti Hivatala**

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(73) Jogosult(ak):

OSRAM GmbH, 80807 München (DE)

(72) Feltaláló(k):

KONRAD, Armin, 86845 Grossaitingen (DE)**ZACHAU, Martin, 82269 Geltendorf (DE)**

(74) Képviselő:

SBGK Szabadalmi Ügyvivői Iroda, Budapest

(54)

Fénypor összetétel igen magas színhőmérsékletű kisnyomású kisülőlámpához

Az európai szabadalom ellen, megadásának az Európai Szabadalmi Közlönyben való meghirdetésétől számított kilenc hónapon belül, felszólalást lehet benyújtani az Európai Szabadalmi Hivatalnál. (Európai Szabadalmi Egyezmény 99. cikk(1))

A fordítást a szabadalmas az 1995. évi XXXIII. törvény 84/H. §-a szerint nyújtotta be. A fordítás tartalmi helyességét a Szellemi Tulajdon Nemzeti Hivatala nem vizsgálta.

Fénypor összetétel igen magas színhőmérsékletű kisnyomású kisülőlámpához

Technical Field

The invention relates to a phosphor composition for a low-pressure discharge lamp with a high light yield and high colour temperature. The phosphor composition comprises for this purpose:

phosphors emitting in the red wavelength region from the group yttrium doped with europium or gadolinium-zinc-magnesium pentaborate doped with cerium and manganese,

phosphors emitting in the green wavelength region from the group lanthanum phosphate doped with cerium and terbium and/or cerium-magnesium aluminate doped with terbium and/or cerium-magnesium pentaborate doped with terbium, and

optionally a phosphor emitting in the blue wavelength region of the barium-magnesium aluminate type doped with europium.

Prior Art

The user of low-pressure discharge lamps, whether they be linear phosphor lamps or compact phosphor lamps, has recently become increasingly interested in obtaining lamps that when used have a stimulating action on the human body. Measurements have now shown that also the visible part of the electromagnetic spectrum has physiological effects on the human body. In particular it has been found that the human eye contains receptors that are actively involved in controlling the hormone balance of the sleep hormone melatonin. These receptors are sensitive particularly in the blue region of the spectrum, the maximum sensitivity being approximately in the range from 450 to 470 nm.

It was therefore important to look for phosphor compositions that meet this requirement. At the same time, however, the general colour rendering index that the hitherto conventional phosphor lamps have should not experience any significant reduction. Apart from the requirement of a good colour rendering the luminous flux emitted by the lamp should also be as high as possible. The difficulty now is that a high luminous flux and very good colour rendering are conflicting requirements, since a high luminous flux requires a maximum light intensity in the green region, whereas

a precondition for a good colour rendering is a distribution of the light intensity at all wavelengths that is similar to black body radiation, and therefore conflicts with the first requirement.

EP 1 274 120 A2 discloses a long-lasting phosphor lamp with a phosphor component emitting in the red wavelength region, which preferably comprises yttrium oxide doped with europium, and a phosphor component emitting in the green wavelength region, which preferably comprises lanthanum phosphate doped with cerium and terbium, and also with a phosphor component emitting in the blue wavelength region, which preferably comprises calcium-strontium-barium chloroapatite doped with europium.

Outline of the invention

This object is achieved with a phosphor composition having the features of the pre-characterising part of claim 1, by the features of the characterising part of claim 1. Particularly advantageous modifications are disclosed in the dependent claims.

The basic idea of the invention is to provide with a low-pressure discharge lamp that is comparable as regards electrical to a conventional low-pressure discharge lamp, an enhanced activating action on the human body. This effect will take place by increasing the relevant blue fraction, which is defined here via the so-called circadian factor introduced as technical variable. The circadian factor describes the ratio of the activating fraction of the emitted radiant power determined with an assumed sensitivity curve, to the overall luminous flux. In this connection the luminous flux is the radiant power evaluated with the spectral eye sensitivity (with respect to the normal brightness sensitivity). This factor is therefore the ratio of two integrals over the radiant power, in one case with the weighting function of the circadian action on the activating light receptors, and in the other case (in the case of luminous flux) with the spectral brightness sensitivity of the human eye.

The term circadian factor and also the term luminous flux are technical variables introduced per se. Reference should be made to the definition in the publication by Prof. Dr. Dietrich Gall in the Journal "LIGHT", Issue 7-8, 2002. Nevertheless it must be pointed out that the underlying physiological mechanisms depend on various parameters, for example the fact that the dark-adapted eye reacts differently to the bright-adapted eye. There are also differing scientific views concerning details of the correct circadian effect distribution in the blue spectrum, in particular depending on

the light-dark adaptation, which however will not be discussed in more detail here.

