

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG DISPLAY CO., LTD.
Petitioner,

v.

PICTIVA DISPLAYS INTERNATIONAL LTD.,
Patent Owner.

Case No. IPR2024-00855
Patent No. 8,314,547

PATENT OWNER'S PRELIMINARY RESPONSE

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<i>Samsung Elecs. Co. v. Infobridge Pte. Ltd.</i> , 929 F.3d 1363 (Fed. Cir. 2019)	26

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EXHIBIT LIST

Exhibit No.	Document Description
EX2001	Declaration of Dr. Florian Much
EX2002	PCT/DE2008/001302 Application Data
EX2003	2006-05-22 Invention Disclosure, same as Exhibit A to Declaration of Dr. Florian Much
EX2004	Translation of 2006-05-22 Invention Disclosure
EX2005	2006-07-25 Filing Decision (redacted), same as Exhibit B to Declaration of Dr. Florian Much
EX006	Translation of 2006-07-25 Filing Decision
EX2007	2006-08-11 Supplemental Invention Disclosure, same as Exhibit C to Declaration of Dr. Florian Much
EX2008	Certified copy of DE102007044597.2
EX2009	Certified Translation of DE102007044597.2
EX2010	Declaration of Professor Kirk S. Schanze
EX2011	Linked-In Profile of Dr. Norwin Von Malm, available from https://www.linkedin.com/in/dr-norwin-von-malm-0b928052/?originalSubdomain=de .
EX2012	List of applications filed by inventors between 7/31/2006-10/1/2008
EX2013	Krummacher, B. C. et al., "Light Extraction From Solution-Based Processable Electrophosphrescent Organic Light-Emitting Diodes," Journal of Display Technology 3(2), 200-210 (June 2007), downloaded from IEEE Xplore
EX2014	Krummacher, B. C. et al., "General method to evaluate substrate surface modification techniques for light extraction enhancement of organic light emitting diodes," Journal of Applied Physics 100, 054702 (2006)
EX2015	Krummacher, B.C., "Organic White Light-Emitting Diodes basd on Luminescence Down-Conversion," doctorate thesis (2007)
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EX2017	US7,982,387
EX2018	DE102007022090A1
EX2019	DE102007056924A1
EX2020	Salehi, A. et al., “Realization of high-efficiency fluorescent organic light-emitting diodes with low driving voltage,” Nature Communications (2019), available from Available from https://www.nature.com/articles/s41467-019-10260-7 .
EX2021	Kim, N. H., et al., “Color optimization of single emissive white OLEDs via energy transfer between RGB fluorescent dopants,” Journal of Luminescence 143, 723-728 (2013), available from www.elsevier.com/locate/jlumin
EX2022	Kim, T. G. et al., “Study of Deep Blue Organic Light-Emitting Diodes Using Doped BCzVBi with Various Blue Host Materials,” Transaction on Electrical and Electronic Materials, 11(2), pp. 85-88 (Apr. 25, 2010), available from https://koreascience.or.kr/article/JAKO201013343111173.page
EX2023	Kim, Y. H. et al., “Energy transfer between host and dopant molecules in blue organic light-emitting devices,” Journal of Applied Physics, 110, 034501 (2011) available from https://pubs.aip.org/aip/jap/article-abstract/110/3/034501/977524/Energy-transfer-between-host-and-dopant-molecules?redirectedFrom=fulltext
EX2024	EP1804092A1 to SDI
EX2025	Federal Court Management Statistics for U.S. District Courts, available from https://www.uscourts.gov/statistics/table/na/federal-court-management-statistics/2024/06/30-1
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EX2028	Zhang, X.W. et al., “Solution-processed white organic light-emitting diodes with mixed-host structures,” Journal of

	Luminescence 132, 697-701 (2012), downloaded from https://www.researchgate.net/publication/251473369_Solution-processed_white_organic_light-emitting_diodes_with_mixed-host_structures
EX2029	Holmes, R. J. et al., “Efficient, deep-blue organic electrophosphorescence by guest charge trapping,” Applied Physics Letters 83(18), 3818-19 (Nov. 2003)
EX2030	Sajoto, T. et. al, “Blue and Near-UV Phosphorescence from Iridium Complexes with Cyclometalated Pyrazolyl or <i>N</i> -Heterocyclic Carbene Ligands,” Inorganic Chemistry, Vol. 44, 7992-8003 (2005)
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EX2040	US8,314,541
EX2041	US8,791,490
EX2042	US8,710,537
EX2043	US8,772,818
EX2044	US8,492,973
EX2045	Klein, M., et al., “OLED lighting – light where it never has been before,” Proc. Of SPIE 6486, 64860E-1 to E10 (2007)
EX2046	Krummacher, B. et al., “Optical Analysis of Down-Conversion OLEDs,” Proc. Of SPIE 6910, 691007-1 to 691007-17
EX2047	SPIE Call for Paper for 2007 OP406 Meeting
EX2048	DE102007044597A1 (published version)

EX2049	WO2009/036718A1 (published version of PCT/DE2008/001302
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I. Introduction

The six grounds rely primarily either on Igarashi (EX1004) or Shiotani (EX1005). But neither discloses the required “second regions.”

For instance, like Kobori, Igarashi’s organic layer emits an electromagnetic radiation having significant emissions in a wavelength range that Petitioner alleges are blocked by the alleged “filter layer” in the second regions. *See* Section IV.A below.

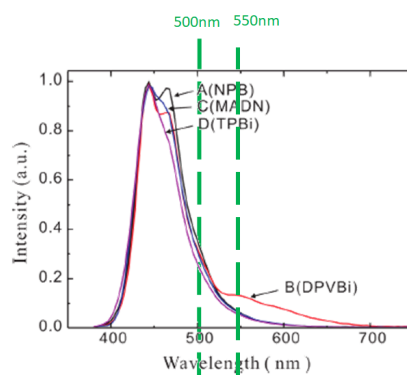
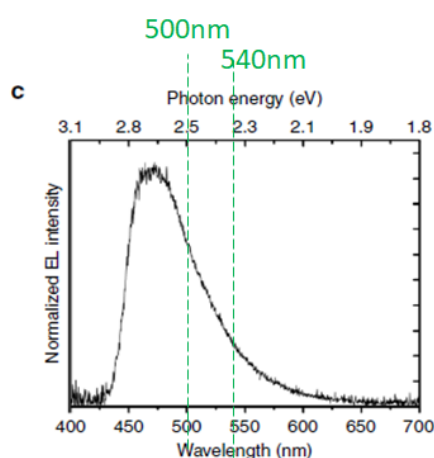


FIG. 3. (Color online) Normalized electroluminescence spectra from the present devices A, B, C, and D. See text for more details.

EX2023, Fig. 3 (device B(DPVBi))

EX2020, Fig. 2c; EX2010, ¶ (35-40% of emission above 500 nm).

The claims, however, require the filter layer be both

- transparent to an electromagnetic radiation having a first wavelength spectrum, emitted by an organic layer sequence (1[f]); and
- at least partially opaque to an electromagnetic radiation having a third wavelength range (1[d])—which Petitioner contends include at least the

green light in the 500-540 nm range for Igarashi (Pet. 22).

Petitioner has not explained how Igarashi's filter can simultaneously block light in the 500-540nm range and be transparent to light having a first wavelength range with significant fractions in that range to satisfy both 1[d] and 1[f]. To be clear this is not a dispute about the weight of evidence. The Petition simply assumes that Igarashi's organic layer emits in the 450-470nm range, and fails to investigate the actual emission characteristics.

Furthermore, Igarashi does not even qualify as prior art. The inventors conceived the invention prior to the critical date of 2/1/2007 (and for many claims before Igarashi's US filing date of 7/27/2006). They then exercised reasonably continuous diligence by improving the optoelectronic devices that are the subject of the invention disclosure in the critical period, and by working with the prosecution attorney to constructively reduce the inventions to practice with the filing of the German priority application. *See* Section III.C. Petitioner had the May 2006 conception document in its possession before the IPR, but chose to ignore it.

As to Grounds 4-6, the purported "second regions" in Shiotani pointed to by Petitioner are actually just another example of "first regions" each having a wavelength conversion layer that satisfies the requirement of 1[c]. *See* Section V.A. Petitioner therefore has not shown that Shiotani has recited "second regions."

Moreover, for the same reasons as for Igarashi, Petitioner has also not shown why Shiotani's purported filter layer satisfies 1[d] and 1[f] simultaneously. *See* V.B.

Finally, discretionary denial under 325(d) and 314(a) are proper in this case.

For these and reasons stated below, the Petition does not establish a reasonable likelihood of success on any proposed ground.

II. The Inventions

A. Skill Level

Petitioner has not correctly defined a person of ordinary skill in the art. For example, Dr. von Malm, one of the co-inventors, had a degree in chemistry. *See* EX2011. As another example, Petitioner contends Igarashi is analogous art, but Igarashi relates to the development of new phosphor materials, a field generally addressed by chemists and material scientists, rather than electrical engineers or physicist. Thus, a skilled artisan would include chemists and material scientists working in the relevant field. EX2010, ¶15.

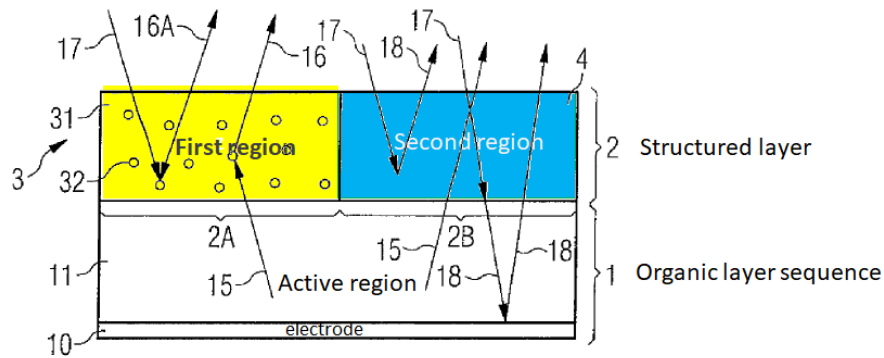
B. The '547 Patent

The '547 patent names Drs. Klein, Von Malm and Krummacher as the inventors. The inventions resulted from the OLED research programs of OSRAM Opto Semiconductor GmbH ("OSRAM OS"). Pictiva is the successor to OSRAM OS's OLED patent portfolio.

The inventors aimed to provide an optoelectronic device with "a desired [color] impression" in even the switched-off state. EX1001, 1:13-15. To achieve

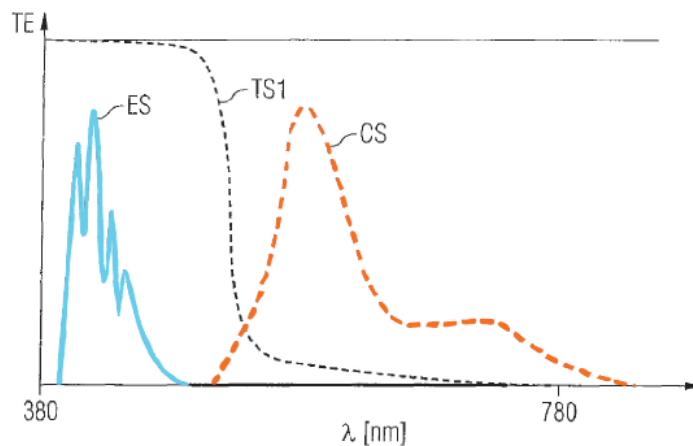
this, the inventors proposed an architecture with a “structured layer,” disposed downstream of an organic layer sequence that emits light. EX1001, 1:23-31.

FIG 1A



The organic layer sequence 3 emits light having a first wavelength spectrum, such as the blue wavelength in the annotated Figure 2 below:

FIG 2



EX1001, Fig. 2, 11:32-36 (“An emission characteristic or an emission spectrum ES represents, for example, a spectral profile of the electromagnetic radiation 15

emitted by the organic layer sequence 1. In this case, the emission spectrum ES comprises a blue wavelength range.”).

The structured layer 2 includes first regions and second regions. *See* EX1001, Figs. 1A-1B, 3, 4A-4C, 5-7. The first regions each have a wavelength conversion layer 3 that converts at least part of the light emitted by the organic layer sequence 1 “into an electromagnetic radiation having a second wavelength spectrum,” such as the one illustrated by the (red) CS spectrum shown in Figure 2.

FIG 1A

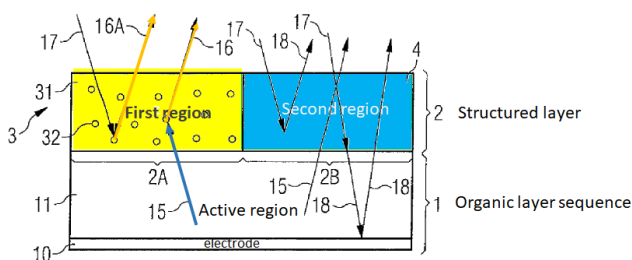
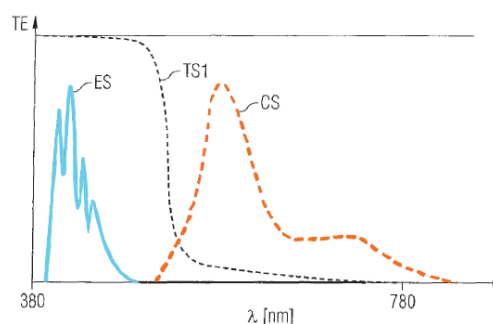


FIG 2



EX1001, 1:30-34, Figs. 1A-1B, 4A, 5-7 (showing conversion of emitted light 15 into converted light 16), 11:36-42 (“A conversion spectrum CS represents the wavelength spectrum which is emitted by the wavelength conversion layer 3 and on which the electromagnetic radiation 16, 16A is based, by way of example. The conversion spectrum CS accordingly comprises a yellow wavelength range and a red-green wavelength range, respectively.”).

The second regions of the structured layer 3 do not include a wavelength conversion layer that down converts the light emitted by the organic sequence

layer 1 to electromagnetic radiation having a higher wavelength. Instead, they each have a filter layer, which is transparent to the light having a first wavelength range (emitted by the organic sequence layer) but is opaque to at least a part of the second wavelength spectrum (emitted by the wavelength conversion layer 3), as illustrated in Figure 2. *See* EX1001, 1:34-37, 1:54-59, 11:42-47 (“[T]he filter layer 4 is transmissive to the blue light and thus to the electromagnetic radiation 15 emitted by the organic layer sequence 1, while it is opaque to electromagnetic radiation having a yellow wavelength range and a red and green wavelength range.”), Figs. 1A-1B, 4A, 5 (emitted light 15 passes through the filter layer 4), Fig. 2 (TS1 has high transmissions for radiation in the ES spectrum, but low to no transmissions for light in the CS spectrum to the right of the green vertical line).

FIG 1A

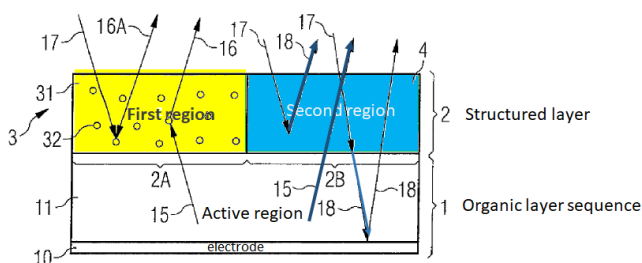
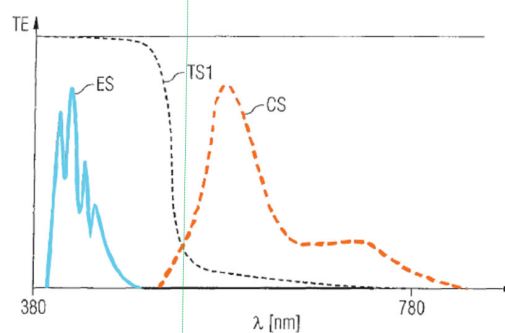
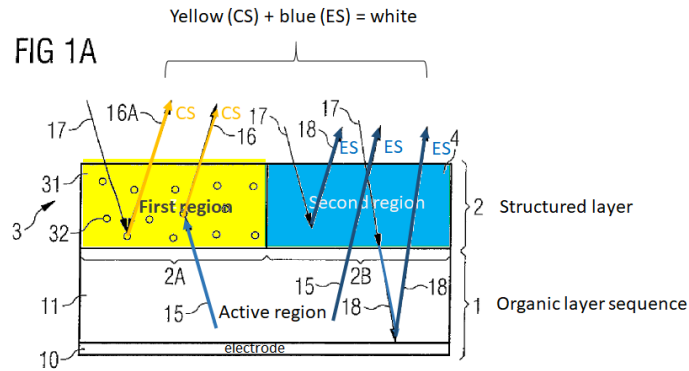


FIG 2

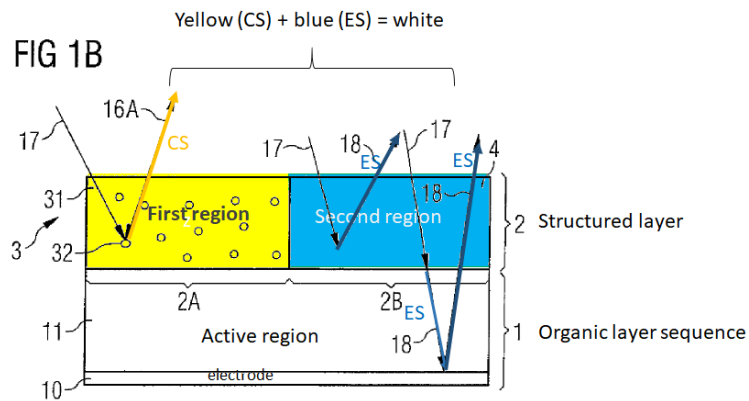


With this architecture, superimposition of light having the first wavelength range from the second regions and light having the second wavelength range from the first regions provide the overall impression of light emitted by the optoelectronic device. EX1001, 1:38-45, 1:59-62. In the preferred embodiments,

because the light from the first regions and the light from the second regions are mostly complementary to each other, this architecture avoids the undesirable yellowish impression seen in the prior art, even when the organic layer sequence does not emit light. *Id.*, 3:27-45.



(non-yellowish color when the organic layer sequence emits light)



(non-yellowish color when the organic layer sequence does not emit light)

See also EX2003, Fig. 3.

III. Igarashi Is Not Prior Art

A. Igarashi Does Not Qualify Under 102(b)

Contrary to Petitioner’s assertion, Igarashi is not 102(b) art to any of the challenged claims. *Contra* Pet. 3. This is because the challenged claims (and at least one pending German claim) are fully supported by the German priority application DE102007044597 as demonstrated by the chart below. The PCT application also did not add any new matter with respect to the issued claims. *See* EX2001, ¶¶21-27 (the only new matter concerning applicability to inorganic LED is not claimed), Ex. D.

Claim Element	<u>As-filed DE102007044597 (EX2009)¹</u>
1[pre]	“1. An optoelectronic device, comprising, ...” <i>See also, e.g.,</i> Title: “Optoelectronic device” Abstract [0001]: “The present invention relates to an optoelectronic device that can emit electromagnetic radiation during operation and has a desired color impression in the switched-off state.”

¹ Inserted paragraph numbers to EX2008 for ease of reference: [0001]-[0030], [0031]-[0037] and [0038]-[0089] correspond respectively to [0001]-[0030], [0031], [0032]-[0083] of EX2048.

