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Datasheet for the decision of 25 March 2022

Case Number: T 2621/17 - 3.4.03

Application Number: 10184754.9

Publication Number: 2276080

IPC: H01L33/50

Language of the proceedings: EN

Title of invention:
Light emitting device and display

Patent Proprietor:
Nichia Corporation

Opponent:
Everlight Electronics Co., Ltd.

Relevant legal provisions:
EPC Art. 123(2), 54(3)
EPC 1973 Art. 76(1), 54(1), 54(2), 56, 87(1), 84

Keyword:

Amendments - added subject-matter (no)
Priority - partial priority (yes)
Novelty - (yes)
Inventive step - (yes)
Claims - support in the description (yes)
Late-filed ground for opposition (sufficiency of disclosure) - admitted (no)

Decisions cited:

G 0001/15

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Case Number: T 2621/17 - 3.4.03

D E C I S I O N
of Technical Board of Appeal 3.4.03
of 25 March 2022

Respondent: (Patent Proprietor)	Nichia Corporation 491-100, Oka Kaminaka-cho Anan-shi Tokushima 774-8601 (JP)
Representative:	Betten & Resch Patent- und Rechtsanwälte PartGmbB Maximiliansplatz 14 80333 München (DE)
Appellant: (Opponent)	Everlight Electronics Co., Ltd. No. 6-8, Zhonghua Rd., Shulin Dist., New Taipei City (TW)
Representative:	Himmelsbach, Mathias Frohwitter Patent- und Rechtsanwälte Possartstraße 20 81679 München (DE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 23 October 2017 concerning maintenance of the European Patent No. 2276080 in amended form.**

Composition of the Board:

Chairman	T. Häusser
Members:	M. Ley
	C. Heath

Summary of Facts and Submissions

I. The opponent's appeal concerns the interlocutory decision of the opposition division to maintain European patent No. 2 276 080 in amended form pursuant to Article 101(3)(a) EPC.

II. The patent was opposed on the grounds of Article 100(c) EPC 1973 and Article 100(a) EPC 1973 in conjunction with Articles 52(1) and 54(3) EPC and Articles 54(1), (2) and 56 EPC 1973. After expiration of the period according to Article 99(1) EPC, the opponent brought forward the ground for opposition under Article 100(b) EPC 1973.

III. In the contested decision, the opposition division held that the ground for opposition under Article 100(c) EPC 1973 prejudiced the maintenance of the patent as granted and that the first auxiliary request then on file met the requirements of the EPC.

IV. The appellant (opponent) requests that the decision be set aside and the patent be revoked.

V. The respondent (proprietor) requests that the appeal be dismissed, i.e. that the opposed patent be maintained in the version maintained by the opposition division.

The proprietor had initially filed an appeal against the impugned decision and had requested that the decision be set aside and the opposition be rejected (main request) or that the opponent's appeal be dismissed (first auxiliary request). The proprietor withdrew its appeal during the oral proceedings before the board.

VI. Reference is made to the following documents:

E1	EP 2 276 080 A2
E2	EP 2 276 080 B1
E3	EP 0 936 682 A1
E4	EP 1 017 112 A2
E5	English translation of JPA H8-198585
E6	English translation of JPA H8-244339
E7	"The 264th Proceedings of the institute of Phosphor Society", pages 1, 5 to 14
E7a	English translation of E7
E8	JP H5-152609
E8a	English translation of E8
E10	EP 0 862 794
E10a	WO 98/12757
E11	Newspaper "Nikkei Sangyo Shimbun", 13 September 1996
E11a	English translation of E11
E12	Nakamura et al., "Candela-class high-brightness InGaN/AlGaN double heterostructure blue-light-emitting diodes", Appl. Phys. Lett. 64(13), 28 March 1994
E13	Nichia NSPW310DAS product guide
E14	Invoice for sale of Nichia product NSPW310DAS
E15	US 6252254 B1
E16	Article in Nikkei Electronics of 23 Sept. 1996
E16a	English translation of E16
E17	JP 07-99345
E17a	English translation of E17
E18	G. Blasse, B.C. Grabmaier, "Luminescent Materials", Springer Verlag, 1994, pages 124 and 125
E19	G. Blasse, B.C. Grabmaier, "Investigation of Some Ce^{3+}-Activated Phosphors", J. Chem. Phys., vol. 47, number 12, 1967

E20 Decision of the U.S. Court of Appeals for the Federal Circuit, Case 16-1577, 2016-1611

E22 G. Wyszecki, W.S. Stiles, Color Science, John Wiley & Sons, 1982, pages 176 to 179

Document E1 is the published European patent application the opposed patent is based upon, and E2 is the publication of the opposed patent itself.

E1 is a divisional patent application within the meaning of Article 76 EPC 1973 of the European patent application E4 (hereinafter: the parent application). E4 is itself a divisional European patent application within the meaning of Article 76 EPC 1973 of the European patent application E3 (hereinafter: the grandparent application).

