Internal distribution code:

(A) [-] Publication in OJ
(B) [-] To Chairmen and Members
(C) [-] To Chairmen
(D) [X] No distribution

Datasheet for the decision of 24 October 2019

Case Number: T 1862/15 - 3.4.03

Application Number: 06785389.5

Publication Number: 1908135

IPC: H01L51/50

Language of the proceedings: EN

Title of invention:
BROADBAND LIGHT TANDEM OLED DISPLAY

Applicant:
Global OLED Technology LLC

Headword:

Relevant legal provisions:
EPC 1973 Art. 84, 56
EPC Art. 123(2)

Keyword:
Amendments - allowable (no)
Inventive step - (no) arbitrary selection

Decisions cited:

Catchword:

Europäisches Patentamt
European Patent Office
Office européen des brevets

Beschwerdekammern

Boards of Appeal

Chambres de recours

Boards of Appeal of the
European Patent Office
Richard-Reitzner-Allee 8
85540 Haar
GERMANY
Tel. +49 (0)89 2399-0
Fax +49 (0)89 2399-4465

Case Number: T 1862/15 - 3.4.03

D E C I S I O N
of Technical Board of Appeal 3.4.03
of 24 October 2019

Appellant: (Applicant)	Global OLED Technology LLC 13921 Park Center Road, Suite 380 Herndon, VA 20171 (US)
Representative:	Wibbelmann, Jobst Wuesthoff & Wuesthoff Patentanwälte PartG mbB Schweigerstrasse 2 81541 München (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 1 April 2015 refusing European patent application No. 06785389.5 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	S. Ward
Members:	M. Stenger
	G. Decker

Summary of Facts and Submissions

I. The appeal concerns the decision of the Examining Division to refuse European patent application No. 06785389 for lack of novelty in view of an intermediate document. The contested decision further comprises comments relating to lack of inventive step.

II. At the end of the oral proceedings, the appellant/ applicant requested that the contested decision be set aside and that a patent be granted on the basis of the main request or auxiliary request 1, both filed with the grounds of appeal (auxiliary request 1 having been filed as "auxiliary request"). Further, the grant of a patent was requested on the basis of auxiliary request 2 filed with letter dated 23 September 2019, or auxiliary request 3 or 4 filed during oral proceedings before the Board.

III. The following documents are referred to:
D1: EP1339112 A2
D5: US2004/0183066 A1

IV. Claim 1 of the main request has the following wording:

A tandem OLED display (100) for producing broadband light having at least two spaced electrodes (110, 170) comprising:
a) two or more broadband light-emitting units (120.x) disposed between the electrodes (110, 170), at least two of which produce light having different emission spectra (300) and wherein at least one of such

broadband light-emitting units (120.x) does not produce white light; and
b) an intermediate connector (130.x) disposed between each of adjacent ones of the two or more broadband light-emitting units (120.x),
wherein the tandem OLED display (100) does not comprise a color-compensating light-emitting unit between the electrodes (110, 170).

V. Claim 1 of auxiliary request 1 differs from claim 1 of the main request in that it comprises, at the end of feature a) just before the word *and*, the additional feature

wherein each broadband light-emitting unit (120.x) comprises a plurality of layers and is capable of supporting hole transport, electron transport and electron-hole recombination to produce light;

VI. Claim 1 of auxiliary request 2 differs from claim 1 of the main request in that the last feature relating to the color-compensating light-emitting unit is deleted and in that feature a) reads

a) two or more broadband light-emitting units (120.x) disposed between the electrodes (110, 170),
wherein at least two of the broadband light-emitting units (120.x) produce light having different emission spectra (300),
wherein each of the broadband light-emitting units (120.x) produces light having two or more spaced peak spectral components (365, 370) in the visible spectrum, and
wherein at least one of the broadband light-emitting units (120.x) does not produce white light; and