[1a]

“1. An optoelectronic device, comprising:

an organic layer sequence (1) that during operation emits electromagnetic radiation (15) with a first wavelength spectrum

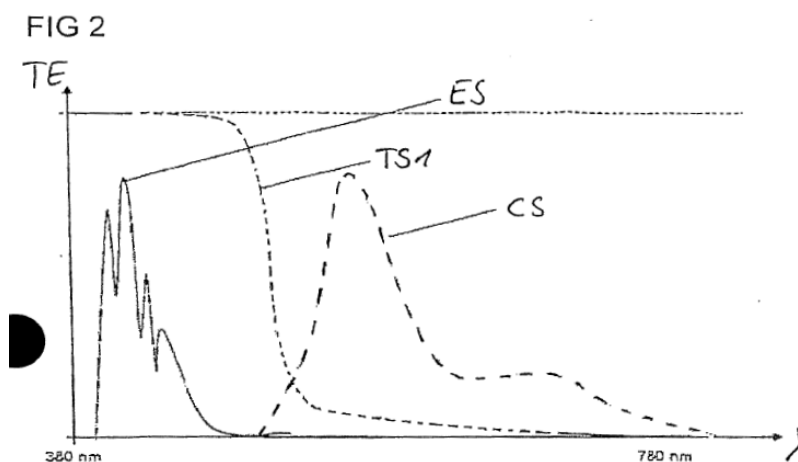
...”

See also, e.g.,

[0004]: “An optoelectronic device according to an embodiment of the invention comprises in particular an organic layer sequence, which in operation emits electromagnetic radiation having a first spectrum”

[0063]: “The organic layer sequence 1 ... is for example configured as an OLED. The active region 11 of the organic layer sequence 1 is in particular suitable for emitting electromagnetic radiation 15 having a first wavelength spectrum.”

[0071]: “Figure 2 shows an exemplary spectral diagram with different transmission characteristics or emission characteristics as a function of a wavelength λ . An emission characteristic or an emission spectrum ES for example represents a spectral profile of the electromagnetic radiation 15 emitted by the organic layer sequence 1. The emission spectrum ES comprises a blue wavelength range.”



See also

FIG 1A

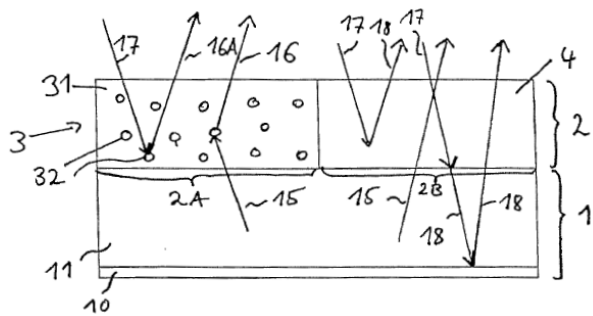


FIG 1B

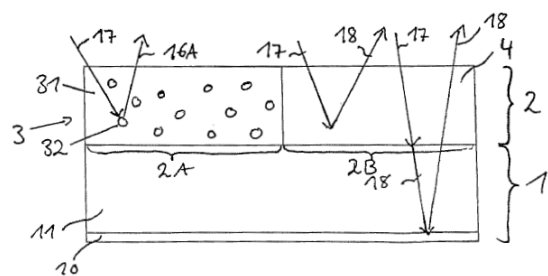


FIG 4A

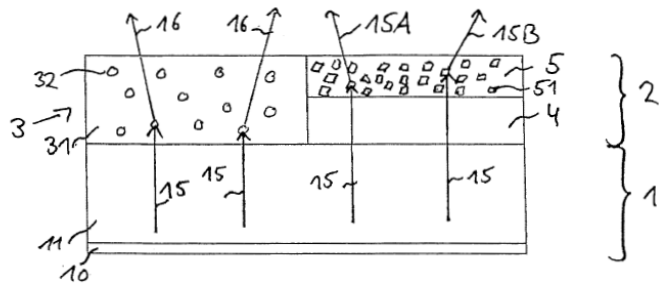
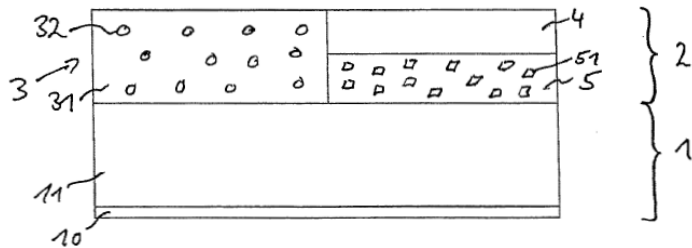
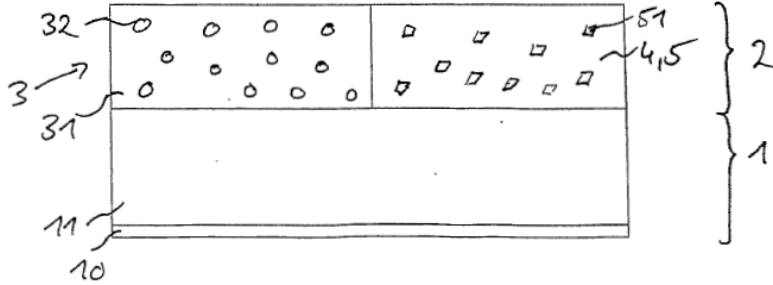
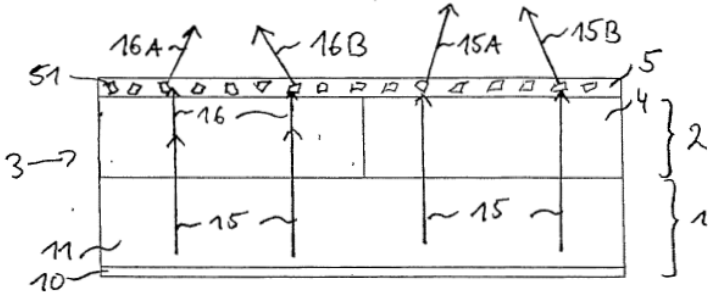
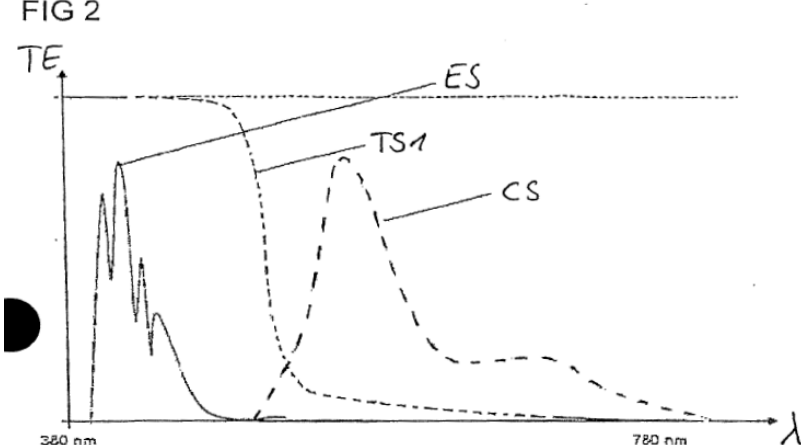
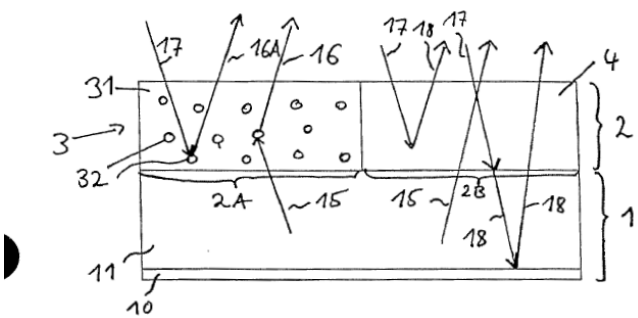


FIG 4B

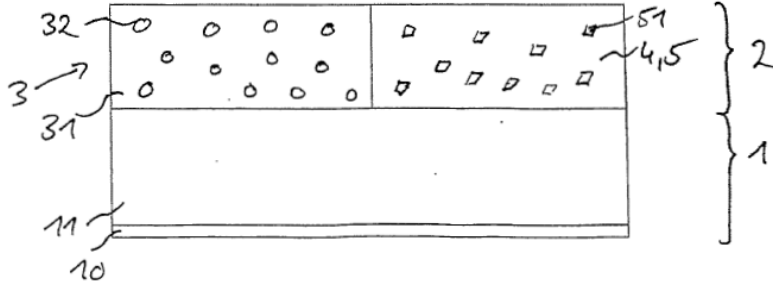
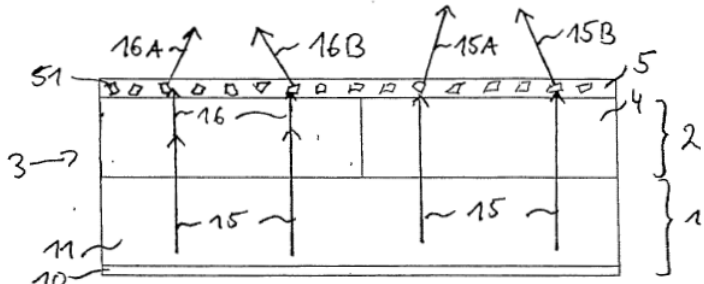


Claim Element	<u>As-filed DE102007044597 (EX2009)¹</u>
	FIG 4C  FIG 5 
[1b]-[1d]	“1. An optoelectronic device, comprising: ... a structured layer (2) disposed downstream of the organic layer sequence (1) in the beam path of the electromagnetic radiation (15) emitted by the organic layer sequence (1) and comprising first and second regions (2A, 2B); wherein the first regions (2A) each have a wavelength conversion layer (3) configured to at least partially convert electromagnetic radiation with the first wavelength spectrum into electromagnetic radiation (16) with a second wavelength spectrum; and the second regions (2B) each comprise a filter layer (4), which is at least partially opaque to electromagnetic radiation with a

Claim Element	<u>As-filed DE102007044597 (EX2009)¹</u>
	third wavelength spectrum corresponding to at least a part of the second wavelength spectrum.” <i>See also, e.g.,</i> [0004]: “An optoelectronic device according to an embodiment of the invention comprises in particular ... a structured layer disposed downstream of the organic layer sequence in the beam path of the electromagnetic radiation emitted by the organic layer sequence and comprises first and second regions. The first regions each have a wavelength conversion layer adapted to at least partially convert electromagnetic radiation with the first wavelength spectrum into electromagnetic radiation with a second wavelength spectrum. Furthermore, the second regions each comprise a filter layer that is at least partially opaque to electromagnetic radiation with a third wavelength spectrum that corresponds to at least a part of the second wavelength spectrum.” [0064], [0066]: “A structured layer comprising a first region 2A and a second region 2B is disposed in the beam path of the electromagnetic radiation 15 with the first wavelength spectrum. The first region 2A has a wavelength conversion layer 3 comprising a wavelength conversion substance 32. ... The second region 2B comprises a filter layer 4. [¶] ... [[¶]] The filter layer 4 is opaque to electromagnetic radiation with a third wavelength spectrum corresponding to at least a part of the second wavelength spectrum. In this exemplary embodiment, the electromagnetic radiation 15 with the first wavelength spectrum can pass through the filter layer 4 unhindered and essentially without changing its spectral portions. In other words, the filter layer 4 is transparent for electromagnetic radiation 15 with the first wavelength spectrum.” [0071]: “Figure 2 shows an exemplary spectral diagram with different transmission characteristics or emission characteristics as a function of a wavelength λ. An ... emission spectrum ES for example represents a spectral profile of the electromagnetic

Claim Element	<u>As-filed DE102007044597 (EX2009)¹</u>
	radiation 15 emitted by the organic layer sequence 1. The emission spectrum ES comprises a blue wavelength range. A conversion spectrum CS represents the wavelength spectrum emitted by the wavelength conversion layer 3... The conversion spectrum CS ... comprises a yellow wavelength range or a red-green wavelength range. The profile labeled TS1 indicates a transmission spectrum of the filter layer 4. Accordingly, the filter layer 4 is transmissive to ... the electromagnetic radiation 15 emitted by the organic layer sequence 1, while electromagnetic radiation with a yellow wavelength range or a red and green wavelength range is opaque.” FIG 2  See also FIG 1A 

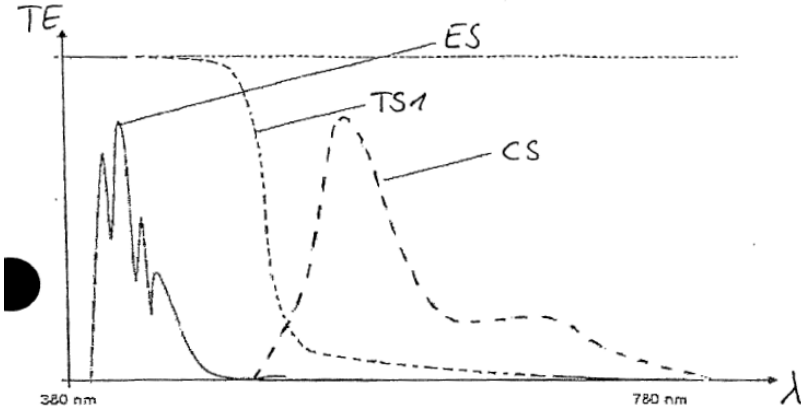
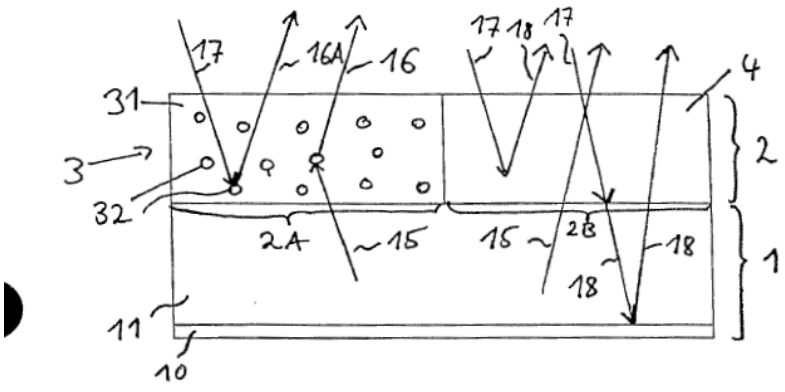
Claim Element	As-filed DE102007044597 (EX2009) ¹
	FIG 1B FIG 4A FIG 4B

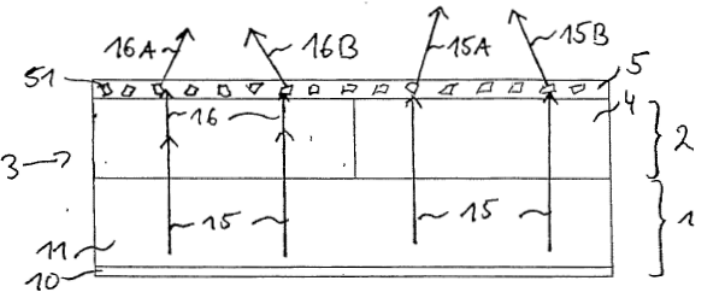
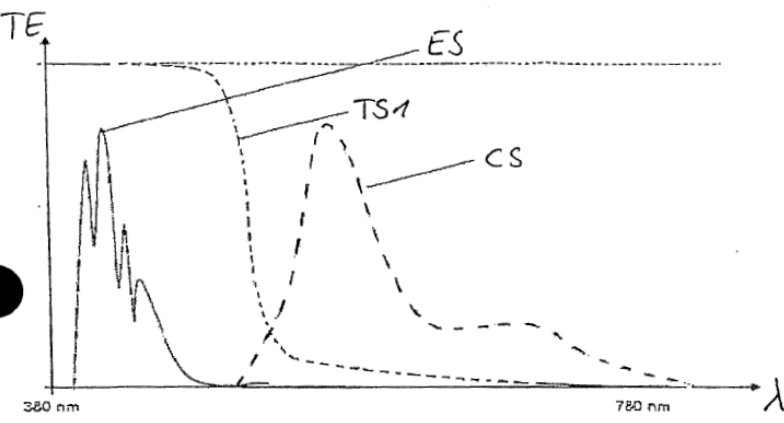
Claim Element	<u>As-filed DE102007044597 (EX2009)¹</u>
	FIG 4C  FIG 5  EX1002, 34:3-6, 1:23-27, 22:20-25, 25:25-32, Figs. 2, 1A-1B, 4A-4C, 5.
[1e]	Claim 31, “The optoelectronic device as claimed in any of Claims 1 through 30, <i>wherein the first and second regions (2A, 2B) of the structured layer (2) are disposed laterally in the beam path of the optoelectronic device.</i>” <i>See also, e.g.,</i> [0008]: “The regions of the structured layer are preferably disposed laterally or side by side in the beam path of the optoelectronic component.”

Claim Element	<u>As-filed DE102007044597 (EX2009)¹</u>
	FIG 1A FIG 1B FIG 3 FIG 4A

Claim Element	As-filed DE102007044597 (EX2009) ¹
	FIG 4B FIG 4C FIG 5

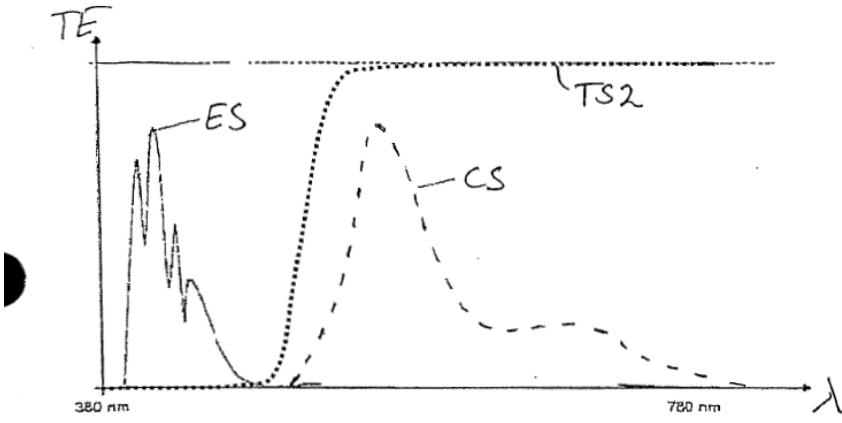
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Claim Element	As-filed DE102007044597 (EX2009) ¹
	FIG 2  See also FIG 1A 

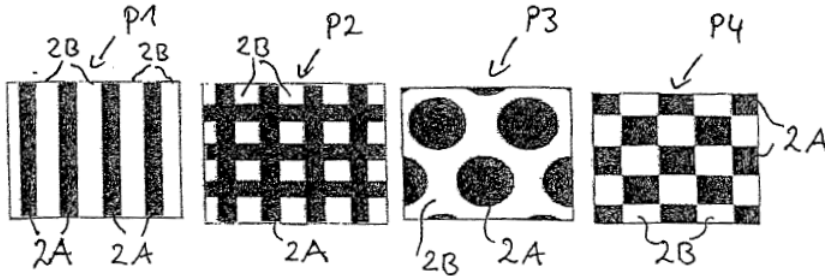
Claim Element	<u>As-filed DE102007044597 (EX2009)¹</u>
	FIG 5 
2	Claim 3 (“... wherein the first wavelength spectrum comprises a blue wavelength range and the second wavelength spectrum comprises a yellow wavelength range.”). [0071]: “... [A]n emission spectrum ES for example represents a spectral profile of the electromagnetic radiation 15 emitted by the organic layer sequence 1. The emission spectrum ES comprises a blue wavelength range. A conversion spectrum CS represents the wavelength spectrum emitted by the wavelength conversion layer 3 The conversion spectrum CS therefore comprises a yellow wavelength range” FIG 2 
3	Claim 4 (“... wherein the optoelectronic device in a switched-off state generates a non-yellowish color impression for an observer.”)