The opposed patent claims priority within the meaning of Article 87 EPC 1973, *inter alia*, of the Japanese patent applications published as JPA H8-198585 and JPA H8-244339; E5 and E6 are English translations of these applications.

VII. Using the opposition division's numbering, claim 1 in the version as maintained by the opposition division has the following wording:

1 A light emitting device comprising:
2 a light-emitting diode (LED) chip
2.1 having a gallium-nitride-based compound semiconductor and
2.2 having a light emitting layer
2.2.1 being capable of emitting light having a wavelength of 420nm to 490nm, and

3 a phosphor
3.1 being excited by the light emitted from said LED chip and
3.2 emitting light which is in relation of complementary colors with the emitted light,
4 wherein said phosphor is contained in a coating material that coats said LED chip, and
5 wherein said light emitting device emits white light by blending the light emitted by said LED chip and the light emitted by the phosphor, characterised in that
6 said LED chip has a single quantum well structure or multiple quantum well structure,
7 and in that the phosphor is a garnet phosphor activated with cerium containing at least one element selected from Y, Lu, Sc, La, Gd and Sm and at least one element selected from Al, Ga and In.

VIII. The parties' relevant submissions in relation to extension of the subject-matter of the patent beyond the application as filed and the parent and grandparent applications, sufficiency of the disclosure, novelty, inventive step, and clarity are contained in the Reasons below.

Reasons for the Decision

1. The appeal is admissible.

2. The invention concerns a light emitting device used in an LED display, a back light source, a traffic signal, a railway signal, an illuminating switch, an indicator, etc. More particularly, it relates to a light emitting device comprising a gallium nitride based semiconductor

light-emitting diode chip and a phosphor, which absorbs blue light emitted by a light emitting diode and emits light having a longer wavelength than the absorbed light. Thus, white light is emitted by the light emitting device. The phosphor is a garnet fluorescent material activated with cerium containing at least one element selected from Y, Lu, Sc, La, Gd and Sm and at least one element selected from Al, Ga and In, e.g. $(Y, Gd)_3(Al, Ga)_5O_{12}:Ce$.

3. Added subject-matter - Articles 76(1) and 100(c) EPC 1973, Article 123(2) EPC

3.1 The opposition division found a basis for the features of claim 1 in E1, E3 and E4 (see sections 2.2.1 to 2.2.7, 3.2 and 3.3 of Reasons of the contested decision).

3.2 For the appellant, the disclosure of paragraphs [0029] to [0063] of E1 or paragraphs [0047] to [0083] of E3 represented a conglomerate of different embodiments, but not one specific embodiment according to claim 1. A direct link between said different embodiments was not disclosed. For example, paragraph [0032] of E1 mentioned an LED chip emitting UV light, contrary to feature 2.2.1. More specific examples were described from paragraph [0089] of E1 or from paragraph [0111] of E3 onwards.

More specifically, the appellant questioned that the combination of the features of claim 1 was disclosed in E1, E3 or E4 and added that the phosphor composition being "selected from Y, Lu, Sc, La, Gd and Sm and at least one element selected from Al, Ga and In" was not disclosed in combination with the wavelength range between 420 nm and 490 nm. In the "first embodiment",

the wavelength range emitted by the LED could also be 400 to 530 nm (see E3, [0072]) or ultraviolet light (see E3, [0050]). The phosphor composition changed the radiation wavelength. There was no reason why the compositional range of feature 7 (E3, [0050]) would be applicable to a wavelength range from 420 to 490 nm. The only possible phosphors might be those disclosed in specific examples of paragraph [0112] of E3 onwards.

Furthermore, "complementary colours" were only disclosed for "yellow body colour", see E4, [0032], [0053], E3, [0050], [0072] or E1, [0032], [0053]. The omission of "yellow body colour" and the formula of paragraph [0032] of E1 in claim 1 resulted in an unallowable intermediate generalisation.

Moreover, the wavelength range of 420 nm to 490 nm was not disclosed in combination with a single quantum well or multiple quantum wells. According to paragraph [0053] of E1 or paragraph [0072] of E3, feature 2.2.1 implied a continuous emitted light spectrum as shown in Figure 4 of the opposed patent. The skilled person would understand that an LED chip having a single quantum well or multiple quantum wells would have a narrower emission spectrum such as the one of paragraph [0072] of E3 (450 to 475 nm). The appellant referred to the examples of paragraphs [0090], [0104] and [0105] of E1 (peak wavelength of 450 nm, half width of 30 nm, Figures 19B, 20B, 21B, emitted spectrum from 430 nm to 480 nm).

Regarding claim 3, the appellant argued that the case r=1 according to the formula of that claim was not disclosed in E3 or E4 so that the requirements of Article 76(1) EPC 1973 were not met.