VII. Claim 1 of auxiliary request 3 differs from claim 1 of auxiliary request 2 in that feature a) reads

a) two or more broadband light-emitting units (120.x) disposed between the electrodes (110, 170),
wherein at least two of the broadband light-emitting units (120.x) produce light having different emission spectra (300),
wherein each of the broadband light-emitting units (120.x) produces light having two or more spaced peak spectral components (365, 370) in more than a single region of the visible spectrum,
wherein the number of regions is two, wherein
- one of the regions is the blue region and the other of the regions is the green region,
- one of the regions is the blue region and the other of the regions is the red region,
- one of the regions is the green region and the other of the regions is the red region, and
- one of the regions is the cyan region and the other of the regions is the yellow region, and
wherein at least one of the broadband light-emitting units (120.x) does not produce white light; and

VIII. Claim 1 of auxiliary request 4 differs from claim 1 of auxiliary request 2 in that feature a) reads

a) two or more broadband light-emitting units (120.x) disposed between the electrodes (110, 170),
wherein at least two of the broadband light-emitting units (120.x) produce light having different emission spectra (300),
wherein each of the broadband light-emitting units (120.x) produces an emission spectrum (300) with a first and a second emission peak (365, 370), wherein

the first emission peak (365) has a greater intensity than the second emission peak (370), and wherein the first emission peaks (365) of the broadband light emitting units (120.x) are selected so that the combined emission produces white light, and wherein at least one of the broadband light-emitting units (120.x) does not produce white light; and

IX. The arguments of the appellant, as far as they are relevant for the present decision, may be summarised as follows.

(a) Broadband light

The expression *broadband light* was clear per se and could be understood, for example, as meaning the opposite of *narrowband light*. *Broadband light* did not necessarily imply that it comprised light of different colors, because the expression *portions/regions of the visible spectrum* did not necessarily refer to the main colors normally used to describe the visible spectrum. For example, the term *region* could refer to olive green or grass green as well instead of to green. A *region* or *portion* could thus refer to a part of the visible spectrum which is narrower than one of the main colors normally used to describe it.

(b) More than a single region

The additional feature of claim 1 of auxiliary request 2 had a basis on page 11, lines 27 to 30 of the original application. The expression *in more than a single region of the visible spectrum* of that passage did not need to be integrated into claim 1 since it was redundant. A *region of the visible spectrum* did not necessarily correspond to a main color and the presence of two spaced peaks already implied that there were at least two, possibly very narrow, *regions*, one around each of the peaks.

(c) Closest state of the art

The disclosure of D5 related essentially to p-type semiconductor materials. The main purpose of this document was the improvement of these materials which could be used not only in connecting units of cascaded OLEDs, but also in other electronic devices (see [4] and [31]). Further, even in the parts relating to cascaded OLEDs, D5 aimed at improving the connecting units and not the light-emitting layers (LELs), in contrast to the application.

In addition, [124] did not disclose a cascaded OLED including a plurality of broadband light emitting units. Instead, it disclosed different embodiments, the first one relating to cascaded OLEDs including a plurality of light emitting units with unspecified emission and the second one relating to OLEDs with only one light-emitting unit that generated broadband light.

For these reasons, D5 was not a suitable starting point for the problem and solution approach. Claim 1 of the main request as well as of auxiliary requests 1 and 2 were therefore inventive as not obvious from D5.

(d) Auxiliary request 3 / technical effects

The features by which claim 1 of auxiliary request 3 differed from D5 achieved a number of technical effects.

(i) The particular color combinations claimed enabled the reduction of the number of EL units, thereby improving the optical properties of the OLED.

(ii) The interactions between the multiple dopant molecules were reduced in the sense that energy transfer between the different dopant molecules and thus quenching would be reduced. The problem of quenching was implied by page 2, lines 9 to 10 of the application and further mentioned in [57] of D1.

(iii) The particular color combinations claimed reduced the amount of light that had to be filtered out and thus wasted when creating a full color display. Thereby, power consumption of the tandem OLED was reduced. This problem was mentioned on page 6, lines 4 to 17 of the application.

(iv) On a more general level, the differentiating features improved the luminance and overall color balance of the tandem OLED.

(e) Auxiliary request 4 / disclosure of D5

D5 did not mention an emission spectrum with peaks at all and even less an emission spectrum with a first emission peak of a greater intensity than a second emission peak according to the additional features of claim 1 of auxiliary request 4.