Claim Element	<u>As-filed DE102007044597 (EX2009)¹</u>
	<i>See also, e.g.</i>, [0015] (“[E]ven in the switched-off state, there is a superimposition of electromagnetic radiation with a wavelength range of the first wavelength spectrum and an electromagnetic radiation with the wavelength range of the second wavelength spectrum, thus achieving a desired, preferably non-yellowish color impression.”), [0020] (“permitting a white illumination impression”), [0070] (“non-yellow, preferably white, color impression ...”);
4.	Claim 5 (“... wherein the filter layer (4) is configured to convert the electromagnetic radiation with the third wavelength spectrum into electromagnetic radiation from a non-visible wavelength range.”). <i>See also, e.g.</i>, [0016]: “In different embodiments of the invention, the filter layer is configured to convert the electromagnetic radiation with the third wavelength spectrum into electromagnetic radiation from a non-visible wavelength range. For example, electromagnetic radiation from a yellow wavelength range is converted in the filter layer into electromagnetic radiation from an infrared wavelength range.” [0067]: “For example, spectral portions of an electromagnetic radiation 17 corresponding to the third wavelength spectrum and incident from the outside onto the optoelectronic device are converted into an electromagnetic radiation from a non-visible wavelength range”
5.	Claim 6 (“... wherein the filter layer (4) is configured to absorb the electromagnetic radiation with the third wavelength spectrum.”). <i>See also, e.g.</i>, [0018]: “The filter layer is thus for example configured to absorb the electromagnetic radiation with the third wavelength spectrum. ... The filter layer can therefore also be understood

Claim Element	<u>As-filed DE102007044597 (EX2009)¹</u>
	in different exemplary embodiments as an absorption layer for electromagnetic radiation with the third wavelength spectrum.”
8.	Claim 22 (“... wherein the first regions (2A) each have a second filter layer (7) disposed downstream of the wavelength conversion layer (3) in the beam path of the electromagnetic radiation (15) emitted by the organic layer sequence (1) and which is at least partially opaque to electromagnetic radiation with a fourth wavelength spectrum corresponding to at least a part of the first wavelength spectrum.”). <i>See also, e.g.,</i> [0046]: “In a further exemplary embodiment of the invention, the first regions each comprise a second filter layer disposed downstream of the first wavelength conversion layer in the second regions in the beam path of the electromagnetic radiation emitted by the organic layer sequence. The second filter layer is at least partially opaque to electromagnetic radiation with a fourth wavelength spectrum that corresponds to at least a part of the first wavelength spectrum. ...” [0084]: “In a further exemplary embodiment in Figure 7, a second filter layer of the first wavelength conversion layer 3 is disposed downstream in the beam path of the electromagnetic radiation 15 emitted by the organic layer sequence. The second filter layer 7 is opaque to electromagnetic radiation with a fourth wavelength spectrum that corresponds to at least a part of the first wavelength spectrum.” [0087]: “Figure 8 shows a further exemplary spectral diagram with transmission or emission spectra. ... A transmission spectrum TS2 represents the exemplary spectral profile of the second filter layer 7. The second filter layer is therefore opaque to electromagnetic radiation with the emission spectrum of the organic layer sequence....”)

Claim Element	<u>As-filed DE102007044597 (EX2009)¹</u>
	FIG 8 
9.	Claim 23 (“... wherein the second filter layer (7) is configured to at least partially absorb the electromagnetic radiation with the fourth wavelength spectrum.”). <i>See also, e.g.,</i> [0047]: “In different embodiments, the second filter layer can be configured to at least partially absorb the electromagnetic radiation with the fourth spectrum.” [0085]: “Alternatively or additionally, the second filter layer 7 can also absorb the electromagnetic radiation with the fourth spectrum. For example, the second filter layer 7 has a spectral characteristic complementary to the first filter layer 4.”
10.	Claim 24 (“...wherein the second filter layer (7) is configured to at least partially reflect the electromagnetic radiation with the fourth wavelength spectrum.”). <i>See also, e.g.,</i> [0047]: “Alternatively or additionally, the second filter layer can also be configured to at least partially reflect the electromagnetic radiation with the fourth spectrum.”

Claim Element	<u>As-filed DE102007044597 (EX2009)¹</u>
	[0085]: “The second filter layer 7 can, for example, reflect the electromagnetic radiation with the fourth spectrum.”
11-12	Claim 27 (“... comprising an encapsulation disposed upstream or downstream of the structured layer (2) in the beam path of the electromagnetic radiation (15) emitted by the organic layer sequence (1).”). Claim 28 (“... wherein the encapsulation is configured as a thin-film encapsulation.”). <i>See also, e.g.,</i> [0048]: “For different exemplary embodiments of the invention in which the organic layer sequence is configured as a top emitter structure, the optoelectronic device can have an encapsulation disposed upstream or downstream of the structured layer in the beam path of the electromagnetic radiation emitted by the organic layer sequence. In other words, the structured layer can be encapsulated together with the organic layer sequence or can alternatively lie outside an encapsulation of the organic layer sequence. The encapsulation can be configured as a thin-film encapsulation.”
13.	Claim 29 (“... wherein the electromagnetic radiation emitted by the optoelectronic device and perceived by an observer corresponds to overlay superimposition of the electromagnetic radiation (15) with the first wavelength spectrum and the electromagnetic radiation (16) with the second wavelength spectrum.”). <i>See also, e.g.,</i> [0005]: “In particular, an observer can in this case detect the electromagnetic radiation emitted when the optoelectronic component is in operation. This can substantially correspond to a superimposition of the electromagnetic radiation with the first wavelength spectrum emitted by the second regions, and to the

Claim Element	<u>As-filed DE102007044597 (EX2009)¹</u>
	electromagnetic radiation with the second wavelength spectrum emitted by the wavelength conversion layer of the first regions. [0006]: “In the overall impression of the electromagnetic radiation emitted by the optoelectronic device, the first and second wavelength spectrums are therefore superimposed.” [0015]: “Thus, even in the switched-off state, there is a superimposition of electromagnetic radiation with a wavelength range of the first wavelength spectrum and an electromagnetic radiation with the wavelength range of the second wavelength spectrum, thus achieving a desired, preferably non-yellowish color impression.”
14.	Claim 30 (“... wherein the structured layer (2) comprises striped or crossed striped or circular or triangular or rectangular regions, or a combination of the said regions.”) <i>See also, e.g.,</i> 0008]: “In different embodiments of the invention, the structure of the structured layer can comprise striped, crossed striped, ... circular, triangular or rectangular, ...or regions of any geometry as a combination of the above-mentioned geometric forms.” [0072] (description of Fig. 3). FIG 3 

The chart above also demonstrates how the German application support the pending German claims given the correspondence between the issued claims and the German claims.

Because the claims are fully supported by DE102007044597, the effective filing date of the '547 patent is no later than 9/19/2007 when DE102007044597 was filed. As Petitioner admits, however, Igarashi was not published until 2/1/2007 (Pet. 3), less than a year before 9/19/2007. As such Igarashi does not qualify as prior art under pre-AIA 35 U.S.C. §102(b).

B. 102(e) Art Is Not a Proper Basis for IPRs

Although Igarashi is pre-AIA 102(e)(1) art, such art is not a proper basis for IPRs because a ground of challenge in an IPR proceeding must be “only on the basis of prior art consisting of patents or printed publications.” 35 U.S.C. §311(b). But Igarashi is not a patent, and it did not become a printed publication until it was “published, *i.e.*, accessible to the public.” *Samsung Elecs. Co. v. Infobridge Pte. Ltd.*, 929 F.3d 1363, 1368, 1370 (Fed. Cir. 2019). As such, the only basis for Igarashi to qualify as proper art in an IPR proceeding is under pre-AIA 35 U.S.C. §102(a). Igarashi did not become 102(a) art until February 1, 2007 when it was published. Hence, *for the purpose of this IPR proceeding under 35 U.S.C. §311(b), the critical date for Igarashi is 2/1/2007, and not its US filing date of 7/27/2006.* Nevertheless, the analysis below covers the period starting 7/27/2006.

Furthermore, even under pre-AIA 35 U.S.C. §102(e), Igarashi cannot benefit from its foreign filing date because that provision only applies to applications filed in the US or PCT applications meeting certain requirements. *See In re Hilmer*, 359 F.2d 859, 862 (CCPA 1966).

C. Igarashi Does Not Qualify Under 102(a) (or 102(e)) Because the Inventors Conceived the Claimed Invention and Exercised Reasonably Continuous Diligence Before the Critical Date

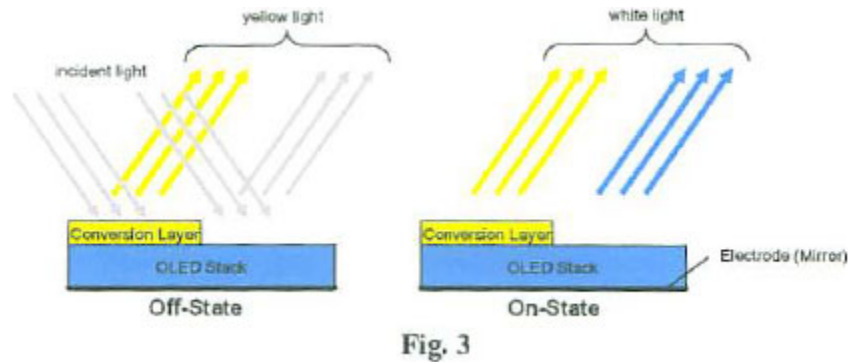
As of at least May 22, 2006, the inventors had conceived the inventions embodied in at least claims 1-7 and 11-14. *See* pp. __ below. The inventors further conceived the additional features of claims 8-10 by at least August 11, 2006. *See* pp. __ below. The inventors exercised reasonable diligence from a time before Igarashi's critical date to when the inventions were constructively reduced to practice on 9/19/2007 with the filing of the German priority application that fully supports the issued claims (*see* III.A chart). *See* Section III.C.2 below.

1. The Invention Disclosures Demonstrate that the Inventions Were Conceived Before Igarashi's Critical Date

On May 22, 2006, the inventors submitted their invention disclosure to their supervisor and the same disclosure was forwarded to EHF on May 31, 2006.² EX2004-p.2; EX2001, ¶8; EX2003, cover. The inventors described a perceived problem in “down-conversion light sources,” namely, “in the off-state of the

² Samsung had access to this document before the filing of this IPR.

lighting device the incident light of the short wavelength also is being converted by the phosphor layer leading to a shortage of blue in the emitted spectrum, i.e., the device typically looks annoyingly yellowish in the off-state.” EX2003-p.8; *see* illustration below:

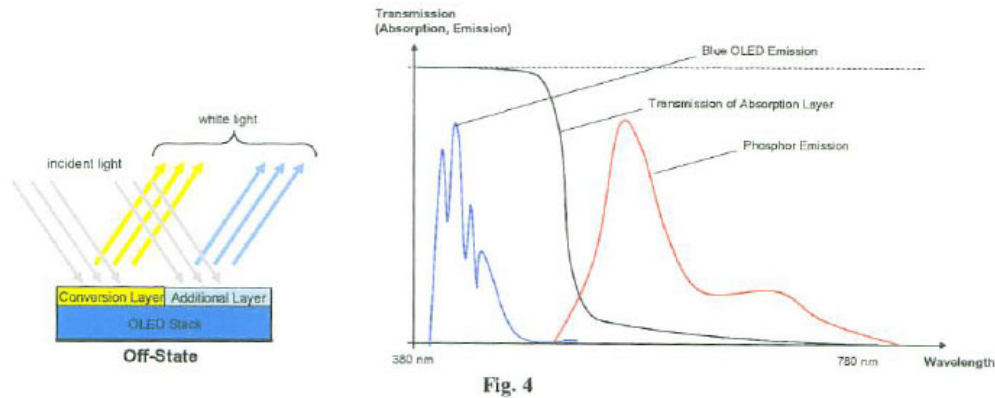


(EX2003, Fig. 3)

Specifically, “[i]n the off-state of the device[,] the conversion layer typically absorbs the blue fraction from the ambient light and converts it into red-shifted light.” EX2003-p.9. In contrast, the light reflected off the area that has no conversion layer, has “hardly any red-shift[.]” *Id.* Superimposing the laterally spaced “reddish and white light reflection,” one “gets a yellowish appearance of the device” *Id.*

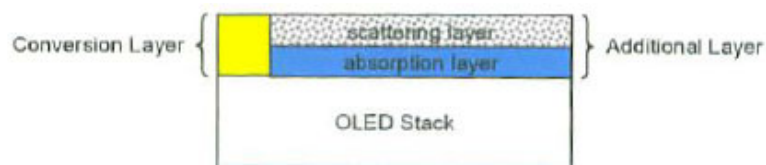
To address this, the inventors proposed to provide an additional layer that is placed laterally to the conversion layer, such as one that “absorbs incident long wavelength light whereas it is transparent in the blue [light of first wavelength]” so that “[i]n the on-state, the layer ... does not absorb the emitted light, whereas in the

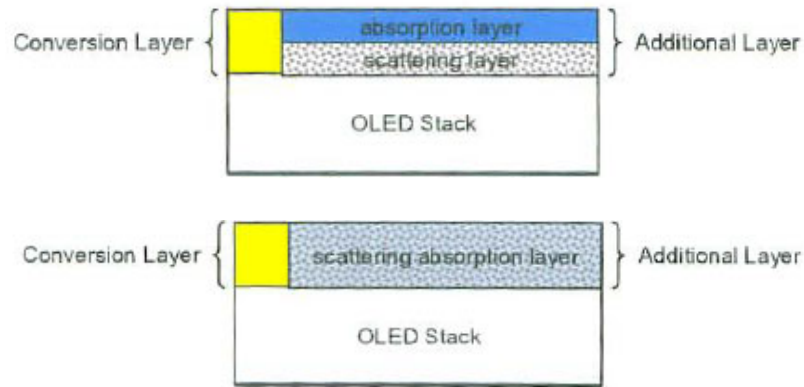
off-state it makes the reflected incident white light look blue-ish,” as illustrated below. *Id.*



“The superimposition of the reddish reflected light from the conversional areas together with the blue-ish reflected light forms again white light.” *Id.* In fact, “[t]he color coordinates of the appearance of the device can now be tuned to match the criteria of the customer (white or color) by adapting the absorption spectrum of the additional layer.” *Id.*

The inventors further explained that “scattering can be included in the additional layer to more isotropically emit the reflected light.” *Id.* They provided several examples of the arrangement where the scattering layer may be above, below or co-located as the absorption layer:





(EX2003-pp. 9-10)

They also explained that scattering could be achieved by, *e.g.*, “a surface modification” such as “roughening.” EX2003-p.9. This proposal corresponds to Figure 5 of the ‘547 patent which illustrates a scattering layer 5 above the conversion layer 3 and filter (additional) layer 4 in the beam path. *See* EX1001, Fig. 5, 12:39-42, 12:56-61.

The inventors further proposed a second conversion layer for converting light of a lower wavelength than that of a first wavelength (*e.g.*, UV) to light of the first wavelength (*e.g.*, blue). *Id.*, 10. This corresponds to claims 6-7 of the ‘547 patent. *cf.* EX1001, Fig. 6, claims 6-7, 12:62-13:15.

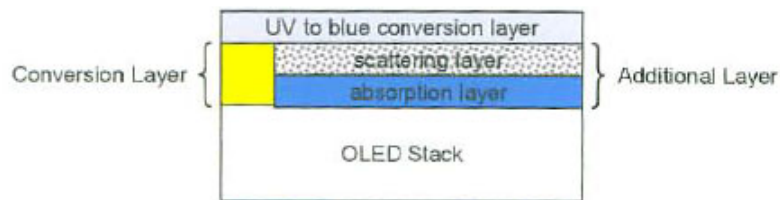
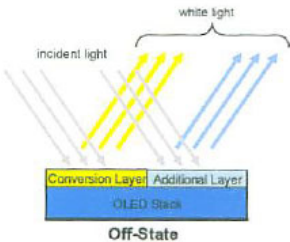
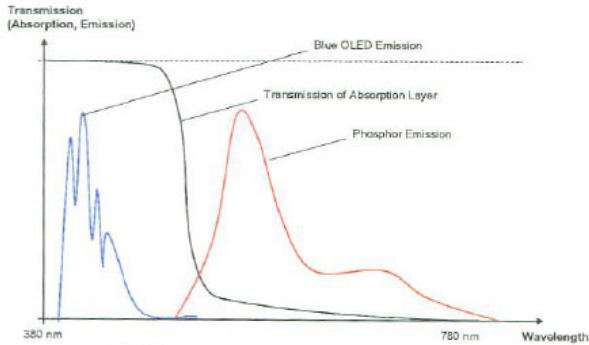


Fig. 6

The chart below maps exemplary portions of the invention disclosure to challenged claims 1-5 and 11-14³:

Claim	Exemplary disclosures
1[pre]	Abstract: “In this disclosure a new type of structure for OLED-lighting devices is proposed.”
1[a]	<i>E.g.</i>, Figs. 1, 3B, 4-6 and associated text, showing an organic layer sequence (<i>e.g.</i>, the OLED stack that provides “Blue OLED Emission” during operation) which emits an electromagnetic radiation having a first wavelength spectrum (<i>e.g.</i>, wavelength corresponding to the blue OLED Emission, as represented by the blue curve in Fig. 4) during operation (on-state).   Fig. 4

³ Claims 6-7 are not challenged, but is supported by Fig. 6 and associated text of EX2003.

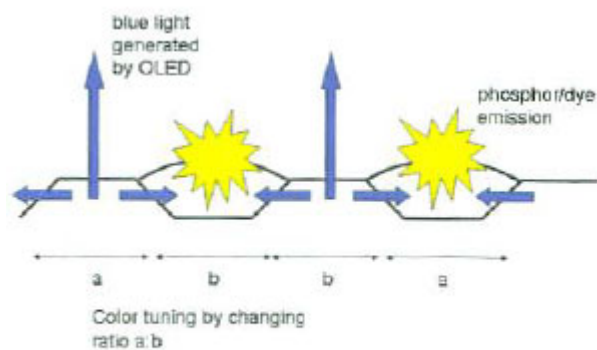


FIG. 1

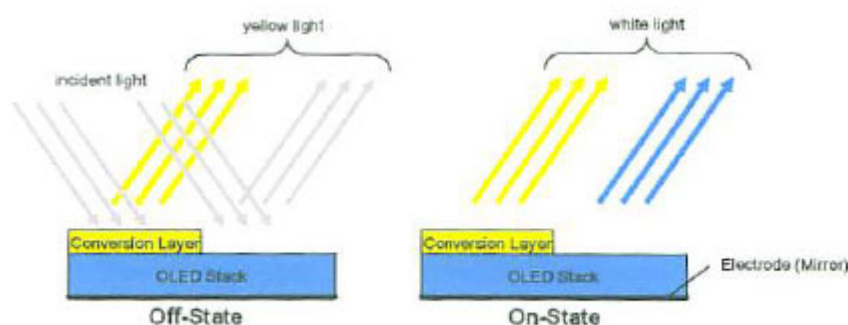


Fig. 3

See also Figs. 5-6.

1[b]

E.g., Figs. 4-6 and associated text, showing a structured layer (*e.g.*, the layer comprising the conversion layer and the additional layer) disposed downstream of the organic layer sequence (*e.g.*, the OLED stack) in a beam path of the electromagnetic radiation emitted by the organic layer sequence (*e.g.*, in the layer above the OLED stack for *e.g.*, a top-emitter configuration) and including first and second regions (conversion layer and additional layer).

