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**Datasheet for the decision
of 14 July 2021**

Case Number: T 1115/18 - 3.4.03

Application Number: 04755918.2

Publication Number: 1644985

IPC: H01L29/20

Language of the proceedings: EN

Title of invention:

FULL SPECTRUM PHOSPHOR BLENDS FOR WHITE LIGHT GENERATION WITH
LED CHIPS

Applicant:

Current Lighting Solutions, LLC

Relevant legal provisions:

EPC Art. 52(1)
EPC 1973 Art. 54(1), 54(2)
RPBA 2020 Art. 13(2)

Keyword:

Novelty - main request, first auxiliary request (no)
Late-filed second auxiliary request - admitted (no)

Decisions cited:

T 1080/15, T 1707/17



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Case Number: T 1115/18 - 3.4.03

D E C I S I O N
of Technical Board of Appeal 3.4.03
of 14 July 2021

Appellant: Current Lighting Solutions, LLC
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted on 14 December
2017 refusing European patent application No.
04755918.2 pursuant to Article 97(2) EPC.

Composition of the Board:

Chairman M. Stenger
Members: M. Ley
D. Prietzel-Funk

Summary of Facts and Submissions

- I. The appeal is against the decision of the examining division to refuse European patent application No. 04 755 918 pursuant to Article 97(2) EPC.

The examining division decided that the term "a full spectrum between 400 and 700 nm" in claim 1 according to a main request and to a first auxiliary request lacked clarity (Article 84 EPC 1973) and that its subject-matter lacked an inventive step (Article 56 EPC 1973) in view of D1 (WO 01/89001 A2).

In a section entitled "III. Further comments", the examining division objected to the clarity of the expressions "gap filling phosphor" and "full spectrum" in claim 1 of both the main and the first auxiliary requests.

- II. In a communication pursuant to Article 15(1) RPBA 2020, the Board introduced the following document:

D6 US 2002/0158565 A1

The Board informed the appellant about its provisional opinion that *inter alia* the subject-matter of claim 1 according to the main request and to the first auxiliary request underlying the decision was not novel (Article 52(1) EPC, Article 54(1) and (2) EPC 1973) over the disclosure of either one of D1 or D6, or did not involve an inventive step (Article 56 EPC 1973) over D1 and the common general knowledge of the skilled person.

- III. At the end of oral proceedings before the Board, the appellant requested that the decision be set aside and a European patent be granted on the basis of the main request or the first auxiliary request underlying the impugned decision, or on the basis of a second auxiliary request filed during the oral proceedings before the Board.
- IV. Claim 1 according to the main request filed with the statement setting out the grounds of appeal additionally comprised the term "to fill any gaps in the resultant light spectrum" and was thus identical to the first auxiliary request. During the oral proceedings before the Board, the appellant stated that said term was to be disregarded and that its main request was the grant of a European patent based on the main request underlying the contested decision.

Claim 1 according to the main request has the following wording:

A lighting apparatus for emitting white light comprising:

a semiconductor light source emitting radiation at from about 250 nm to about 450 nm; and

a phosphor material radiationally coupled to the light source,

the phosphor material comprising a red emitting phosphor having a peak emission between about 615 and 680 nm, an orange emitting phosphor having a peak emission between about 575 and 615 nm, a green emitting phosphor having a peak emission between about 500 and 575 nm, a blue emitting phosphor having a peak emission between about 400 and 500 nm, and one or more additional gap filling phosphors,

wherein said lighting apparatus has a full spectrum between 400 and 700 nm.

Claim 1 according to the first auxiliary request corresponds to claim 1 according to the main request, with the expression "to fill any remaining gaps in the resultant light spectrum" being included after the term "additional gap filling phosphors".

Claim 1 according to the second auxiliary request corresponds to claim 1 according to the main request, with the expression "wherein gap is defined as places wherein the emission has a spectral intensity of approximately zero" being included after the term "additional gap filling phosphors" and with the following feature added at its end:

wherein the gap filling phosphors are selected from the group consisting of $(Mg, Ca, Sr, Ba, Zn)_4Si_2O_8:Eu^{2+}$; $(Ba, Ca, Sr)_2MgAl_{16}O_{27}:Eu^{2+}$, Mn^{2+} , and mixtures thereof.