(f) Auxiliary request 4 / technical effects

The additional features of claim 1 of auxiliary request 4, in particular the difference in intensity of the first and second peaks, had the technical effect to reduce the problems created by the wavelength-dependence of the variation of emission intensity with the distance of the light emitting layer to the cathode by enabling placement of the EL units near their optimum locations. This issue was explained on page 5, line 27 to page 6, line 3 of the application.

(g) Auxiliary request 4 / incentive to modify D5

Even if the problem to be solved was formulated as providing an alternative tandem OLED for producing broadband light, the skilled person would still require an incentive to modify D5 by integrating the differentiating features. Such an incentive was not present in the prior art.

Reasons for the Decision

1. The appeal is admissible.

2. Colors / regions / portions of the visible spectrum (see point IX.(a) above)

The visible spectrum is continuous and contains wavelengths in the range approximately from 380 nm to 740 nm. It is commonly divided into 6 main color bands, namely, red, orange, yellow, green, blue and violet. Sometimes, either indigo (located between blue and violet) or cyan (characterising a wavelength region between green and blue) is used as an additional main color band.

The boundaries between one main color band and the next are not defined in a very precise manner. Instead, they differ by a few nanometers depending on the definition.

Nonetheless, these main color bands are commonly used in the art of light generation to define *portions* or *regions* of the visible spectrum and parts of the visible spectrum which are narrower than or shifted as compared to the main color bands as mentioned above would, in the absence of any explicit different definition, not be considered by the skilled person to correspond to a portion or region of the visible spectrum, contrary to the argument of the appellant.

The Board notes that the interpretation of the expressions *colors* / *portions* / *regions of the visible spectrum* as corresponding to main color bands of the visible spectrum is consistent with the examples given in the application according to which particular *portions* or *regions* of the visible spectrum are always referred to by one of these *main colors* (see, e.g., page 8, line 28 to page 9, line 1 and page 11, lines 27 to 31).

The Board further notes that the colors olive-green and grass-green mentioned by the appellant as representing narrower *portions* or *regions* of the green part of the visible spectrum can not be represented by a single wavelength and are thus not spectral colors. Instead, olive-green and grass-green are different mixtures of red and green light. They can thus be considered as shades of green, but not as a particular *color*, *portion* or *region of the visible spectrum*.

3. The application

The application concerns OLEDs producing broadband light (page 6, lines 19 and 20). The broadband light produced may or may not be white (e.g., page 16, lines 28 to 30).

For this purpose, tandem OLED displays are disclosed which consist of at least two light-emitting units (EL units) in a stacked configuration arranged between a cathode and an anode and separated by intermediate connectors. Each EL unit consists of a number of different layers including at least one light emitting layer LEL (page 11, lines 4 to 27).

In all the examples given in the application, each EL unit emits light with components in at least two regions of the visible spectrum (page 8, line 28 to page 9, line 1). Such an emission is defined in the description as a broadband emission. Light of different regions / colors is then combined in accordance with the well known 1931 CIE chromaticity diagram (page 8, line 28 to page 9, line 6).

4. The relevant prior art

4.1 D1

Document D1 discloses a tandem white OLED that may consist of a red, a green and a blue emitting EL unit (see figure 7). The document mentions that interactions between different luminescent materials may occur and that quenching often happens in the presence of a red-emitting dopant and a blue-emitting dopant (see [57]). A family member of D1 is cited in the present application on page 4, lines 13 to 21.

4.2 D5

D5 is directed to particular p-type materials for use in electronic devices (see [2]). The materials described are specifically useful in tandem (also known as *cascaded* or *stacked*) OLED devices which include connecting units separating adjacent EL units ([21] to [23]) as described in the present application.
D5 describes tandem OLED devices with two or more EL units wherein each EL unit can be selected to achieve, e.g., a desired light emission color ([39] to [42]). Further, D5 discloses that one or more dopants can be added to one or more layers to create a white-emitting OLED and gives some examples of such dopant combinations ([124]).

5. Main request and auxiliary request 1 / the expression *broadband light* (see point IX.(a) above)

Emitted light with a spectral width of more than a few tenths of nanometers or emitted light that is spectrally distributed such that it appears to be white would *per se* be considered by the skilled person to fall under the expression *broadband light* used in claim 1 of the main request and of auxiliary request 1.