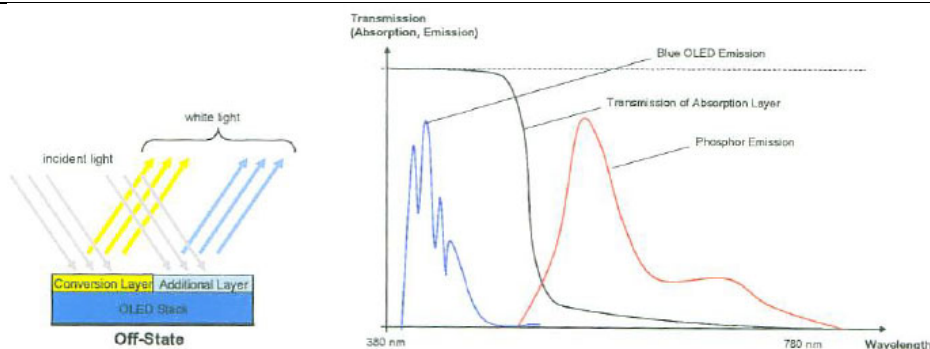


Fig. 4

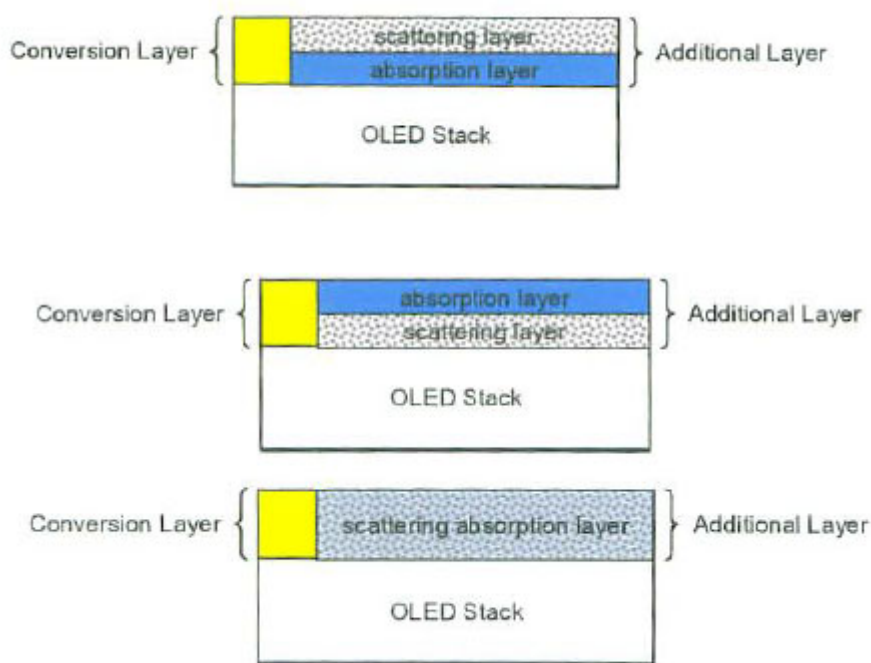


Fig. 5

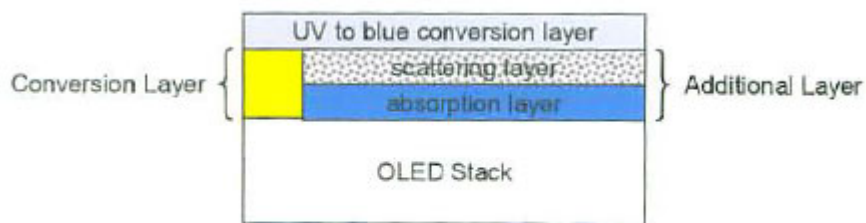
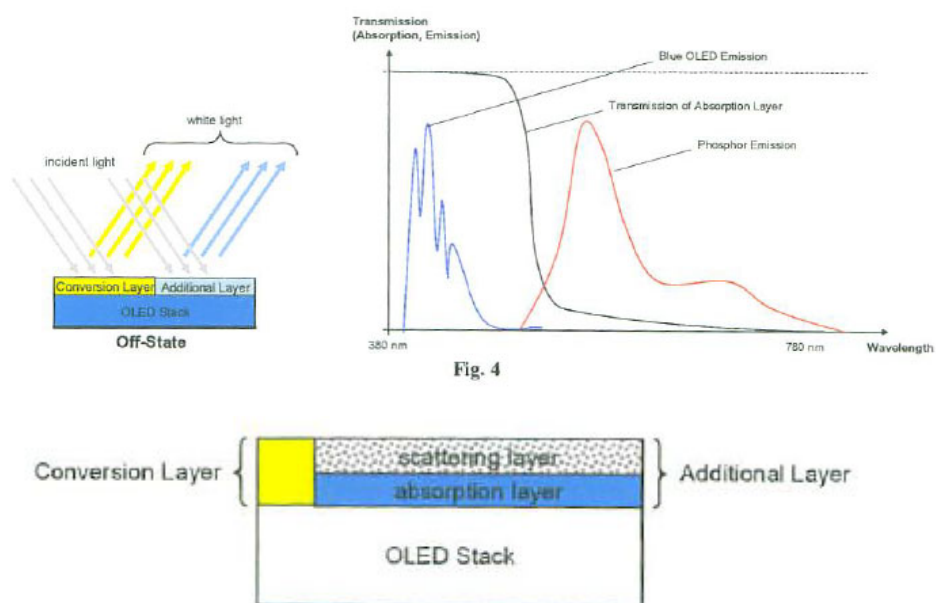


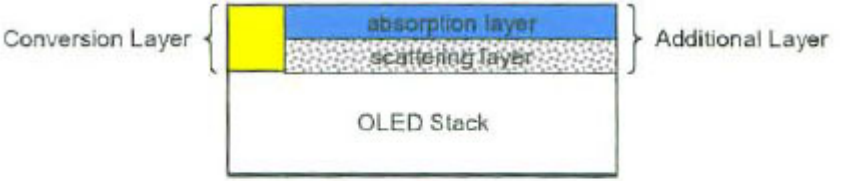
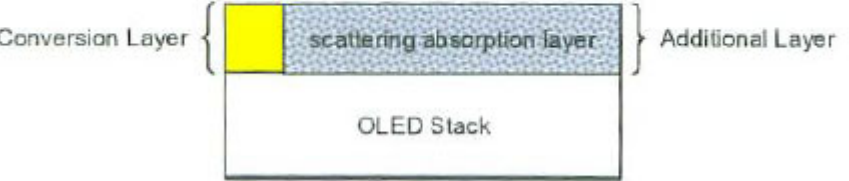
Fig. 6

p.10 (“The here proposed structures can be applied to both, bottom and top emitting OLEDs”).

1[c]

E.g., Figs. 4-6 and associated text, showing that the first regions each include a wavelength conversion layer regions (*e.g.*, the “Conversion Layer” region) configured to convert at least partially electromagnetic radiation having a first wavelength spectrum (*e.g.*, blue curve for “Blue OLED Emission”) into an electromagnetic radiation having a second wavelength spectrum (*e.g.*, red-shifted to wavelengths corresponding to the “Phosphor Emission” shown in the red curve of Fig. 4).



	 Fig. 5  Fig. 6 p.8: “Preferably, in areas where a conversion layer is applied, the original OLED emission is completely converted by the phosphor making the device less sensitive to uniformity variations in the conversion layer.”
1[d]	<i>E.g., Figs. 4-6 and associated text, showing that the second regions each include a filter layer (e.g., the additional layer that includes an adsorption and/or scattering layer) which is at least partially opaque to an electromagnetic radiation having a third wavelength spectrum which corresponds to at least one part of the second wavelength spectrum. For example, as shown by the transmission spectrum of the adsorption layer (the black curve in Fig. 4 below), the absorption layer and hence the filter is opaque to at least a portion of the red “Phosphor Emission”</i>

spectrum, such as the radiation at wavelengths above the dashed red line).

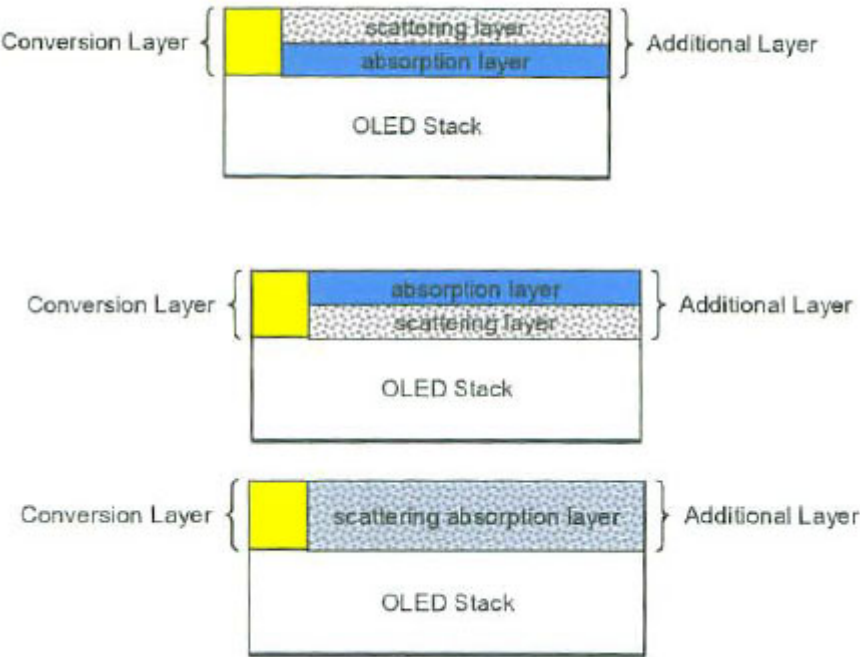
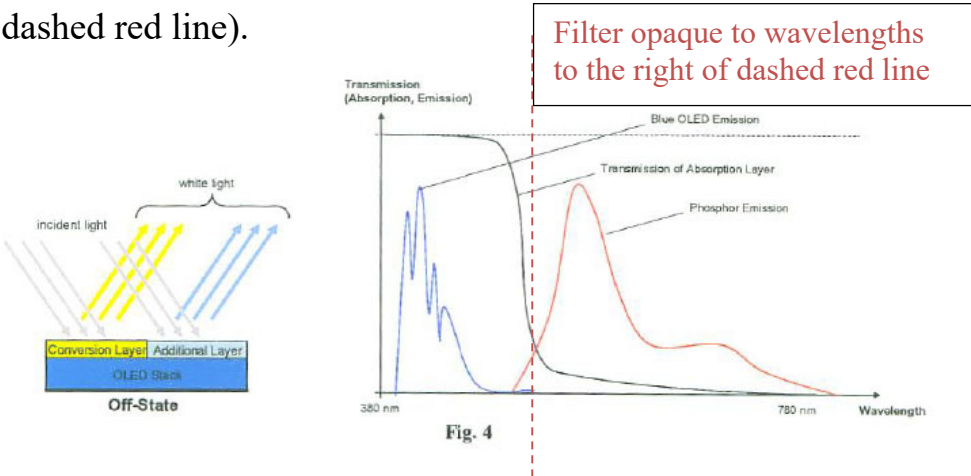


Fig. 5

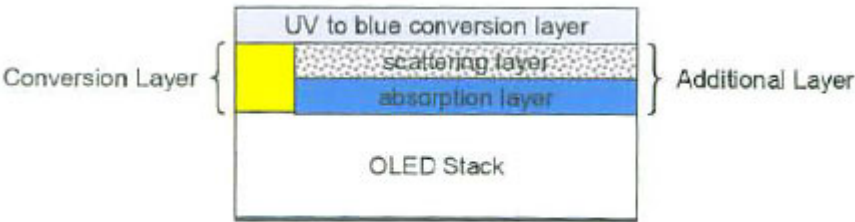


Fig. 6

1[e]

E.g., Figs. 1-2, 4-6 and associated text, showing that the first and second regions of the structured layer (*e.g.*, conversion layer region and additional layer region) are arranged laterally in a beam path of the optoelectronic device (*e.g.*, in the blue OLED emission path of the OLED device). As shown by the various figures, the conversion layer and the additional layer are arranged side by side and in the blue light's beam path.

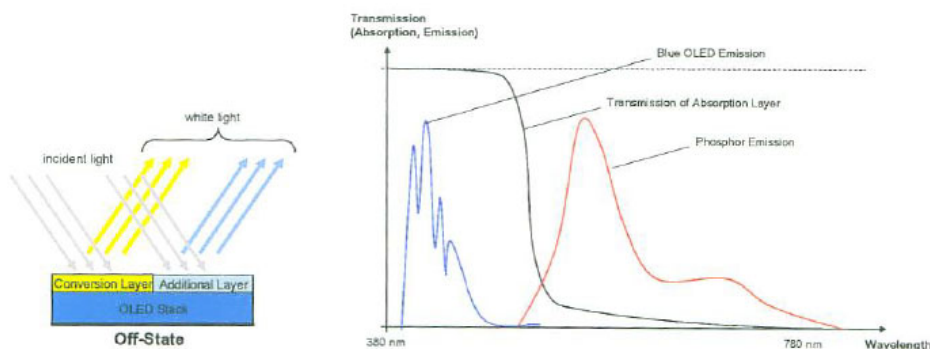


Fig. 4

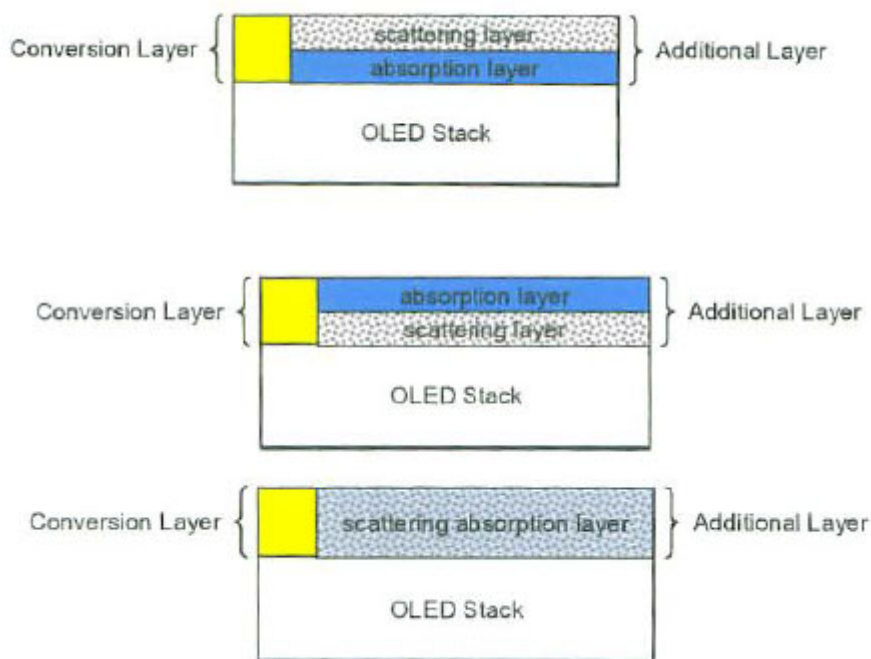


Fig. 5

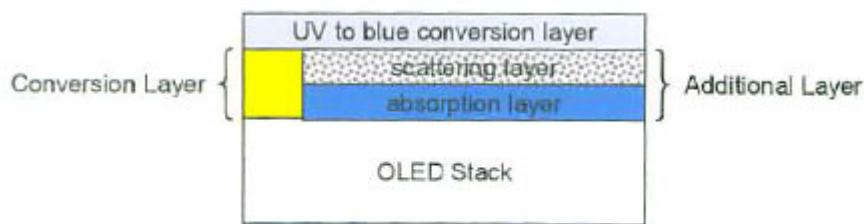


Fig. 6



Fig. 2

p.10 (“laterally structured conversion/absorption layer”)

p.8: “Fig. 1 shows a typical setup of a conversion OLED where the emission spectrum of the device is tuned by laterally structuring the lighting tile into areas in which OLED light simply is passing towards the spectator (a) and areas where it is being converted by a color conversion (e.g. phosphor) layer (b).” [[NB: in the inventions, an additional layer is added to the areas (a).]]

s

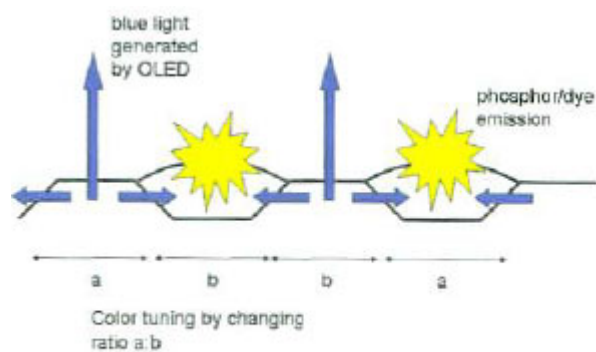
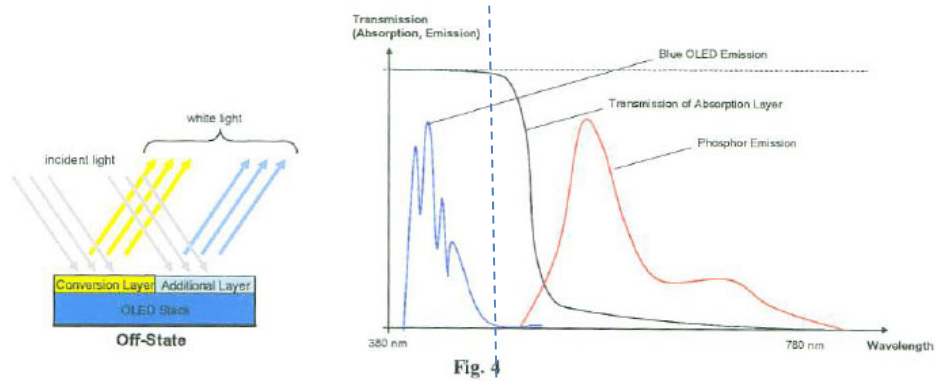


FIG. 1

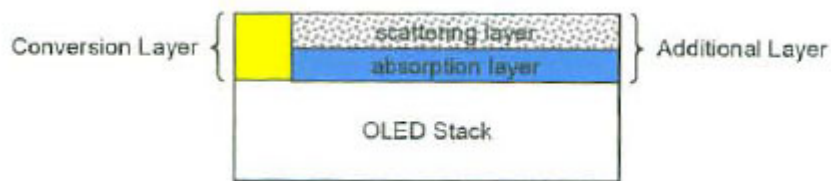
1[f]

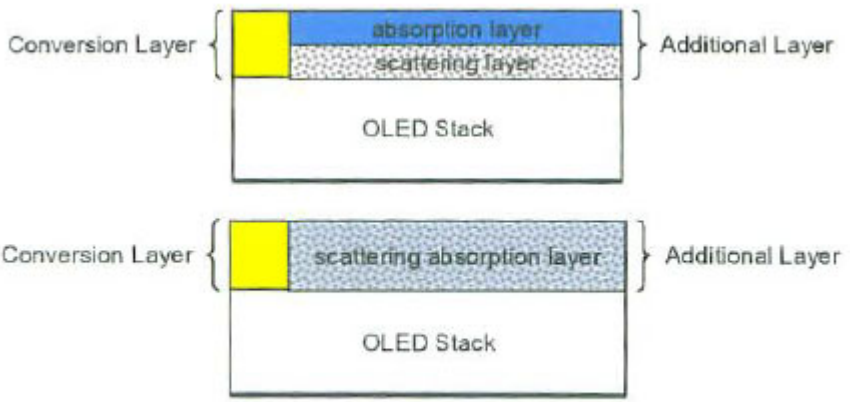
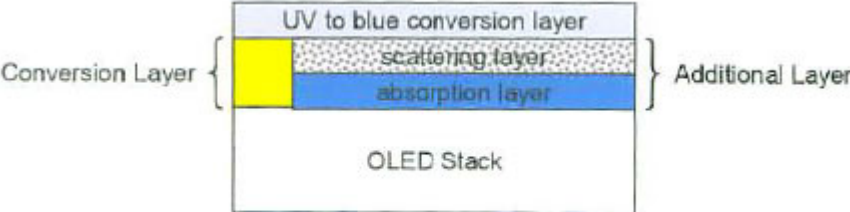
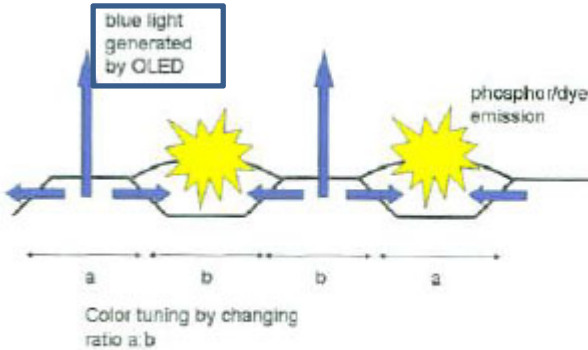
E.g., Figures 3, 4-6 and the associated text, showing that the filter layer (e.g., the additional layer) is transparent to the electromagnetic radiation having the first wavelength (e.g., transparent to the blue OLED emission).