3.3 The respondent argued that the first embodiment disclosed in paragraphs [0029] to [0063] of E1, paragraphs [0047] to [0083] of E3, and paragraphs [0029] to [0063] of E4 disclosed all features in combination of claim 1. In particular, E1, paragraph [0050], E3, paragraph [0069] and E4, paragraph [0050] disclosed feature 6 and E1, paragraphs [0050] to [0053], E3, paragraphs [0069] to [0072], and E4, paragraphs [0050] to [0053] disclosed features 2.2.1 and 3.2. Paragraph [0032] of E1, paragraph [0050] of E3 and paragraph [0032] of E4 disclosed the phosphor according to feature 7.

The claimed wavelength of 420 to 490 nm did not define an "emission bandwidth", but rather the range of wavelengths within the LED was required to emit.

3.4 The board is of the opinion that the requirements of Articles 123(2) EPC and 76(1) EPC 1973 are fulfilled so that the ground of opposition under Article 100(c) EPC 1973 does not prejudice the maintenance of the patent in the version maintained by the opposition division.

Regarding features 1 to 6, the board is satisfied that these features are disclosed in the parts of the application as originally filed indicated by the opposition division and in E3 or E4, the following tables gives a corresponding overview:

feature	E1 or E4	E3
1	[0029] to [0063]	[0047] to [0083]
2	[0024], [0029]	[0040], [0041], [0047]
2.1	[0013], [0050]	[0013], [0069]
2.2	[0050] to [0056]	[0069] to [0075]
2.2.1	[0053]	[0072]

3	[0032] to [0049]	[0050] to [0068]
3.1	[0032]	[0050]
3.2	[0032]	[0050]
4	[0033], [0034]	[0051], [0052]
5	[0029]	[0047]
6	[0050]	[0069]

The first embodiment described in [0029] to [0063] of E1 and E4 or in paragraphs [0047] to [0083] of E3 relates to the devices shown in respective Figures 1 and 2, wherein the different sub-sections provide details about the sub-parts of the devices. For example, paragraphs [0032] to [0049] of E1 describe the phosphor, paragraphs [0050] to [0056] the LED chip, etc.

The board agrees that the passages indicated by the respondent disclose features 2.2.1, 3.2 and 6 in one embodiment and observes that feature 2.2.1 merely requires that the LED chip emits a wavelength between 420 and 490 nm without stipulating that the emission is "continuous" over the entire wavelength range, as argued by the appellant. Feature 2.2.1 does not exclude that the LED chip additionally emits light outside the claimed range, for example, in the ultraviolet or in a broader range from 400 to 530 nm. The use of quantum well structures is thus also possible and disclosed for the claimed wavelength range from 420 to 490 nm, as also illustrated e.g. by Figures 19B, 20B and 21B relating to Examples 5, 6, and 7 of E1.

Light emitted in the range of 420 nm to 490 nm is blue light, so that the term "in relation of complementary colors" according to feature 3.2 necessarily concerns yellow light, as disclosed in E4, [0032], [0053], in

E3, [0050], [0072], and in E1, [0032], [0053]. Therefore, the omission of the term "yellow colour body" does not introduce subject-matter extending beyond the disclosures of E1, E3 or E4 as filed.

Feature 7 is also disclosed in the context of the first embodiment, see paragraph [0032] of E1, paragraph [0050] of E3 and paragraph [0032] of E4. Said paragraphs explicitly state that the phosphor is a garnet phosphor activated with cerium containing at least one element selected from Y, Lu, Sc, La, Gd and Sm and at least one element selected from Al, Ga and In, and make it clear that the general formula mentioned by the appellant is no more than a preferred option.

Regarding claim 3, the board notes that claim 3 as originally filed includes the case r=1 so that the requirement of a sufficient basis in the application as filed is fulfilled. In addition, paragraph [0050] of E3 and respective paragraph [0032] of E1 or E4 disclose a phosphor garnet activated with cerium and comprising Sm together with Al and/or Ga, which includes a phosphor consisting of $Sm_3(Al_{1-s}Ga_s)_5O_{12}$:Ce, as also pointed out by the opposition division. The subject-matter of claim 3 does not extend beyond the content of the application as filed or beyond the content of the parent or grandparent as filed.

4. Sufficiency of disclosure - Article 100(b) EPC 1973

4.1 During the opposition proceedings, the opponent (now: the appellant) for the first time in its letter dated 12 Juli 2017 argued that the patent did not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled

in the art (Article 100(b) EPC 1973), since the patent failed to provide examples of LEDs having the claimed bandwidth extending from 420 nm to 490 nm or examples of how to produce a phosphor which included Sm in the absence of any other rare earth material, and since the claimed composition range included a composition known to be non-luminescent, namely $Y_3Ga_5O_{12}$:Ce (see E19).

4.2 The opposition division noted that the ground for opposition under Article 100(b) was late-filed, as it was raised for the first time after the expiration of the nine months period according to Article 99(1) EPC. It held that the late-filed ground was not *prima facie* relevant and therefore to be disregarded and not admitted into the procedure, see the minutes of oral proceedings, page 2, fifth to last paragraphs and the contested decision, point 3.4 of the Reasons, last sentence.