However, this expression *per se* does not imply a particular minimum spectral width or a particular form of spectral distribution (see also point 2 of the communication of the Examining Division dated 9 February 2011).

The appellant interpreted the expression *broadband light* as being the opposite of the expression *narrowband light*.

It was not contested by the appellant that the emission of a laser, e.g. a He-Ne laser at 633 nm, had to be considered as a narrowband light emission. Conversely, any light emission substantially broader than laser emission would have to be considered as being broadband light.
Such light emissions could include, for example, light components throughout the whole red spectral region (spanning roughly from 620 nm to 780 nm) without containing components of any other main color than red. Such an emission with a spectral width of more than 100 nm would commonly be considered by the skilled person as "broadband light", and this was also the stated position of the appellant at oral proceedings.

However, the definitions as well as the examples for "broadband light" given in the description and the figures of the application are restricted to light including components of at least two different colors/ portions/regions of the visible spectrum (page 1, lines 17 to 21, page 8, lines 28 to 30 and page 11, lines 27 to 31).

Adopting the interpretation of the appellant, it thus follows from the above that the skilled person would understand from the wording of claim 1 alone the expression "broadband light" as including light having only components of one (e.g., the red) portion/color of the visible spectrum. However, from the definitions and examples in the description and the figures, the skilled person would understand the expression "broadband light" as requiring the presence of components of at least two different portions/colors of the visible spectrum.

In view of this inconsistency, it is not clear whether light which is exclusively of a single color, but with a spectral width substantially broader than a laser emission line falls under the expression "broadband light" as defined in the independent claims of the main request and auxiliary request 1 or not.

Therefore, the independent claims of the main request and of auxiliary request 1 do not comply with the requirements of Article 84 EPC 1973.

6. Auxiliary request 2 / spaced peak central components (see point IX.(b) above)

Claim 1 of auxiliary request 2 comprises the additional feature

wherein each of the broadband light-emitting units produces light having two or more spaced peak spectral components in the visible spectrum.

Lines 27 to 31 on page 11 of the original description (indicated by the appellant as a basis for the additional feature) contain the additional condition that the two or more spaced peak spectral components are located *in more than a single region* of the visible spectrum.
As argued above, the expression *single region of the visible spectrum* has to be understood as corresponding to *one of the main color bands of the visible spectrum.* That is, according to that passage, the two peaks represent two different main colors of the visible spectrum. In line therewith, the examples in lines 30 and 31 of page 11 correspond to light with peaks in more than a single (main) color of the visible spectrum

(blue and green, blue and red, green and red, cyan and yellow).

Thus, contrary to the argument of the appellant, the condition contained in lines 27 to 31 of page 11 is not redundant, but represents a restriction and provides a basis only for peaks being located in different spectral regions / having different spectral colors.

In contrast thereto, the wording of claim 1 of auxiliary request 2 covers EL units which produce light where both peak components are in the same spectral region of the visible spectrum.
For such an EL unit, however, there is no basis in the original application. Thus, the subject-matter of claim 1 of auxiliary request 2 does not comply with the requirements of Article 123(2) EPC.

7. Auxiliary request 3

7.1 Articles 123(2) EPC and 84 EPC 1973

Claim 1 of auxiliary request 3 includes the expression "in more than a single region", so that the objection made with respect to claim 1 of auxiliary request 2 does not apply. Further, claim 1 now specifies the expression "broadband light" by the definition that each of the broadband light-emitting units produces light having two or more spaced peak spectral components in more than a single region of the visible spectrum. This limits the claim to the examples given in the description and the figures and thereby overcomes the clarity objection raised with respect to the expression "broadband light" relating to the main request and auxiliary request 1.

7.2 Closest state of the art (see point IX.(c) above)

The Board accepts the argument of the appellant that document D5 is mainly concerned with particular p-type semiconductor materials, whereas the application focuses on details of EL units in tandem OLEDs.

However, one, if not the, main application of the materials proposed in D5 is their use in connecting units between the EL units in cascaded OLEDs for producing broadband light (see [22], [23] and [124]). This corresponds to the objective of the claimed invention.