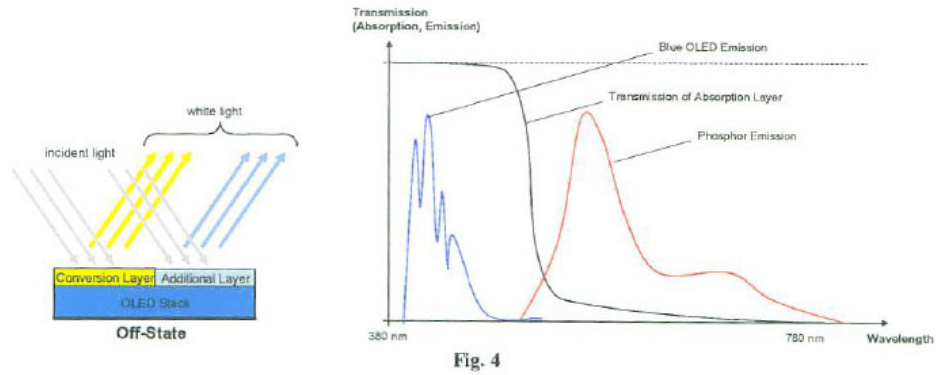


For example, as shown in Fig. 4, Blue OLED Emission falls within the high transmission region of the adsorption layer (compare blue curve and black curve).

See also p.9: ***“The additional layer absorbs incident long wavelength light whereas it is transparent in the blue.*** In the on-state, the layer therefore does not absorb the emitted light, whereas in the off-state it makes the reflected incident white light look blue-ish.”



	 Fig. 5  Fig. 6
2	The disclosure teaches that first wavelength spectrum (blue curve in Figure 4) comprises a blue wavelength range and the second wavelength spectrum (red curve) comprises a yellow wavelength range.  FIG. 1

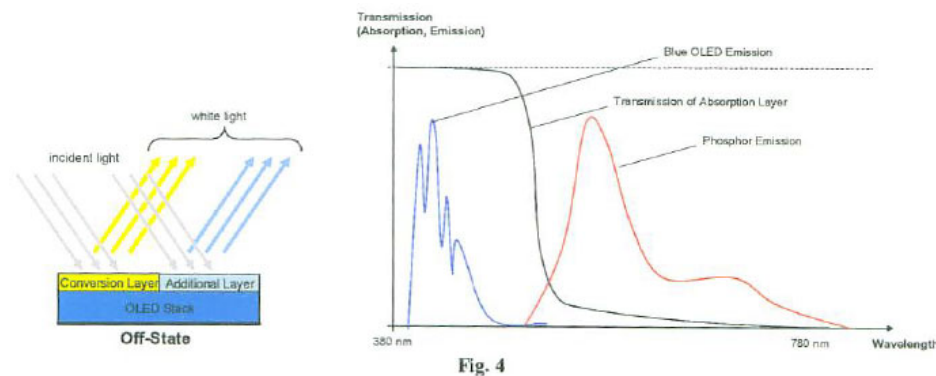


(the reflection of yellow light indicates that the output of the conversion layer comprises yellow light).

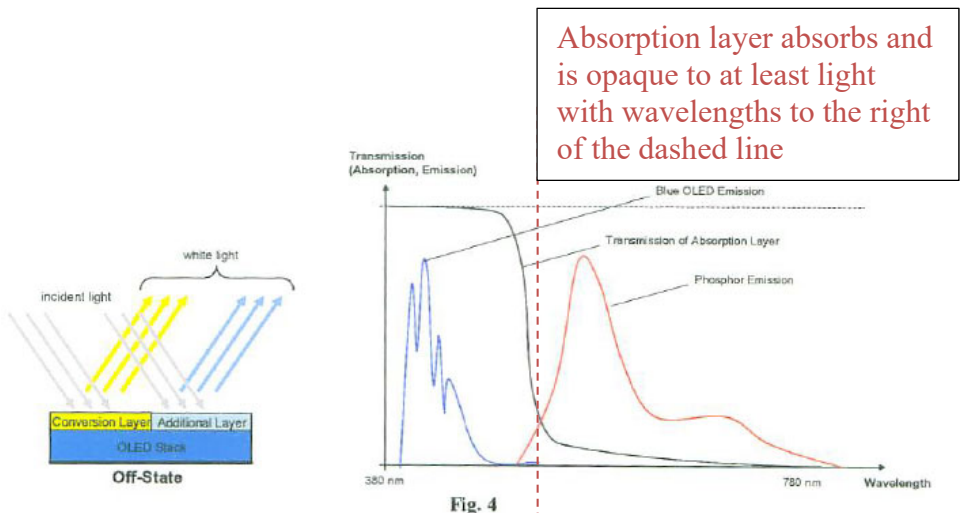
See also p.9: *“The additional layer absorbs incident long wavelength light whereas it is transparent in the blue. In the on-state, the layer therefore does not absorb the emitted light, ...,”* which implies that the emitted light in the on-state is blue (the color that that additional layer does not absorb).

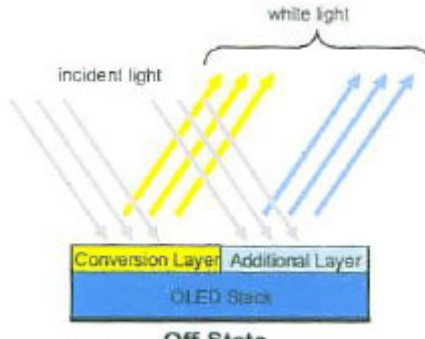
3

The disclosed optoelectronic device has a non-yellow color impression as illustrated in Fig. 4, showing a white overall impression.



p.9: *“The additional layer absorbs incident long wavelength light where it is transparent in the blue. ... The superposition of*

	the reddish reflected light from the conversion areas together with the blue-ish reflected light forms again white light.”
4.	Under Petitioner’s own theory that “absorbed light is converted into electromagnetic radiation from a non-visible wavelength range (i.e., heat or thermal/infrared radiation,” (Pet. 31-32), the disclosure’s description of light absorption layers that “absorbs incident long wavelength light” (EX2003-p.9) discloses this limitation.
5.	As shown in Figure 4, the absorption layer absorbs electromagnetic radiation having the third wavelength (that is, the wavelength range blocked by the filter):  Fig. 4
11	p.10: “The encapsulation layer or layers can be applied between OLED device and laterally structured conversion/absorption layer [i.e., upstream of the structured layer in the OLED light beam path] or on the outside surface of OLED conversion/absorption layer device [i.e., downstream of the structured layer in the OLED light beam path].”

12	p.10: “In the case of top emitter structures, the proposed concept can also be combined with any kind of <i>thin film encapsulation of the OLED device.</i> ”
13	See Fig. 4 illustrating that the emitted light is a superimposition of the light in the first wavelength spectrum (e.g., blue) and the light in the second wavelength spectrum (e.g., yellow): 
14	Fig. 2 discloses the claimed pattern, as a POSITA would understand that the dark areas are the “conversion areas” and the “additional layer” will be patterned in the white areas in the novel structures:  Fig. 2

Claims 8-10 find support in the supplemental disclosure sent on August 11, 2006, in which the inventors disclosed that “[o]n top of the conversion layer an additional layer is arranged that absorbs incident short wavelength (blue) light.” EX2007.

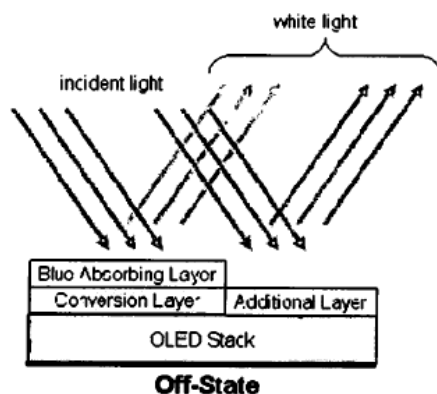
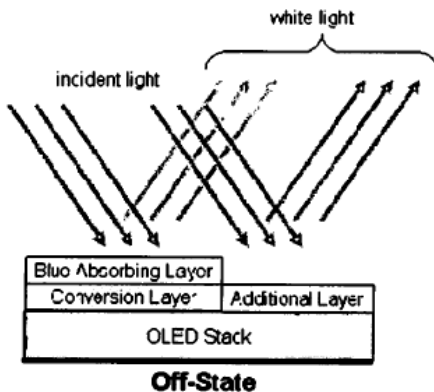
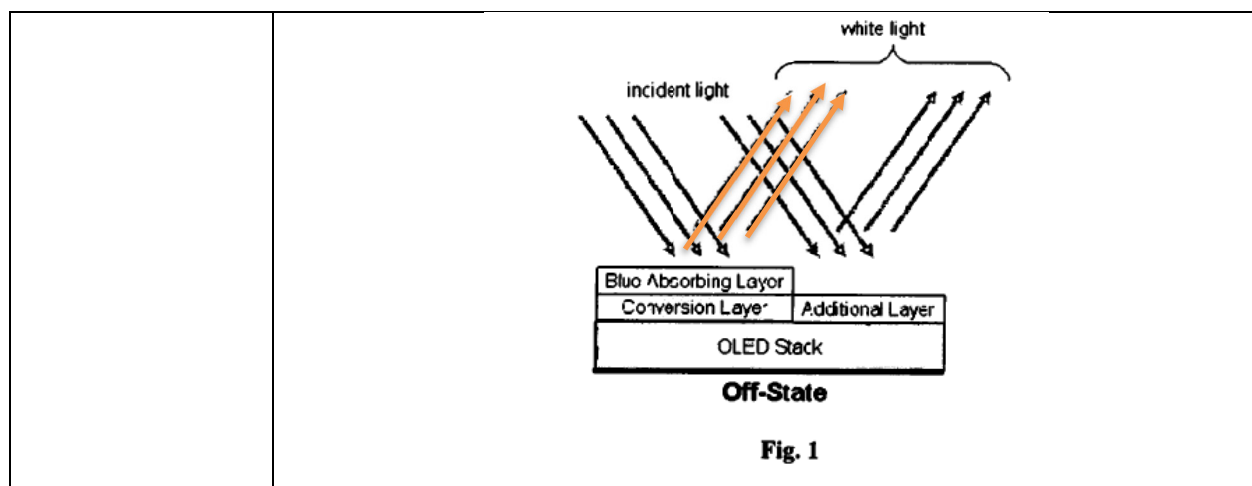


Fig. 1

The chart below maps exemplary portions of this supplemental disclosure to challenged claims 8-10.

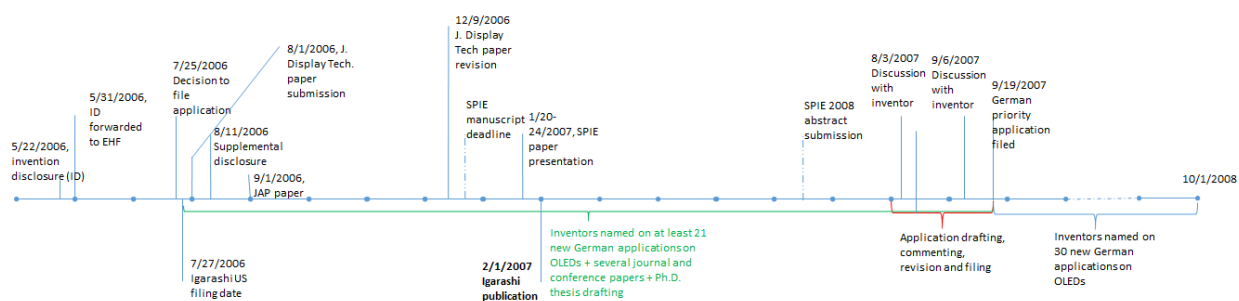
Claim	Exemplary disclosures (EX2007)
8	The supplemental disclosure discloses that the first regions each have a second filter layer disposed downstream of the electromagnetic radiation emitted by the organic layer sequence (<i>e.g.</i>, the “Blue Absorbing Layer” above the “Conversion Layer” that is downstream of the light emitted by the OLED stack).  The diagram illustrates an OLED stack in an off-state. The stack is composed of four layers: an OLED Stack at the bottom, followed by a Conversion Layer, a Blue Absorbing Layer, and an Additional Layer on top. Incident light enters from the left, and white light is emitted from the right. The diagram shows the light path through the layers, with the Blue Absorbing Layer and Conversion Layer positioned above the OLED Stack. Fig. 1 The second filter layer is also “at least partially opaque to an

	electromagnetic radiation having a fourth wavelength spectrum which corresponds to at least one part of the first wavelength spectrum.” For example, the blue absorbing layer is “arranged that absorbs incident short wavelength (blue) light,” (EX2007), meaning the blue absorbing layer is opaque to at least partially the blue light portion of the incident light, which corresponds to at least one part of the first wavelength spectrum (<i>e.g.</i> , one part of the blue light wavelength spectrum emitted by the OLED stack).
9	As explained above, the blue absorbing layer (the second filter layer) is configured to “ <u>absorb</u> [] incident short wavelength (blue) light,” (EX2007), therefore disclosing a second filter layer configured to at least partially <u>absorb</u> electromagnetic radiation having the fourth wavelength (<i>e.g.</i> , the blue light portion of the incident light).
10	EX2007 also discloses that the second filter layer (blue absorbing layer) is configured to at least partially reflect the electromagnetic radiation having the fourth wavelength spectrum, that is, the blue absorbing layer reflects the unabsorbed wavelength spectrum of the incident light, as depicted by the orange arrows below:



2. There Was Reasonably Continuous Diligence

There are two independent bases for reasonable diligence, both of which are based on objective evidence for which Samsung has not offered any evidence to the contrary. First, the inventors were engaged in continuous development efforts on the project that resulted in the patented inventions throughout the critical periods. Second, the objective evidence shows that the patent attorneys were diligent in the preparation of the application that led to the patent.



(a) Objective Evidence Shows That the Inventors Exercised Reasonably Continuous Diligence During the Critical Period.

Between a time before Igarashi's July 27, 2006 filing date and the inventor's constructive reduction to practice on September 19, 2007 (DE102007044597's filing date), the inventors exercised reasonably continuous diligence by working on improving the optoelectronic devices that are the subject of the invention disclosures. For instance, on August 11, 2006, the inventors submitted an update to their invention disclosures, proposing another arrangement whose features are incorporated into issued claims 8-10. EX2001, ¶¶12-13; EX2007; chart on pp. 44-46.

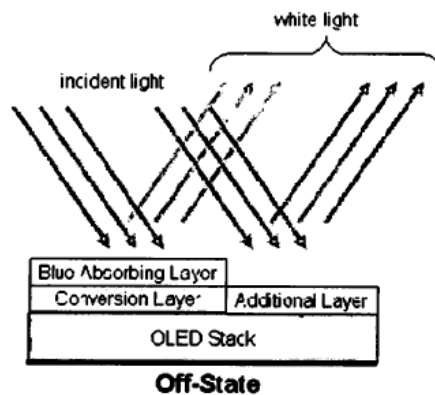


Fig. 1

The inventors' reasonably continuous diligence on the subject matter of the '547 patent (*e.g.*, an OLED device with down-conversion layers) is also evidenced by the patent applications they filed and the peer-reviewed papers they submitted in the critical period. For instance, on "August 1, 2006," Inventor Krummacher

submitted a paper co-authored with other OSRAM engineers to Journal of Display Technology, titled “Light Extraction from Solution-Based Processable Electrophosphorescent Organic Light-Emitting Diodes.” EX2013, 200. The paper was “revised [on] December 9, 2006” and published in “JUNE 2007.” *Id.*, 200. The paper discussed a blue OLED having “efficient down-conversion from blue to white light[.]” *Id.*, abstract. On September 1, 2006, Dr. Krummacher published a paper with others on “General method to evaluate substrate surface modification techniques for light extraction enhancement of organic light emitting diodes” in Journal of Applied Physics. EX2014, cover. Dr. Krummacher was also working towards his Ph.D. during the time, and submitted his thesis in November 2007 on “Organic White Light-Emitting Diodes based on Luminescence Down-Conversion.” EX2015-pp.i–ii.

Drs. Klein and Krummacher were co-authors on an invited paper for Jan. 2007’s SPIE conference, noting the challenges associated with down-converting blue light emitted by an organic material and for commercialization. EX2045, 64860E-3, 64860E-9. At the Jan. 2008 SPIE conference, the inventors reported their experimental and modeling work on phosphor-based down-conversion of blue OLEDs. EX2046, Abstract. For a SPIE conference, abstracts may be due eight months before the meeting, and accepted papers may be due one month before the meeting. *E.g.*, EX2047 (for an 8/26/2007 meeting, abstracts due on 12/12/2007

deadline and manuscripts due on 7/30/2007). The 2007 and 2008 SPIE papers would therefore reflect the inventors' work from May 2006 to December 2007.

As another example, the inventors filed nearly two dozen German patent applications on OLEDs and optoelectronic devices between 7/27/2006 and 9/20/2007. EX2001, ¶16; EX2012, 1-2. They filed at least 30 additional German application with US counterparts on OLEDs and optoelectronic devices between 9/21/2007 and 10/1/2008, indicative of continued work during the critical period given the lead time to filing. *See* EX2012, 3-5.

For instance, the inventors examined how to improve color impressions of OLED devices with down-conversion layers (elements 1[a], 1[c]) in order to make a commercially acceptable product. *See* EX2016, Abstract, [0001], [0004] (priority 9/29/2006 and 11/2/2006, invention examines the use of a light-scattering translucent layer downstream of the down-conversion layer to mitigate the yellow impression); EX2017 [US7982387], 1:5-8 & Abstract (priority 6/8/2007 and 7/11/2007, describing OLEDs with down-conversion layers).

The inventors also explored how to best combine the light-emission organic layer sequence layer with the color conversion layer, which is necessary for the '547 inventions (*e.g.*, 1[a], 1[c]). *See* EX2018, Abstract (filed 5/11/2007; describing an adjustable transparent element (2) arranged between an OLED layer (1) and a light conversion unit (3)); EX2031, Abstract, [0001] (priority 9/20/2007

and 10/31/2007, describing optoelectronic components with a radiation component and an encapsulation arrangement having a barrier layer and a wavelength conversion layer); EX2032, Abstract, 1:8-12 (priority 9/20/2007 and 11/8/2007, describing methods of arranging wavelength conversion layer over the light-emitting element); EX2037, Abstract, 1:9-12 (priority 9/27/2007 and 11/7/2007, describing materials and methods for forming conversion layer); .