4.3 The appellant argued that the ground for opposition under Article 100(b) EPC 1973 was admitted into the procedure, but rejected by the opposition division. Even if the minutes of oral proceedings and the impugned decision were to be considered as an indication that said ground was not admitted, the decision of non-admission was based on an incorrect understanding and should be overturned. The appellant requested that the board used its discretion under Article 12(4) RPBA 2007 to admit the ground for opposition under Article 100(b) EPC 1973 into the appeal proceedings.

4.4 The respondent argued that the opposition division did not admit the ground for opposition under Article 100(b) EPC 1973 and that the opposed patent enabled the skilled person to carry out the invention.

4.5 Even if the opposition division used the wording that the new objection was "consequently to be disregarded", see point 3.4 of the Reasons for the decision, last sentence, the board takes the view that considering the context of this statement and the minutes of the oral proceedings (see five last paragraphs on page 2), the opposition division did not admit the ground for opposition into the proceedings under Article 114(2) EPC 1973.

Furthermore, the non-admission was examined by the opposition division and discussed with the parties during the oral proceedings and the opposition division correctly used their discretion not to admit the late filed ground for opposition considering it *prima facie* not relevant. The board sees no reasons to overturn the opposition division's decision.

Since the respondent has not agreed that the ground for opposition under Article 100(b) EPC 1973 may be considered during the appeal proceedings, this ground may not be introduced into the proceedings (see G10/91, point 18 of the Reasons). Contrary to the appellant's view, the board has no discretion under Article 12(4) RPBA 2007 to admit it under the present circumstances.

Thus, the ground for opposition under Article 100(b) EPC 1973 is not admitted into the appeal proceedings.

5. Priority and effective dates of the claimed subject-matter - Article 87 EPC 1973

5.1 The opposition division decided that the effective date of claim 1 was in relation to a garnet phosphor activated with cerium containing at least one element

selected from Y, Gd and Sm and at least one element selected from Al and Ga the filing date of E5 (29 July 1996) and that it was the filing date of the patent (29 July 1997) in relation to all other compositions, see point 3.5 of the Reasons of the decision.

The opposition division was of the opinion that the light emitting device disclosed in E6 included a phosphor layer comprising two fluorescent materials of different composition, the second material being represented by the formula $Re_3Al_5O_{12}$:Ce where Re was at least one element selected from Y, Gd or La. No priority right deriving from E6 could be attributed to the subject-matter of claim 1, see point 3.5.5 of the Reasons of the decision.

5.2 The appellant argued that the effective date for the subject-matter of claim 1 was the filing date of the opposed patent (i.e. 29 July 1997). As a consequence, documents E7/E7a, E11/E11a and E16/E16 were prior art documents under Article 54(2) EPC 1973 and E10/E10a was prior art under Article 54(3) EPC.

Neither E5 nor E6 disclosed the same invention within the meaning of Article 87(1) EPC 1973, because they did not disclose the combination of the features of claim 1, and in particular not the claimed phosphor composition (feature 7) in combination with the wavelength of 420 to 490 nm (feature 2.2.1). E5 concerned a wavelength range from 400 to 530 nm and did not disclose a phosphor containing Lu, Sc or In. Moreover, they did disclose a "complementary colour mixing" only for a "yellow body colour", see E5, paragraph [0018].

E6 was concerned with arrangements including two different phosphors. The other three remaining priority applications did not disclose the claimed subject-matter, either.
Furthermore, the appellant argued that E5 was not an enabling disclosure for the reasons brought forward for the non-admitted ground for opposition under Article 100(b) EPC 1973.

5.3 The respondent argued that the embodiment of paragraphs [0017] to [0039] of E5 concerned a light emitting device according to claim 1, wherein the phosphor was a garnet phosphor activated with cerium containing at least one element selected from Y, Gd and Sm and at least one element selected from Al and Ga. E6 concerned a same light emitting device with garnet phosphor activated with cerium containing at least one element selected from Y, Gd and La and at least one element selected from Al and Ga. Accordingly, claim 1 enjoyed three different partial priorities, see its statement of grounds of appeal, page 8, second half or its letter dated 7 December 2018, point 31.

During the oral proceedings, the respondent argued that claim 1 enjoyed (at least) the two partial priorities as held by the opposition division.

5.4 The board agrees with the parties that the formulation of feature 7 encompasses a considerable number of embodiments as the content of each of the rare earth elements (Y, Lu, Sc, La, Gd, Sm) and the "group 13" elements (Ga, Al, In) in the claimed garnet phosphor activated with Ce can range from very small amounts up to 100 %. The board considers therefore that claim 1 might legitimately be seen as a generic "OR"-claim in the sense of **G 1/15**.