V. The appellant's relevant arguments may be summarized as follows:

(a) Novelty of the main and the first auxiliary requests

The appellant referred to paragraphs [0011] and [0050] of the application and argued that the expression "a full spectrum between 400 and 700 nm" meant that the spectrum emitted by the lighting apparatus had no "gaps between 400 to 700 nm", i.e. no places where the emission had a spectral intensity of approximately (or essentially) zero. The appellant admitted that the application did not provide any clear definition of "approximately zero". The skilled person would know what was meant

and that a valley between two emission peaks would not necessarily be a "gap" in the sense of the application. D6 disclosed a phosphor blend with four phosphors corresponding to the four different colours according to claim 1, but did not disclose a "gap filling phosphor".

The appellant did not provide any specific arguments with respect to the first auxiliary request.

(b) Admission of the second auxiliary request

The appellant justified the late submission of the second auxiliary request by a change of its representative only four weeks prior to the oral proceedings and mentioned the coronavirus pandemic. The amendments made to claim 1 were intended to clarify the term "gap filling phosphors" and to render claim 1 novel over the cited prior art and thus constituted a reaction to issues first raised in the Board's communication preparing the oral proceedings.

Reasons for the Decision

1. The appeal is admissible.
2. The application concerns a white light emitting device including a semiconductor light emitting source (e.g. a light emitting diode or LED, see paragraphs [0031] to [0033]) emitting radiation in a wavelength range from 250 to 450 nm and a phosphor material, which comprises red, orange, green and blue emitting phosphors and at least one additional "gap filling phosphor", see

paragraphs [0043] to [0047]. The "gap filling phosphor" emits radiation in a portion of the spectrum in which the other four phosphors have an emission of relatively low intensity. The light emitting device has a full spectrum from 400 nm to 700 nm.

Preferably, the materials should be selected so as to obtain a general color rendering index (CRI) over 95.

3. Main request and first auxiliary request - Novelty (Article 52(1) EPC and Article 54(1) and (2) EPC 1973)

3.1 Before comparing the subject-matter of claim 1 to the disclosure of document D6, the Board would like to explain its understanding of two expressions present in claim 1 and objected to by the examining division.

3.1.1 "full spectrum between 400 and 700 nm"

The examining division held that the term "a full spectrum between 400 and 700 nm" defined the invention by a result to be achieved, only amounted to claiming the underlying technical problem of achieving an efficient conversion of radiation from UV sources and thus was unclear, contrary to the requirements of Article 84 EPC. The examining division considered said term as "representing the ideal scenario of a combination of wavelengths corresponding to different colors to make white light".

The Board agrees with the appellant that the term "full spectrum between 400 and 700 nm" does not render claim 1 unclear. Claim 1 neither requires a flat and perfectly uniform spectrum nor excludes a spectrum characterised by peaks and valleys of higher and lower intensity due to the superposition of the individual

spectrums corresponding to the various phosphor elements. The term "full spectrum" does not require any particular intensity at a given wavelength, but only implies that an emission of light at any wavelength between 400 nm and 700 nm is measurable.

3.1.2 "gap filling phosphors"

According to paragraphs [0010] to [0012] and [0050], the "one or more additional gap filling phosphors" are to "fill any remaining gaps" with a spectral intensity of approximately zero in the spectrum emitted by the red, orange, green and blue emitting phosphors and by the semiconductor light source. In other words, the red, orange, green and blue emitting phosphors and the semiconductor light source have a relatively low (e.g. "approximately zero" or "essentially zero") light emission in a portion of the spectrum called "gap" and a "gap filling phosphor" emits radiation in a wavelength range within said portion.