The inventors also continued to work on improving OLED emissions, a required component for element 1[a]. *See* EX2033, Abstract 1:7-11 (priority 2/16/2007, describing an OLED with “a layer that generates light by recombination of charger carriers” with electrodes having “a highly conductive organic sublayer”); EX2034, Abstract, [0001] (priority 3/30/2007, describing an improved OLED with a charger carrier transport layer having a charge carrier transport material and a salt); EX2035, Abstract, 1:6-9, 6:38-42 (priority 4/18/2007 and 5/24/2007, describing improvement for “an organic optoelectronic component ... particularly suitable for being formed as a large-area, white-colored illumination device”); EX2019, Espacenet cover (8/31/2007 priority, OLED having electrodes with structured surfaces); EX2036, cls. 1-2, 1:9-12, 1:21-2:9 (priority 9/25/2007 and 12/3/2007, an improved OLED device with *e.g.*, a doped charge transport layer between two emission layers); EX2039, 1:7-16, Abstract (four priority filings between 1/30/2008 and 9/23/2008, improved barrier layers for

improved OLEDs); EX2038-EX2044 (applications co-invented by Dr. Klein on various new OLED structures, claiming priority to applications filed between 12/12/2007 and 10/27/2008).

The Federal Circuit is clear that diligence can be established by showing work on related parts of a research program that resulted in the patent. *ATI Technols. ULC v. Iancu*, 920 F.3d 1362, 1370-75 (Fed. Cir. 2019) (work done on the R400 in general sufficient to establish diligence, noting “[d]iligence is not negated if the inventor works on improvements and evaluates alternatives while developing an invention” and can be shown by “work required to develop a first invention in order to develop or reduce to practice a second invention”). Here, the papers and applications filed in the critical period and those reflecting work in the critical period provide substantial objective evidence of continuous improvement on creating a commercial OLED embodying the inventions during the critical period.

(b) Objective Evidence Shows That the Prosecutors Exercised Reasonably Continuous Diligence Through the Critical Period.

The prosecuting attorneys at EHF also worked diligently. The invention disclosure was forwarded to EHF on May 31, 2006. On July 25, 2006, shortly before Igarashi’s US filing date of 7/27/2006, OSRAM decided to file an

application on the disclosed invention, and communicated the decision to EHF on the same day. EX2001, ¶¶9-10; EX2006.

In 2006-2007, EHF handled all of OSRAM OS's patent filings. EX2001, ¶14. It had one patent attorney and 2-3 technical experts who specialized in OLED-related technologies and worked under the patent attorney's supervision. *Id.* All of OSRAM's OLED-related applications were assigned to these persons. *Id.*

In 2006-2007, EHF processed on average 40 new invention disclosures per year on OLED-related technology for OSRAM, in addition to handling all office actions for applications that had been filed, coordinating PCT and international filing and responses, and working on dockets for other clients. *Id.*, ¶15. "Considering the full docket load, the patent attorney in charge of OSRAM OS's OLED patent portfolio oversaw on average well over 300 new applications and office action responses per year in 2006-2007." *Id.*

As Dr. Much testified:

The patent attorney and technical experts responsible for OSRAM OS's OLED patent applications—who also worked on dockets for other clients and on dockets related to light conversion materials for OSRAM OS—generally drafted the applications and processed the dockets in chronological order, that is, in the order the filing approvals were received. Occasionally, they would process an application out of order if the application was closely related to another application that was

being drafted (as such a procedure would make drafting more efficient) or if the application related to a presentation or submission with an imminent deadline.

Id., ¶17.

On August 1, 2007, EHF sought a teleconference with Dr. Krummacher to discuss the inventions. EX2001, ¶18. On August 3, 2007, EHF had a discussion with Dr. Krummacher. *Id.* It then drafted the applications based on the discussion, sought feedback from the inventors, and followed up with additional discussions with other co-inventors on September 5 and September 6, 2007, including a discussion with Dr. Klein. *Id.* It then revised and finalized the draft, performed the necessary administrative acts and filed the applications on September 19, 2007 as DE102007044597. *Id.* Dr. Much confirmed that the “1.5-month interval between when EHF started drafting and when it filed the German priority application (DE102007044597) was common for this type of applications” in the relevant time period. EX2001, ¶19 (also describing the general drafting-to-filing work flow).

As the Federal Circuit has explained, a patent owner “need not prove the inventor *continuously* exercised reasonable diligence throughout the critical period; it must show there was *reasonably continuous* diligence.” *Perfect Surgical Techns. v. Olympus Am.*, 841 F. 3d 1004, 1009 (Fed. Cir. 2016) (emphasis in original). “Under this standard, an inventor is not required to work on reducing his

invention to practice every day during the critical period.” *Id.* The Federal Circuit also explained that the purpose for requiring diligence “is to assure that, in light of the evidence as a whole, ‘the invention was not abandoned or unreasonably delayed.’” *Id.* at 1009 (citations omitted).

The Federal Circuit has also emphasized “the importance of considering an attorney’s prosecuting activities as part of the inventor’s diligence.” *Id.* at 1011; *see also id.* at 1010 (“An attorney’s work in preparing a patent application is evidence of an inventor’s diligence.”); *id.* at 1018 (“An attorney’s diligence is imputable to the inventor.”). Thus, “reasonable diligence can be shown if it is established that the attorney worked reasonably hard on the particular application in question during the continuous critical period.” *Bey v. Kollonitsch*, 806 F.2d 1024, 1027 (Fed. Cir. 1986).

In evaluating an attorney’s diligence, the Federal Circuit explained:

[I]t is not necessary that an inventor or his attorney should drop all other work and concentrate on the particular invention involved; and if the attorney has a reasonable backlog of work which he takes up in chronological order and carries out expeditiously, that is sufficient.

Id. at 1028 (quoting *Rines v. Morgan*, 250 F.2d 365, 369 (CCPA 1957)). The Federal Circuit has also recognized that there would be occasions when “an inventor or group of inventors may file more than one patent application involving closely related subject matter.” *Bey*, 806 F.2d at 1028. In those cases, “there may

be significant overall savings in time and expense by having one attorney prepare the applications [on related subject matter] together as a group.” *Id.* As a result, “the inventor should not be penalized because his attorney reasonably prepared the closely related applications together, thereby *expediting* the filing of the applications and the prompt disclosure to the public of the closely related inventions contained therein.” *Id.* at 1029. The Federal Circuit has thus held, “work on related case is to be credited toward reasonable diligence if the work on the related case ‘contribute[s] substantially to the ultimate preparation of the involved application.’” *Id.*

Here, as Dr. Much testifies, OSRAM decided to pursue patent filing on the inventions as of July 25, 2006 and so instructed its prosecution firm. EX2001, ¶9. The firm assigned all of OSRAM’s OLED-related applications to the 2-3 technical specialists in the area to leverage their expertise and expedite the prosecution. *Id.*, ¶14. The attorney and specialists worked on the dockets generally in chronological order, except to group related applications together for prosecution or to meet critical deadlines (such as date of paper submission or presentations). *Id.*, ¶17. The prosecuting attorney has therefore followed a course of reasonable diligence as approved by the Federal Circuit. *E.g., Bey*, 806 F.2d at 1028 (“if the attorney has a reasonable backlog of work which he takes up in chronological order and carries out expeditiously, that is sufficient”); *id.* at 1029 (“the inventor should not be

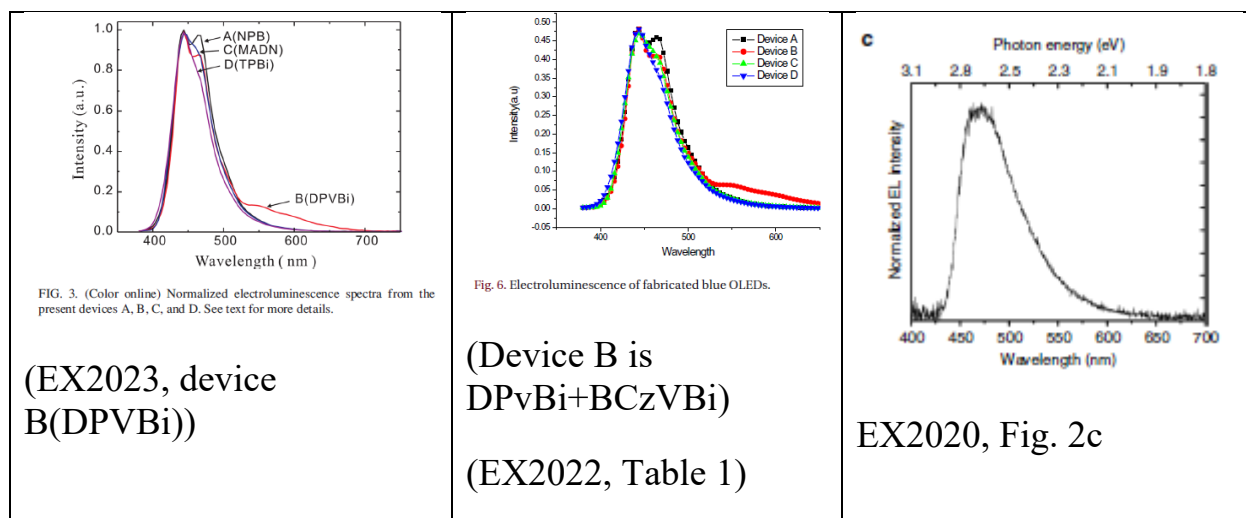
penalized because his attorney reasonably prepared the closely related applications together”).

Thus, because the inventors conceived the inventions before Igarashi’s critical date and had worked with reasonably continuous diligence in the critical period, Igarashi does not qualify as prior art.

IV. Petitioner Has Not Shown a Likelihood of Success for Grounds 1-3

A. Igarashi’s Display Does Not Simultaneously Satisfy Elements 1(d) and 1(f) under Petitioner’s Own Theory

Igarashi concerns the development of a green phosphor with a high color purity and an improved luminescence, using *e.g.*, a blue light to excite the phosphor to generate green light. EX1004, [0013], [0010]-[0012]. Igarashi uses 5% BCzVBi in DPVBi as its emission material. *Id.*, [0107]; EX2010, ¶¶19-20. However, as Inventor Krummacher noted, while OSRAM focused on “deeply blue organic electrophosphorescence” such as newer Iridium-based compounds, “*more stable state-of-the-art blue PHOLEDs offer usually greenish blue (sky-blue) emission ...*” with “*high fraction of green light emitted by such PHOLEDs.*” EX2015, 115 n.15. The blue emitter used by Igarashi likewise emitted significantly in the green light region (500-540nm). *See* EX2010, ¶¶21-23, 28-29. Consequently, Petitioner has not shown how, under its theory, Igarashi can satisfy 1[d] and 1[f] simultaneously by both being opaque to green light and be transparent to Igarashi’s emissions having a significant green portion.



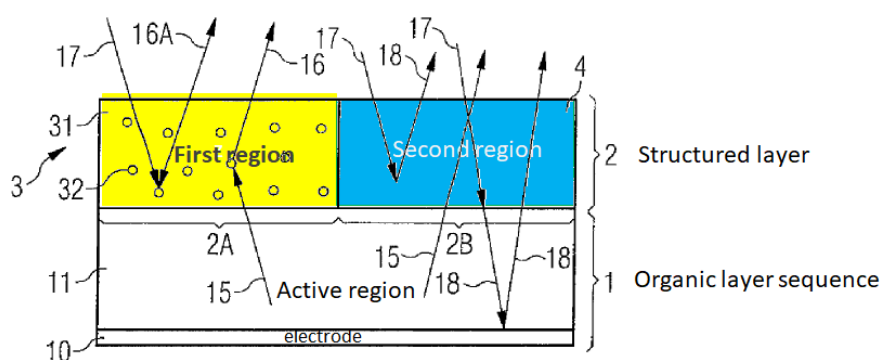
Specifically, claim 1 requires, *inter alia*,

- “an organic layer sequence which emits an electromagnetic radiation having a first wavelength spectrum during operation” (1[a]),
- “a wavelength conversion layer configured to convert at least partially electromagnetic radiation having a first wavelength spectrum into an electromagnetic radiation having a second wavelength spectrum” (1[c]), and
- a filter layer in the second region be “at least partially opaque to an electromagnetic radiation having a third wavelength spectrum which corresponds to at least one part of the second wavelength spectrum” (1[d]) and be “transparent to the electromagnetic radiation having the first wavelength spectrum” (1[f]). EX1001, cl. 1.

Figures 1A and 2 of the '547 patent describe one preferred embodiment of claim 1. This embodiment, however, is consistent with the specification as a whole, which makes clear that the “first wavelength range” cannot be an arbitrary portion of the emission spectrum of the organic layer sequence that excludes substantial portions of emission, the implicit construction applied by the Petitioner.

For instance, Figure 1A depicts an organic layer sequence 1 that emits an electromagnetic radiation 15 having a first wavelength spectrum. EX1001, 10:9-12.

FIG 1A

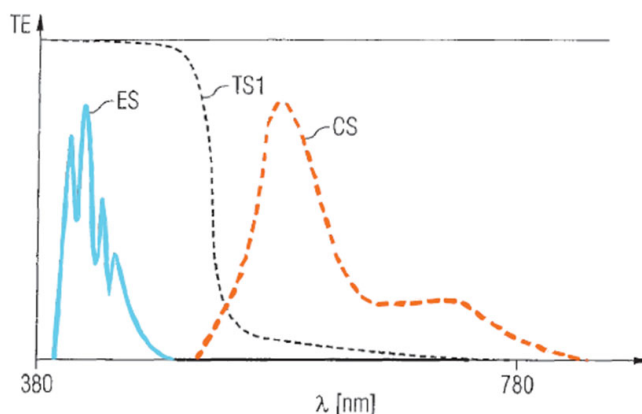


It further teaches that

the electromagnetic radiation 15 having the first wavelength can pass through the filter layer 4 in an unimpeded manner and *substantially without any alternation of its spectral components*. To put it another way, the filter layer 4 *is transparent to electromagnetic radiation 15 having the first wavelength spectrum*. EX1001, 10:36-42.

That is, being transparent to emission having a first wavelength spectrum implies the emission would pass through the filter “substantially without any alteration of its spectral components.” *Id.* Figure 2 depicts the same.

FIG 2



(Figs. 1A, 2, annotated)

In Figure 2, the blue curve depicts an “emission spectrum” of “*a spectral profile of the electromagnetic radiation 15 emitted by the organic layer sequence 1.*” EX1001, 11:30-47. The orange CS curve depicts a conversion spectrum that “*represents the wavelength spectrum which is emitted by the wavelength conversion layer 3*” (*i.e.*, emission having a second wavelength spectrum) that “comprises a yellow wavelength range and a red-green wavelength range, respectively.” *Id.* “The curve designated by TS1 indicates a transmission spectrum of the filter layer 4.” *Id.*

As Figure 2 shows, “the filter layer 4 is transmissive to blue light and thus to the electromagnetic radiation 15 [having a first wavelength spectrum] emitted by

the organic layer sequence 1, while it is opaque to electromagnetic radiation having a yellow wavelength range and a red and green wavelength range [i.e., a third wavelength spectrum which corresponds to at least one part of the second wavelength spectrum].” *Id.*

Igarashi operates differently: under Petitioner’s theory, Igarashi’s filter would ***substantially alter*** Igarashi’s organic layer’s emission ***spectral components*** by blocking a significant portion of the emission in Igarashi’s emission spectrum.

Petitioner’s mapping of the claim elements against Igarashi is as follows:

Claim elements	Igarashi’s elements
wavelength conversion layer	29G. <i>See</i> Pet. 19
electromagnetic radiation having a second wavelength spectrum	green output light in the pixel 28G. <i>See</i> Pet. 20
electromagnetic radiation having a third wavelength spectrum	green light. Pet. 22

Petitioner also points to Igarashi’s organic layer 24 as the “organic layer sequence” that “emits an electromagnetic radiation having a first wavelength spectrum during operation.” Pet. 17; EX1003, ¶76. Petitioner, however, does not present any evidence on what emission spectrum Igarashi’s organic layer 24 generates, asserting only that it emits in the 450-470nm range. Pet. 17 (citing EX1004, [0088]).

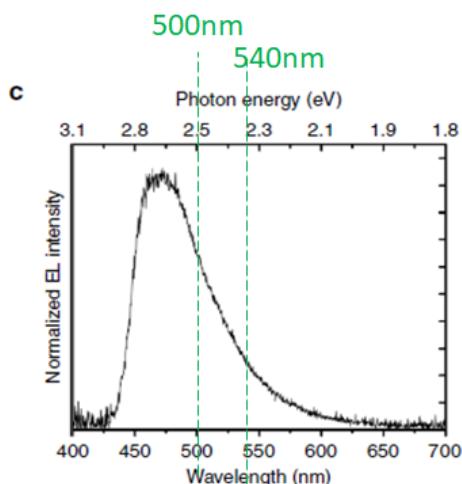
But the full context of the paragraph reads, “In the structure, light having, for example, a wavelength range of 380 to 780 nm ... is emitted from the organic layer 24. In particular, in this embodiment, light in the blue region having a wavelength range of 450 to 470 nm is emitted.” EX1004, [0088]. This disclosure, however, implies that Igarashi’s electromagnetic radiation has an emission spectrum with wavelengths other than 450-470 nm. Indeed, Petitioner has not shown any evidence that at the time of the invention, there were blue emitters emitting only in the 450-470 nm range. *See, e.g.*, EX2010, ¶¶ 35-42 (Professor Schanze showing emission spectrums of blue OLEDs known in 2006-2007, most having tails in the long wavelengths); *see also* EX2015, 115 n.15 (state-of-the-art blue PHOLEDs had significant green fractions).

Igarashi’s disclosure of the materials for the organic layer 24 further confirms that the light emitted by the organic layer 24 has emissions in the green light region and beyond. In particular, [0088] cited by Petitioner states that the “organic layer 24 composed of an organic luminescent material ... will be described below.” EX1004, [0088]. A POSITA would understand that the description appears in [0107], which is part of [0105]-[0109] that describes a method of manufacturing for the display device 11 shown in Figure 5. *Id.*, [0105]-[0109], Fig. 5; EX2010, ¶¶ 18-20.

Igarashi uses BCzVBi in DPVBi for blue emission. *See* EX1004, [0107]

(“... a blue light emitting layer (EML) ... that is composed of ... (DPVBi) that contains 5% of 4,4-bis(3-carbazoylvinyl)biphenyl (BCzVBi) as blue emission species serving as a dopant is formed”). Literature provides insight to Igarashi’s emission spectrum.

As Professor Schanze observes, “BCzVBi does not emit simply in the 450-470nm region as Samsung seems to assume. Instead, it has significant emissions at wavelengths above 500 nm.” EX2010, ¶21. This can be seen in an “EL spectrum” of a “single layer BCzVBi device”:



EX2020, Fig. 2c (annotated with dashed lines showing the 500-540 nm range for green light).⁴

⁴ EX2020-EX2023, although post-dating the inventions, illustrate BCzVBi’s inherent emission characteristics.

Studies also showed that when the host material used to disperse BCzVBi is DPVBi as in Igarashi (*see* EX1005, [0107]), a shoulder in the green light region appears in the blue OLED's emission spectrum:

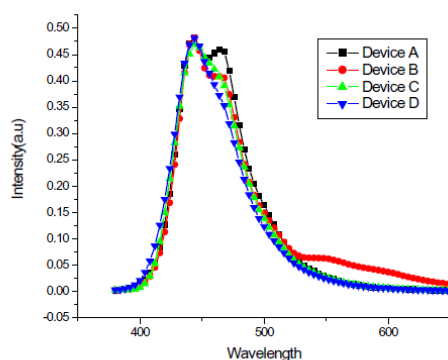


Fig. 6. Electroluminescence of fabricated blue OLEDs.