E5 discloses a light emitting device ([0016] to [0039], Figures 1 and 2) comprising:
a light-emitting diode (102, 202, [0029] to [0032]) chip having a gallium-nitride-based compound semiconductor ([0016], [0029]) and having a light emitting layer being capable of emitting light having a wavelength of 420 nm to 490 nm ([0030], [0032]), and a phosphor (101, 201, [0018] to [0028]) being excited by the light emitted from said LED chip and emitting light which is in relation of complementary colors with the emitted light ([0018], [0032]), wherein said phosphor is contained in a coating material (101, 201, [0038]) that coats said LED chip, and wherein said light emitting device emits white light by blending the light emitted by said LED chip and the light emitted by the phosphor ([0016], [0017]), wherein said LED chip has a single quantum well structure or multiple quantum well structure ([0029]), and the phosphor is a garnet phosphor activated with cerium containing at least one element selected from Y, Gd and Sm and at least one element selected from Al and Ga ([0011], [0012], [0016], [0017], [0018]).

Paragraphs [0016] to [0039] of E5 describe an embodiment having all the features of claim 1, insofar the phosphor is a garnet phosphor activated with cerium containing at least one element selected from Y, Gd and Sm and at least one element selected from Al and Ga, i.e. which has the formula $Re_3(Al, Ga)_5:O_{12}:Ce$, where Re is at least one element selected from Y, Gd and Sm. By virtue of the fact that the LED chip emits blue light and that the light emitting device emits white light, the phosphor necessarily has a "yellow body color".

The wording "420 nm to 490 nm" defines the range of wavelength within which the LED is required to emit. Paragraphs [0029] to [0032] of E3 teach how the emission wavelengths are controlled, e.g. by selecting the semiconductor material, its crystallinity or its composition. Regarding the appellant's argument that the phosphor compositions according to E5 covered compositions not showing fluorescence (e.g. $Y_3Ga_5O_{12}$:Ce), these non-luminescent compositions are not covered by claim 1 and the skilled person has no difficulties to exclude them.

Hence, E5 discloses the above in an enabling manner and the subject-matter disclosed in E5 is encompassed by the wording of claim 1.

Thus, in accordance with **G 1/15**, point 6.4 of the Reasons, claim 1 is *de facto* conceptually divided into two parts, the first part corresponding to the invention disclosed directly and unambiguously in the priority document E5, the second part being the remaining part of the generic "OR"-claim not enjoying this priority.

It follows from the above that a light emitting device according to claim 1 and wherein the phosphor is a garnet phosphor activated with cerium containing at least one element selected from Y, Gd and Sm and at least one element selected from Al and Ga enjoys the partial priority of E5. The effective date for this subject-matter is 29 July 1996.

Regarding the disclosure of E6, the board notes that E6 discloses a phosphor layer containing a first fluorescent material ($Y_3(Al,Ga)_5O_{12}$:Ce) and a second fluorescent material ($Re_3Al_5O_{12}$:Ce where Re is at least

one element selected from Y, Gd and La), see E6a, paragraphs [0010], [0012], [0013], [0017]. The question whether any partial priority for a device with garnet phosphor comprising La could be derived from E6 or whether the disclosure of E6 further conceptionally divides claim 1 can, however, be left unanswered, see sections 6.1 to 6.4 below.

6. Novelty - Articles 100(a) and 54(1), (2) EPC 1973 and Articles 52(1) and 54(3) EPC

6.1 The board observes that E7, E10, E11 and E16 are the pieces of prior art mentioned in the parties' submissions, for which the effective date of the claimed subject-matter is of relevance.

E7 was published on 29 November 1996, E11 was published on 13 September 1996, E16 was published on 23 September 1996.

E10 was published on 26 March 1998 and claims a priority of 20 September 1996 so that this document might possibly be prior art under Article 54(3) EPC.

The publication dates of the above documents or the priority claim of E10 have not been questioned by the parties or the opposition division.

6.2 Document E7/E7a

The phosphor disclosed in E7 is a garnet phosphor activated by cerium containing Y, Gd, Al and Ga, see E7a, "3. Manufacturing method of White-LED", "4.2 Evaluation of phosphor", "$(Y,Gd)_3(Al,Ga)_5O_{12}$:Ce)", Table 2. The arrangement contains a GaN based LED having a single quantum well, see section 2. Light is

emitted in the range between 420 nm and 490 nm, see Figure 3.

According to section 5.4 above, E7 only discloses subject-matter falling within first part of claim 1 having an effective date of 29 July 1996. As E7 is published on 29 November 1996, it is not prior art according to Article 54(2) EPC 1973.
E7 is prior art for the second part of claim 1 as defined in section 5.4 above, but does not disclose any examples falling within the second part of claim 1 as defined in section 5.4 above.

Hence, E7 does not put into question the novelty of the subject-matter of claim 1.