- 3.2 As pointed out in the Board's communication, D6 discloses (in the wording of claim 1 according to the main request) a lighting apparatus for emitting white light comprising:
- a semiconductor light source emitting radiation at from about 250 nm to about 450 nm ([0008], [0023]); and
 - a phosphor material (figure 9, Table 1, example 19) radiationally coupled to the light source, the phosphor material comprising
 - a red emitting phosphor having a peak emission between about 615 and 680 nm (MFG, $3.5\text{MgO} \cdot 0.5\text{MgF}_2 \cdot \text{GeO}_2 \cdot \text{Mn}^{4+}$, figure 3B),
 - an orange emitting phosphor having a peak emission between about 575 and 615 nm (SrP, $\text{Sr}_2\text{P}_2\text{O}_7 \cdot \text{Eu}^{2+}, \text{Mn}^{2+}$, Sr pyro phosphate, figure 1B),

a green emitting phosphor having a peak emission between about 500 and 575 nm ($\text{BaMgAl}_{16}\text{O}_{27}:\text{Eu}^{2+},\text{Mn}^{2+}$, BaMn , figure 6),
a blue emitting phosphor having a peak emission between about 400 and 500 nm (SECA , $\text{Sr}_5(\text{PO}_4)_3\text{Cl}:\text{Eu}^{2+}$, $\text{Ba}_2\text{MgAl}_{16}\text{O}_{27}:\text{Eu}^{2+}$, BAM , figure 5), and
one or more additional gap filling phosphors (SAE , see paragraphs [0047] and [0062] of the present application and figure 4 of D6),
wherein said lighting apparatus has a full spectrum between 400 and 700 nm (implicit in view of the phosphors used and the CRI of 95), in view of the following considerations:

The emission spectra of the five phosphors used in example 19 are shown in figures 1B, 3B and 4 to 6, see D6, paragraphs [0011], [0015] to [0018]. For each wavelength in the range from 400 nm to 700 nm, measurable light is emitted by at least one of these five phosphors. The emission spectrum of the lighting apparatus according to example 19 thus must have a "full spectrum between 400 and 700 nm".

The Board considers $\text{Sr}_4\text{Al}_{14}\text{O}_{25}:\text{Eu}^{2+}$ or SAE in example 19 of figure 9 as a "gap filling phosphor", because paragraph [0047] or claim 11 of the application as originally filed explicitly qualify this phosphor as a "gap filling phosphor" in the sense of the invention.

Moreover, the Board is of the view that SAE is a "gap filling phosphor" according to paragraphs [0010] to [0012] or [0050] of the application, see section 3.1.2 above. Both the green emitting phosphor (figure 6) and the blue emitting phosphor (figure 5) of example 19 of figure 9 have a low emission in the region around 490 nm. A skilled person would consider that in this

spectral portion between the emission peak of the blue emitting phosphor (at 450 nm) and the emission peak of the green emitting phosphor (at 520 nm) a "gap" is present. Figure 4 of D6 shows that the emission spectrum of SAE has a strong peak at 490 nm, i.e. within said "gap" so that SAE has the function of a "gap filling phosphor" in the sense of the present application.

Therefore, the Board is convinced that the subject-matter of claim 1 according to the main request lacks novelty over D6.

- 3.3 In example 19 of figure 9 of D6, the SAE fills a "gap in the resultant light spectrum", i.e. the light spectrum provided by the semiconductor light source and the red, orange, green and blue emitting phosphors alone. In view of the spectrums shown in figures 1B, 3B and 4 to 6, the Board can not identify any other "gap" between 400 and 700 nm so that SAE fills "any remaining gap in the resultant light spectrum" as defined by the additional feature of claim 1 of the first auxiliary request. It follows that the subject-matter of claim 1 according to the first auxiliary request also lacks novelty over D6.

4. Second auxiliary request - Admission

- 4.1 The summons to oral proceedings and the Board's communication pursuant to Article 15(1) RPBA 2020 were notified on 23 November 2020. The second auxiliary request was filed during the oral proceedings before the Board, i.e. more than seven months after the notification of a summons to attend oral proceedings.

According to Article 13(2) RPBA 2020 in conjunction with Article 25(1) RPBA 2020, any amendment to a party's appeal case made after notification of a summons to oral proceedings shall, in principle, not be taken into account unless there are exceptional circumstances, which have been justified with cogent reasons by the party concerned.