Further, in that context and as mentioned above, D5 discloses a tandem or cascaded OLED with two or more EL units disposed between two spaced electrodes (see [42] and figure 1). An intermediate connector is disposed between each of adjacent ones of the EL units (see figures 1 and 2). In addition, D5 discloses the addition of multiple dopants to one or more layers of the EL units to create a white-emitting OLED (see [124]).
The Board accepts the argument of the appellant that [124] does not directly and unambiguously disclose a plurality of broadband light-emitting units in one cascaded OLED. However, the whole paragraph is directed at EL units in plural (see first sentence) and can thus not be seen as relating to an embodiment comprising only one EL unit, contrary to the argument of the appellant. Instead, [124] discloses the use of at least one broadband light-emitting unit in a tandem OLED display with at least two EL units for producing broadband light.

D5 thus aims at the same objective as the claimed invention (producing broadband, possibly white, light) and has the most relevant technical features in common with the claimed invention (tandem OLED with connectors and multiple dopants).
Therefore, contrary to the arguments of the appellant, D5 is suitable to be taken as representing the closest prior art in the framework of the problem and solution approach.

7.3 Disclosure of D5

In the words of claim 1 of auxiliary request 3, D5 discloses

A tandem OLED display for producing broadband light having at least two spaced electrodes (110, 140; see figure 1) comprising

two or more light-emitting units (120.N) disposed between the electrodes (figure 1 and [42]), wherein one of the light-emitting units is a broadband light emitting unit ([124]),

wherein the broadband light-emitting unit produces light having two or more spaced peak spectral components in more than a single region of the visible spectrum (see [124]; the color combinations disclosed in this paragraph imply the presence of two spaced peaks, even if such a presence is not explicitly mentioned), and

an intermediate connector disposed between each of adjacent ones of the two or more light emitting units (see figures 1 and 2).

7.4 Difference

The subject-matter of claim 1 of auxiliary request 3 thus differs from D5 in that

i) two or more broadband light-emitting units are disposed between the electrodes,

ii) at least two of the broadband light-emitting units produce light having different emission spectra,

iii) the number of regions in which the spaced peak spectral components of each of the broadband light-emitting units are located is two, wherein
- one of the regions is the blue region and the other of the regions is the green region,
- one of the regions is the blue region and the other of the regions is the red region,
- one of the regions is the green region and the other of the regions is the red region, and
- one of the regions is the cyan region and the other of the regions is the yellow region, and

iv) wherein at least one of the broadband light-emitting units does not produce white light.

As a side remark, the Board notes that feature iv) is implied by feature iii) because none of the combinations mentioned in that latter feature produces white light.

7.5 Technical effects achieved (see point IX.(d) and its sub-points above)

7.5.1 Number of EL units (point IX.(d)(i) above)

The Board accepts that EL units which emit light in a plurality of spectral regions reduce the number of EL units that are necessary to produce a desired overall broadband light spectrum as compared to EL units which emit light in only one spectral region (as shown, for instance, in figure 7 of D1).

However, EL units which emit light in a plurality of spectral regions are already known from D5 (see [124]). That is, the effect of reducing the number of EL units for a given overall broadband light spectrum is already achieved by the tandem OLEDs disclosed in D5, compared, for example, to an arrangement such as that of figure 7 of D1.

To give an example, if the aim were to obtain white light, a *single* EL unit would be sufficient according to [124] of D5.
In contrast to that, a display according to claim 1 of auxiliary request 3 contains at least one EL unit that does not produce white light and would therefore require *at least two* EL units to achieve this aim.

Consequently, the effect of reducing the number of EL units alleged by the appellant is not achieved by differentiating features i) to iv).

7.5.2 Reduction of quenching (see point IX.(d)(ii) above)

The Board notes that [57] of D1 cited by the appellant refers to one of the color combinations (red and blue) defined in claim 1 of auxiliary request 3. Thus, if that color combination *per se* would cause quenching, the same combination defined in claim 1 of auxiliary request 3 would do so as well, whereby the differentiating features would not achieve the alleged technical effect. The Board further notes that D1 only mentions that this color combination would *often* quench.