Table 1. Structures and characteristics of fabricated deep blue OLEDs.

Device A : NPB(600 Å)/NPB:BCzVBi-5%(200 Å)/Bphen(300 Å)/LiF(20 Å)/Al(1000 Å)
Device B : NPB(600 Å)/DPVBi:BCzVBi-5%(200 Å)/Bphen(300 Å)/LiF(20 Å)/Al(1000 Å)
Device C : NPB(600 Å)/MADN:BCzVBi-5%(200 Å)/Bphen(300 Å)/LiF(20 Å)/Al(1000 Å)
Device D : NPB(600 Å)/TPBi:BCzVBi-5%(200 Å)/Bphen(300 Å)/LiF(20 Å)/Al(1000 Å)

OLED: Organic light emitting diode.

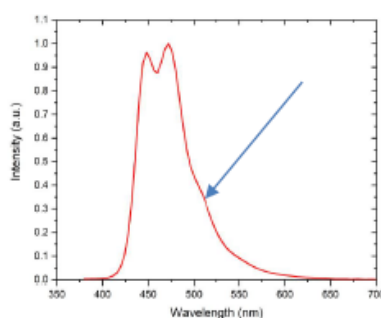
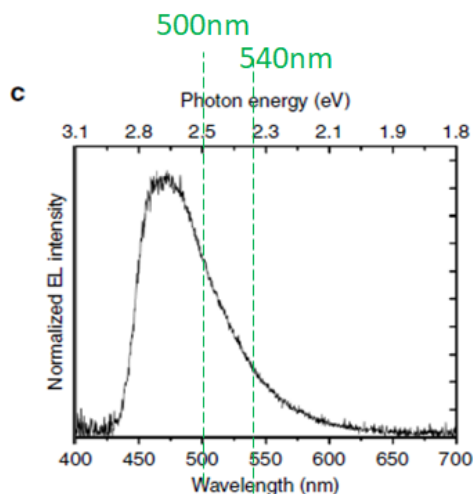


Figure 4.3: The EL spectrum of a BCzVBi-doped device with the structure of ITO/ NPB (70 nm)/ DPVBi:BCzVBi (15%, 30 nm)/ BPhen (30 nm)/ Liq/ Al.

EX2022, Table 1, Fig. 6; EX2023, Abstract (“Blue organic light-emitting devices were fabricated with an activator of 4,4’-bis(9-ethyl-3-carbazovinylen)-1,1’-biphenyl [BCzVBi] doped into the various host materials ... *the DPVBi host induced a complex excimer (electromer) leading to a shoulder spectrum with a longer wavelength emission.*”); EX2027, 54, Fig. 4.3 (noting a “shoulder peak at 508 nm” for 15% BCzVBi in DPVBi); EX2010, ¶28.

Simply put, the “first wavelength” emitted by Igarashi’s organic layer 24 has significant emissions in the 500-540 nm range, *i.e.*, the alleged third wavelength range that is to be blocked by the filter layer. EX1003, ¶27 (Dr. Eden alleges that green light is in the 500-540 nm range); Pet. 22 (alleging that the blue filter is opaque to green light); EX2010, ¶23 (“the EL emissioin spectrum shows that BCzVBi can have significant emissions in the green light region”); ¶28 (EX2022, EX2023 and EX2027 show shoulder peaks in the green region and tail at longer wavelengths).

Thus, if as Petitioner argues, Igarashi’s blue filter has a characteristics similar to that of Huang, whose “transparent region” is in the “400 to 500 nm” region, (Pet. 24; EX1003, ¶104), then the filter would be opaque to radiation at wavelengths above 500 nm, including in the 500-540nm range for green light. But as much as 35-40% of the emission spectrum of BCzVBI is at wavelengths above 500nm (incuding in the 500-540 nm range). *See* EX2010, ¶24.



EX2020, Fig. 2c

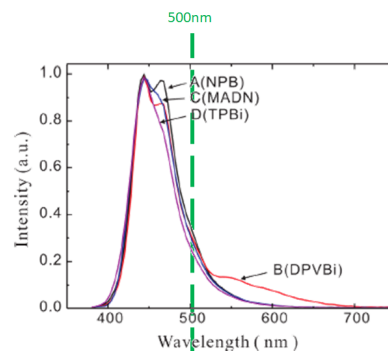


FIG. 3. (Color online) Normalized electroluminescence spectra from the present devices A, B, C, and D. See text for more details.

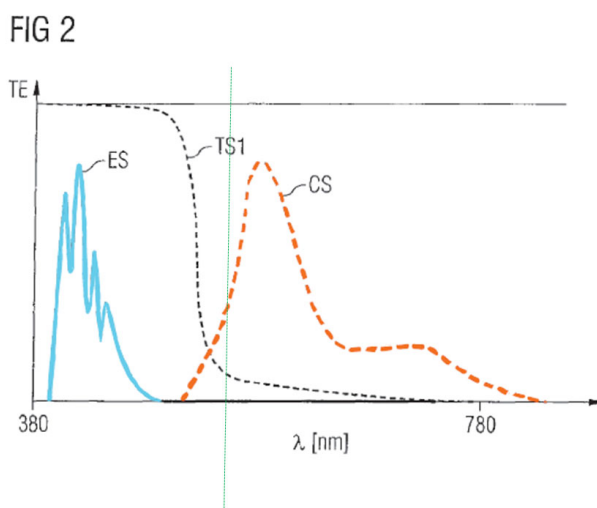
EX2023 (device B(DPVBi))

As such, Igarashi's blue filter is **not** "transparent to the electromagnetic radiation having the first wavelength spectrum" to the extent "the first wavelength spectrum" being the radiation emitted by Igarashi's organic layer. This is because under Petitioner's own theory, the filter is not transparent to green light in the 500-540 nm range that forms a significant fraction of Igarashi's emission. Ex1003, ¶94 (Samsung's expert asserts that Igarashi's "[b]lue filter 30B rejects (*i.e.*, does not transmit) a significant portion of the green light emitted by the phosphor in color conversion layer 29G"), ¶27 (green light is between 500-540 nm); EX2010, ¶¶24-25 (emission intensity at 500 nm is as much as 69% of the peak, and as much as 35-40% of the emission of BCzVBi is at 500nm and above).

Should Petitioner belatedly argue that Huang's filter is but an example, Petitioner has not shown any "blue" filters that would be transparent to the first

wavelength spectrum emitted by Igarashi's organic layer 24 but also be at least partially opaque to green light as it alleges. Pet. 27 n.4 (alleging Igarashi's "blue color filter 30B" "is at least partially opaque to green light"). As shown above, BCzVBI's emission spectrum includes a significant fraction in the green light region that is allegedly blocked by the blue filter. Pet. 22 ("Igarashi's color filter 30B ... constitutes 'a filter that is at least partially opaque to an electromagnetic radiation having a third wavelength spectrum' (green light) ..."). Petitioner does not explain why Igarashi's filter is opaque to the green light in the 500-540 nm region but is also transparent to the first wavelength spectrum emitted by Igarashi's organic layer, which has a significant fraction of green light.

Again, the ES and CS of Igarashi differ in characteristics to those of the '547 patent, Fig. 2. In '547 patent's Figure 2, the CS curve has intense emissions in longer wavelength range where the organic layer sequence 1 almost does not emit. See Fig. 2 (annotated below).



In contrast, Igarashi's organic layer emits significantly in at least the green light region that Petitioner argues the blue filter should be opaque to. *See below.*

ES of a device B using 5% BCzVBi in DPvBi as the emission material—same as in Igarashi—showing significant emission in the green region.

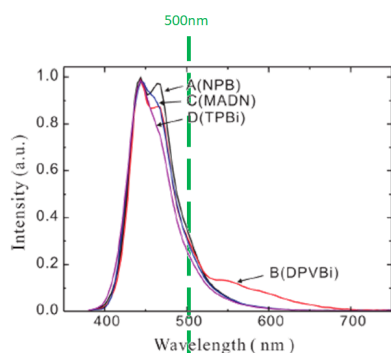
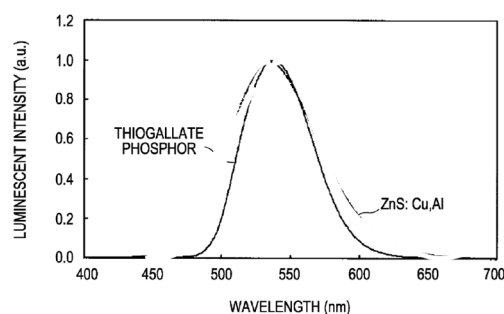


FIG. 3. (Color online) Normalized electroluminescence spectra from the present devices A, B, C, and D. See text for more details.

EX2023, Fig. 3; *see also* EX2022, Fig. 6; EX2020, Fig. 2c; EX2027, Fig. 4.3; EX2010, ¶¶28-29 (concluding “BCzVBi-based OLED ... has significant emissions at wavelengths above 500 nm”).

CS of green phosphor thiogallate, which Petitioner assumes to be similar to that of 29G:⁵

FIG. 10



(CS for ZnS_Cu/Al removed to simplify view)

⁵ *See* Pet. 26-27 (Petitioner alleges that “Igarashi’s improved phosphor differs from the thiogallate phosphor shown in Figure 10 only in the ratio of gallium to strontium” and uses the thiogallate’s spectrum to argue that Igarashi’s phosphors would emit yellow light).

Given this difference, Petitioner has not shown why Igarashi's blue filter simultaneously satisfies the conditions that it be transparent to light having the wavelength spectrum emitted by Igarashi's organic layer (*i.e.*, between 400 and 700 nm with significant extent of emission above 500 nm) and that it be opaque to at least the green light range under Petitioner's theory (*see* Pet. 22). This is not a dispute of fact, it is an absence of analysis.

As Professor Schanze explains, the use of BCzVBi in DPvBi is likely not an accident. EX2010, ¶¶30-32. First, "[t]he combination of DPVBi and BCzVBi would have been the most efficient host-emitter combination for long lifetime and efficient blue emissions" at the time of the invention. *Id.*, ¶30. Second, the shoulder peak in the green region helps advance Igarashi's goal of improving the green thiogallate phosphor's luminescence while retaining color purity. *Id.*, ¶¶31-32; EX1004, [0013], [0007]-[0008]. "By having a shoulder spectrum in the green light emission spectrum, the green phosphor's conversion spectrum would have increased intensity in the green region, improving resulting luminescence." *Id.*

But this also requires Petitioner to explain why Igarashi's system meets both 1[d] and 1[f], especially under Petitioner's interpretation of the claim. Specifically, when reasoning why the examiner allowed the claims over Kabori, Petitioner contends:

The examiner did not find this element [1f] present in Kobori, presumably because [Kobori's] red color filter 22R ... is not transparent to the entire emission spectrum of its organic light-emitting device 10M

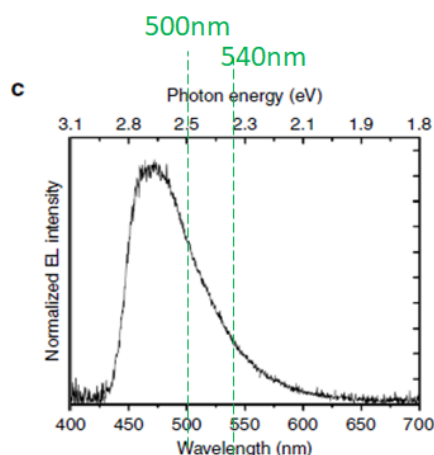
Pet. 8-9.⁶ Under Petitioner's reasoning, if Igarashi's blue filter is at least opaque to green light and the emission spectrum of Igarashi's organic layer includes significant fractions in the green light region, the blue filter is also "not transparent to the ... emission spectrum of its organic light-emitting device" as green light is part of that emission spectrum. Thus, Petitioner has not shown a likelihood of success under its own theory and claim interpretation.

B. Petitioner Has Not Made A *Prima Facie* Case of Obviousness

For the last element of claim 1, Petitioner argues that if Igarashi does not disclose it, "it would have been obvious to use a transparent filter" that is transparent to blue light. Pet. 24. But the question is not whether it would be obvious to use a filter that is transparent to blue light and that blocks green light, but whether it would be obvious to have a filter that is transparent to an electromagnetic radiation emitted by Igarashi's organic layer sequence 24 (under 1[f]) and is also at least partly opaque to the emission spectrum of Igarashi's green phosphor (under 1[d] and as Petitioner alleges on Pet. 21-22).

⁶The red filter is not transparent to blue light emitted by the emission layer.

Petitioner, however, did not perform any of that relevant analysis, assuming instead that Igarashi's organic layer does not emit significantly in the green light region. But as explained above, BCzVBi and BCzVBi-in-DPVBi has a broad emission spectrum, with significant emissions in the 500-540 nm region that Petitioner argues the filter is opaque to. *See* EX2010, ¶¶23, 27-29; *see also* ¶24 (in the emission spectrum of EX2020, 35-40% of the emission is above 500 nm); ¶28 (emission of 5% BCzVBi in DPVBi has a shoulder in 525-550nm).



EX2020, Fig. 2c; *see also* EX2021, Fig. 2b

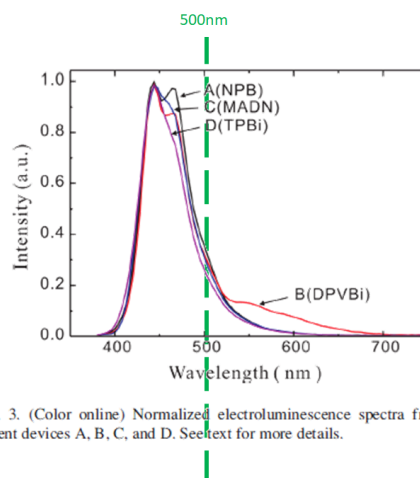


FIG. 3. (Color online) Normalized electroluminescence spectra from the present devices A, B, C, and D. See text for more details.

EX2023, Fig. 3 (device B(DPVBi))

To the extent Petitioner were to argue that the claim only requires the emission spectrum of the organic layer 24 to include a blue component (this argument is not present in the Petition), Petitioner does not explain why Igarashi's filter would be transparent to blue light but opaque to at least the green light. Pet.

24-25; EX1003, ¶¶ 107-109. For example, Petitioner argues that a POSITA would have made the blue filter transparent to “allow more light to reach the viewer than a filter that is not transparent.” But by blocking light with a wavelength above 500 nm, the filter would block out as much as 35-40 % of the light intensity (about 25% for green light). EX2010, ¶¶ 24-25. Petitioner does not explain how such a design is consistent with its stated reason for designing a transparent filter.

And by blocking spectral components with appreciable intensity, under Petitioner’s own reasoning,

it would have been necessary to increase the current through organic electroluminescent element 12 to generate more light in order to compensate for the light that was not transmitted by the filter. This would increase the power consumed by the display, making it less energy efficient and reducing the lifetime of the OLED emitters because increasing current heats OLEDs and LEDs.

EX1003, ¶108. Put another way, under Petitioner’s own theory, using a filter that is opaque to a significant fraction of the emission spectrum of Igarashi’s organic layer 24 would shorten the life of display and decrease the value to the customer because of the display’s decreased brightness. *Id.* Petitioner does not explain why a POSITA would do so.

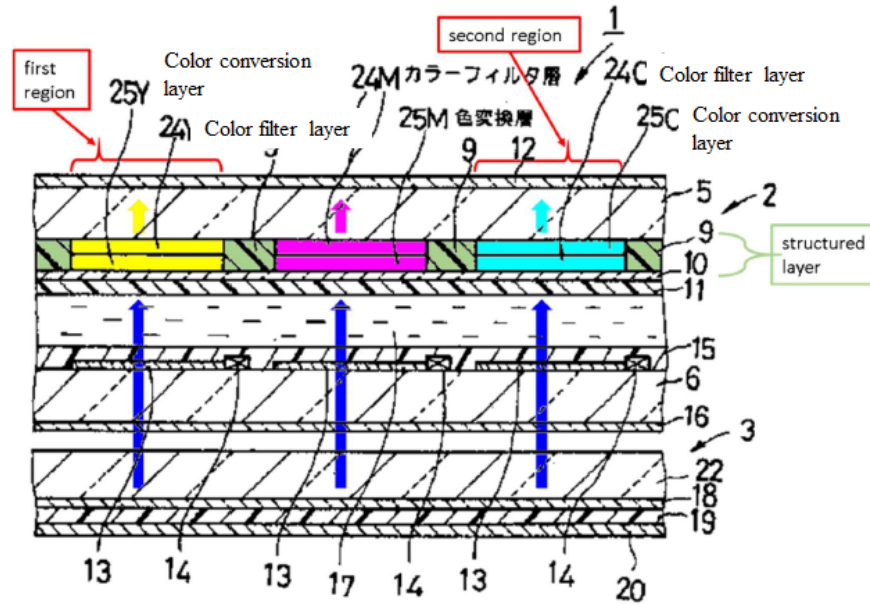
Thus, Petitioner has not shown why a POSITA would have designed a filter that is transparent to the blue light emitted by Igarashi’s organic layer 24 but not to

the light having a wavelength in the green light range (500-540 nm) and above. To be clear, this is not a dispute about the weight of evidence. There is an absence of analysis in the Petition. Consequently, Petitioner has not shown a *prima facie* case of obviousness. *In re Omeprazole Patent Lit.*, 536 F.3d 1361 (Fed. Cir. 2008) (claim not obvious when the proposed modification amounted to extra work and greater expense for no apparent reason); *Amerigen Pharms. Ltd. v. UCB Pharma GmbH*, 913 F.3d 1076, 1089 (Fed. Cir. 2019) (Petitioner must show that the “prior art would have suggested making the specific [] modifications necessary to achieve the claimed invention” (citations omitted)).

V. Petitioner Has Not Shown a Likelihood of Success for Grounds 4-6

A. The Relied-on Embodiment of Shiotani Has Only “First Regions,” but No “Second Regions” as Required by the ‘547 Patent

All challenged claims require a structured layer “including first and second regions.” EX1001, 14:59-62. Petitioner maps these to two different areas, each with a conversion layer that converts the emitted “blue” light to red-shifted light and a corresponding filter layer. But in the context of the ‘547 patent, both are examples of “first regions,” and not “second regions.”



(EX1005, Fig. 7; Pet. 52-56)

Specifically, for the ‘547 patent, the first regions are regions that “each include a wavelength conversion layer configured to convert at least partially electromagnetic radiation having a first wavelength spectrum [*e.g.*, the blue light emitted by the organic layer sequence] into an electromagnetic radiation having a second wavelength spectrum [*e.g.*, a red-shifted light].” *Id.*, 14:63-67. Regions of different shapes or configured to convert the emitted blue light to different colors are still examples of “first regions.” In contrast, the ‘547 patent consistently teaches that second regions are regions without such a down-conversion layer. EX1001, Figs. 1A-1B, 3, 4A-4C, 5-7 and associated text. Hence, as used in the ‘547 patent’s claims, Shiotani’s cyan pixel regions in its Figure 7, like the yellow

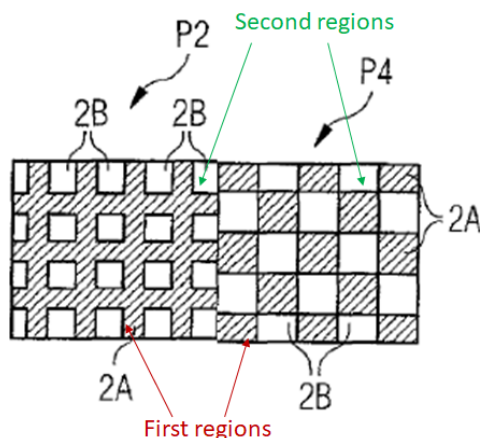
pixel regions, are just another example of “first regions.” EX1005, [0041].