6.3 Document E11/E11a and E16/E16a

Both E11 and E16 disclose a light emitting device with a blue LED (unspecified type in E11, GaN based single quantum well LED in E16) and a layer of yittrium-aluminium-garnet (YAG) phosphor. Hence, at most, they disclose a phosphor garnet comprising yttrium and aluminium. It can be left unanswered whether - as argued by the appellant - E11 uses the LED known from E12.

Both E11 and E16 only disclose subject-matter falling within the first part of claim 1 having an effective date of 29 July 1996. As E11 was published thereafter on 13 September 1996 and E16 was published on 23 September 1996, they are not prior art according to Article 54(2) EPC 1973.

E11 and E16 are prior art documents for the second part of claim 1 as defined in section 5.4 above, but neither

E11 nor E16 disclose examples falling within this second part.

Hence, the subject-matter of claim 1 is novel over E11 or E16.

6.4 Document E10/E10a

E10a is an international application published on 26 March 1998 claiming a priority of 20 September 1996. Under the assumption that the priority claim of E10a is valid, E10 is possibly prior art under Article 54(3) EPC. Page 7, lines 5 to 7 in combination with lines 16 and 17, page 11, line 32 to 35 discloses a garnet-phosphor $La_3Ga_5O_{12}$.

The opposition division found that E10/E10a did not disclose a quantum well.

The appellant argued that the presence of a quantum well could be derived from Figure 7 and page 16, lines 6 to 20 in view of the narrow spectral width between 400 nm and 430 nm. A skilled person would understand that either a single quantum well or multiple quantum wells had to be present.

The respondent disagreed and argued that E10a, page 12, lines 22 to 24, page 15, line 33 to page 16, line 2, page 16, lines 6 to 7 and 23 to 24 made it clear that the emission spectrum of the LED was disclosed in Figure 6 and not Figure 7. For the proprietor, a skilled person could not derive from a particular emission bandwidth the presence of a single or multiple quantum well structure in the LED device.

The board is of the opinion that E10 neither explicitly discloses a quantum well according to feature 6 nor provides the skilled person indications which allowed to directly and unambiguously derive feature 6 from the disclosure of E10 as a whole. The bandwidth of a semiconductor LED is dependent on several different factors such as, for example, the quality of the crystal structure and the dopant concentration. A particular emission bandwidth of an LED device thus cannot be a direct and unambiguous disclosure of a single or multiple quantum well structure of this LED device. The board agrees with the respondent in that respect.

Moreover, Figure 7 of E10/E10a discloses the emission of the light emitting device (LED chip plus phosphor), whereas it is Figure 6 which shows the emission spectrum of the LED chip itself, see the paragraph bridging pages 15 and 16 of E10a. The emission spectrum in E10a is thus much broader than the 30 nm indicated by the appellant, thus rendering moot the appellant's argument regarding an narrow light emission spectrum in E10a.

The device known from E10/E10a therefore lacks a quantum well structure. Hence, even under the assumption that the priority claims of the contested patent from E5, E6 and the third priority document JP 245381/1996 (filed on 18 September 1996) were invalid and that the priority claim of E10/E10a was valid, document E10/E10a would not be prejudicial to novelty within the meaning of Article 54(3) EPC.

6.5 Only in a short paragraph on page 4 of the appendix annexed to its reply dated 9 July 2018, the appellant questioned the novelty of claim 1 in view of documents

E13 to E15. The appellant argued that E13 and E14 concerned the sale of the device known from E15.

The board merely notes that E13 and E14 do not disclose any phosphor composition, whereas E15 mentions that yttrium aluminium garnet doped with cerium was used in product NSPW310AS, see E15, column 1, lines 21 to 25. As the effective date for this subject-matter of claim 1 is 29 July 1996, it appears that E13 to E14 are not prior art under Article 54(2) EPC 1973. In view of its late publication date, E15 alone is not prior art under Article 54(2) EPC 1973, either. Thus, E13 to E15 do not anticipate the subject-matter of claim 1.

6.6 In view of the above the board concludes that the subject-matter of claim 1 is new (Articles 100(a) and 54(1), (2) EPC 1973 and Articles 52(1) and 54(3) EPC)

7. Inventive step - Articles 100(a), 56 EPC 1973

7.1 Document E8 as closest state of the art

7.1.1 The opposition division considered document E8 as the closest prior art and found four distinguishing features, see point 3.10.5 of the Reasons of the decision, which correspond to features 3.2, 5, 6 and 7 of claim 1. The opposition division acknowledged a synergistic effect between features 6 and 7 in view of paragraph [0055] of E2 and concluded that an inventive step was present.

7.1.2 The appellant argued that the subject-matter of claim 1 lacked an inventive step in view of the disclosure of E8 in combination with E17 and in the light of the common general knowledge of the skilled person as shown for example by E18. E8 already disclosed the concept of

mixing green light with a red light emitting pigment to generate white light, see paragraph [0003]. The skilled person would understand that using complementary colours was the principle enabling the generation of white light.