The invention has in this connection also the advantage that the lamp not only has a refreshing action and improves bodily and mental motivation and stimulation, but is subjectively felt by the user to be "fresher". This is due to the whiter light as a result of the intensified blue fraction. In this way a vision and in particular reading ability richer in contrast and less tiring, and a fresher and more natural colour rendering can be achieved. The original functions of the lower-pressure discharge lamp are therefore not only maintained but with a suitable design and construction are even improved by the invention. In particular colour temperatures of 8000 K and colour rendering index values R_a of greater than 80 are preferred. By adding appropriate blue phosphors colour temperatures of up to 20,000 K are also conceivable. The colour rendering index is also an introduced variable and denotes the level of agreement of the body colour with its appearance and the illumination by the corresponding lamp. For this purpose colour shifts after 8 in the German industry standard DIN 6169 of standard test colours are determined and a corresponding index value is calculated. A theoretical optimum lamp has a value of $R_a = 100$.

Measurements have now shown that by the addition of the manganese-strontium-barium-magnesium aluminate phosphor emitting in the blue wavelength region and doped with manganese and europium, a circadian factor of between 0.8 and 1.2 can be achieved.

In order to achieve a particularly high circadian factor with at the same time a colour rendering index R_a of greater than 80, the weight proportion of the europium-doped yttrium oxide phosphor doped is advantageously between 30 to 50%, preferably between 35 to 41%.

If gadolinium-zinc-magnesium pentaborate phosphor doped with cerium and magnesium is also added in addition to the yttrium oxide phosphor doped with europium as red phosphor, then advantageously the weight proportion of the gadolinium-zinc-magnesium pentaborate phosphor doped with cerium and magnesium is between 5 and 30%.

A phosphor or a phosphor combination from the group lanthanum phosphate doped with cerium and terbium and/or cerium-magnesium aluminate doped with terbium and/or cerium-magnesium pentaborate doped with terbium are advantageously used

as green phosphor components. The weight proportion of the lanthanum phosphate phosphor doped with cerium and terbium should in this case be between 22 to 40%, preferably between 30 to 34%.

A barium-magnesium aluminate phosphor doped with europium can possibly be used as blue phosphor component, wherein the weight proportion in the overall phosphor composition should preferably be between 10 to 20%, more preferably between 13 to 17%.

As additional blue or blue-green phosphor component the phosphor composition additionally contains at least one phosphor from the group manganese-strontium-barium-magnesium aluminate doped with manganese and europium or barium-magnesium aluminate doped with europium and manganese or strontium aluminate doped with europium or strontium-barium-calcium chloroapatite doped with europium or strontium-borophosphate doped with europium.

The weight proportion of the manganese-strontium-barium-magnesium aluminate phosphor doped with manganese and europium is in this case between 10 and 20%, preferably between 13 and 17%.

For the barium-magnesium aluminate phosphor doped with europium and manganese the weight proportion is advantageously between 7 and 35%, preferably between 10 and 30%.

Advantageously the weight proportion in the case of the europium-doped strontium aluminate phosphor should be between 3 and 15%, preferably between 4 and 10%.

For the strontium borophosphate phosphor doped with europium the weight proportion in the phosphor composition should preferably be between 3 and 15%, more preferably between 4 and 10%.

It is also possible to use as additional blue-green component in the phosphor composition a barium-magnesium aluminate phosphor doped with europium and manganese, with a weight proportion of between 3 and 20%, preferably between 5 and 15%, and a strontium-barium-calcium chloroapatite phosphate doped with europium in a weight proportion of between 20 and 35%, preferably between 25 and 32%.

The phosphor composition is preferably applied in the form of a single phosphor mixture to the inside of the discharge vessel and consists in this case of a single layer. It may however also be advantageous to apply the phosphor coating in the form of several layers.

In addition a protective layer of Al_2O_3 , Y_2O_3 or a rare earth oxide can be applied between the inside of the discharge vessel and the phosphor layer or layers.

Description of the drawings

The invention is described in more detail hereinafter with the aid of exemplary embodiments.

A phosphor composition according to the invention for a T8 phosphor lamp of 26 mm tube diameter and a power consumption of 58 W is therefore considered in more detail.

The phosphor layer on the inner wall of the tubular discharge vessel consists of 38 wt. % yttrium oxide phosphor doped with europium, 32 wt. % lanthanum phosphate phosphor doped with cerium and terbium, 15 wt. % barium-magnesium aluminate phosphor doped with europium, and 15 wt. % manganese-strontium-barium-magnesium aluminate phosphor doped with manganese and europium.

The phosphor lamp has a colour temperature of 8000 K and a colour rendering index of greater than 80. A circadian action factor of 1.0 is achieved with this coating.

The figure shows the spectrum of the phosphor composition of this lamp, in which the relative intensity is plotted against the wavelength in nm.