- 4.2 In accordance with established case law, a change of representative cannot as such qualify as an exceptional circumstance justifying the admission of a request in appeal proceedings, see Case Law of the Boards of Appeal, 9th edition, 2019, V.A.4.8.2, and T 1080/15, r. 5.4. The appellant also mentioned the coronavirus pandemic, but without further elaborating why the pandemic obliged the appellant in the sense of a *force majeure* to change its representative or why the former and present representatives were not in a position to submit the second auxiliary request or make any other written submissions prior to the oral proceedings before the Board.
- 4.3 The deciding Board in T 1707/17 concluded that "Article 13(2) RPBA 2020 requires the party not only to explain why the case involves exceptional circumstances, but also to explain why its amendment, in terms of both content and timing, represents a justified response to these circumstances. In particular, where a party seeks to amend its case at a very late stage in the proceedings, the cogent reasons referred to in Article 13(2) RPBA 2020 should include reasons why it was not possible to file such an amendment earlier.", see T 1707/17, Catchword and Reasons, point 2.4. The present Board concurs with this conclusion.

In the present case, the objection of lack of novelty in view of document D6 was raised for the first time in the Board's communication, see section 8. A possible lack of clarity of the term "gap filling phosphor" was discussed only in a section entitled "III. Further comments" of the impugned decision, said section containing further comments not forming part of the impugned decision. The issue was also addressed by the appellant in the statement setting out the grounds of appeal and the Board's communication, section 3.2.

Thus, in terms of the content of the amendment, the second auxiliary request is considered to be a justified response in particular to the novelty objection first raised by the Board in its communication preparing the oral proceedings.

However, in terms of timing, the Board was not presented with any cogent reasons why it was not possible to file such an amendment earlier, and the Board cannot identify any exceptional circumstances that would have prevented the appellant itself, its former representative or its present representative from filing the second auxiliary request well before the oral proceedings instead of waiting until the oral proceedings, i.e. until the latest possible stage in the procedure.

- 4.4 Moreover, the Board notes that claim 1 defines for the first time specific materials for the "gap filling phosphor", namely $(\text{Mg}, \text{Ca}, \text{Sr}, \text{Ba}, \text{Zn})_4\text{Si}_2\text{O}_8:\text{Eu}^{2+}$ and $(\text{Ba}, \text{Ca}, \text{Sr})_2\text{MgAl}_{16}\text{O}_{27}:\text{Eu}^{2+}, \text{Mn}^{2+}$. As discussed before, a "gap filling phosphor" emits radiation in a portion of the spectrum for which the intensity emitted by the remaining radiation sources of the lighting device is relatively low, i.e. in a "gap". A particular "gap

filling phosphor" with its characteristic emission spectrum therefore requires a quite particular "gap" resulting from specific red, orange, green and blue emitting phosphors. Otherwise, it would not be "gap filling". The selection of a specific "gap filling phosphor" material thus imposes constraints on the choice of possible materials for the claimed red, orange, green and blue emitting phosphors and also the type of claimed semiconductor light source. The specification of the "gap filling phosphor" materials in claim 1 of the second auxiliary request is thus to be qualified as a major amendment.

Admitting the second auxiliary request would have meant that the Board, during the oral proceedings, would have had to deal with a previously unseen request, to investigate whether any of the examples disclosed in the prior art at hand possibly anticipated the subject-matter of claim 1 or to determine which one of said examples was to be considered as the closest piece of prior art to be used to assess the existence or absence of an inventive step.

Alternatively, the Board would have had to adjourn the oral proceedings.

In any case, the admission of the second auxiliary request would have been detrimental to procedural economy for the above reasons.

- 4.5 In view of the above considerations, the Board decided not to admit the second auxiliary request into the appeal proceedings pursuant to Article 13(2) RPBA 2020.
5. As no allowable request is on file, the appeal must fail.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



S. Sánchez Chiquero

M. Stenger

Decision electronically authenticated