E17/E17a described in paragraph [0004] the use of fluorescent material to emit green light when excited by blue light. According to paragraph [0009] of E17a, a wavelength converting material either converted all the light emitted from the light emitting chip or partially absorbs the emitted light. Paragraph [0010] of E17a indicated that a fluorescent dye or a fluorescent body (i.e. a phosphor) might be used. E17/E17a taught to use a suitable phosphor excited by blue light to emit green light.

The skilled person would know from its common general knowledge that YAG:Ce would be a suitable phosphor for generating white light, applying the principle that complementary colours were to be used for generating white light. The appellant also cited E22 to show the concept of mixing two wavelengths to produce white light was known in 1982. It mentioned the example of 450 nm and 570 nm.

The appellant emphasised by citing page 9, lines 10 to 14 of E20 that "Nichia's own expert conceded [that] the development of a commercially viable blue LED 'gave everyone the incentive to move forward to create a simple blue plus yellow LED that emits white light'".

According to the appellant, starting from E8 as closest prior art, the problem to be solved would be "to identify a luminescent material for using in combination with blue LEDs for the generation of white

light in a similar manner as that described for combining green light from GaP with red light from a pigment". A further problem would be to increase the brightness of the device known from E8.

The skilled person, knowing that complementary colours would have to be used and knowing from E17 that a phosphor would be suitable, would select YAG:Ce, as described in E18. Figure 6.18 of E18 would also disclose a "lower degradation" provided by YAG:Ce.

7.1.3 The respondent argued that the appellant's argumentation solely referred "to the spectral properties of a phosphor" and completely "ignored the stability requirements under the challenging conditions of heat, high light intensity and moisture". The problem to be solved was to be found in paragraph [0012] of the opposed patent E2. None of the documents E8/E8a or E17/E17a nor the skilled person's common general knowledge gave an indication that "from numerous phosphor candidates fulfilling the spectral requirements for conversion of blue light into yellow light in particular a garnet phosphor activated with cerium could have the required stability under LED use conditions".

Furthermore, the appellant did not argue why the skilled person would provide feature 6 in the LED chip of E8. The respondent considered E20 irrelevant for the present case, because it concerned US patents with different claims and a document that was not prior art under the EPC. The expert's statement in E20 was not relevant for the present case as it related to other patent applications.

7.1.4 The board takes the view that E8 discloses a light emitting device (Figure 2) comprising: a light-emitting diode (LED) chip having a gallium-nitride-based compound semiconductor ([0007], $Ga_xAl_{1-x}N$) and having a light emitting layer being capable of emitting light having a wavelength of 420nm to 490nm ([0006], "430 nm"), and a phosphor (5, "fluorescent pigment", "fluorescent dye") being excited by the light emitted from said LED chip and emitting light ([0007], [0008]) ~~which is in relation of complementary colors with the emitted light~~, wherein said phosphor is contained in a coating material (4, [0008]) that coats said LED chip (Figure 2), and wherein said light emitting device emits ~~white~~ light by blending the light emitted by said LED chip and the light emitted by the phosphor ([0008], [0009])~~, characterised in that said LED chip has a single quantum well structure or multiple quantum well structure, and in that the phosphor comprises a garnet phosphor activated with cerium containing at least one element selected from Y, Lu, Sc, La, Gd and Sm and at least one element selected from Al, Ga and In~~.

Therefore, the subject-matter of claim 1 of the first auxiliary request differs from the light emitting device of E8 in that:

(a) the phosphor emits light which is in relation of complementary colours with the emitted light by the light emitting layer (feature 3.2),
(b) the light emitting device emits white light (part of feature 5),
(c) the LED chip has a single quantum well structure or multiple quantum well structure (feature 6), and
(d) the phosphor is a garnet phosphor activated with cerium containing at least one element selected from Y,

Lu, Sc, La, Gd and Sm and at least one element selected from Al, Ga and In (feature 7).

The board disagrees with the opposition division in that a synergistic effect might be obtained by the combination of features 6 and 7. Paragraph [0050] of E1 or paragraph [0055] of E2 state that according to "the present invention, a light emitting diode capable of emitting with higher luminance without deterioration of the phosphor can be made by making the activation layer of the light emitting component in single quantum well structure of InGaN". Hence, a higher luminance is obtained by implementing a single quantum well in an "activation layer" (i.e. within the light emitting layer) of an InGaN. However, as claim 1 neither specifies that the quantum well according to feature 6 is a part of the light emitting layer nor is limited to an InGaN semiconductor, a functional relation between the claimed quantum well and the phosphor according to feature 7 is not necessarily present in the claimed device.

Features (a), (b) and (d) concern the objective technical problem of how to modify the light emitting device of E8 such that white light emission is obtained.