A phosphor composition that contains as blue-green phosphor a barium-magnesium aluminate phosphor doped with manganese and europium preferably has the following weight proportions:

37 wt. %	Yttrium oxide: Eu
30 wt. %	Lanthanum phosphate: Ce, Tb
15 wt. %	Barium-magnesium aluminate: Eu

16 wt. % Barium-magnesium aluminate: Mn, Eu

For a phosphor composition according to the invention with strontium aluminate doped with europium as green-blue phosphor component, the following percentages by weight apply:

37 wt. % Yttrium oxide: Eu

30 wt. % Lanthanum phosphate: Ce, Tb

26 wt. % Barium-magnesium aluminate: Eu

7 wt. % Strontium aluminate: Eu

In the case of strontium borophosphate doped with europium as blue-green fourth phosphor component, the following weight composition applies:

39 wt. % Yttrium oxide: Eu

28 wt. % Lanthanum phosphate: Ce, Tb

26 wt. % Barium-magnesium aluminate: Eu

7 wt. % Strontium borophosphate: Eu

When using barium-magnesium aluminate doped with manganese and europium and strontium-barium-calcium chloroapatite doped with Eu as blue-green components and with the omission of barium-magnesium aluminate doped with Eu as blue component, the following composition has proved to be best:

37 wt. % Yttrium oxide: Eu

28 wt. % Lanthanum phosphate: Ce, Tb

7 wt. % Barium-magnesium aluminate: Mn, Eu

28 wt. % Strontium-barium-calcium chloroapatite: Eu



Szabadalmi igénypontok

1. Fénypor összetétel nagy fényhasznosítású és magas színhőmérsékletű kisnyomású kisülőlámpához, ahol a fénypor összetétel

- a vörös hullámhossz-tartományban emittáló fényporokat tartalmaz, amelyekben európiummal adalékolt ittrium-oxid van,
 - a zöld hullámhossz-tartományban emittáló fényporokat tartalmaz, amelyekben cériummal és terbiummal adalékolt lantan-foszfát van, és
 - ezenkívül legalább egy, a kék ill. a kékeszöld hullámhossz-tartományban emittáló fényport tartalmaz,
- azzal jellemezve, hogy
- az európiummal adalékolt ittrium-oxid fénypor tömegaránya 30% és 50% között van,
 - a cériummal és terbiummal adalékolt lantan-foszfát fénypor tömegaránya 22% és 40% között van, és
 - a legalább egy, a kék ill. a kékeszöld hullámhossz-tartományban emittáló fénypor
 - európiummal és mangánnal adalékolt bárium-magnézium-aluminát 7% és 35% közötti tömegarányal, vagy
 - európiummal és mangánnal adalékolt mangán-stroncium-bárium-magnézium-aluminát 10% és 20% közötti tömegarányal, vagy
 - európiummal adalékolt stroncium-aluminát 3% és 15% közötti tömegarányal, vagy
 - európiummal adalékolt stroncium-bór-foszfát 3% és 15% közötti tömegarányal.

2. Az 1. igénypont szerinti fénypor összetétel, amelynél az európiummal adalékolt ittrium-oxid fénypor tömegaránya 35% és 41% között van.

3. Az 1. igénypont szerinti fénypor összetétel, amely további, a vörös hullámhossz-tartományban emittáló fényporként cériummal és mangánnak adalékolt gandolínium-cink-magnézium-pentaborátot tartalmaz 5% és 30% közötti tömegarányban.

4. Az 1. igénypont szerinti fénypor összetétel, amelynél az cériummal és terbiummal adalékolt lantan-foszfát tömegaránya 30% és 34% között van.

5. Az 1. igénypont szerinti fénypor összetétel, amelynél a fénypor összetétel egy, a kék hullámhossz-tartományban emittáló, európiummal adalékolt bárium-magnézium-aluminát típusú fényport tartalmaz.

6. Az 1. igénypont szerinti fénypor összetétel, amelynél az európiummal és

mangánnal adalékolt bárium-magnézium-aluminát fénypor tömegaránya 10% és 30% között van.

7. Az 1. igénypont szerinti fénypor összetétel, amelynél a mangánnal és európiummal adalékolt mangán-stroncium-bárium-magnézium-aluminát fénypor tömegaránya 13% és 17% között van.

8. Az 1. igénypont szerinti fénypor összetétel, amelynél az európiummal adalékolt stroncium-aluminát fénypor tömegaránya 4% és 10% között van.

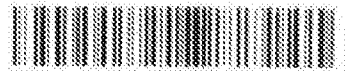
9. Az 1. igénypont szerinti fénypor összetétel, amelynél az európiummal adalékolt stroncium-bór-foszfát fénypor tömegaránya 4% és 10% között van.

10. Az 1. igénypont szerinti fénypor összetétel, amelynél a fénypor összetétel a kékeszöld hullámhossz-tartományban emittáló fénypor összetevőként európiummal és mangánnal adalékolt bárium-magnézium-aluminát fényport tartalmaz 7% és 20% közötti tömegarányban, és európiummal adalékolt stroncium-bárium-kalcium-klór-apatit fényport tartalmaz 20% és 35% közötti tömegarányban.

11. Az 1. igénypont szerinti fénypor összetétel, amelynél a zöld hullámhossz-tartományban emittáló fényporok terbiummal adalékolt cérium-magnézium-aluminátot vagy ill. és terbiummal adalékolt cérium-magnézium-pentaborátot tartalmaznak.

12. Az 1. igénypont szerinti fénypor összetétel, amelynél a fénypor összetétel a kisnyomású kisülőlámpa kisülődényének belső felületén egy rétegben van felhordva.

13. Az 1. igénypont szerinti fénypor összetétel, amelynél a fénypor összetétel a kisnyomású kisülőlámpa kisülődényének belső felületén több rétegben van felhordva.



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