Irrespective of that, quenching is an effect that depends on the details of the electron configurations of the host and dopant molecules involved. Consequently, in order to reduce quenching, particular dopant molecules in combination with particular host molecules must be selected taking into account specific physical properties of these molecules like electron state energies, upper level lifetimes and transition probabilities between different electron states.

Thus, contrary to the argument of the appellant, the effect of reducing quenching can not be achieved in a reliable manner by simply choosing particular color combinations according to the differentiating features i) to iv) as defined above.

7.5.3 Reduction of power consumption (see point IX.(d)(iii) above)

Power waste caused by the generation of light of undesired wavelengths is mentioned in the application on page 6, lines 4 to 17.

However, for a full color display comprising pixels of the primary colors blue, green and red, white light has to be generated in a first step. For example, a cascaded OLED comprising one blue/green EL unit, one blue/red EL unit and one red/green EL unit which would fall under the terms of claim 1 of auxiliary request 3 could provide such white light.
In a second step, however, for each pixel of one primary color, the other two primary colors and thereby

two thirds of the generated light would have to be filtered out.

That is, according to the claimed invention, the same amount of light (two thirds) has to be filtered out in the second step as in any other full color display which is based on white light generated from blue, green and red emissions and which employs absorptive color filters. Thereby, the same amount of light has to be generated and thus, the power consumption is not reduced as compared to any such other full color display.

As a matter of fact, wasting a part of the generated light is typical in such systems and the appellant has not provided a convincing explanation how this waste could be reduced in cascaded OLEDs by a particular choice of color combinations in the different EL units.

Thus, the Board is not persuaded that the technical effect alleged by the appellant is achieved by the differentiating features i) to iv), either.

7.5.4 Improvement of luminance and color balance (see point IX.(d)(iv) above)

The application mentions better color and better luminance efficiency in the general background section on page 2, lines 7 to 11. However, the skilled person would always strive to achieve a desired luminance and color balance of the light generated when designing an OLED.

The skilled person would do so using the generally known 1931 CIE chromaticity diagram that is mentioned in the application (page 14, lines 17 to 24) using appropriate gamut-defining colors and adjusting their intensities, which would include choosing appropriate dopant and host materials.

However, the Board fails to see how the effect of improving luminance and color balance could be achieved by simply choosing particular color combinations on the general level as defined by the differentiating features i) to iv).

7.6 Inventive step

It follows from the above that the technical effects alleged by the appellant are in fact not achieved by the differentiating features i) to iv).
The Board can also not perceive any other particular technically useful property of the differentiating features in the framework of cascaded OLED devices for producing broadband light.

Therefore, the Board holds that the only possibility to formulate the objective technical problem is how to provide an *alternative* tandem OLED for producing broadband light (Case Law of the Boards of Appeal, 9th edition 2019, section I.D.4.5.).

The Board accepts that an alternative means for achieving a known technical effect could, in some cases, be considered to involve an inventive step. However, achieving a known technical effect by means of modifications of the closest prior art which would be obvious to the skilled person cannot be considered inventive.

In the present case, the differentiating features only pertain to a rearrangement of the distribution of the color emissions in the different EL units. On that general level and in view of the commonly known CIE 1931 chromaticity diagram, the skilled person would be aware of a great number of equivalent possibilities to solve the equally general objective technical problem as defined above.

Therefore, in the present case, the differentiating features i) to iv) do not amount to more than an arbitrary choice from a number of different solutions, each of which would be obvious to the skilled person. Such an arbitrary choice cannot involve an inventive step (Case Law of the Boards of Appeal, 9th edition 2019, section I.D.9.19.8).

Consequently, the subject-matter of claim 1 of auxiliary request 3 lacks an inventive step according to Article 56 EPC 1973.

8. Auxiliary request 4

8.1 Disclosure of D5 (see point IX.(e) above)

It was undisputed that D5 discloses, in the words of claim 1 of auxiliary request 4

- a tandem OLED display for producing broadband light having at least two spaced electrodes (110, 140) comprising

- two or more light-emitting units (120.N) disposed between the electrodes (figure 1 and [42]), wherein one of the light-emitting units is a broadband light emitting unit ([124])

- and an intermediate connector disposed between each of adjacent ones of the two or more light emitting units (see figures 1 and 2).