Regarding (c), paragraph [0055] of E2 or paragraph [0050] of E1 mention a quantum well among other possible alternative arrangements of the LED chip (i.e. light emitting component 102, 202): "The structure of the light emitting component may be homostructure, heterostructure or double-heterostructure which have MIS junction, PIN junction or PN junction. Various wavelengths of emission can be selected depending on the material of the semiconductor layer and the

crystallinity thereof. It may also be made in a single quantum well structure or multiple quantum well structure where a semiconductor activation layer is formed as thin as quantum effect can occur."
Hence, feature (c) solves the problem of finding an alternative arrangement of the light-emitting diode chip.

While the board considers it obvious to include a well-known quantum well structure (see e.g. E12) in the LED chip known from E8, it is not convinced that the skilled person would arrive at a light emitting device for white light according to claim 1 with a combination of E8, E17 or E18.

It is at least questionable if the skilled person would be motivated by the last sentence of paragraph [0003] in E8 to look for possibilities of modifying the light emitting device so as to emit white light. The aim of E8 is be to improve the brightness of a blue LED, see E8, paragraph [0004].

Document E17/E17a discloses that an LED chip 1 with a "wavelength converting material" that either completely transforms the emitted wavelength into another wavelength or acts as a filter substance absorbing a part of the emitted wavelength, see paragraphs [0004], [0006], [0009] and [0010]. In other words, E17 does not teach the mixture of two colours to obtain white light. The board does not agree that E17 would motivate the skilled person to arrive at the claimed subject-matter.

Even assuming that before the relevant priority date of the opposed patent there was an incentive to modify a blue LED to emit white light - as stated by the respondent's expert during the US court proceedings

(see E20) - and assuming that the skilled person knew that complementary colours should be used (see E22), the board is not persuaded that the skilled person would consider a phosphor used in a tricolor lamp according to E18. As pointed out by the respondent, E18 describes YAG:Ce for a different application. Although phosphors according to feature 7 were known as such before the priority date of the opposed patent (see E18 or E19), there is no indication in any document at hand that would suggest that the claimed garnet phosphors activated with cerium would have the properties (see paragraph [0012] of the opposed patent) necessary to be integrated into the resin material 4 of E8 in order to solve the objective technical problem. None of the documents indicated by the appellant provides technical instructions how to include a garnet phosphor activated by cerium into a resin mold, whereas the opposed patent gives this information in a rather detailed way, see e.g. paragraphs [0102] and [0103] of E2.

The Board is thus convinced that a skilled person would not arrive at a light emitting device according to claim 1 when starting from document E8 as the closest prior art and attempting to modify the light emitting device of E8 such that white light emission is obtained.

The subject-matter of claim 1 thus involves an inventive step when starting from document E8 as closest state of the art (Article 56 EPC).

7.2 Documents E11/E11a, E7/E7a, E16/E16a

7.2.1 In the statement setting out the grounds of appeal, the appellant briefly argued that it would be obvious to include a quantum well structure for the LED used in

E11 since quantum well LEDs were known to be more efficient than double heterostructure devices. The skilled person would then arrive at a device including an yttrium aluminium garnet phosphor for emitting white light.

The board notes that for light emitting devices with a an yttrium aluminium garnet phosphor, document E11 does not belong to the state of the art, see section 6.3 above.

7.2.2 Regarding E7 and E16, the appellant merely stated that any differences between the subject-matter of claim 1 and the disclosure of E7 or E16 would be "trivial and non-inventive".

The board is not convinced by this unsubstantiated allegation that a lack of inventive step should be acknowledged when starting from E7 or E16.

7.2.3 In summary, for the first part of claim 1 as defined in section 5.4 above, documents E7, E11 and E16 are not prior art under Article 54(2) EPC 1973.

Moreover, the appellant has not provided any arguments why it might be obvious for the skilled person, when starting from E7, E11 or E16, to arrive at an object falling within the scope of the second part of claim 1.

8. Clarity

8.1 In the statement setting out the grounds of appeal, the appellant objected to the patent due to lack of clarity (Article 84 EPC). Claim 1 as maintained by the opposition division excluded arrangements including more than one garnet phosphor. There was a

contradiction between the claims and the description that included examples with more than one phosphor.

8.2 The respondent argued that the wording of feature 7 of claim 1 included a phosphor which was composed of two phosphors, both being garnet phosphors activated with cerium and having the claimed composition. There was thus no inconsistency between the claims and the description.

8.3 The board shares the opposition division's statement at the beginning of page 9 of the contested decision that the application as originally filed discloses that the phosphor used for the invention consists either of one garnet-phosphor according to feature 7 or of a plurality of such garnet phosphors of different compositions (but each phosphor still having a composition according to feature 7). In the board's view, the wording of claim 1 encompasses both possibilities so that there is no inconsistency between claim 1 as maintained by the opposition division and the description. The requirement of Article 84 EPC that the claims should be supported by the description is therefore met.

9. For the above reasons, the opposed patent in the version as maintained by the opposition division meets the requirements of the EPC.

Therefore, the appeal must fail.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

S. Sánchez Chiquero T. Häusser

Decision electronically authenticated