The Board accepts that D5 does not explicitly mention peaks in the spectrum of the light emitted by the EL units, as submitted by the appellant (see point IX.(e) above). However, D5 gives in [124] some combinations of colors that yield white light. The colors of the combinations given are spaced apart from each other (for example, blue and yellow). In that context, it is implicit that no other colors (for example, red) are emitted, because this would change the color of the output light to something that is not white. Consequently, the color combinations mentioned in [124] imply that

- the broadband light-emitting unit produces an emission spectrum with a first and a second emission peak.

In practice, two peaks never have the same intensity. In the absence of any definition concerning the amount of the difference in intensity between the first and the second emission peak, it must be concluded that D5 not only discloses an emission spectrum including a first and a second peak, but that these peaks in addition differ, even if only to a small degree, in intensity. That is, D5 also implicitly discloses the feature that

- the first emission peak has a greater intensity than the second emission peak.

8.2 Difference

The subject-matter of claim 1 of auxiliary request 4 differs therefore from D5 in that

i) two or more broadband light-emitting units are disposed between the electrodes,

ii) at least two of the broadband light-emitting units produce light having different emission spectra,

iv) wherein at least one of the broadband light-emitting units does not produce white light,

v) wherein *each* of the broadband light-emitting units produces an emission spectrum with a first and a second emission peak, wherein the first emission peak has a greater intensity than the second emission peak, and

vi) wherein the first emission peaks of the broadband light-emitting units are selected so that the combined emission produces white light.

8.3 Technical effects achieved (see point IX.(f) above)

According to the application, optical interference effects within a multi-layer OLED structure lead to a variation of emission intensity with the distance of the light-emitting layer to the cathode, this variation depending on the wavelength of the emitted light (page 17, lines 19 to 31; see also figure 5).
Achieving the technical effect of reducing these interference effects would therefore require that light emitters of a particular wavelength are positioned at a particular distance to the cathode.

However, the differentiating features i), ii), iv), v) and vi) mention neither such distances nor such wavelengths.

The technical effect alleged by the appellant can thus not be achieved by the differentiating features as defined above.

The Board notes that the disputed feature that the intensities of the first and the second peak are different is already disclosed in D5 because the claim does not specify the amount of the difference. However, even if that feature were interpreted such that the intensities of the first and second peak differed by a large amount, say, a factor of about 3 as seems to be suggested by figure 4, the claim would still not define any particular wavelengths nor distances of the emitters with respect to the cathode. Thus, even in that interpretation, the alleged technical effect would not be achieved by the disputed feature mentioned above, contrary to the argument of the appellant.

8.4 Inventive step (see point IX.(g) above)

Thus, the technical effect alleged by the appellant is not achieved by the differentiating features of claim 1 of auxiliary request 4. Instead, at the level at which this claim is formulated, no objective technical problem can be recognised other than providing an alternative tandem OLED producing broadband light. This corresponds to the Board's finding concerning claim 1 of auxiliary request 3.

Further, as for claim 1 of auxiliary request 3, the differentiating features only pertain to a rearrangement of the distribution of the color emissions in the different EL units to produce the same technical effect as D5. Consequently, the same reasoning as for this claim applies and differentiating features i), ii), iv), v) and vi) again do not amount to more than an arbitrary selection from a number of different solutions, each of which would be obvious to the skilled person.

Contrary to the argument of the appellant, the Board holds that in a case involving such an arbitrary selection, the prior art does not need to contain an incentive for the skilled person to select the particular solution claimed. Instead, all possible solutions have to be regarded as being equally suitable and obvious candidates for solving the objective technical problem as defined above; therefore, they all have to be considered to be suggested to the skilled person (see Case Law of the Board of Appeals, 9th edition 2019, section I.D.9.19.8).

Consequently, such an arbitrary choice cannot involve an inventive step, as already argued above in relation to claim 1 of auxiliary request 3.
Therefore, the subject-matter of claim 1 of auxiliary request 4 does not comply with the requirements of Article 56 EPC 1973.

9. Conclusion

None of the requests fulfills the requirements of the EPC. Thus, the appeal must fail.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

S. Sánchez Chiquero S. Ward

Decision electronically authenticated