Shiotani Figure 7 does not have claimed “second regions.”

Because Petitioner relies only on Shiotani for these limitations for Grounds 4-6 (*see* Pet. 50-54), it has not shown that the combination(s) for Ground 2 disclose all elements of the challenged claims and has therefore not made a *prima facie* case of obviousness.

1. In the Context of the ‘547 Patent, Distinct Subareas With Wavelength Conversion Layers 3 Are All “First Regions”

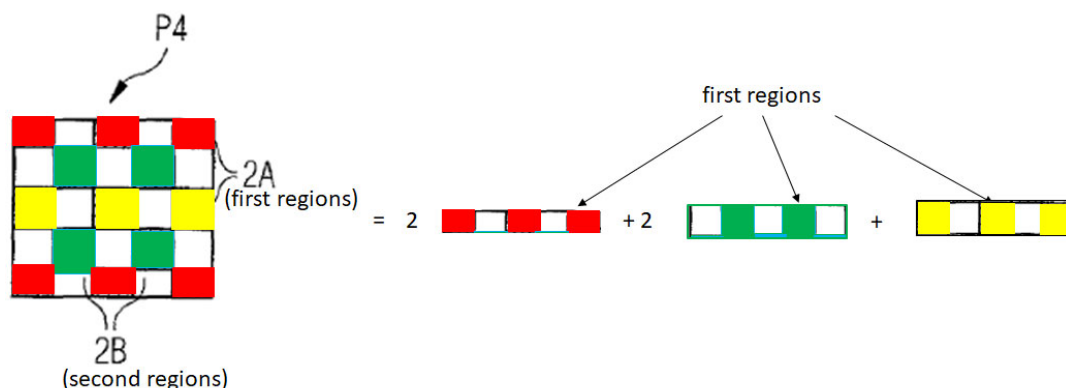
All challenged claims recite “an organic layer sequence which emits an electromagnetic radiation having a first wavelength spectrum during operation” and “first regions” that “each include a wavelength conversion layer configured to convert at least partially electromagnetic radiation having a first wavelength spectrum into an electromagnetic radiation having a second wavelength spectrum.” EX1001, 14:56-67. The plain language makes clear that regions with the recited down-conversion layers are all examples of “first regions.” Take, for instance, a structured layer composed of multiple patterns (*e.g.*, P2 & P4, *see* EX1001, Fig. 3) as illustrated below.



See EX1001, 10:9-42 (2A each including a down conversion layer 3 that can down-convert the first wavelength emitted by the organic layer sequence and 2B each including a filter layer transparent to the first wavelength), 11:54-67 (different patterns for 2A and 2B, and “the first and second regions 2A and 2B can also be provided ... in a combination of these and other forms”), 2:4-9 (“In different embodiments of the invention, *the structure of the structured layer can comprise ... lattice like, circular ... chequered, regions or regions of any desired geometry as combination of the abovementioned geometrical forms.*”).

In the structured layer, shaded regions 2A each include a wavelength conversion layer 3 that down converts the light emitted by the organic layer sequence and are each a “first region.” *Id.* In contrast, the white regions 2B do not have such down-conversion layer(s) and are the “second regions.” *Id.* That is, for the ‘547 patent, a POSITA would not regard 2A regions in P2 (or P4) as “first regions” and 2A regions in P4 (or P2) as “second regions.”

Likewise, should the structured layer be comprised of different 2A regions (e.g., capable of converting the light emitted by the organic layer sequence to different colors), each of 2A remains a “first region.”



This is because such a pattern is a combination of patterns comprised of (1) red conversion layers and second regions; (2) green conversion layers and second regions and (3) yellow conversion layers and second regions, as illustrated above. But the '547 patent explains that “the structure of the structured layer can comprise ... regions of any desired geometry as combination of the abovementioned [e.g., rectangular] geometrical forms.” EX1001, 2:4-9. Hence, even if P4 is composed of several rectangular patterns, 2A in each of the rectangle remains a first region. That is, the red, green and yellow (or another colored) regions above are all examples of “first regions.” Indeed, the specification teaches that color emitted by the wavelength conversion layer 3 in the first regions can include a “yellow wavelength range” and “a red-green wavelength range,” indicating that different areas of the first regions can emit different colors. EX1001, 11:36-42, Fig. 2

(showing two peaks). Yet, despite the different color conversion property, they remain each a “first region.”

This interpretation is consistent with the specification, which consistently refers to regions having a wavelength conversion layer that at least partially down converts the light emitted by the organic sequence layer as the “first regions” and regions without such a down-conversion layer as “second regions.” *See* EX1001, Figs. 1A-1B, 4A-4C, 5-7 (regions with wavelength conversion layer 3 are “first regions” and regions without wavelength conversion layer 3 are “second regions”). This interpretation is also consistent with the prosecution history, where references to 2A and 2B for respectively “first regions” and “second regions” were removed from the claims during the national stage “to conform with the U.S. patent law requirement.” EX1002 at 16; EX2001, ¶28. But a POSITA would still understand that the “first regions” refer to 2A regions with a claimed down-conversion layer and the “second regions” refer to regions without the claimed down-conversion layer, given the intrinsic evidence.

This interpretation is also consistent with how the inventors arrived at the invention which is to address a setup in which “emission spectrum of the device is tuned by laterally structuring the lighting tile into areas in which OLED light simply is passing towards the spectator ... and areas where it is being converted by

a color conversion ... layer” EX2003-p.8. That makes clear that the second regions are regions without the claimed wavelength conversion layer of 1[c].

Indeed, although the specifications teach that a second wavelength conversion layer can be disposed downstream of the second regions (*e.g.*, EX1001, Fig. 6, 12:62-13:15, claims 6-7)⁷ and/or that the filter layer in the second regions can down-convert electromagnetic radiation having a third wavelength spectrum (*e.g.*, 3:46-54, claim 4), it never describes the second regions as having a wavelength conversion layer that down converts the electromagnetic radiation emitted by the organic layer sequence having a first wavelength spectrum to electromagnetic radiation having a second (red-shifted) wavelength spectrum.⁸ For

⁷ This second wavelength conversion layer converts an electromagnetic radiation having a wavelength shorter than that of the first wavelength range (*e.g.*, UV) to an electromagnetic radiation from the wavelength range of the first wavelength spectrum (*e.g.*, blue), so it has a different absorption and emission spectra than the wavelength conversion layer of first regions. *See* EX1001, 13:9-15; *compare* 1[c] and claims 6-7.

⁸The claims require that the filter layer to be transparent to the electromagnetic radiation having the first wavelength spectrum, but be at least partially opaque to the electromagnetic radiation having the third wavelength spectrum. EX1001,

example, Figure 1A shows electromagnetic radiation 15 emitted by the organic layer sequence as passing through the filter layer “in an unimpeded manner and substantially without any alteration of its spectral components,” implying that there is no material wavelength conversion as recited in 1[c] in the second regions.

EX1001, 10:36-42. Figures 4A-4C and 5 likewise only disclose electromagnetic radiation 15 being scattered, but not being down converted in the second regions or in the surface layer 5. *See* 12:1-61, Figs. 4A, 5.

The specification also makes clear that not all regions having a filter are “second regions.” For instance, Figure 7 shows a second filter layer 7 in a first region. But that does not convert the region into a “second region.” *See* EX1001, Fig. 7, 13:52-55, claim 8. Thus, the intrinsic evidence makes clear that “first regions” are regions with the wavelength conversion layer of the property recited in 1[c], and “second regions” are those regions without such wavelength conversion layers but having filter layers of properties recited in 1[d] and 1[f].

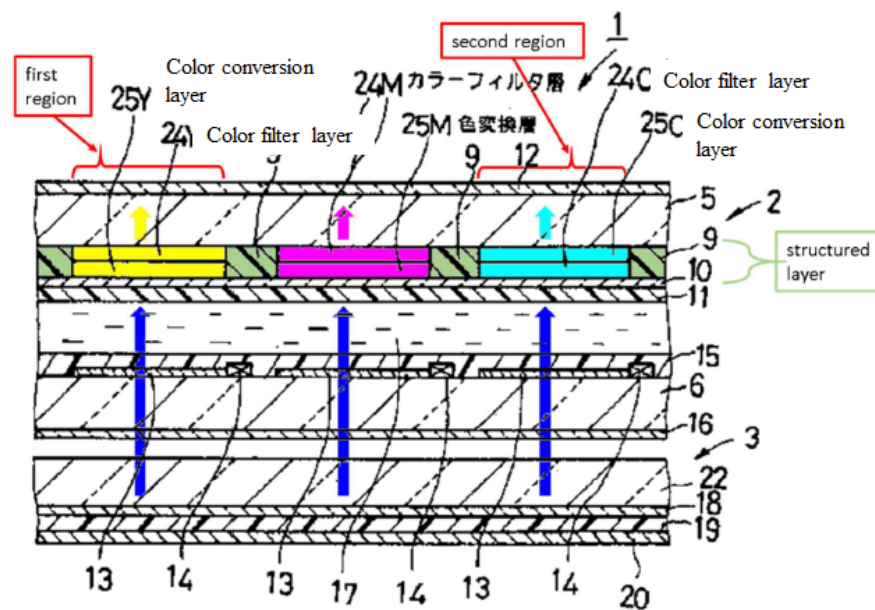
In summary, for reasons stated above, in the context of the ’547 patents, different regions having the property recited by 1[c] (e.g., wavelength conversion layers that can convert the blue light emitted by the organic layer sequence to

15:1-10. This means that first wavelength range and third wavelength range do not overlap.

yellow, green or red) are all examples of “first regions.” A POSITA would not interpret them as “second regions.”

2. Shiotani’s Pixel Regions are All “First Regions,” Not Second Regions

For Grounds 4-6, Petitioner relies on Shiotani’s Figure 7. *See* Pet. 49, 51, 53, 55, 57. Petitioner argues that (1) the first regions correspond to the yellow pixels having a “color conversion layer” 25Y that converts the blue emitted component to red and green light; and (2) that the second regions correspond to the cyan pixel regions having “a color conversion layer” 25C that converts a portion of the blue component to green light to form cyan light. Pet. 52-57.



(EX1005, Fig. 7 annotated as on Pet. 52-56)

See also EX1005, [0041] (“[T]he color conversion layer 25Y is a mixture of a color conversion layer that converts the B component light into R component light and a color conversion layer that converts the B component light into G component light to obtain Y...”), *id.* (“[T]he color conversion layer 25C is essentially a color conversion layer that converts the B component light into G component light, but is set to convert only about half of the incident B component intensity into G component light in consideration of the absorbance. This produces cyan (C)”).

But as explained above, in the claims of the ‘547 patent, both the yellow pixel and the cyan pixel regions are “first regions” as they “each include a wavelength conversion layer configured to convert at least partially electromagnetic radiation having a first wavelength spectrum [*e.g.*, blue in Shiotani’s case] into an electromagnetic radiation having a second wavelength spectrum.” EX1001, 14:63-67. Hence, Petitioner has not identified any second region in the context of the ‘547 patent.

Because Petitioner is not relying on any other references for this limitation, Grounds 4-6 fail as a matter of law.

B. Petitioner Has Not Presented Any Competent Evidence that Shiotani’s Filter in the Alleged Second Regions Meet 1[f]

Independent claim 1 requires, *inter alia*,

- “an organic layer sequence which emits an electromagnetic radiation having a first wavelength spectrum during operation” (1[a]), and

- a filter layer in the second region be “transparent to the electromagnetic radiation having the first wavelength spectrum” (1[f]). EX1001, 14:56-58, 15:10-11.

Petitioner argues that Shiotani discloses element 1[a] because its “EL material ‘generates blue light when a predetermined voltage is applied between the front and rear electrodes.’” Pet. 50 (citing EX1005, [0022]). But as in Igarashi, Shiotani’s emitter material is BCzVBi in DPvBi. EX1005, [0022]; EX2010, ¶26. As explained above, BCzVBi’s emission spectrum includes significant emissions in the wavelength range outside blue and green. EX2010, ¶27

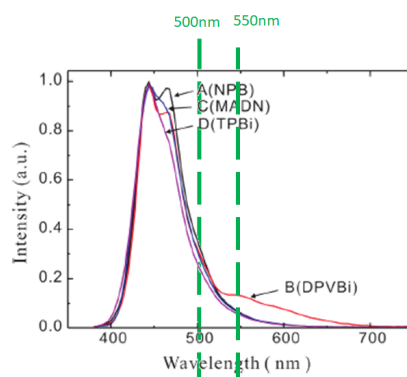
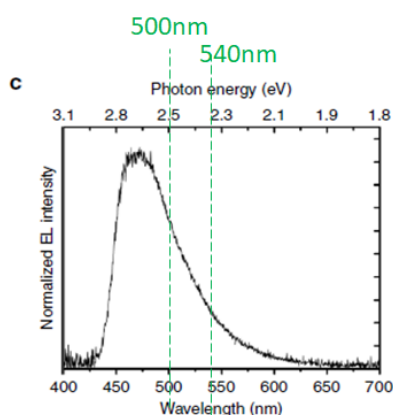


FIG. 3. (Color online) Normalized electroluminescence spectra from the present devices A, B, C, and D. See text for more details.

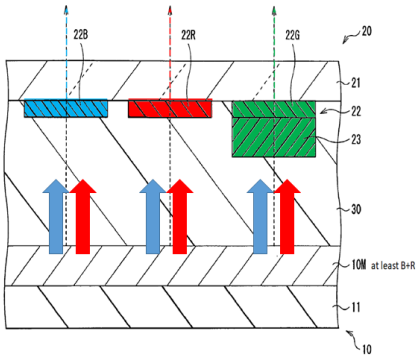
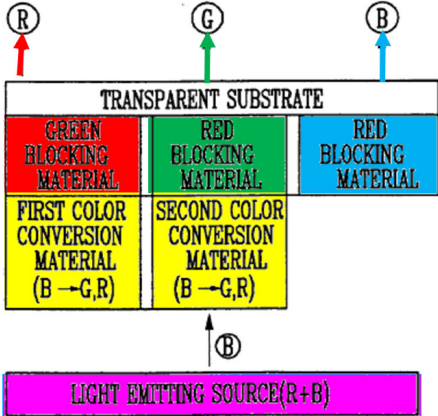
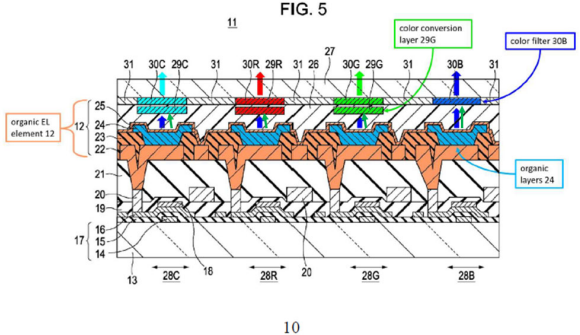
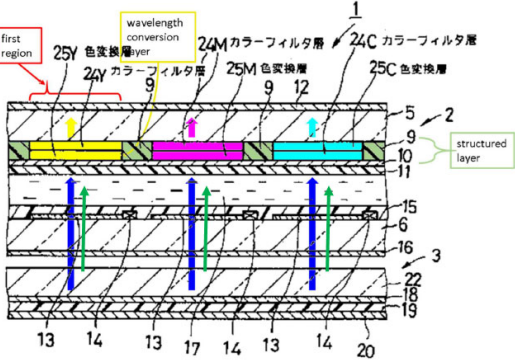
EX2020, Fig. 2c; *see also* EX2021, EX2023, Fig. 3 (device B(DPVBi))
Fig. 2b

But Petitioner also admits that the color filter 24C “transmits only the C component’ (i.e., cyan light)” and does so by “allowing transmission of green and blue light” Pet. 55 (citing EX1005, [0040]). Petitioner also admits that yellow wavelength range falls between 570 and 590 nm and yellow-green light falls between 540 and 570 nm. Pet. 26. Shiotani’s organic emitter’s emission spectrum

includes noticeable emissions in 540-590 nm, but Petitioner does not contend that the cyan filter is transparent to the yellow-green and yellow light in this wavelength range. As such, Petitioner has not shown that the cyan filter in the alleged “second regions” meet the requirement for 1[f] under its own interpretation of the claim.

VI. The Board Should Exercise its Discretion under 325(d)

Igarashi and Shiotani are cumulative of Kobori and EP10804092 that were before the Office. Specifically, all four of the involve (1) an emission spectrum (“ES”) by a purported organic layer sequence that included significant fractions of non-blue light; (2) a “blue” filter that allegedly blocks green (or red) light, and hence the significant non-blue fraction of the light in the ES. The Office found that such references did not simultaneously disclose 1[d] and 1[f]. The same conclusion applies here.

Art considered	Art Asserted
 Kobori (annotated to show blue + red emission) FIG. 2  (EX2024 [EP10804092], Fig. 2)	FIG. 5  Igarashi (adding green arrows to Petitioner's annotated Fig. 5 to show blue + green emission)  Shiotani (adding green arrows to Petitioner's annotated Fig. 7 to show blue + green emission)

Specifically, the 547 patent issued from PCT/DE2008/001302, which in turn claims priority to a German application DE102007044597. EX1001, cover, fields 86, 30. The issued claims correspond to PCT claims 2-15 respectively. See EX1002 at 497 (noting that “English Translation of the IA [International

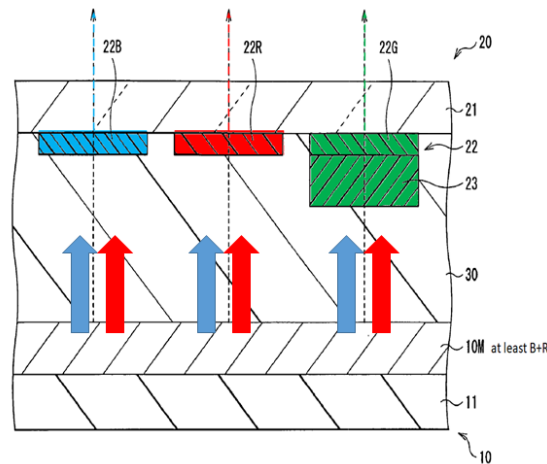
Application]” was “filed on 03/19/2010”); *compare* EX1002, 16-19, 55-58 *with id.*, 561-64 & EX1001, cls. 1-14; *see also* EX2001, ¶28 (Dr. Much confirming that the issued claims correspond to PCT claims 2-15).

The written opinion of the International Searching Authority (“ISA”) submitted with the application (EX1002, 475-83) concluded that the PCT claims 2-13 (corresponding to issued claims 1-12) were novel and inventive. EX1002, 477. In particular, the ISA found that the limitation in the original claim 2, “wherein the filter layer (4) is transparent to the electromagnetic radiation (15) having the first wavelength spectrum,” (EX1002, 55, cl. 2), is not present in US 2005/189857 (Kobori, EX1008) which allegedly disclosed

an OLED comprising an OLED layer sequence (10M), which emits a first wavelength spectrum (see figure 6), a structured layer (22, 23) having first (23) and second regions (22), wherein the first regions (23) have a wavelength conversion layer (column 45), which converts the first wavelength spectrum into a second wavelength spectrum (green), and the second regions (22) have a filter layer (22B), which is at least partly opaque to electromagnetic radiation having a third wavelength spectrum (red-green) corresponding to at least part of the second spectrum (green) (see figure 7).

EX1002, 482, ¶¶3.4, 4 (“The subject matter of claim 2 appears to be novel and inventive”). Figure 6 of Kobori shows that the OLED layer sequence emits at least light in the red and blue light wavelength range. EX1008, [0045], [0050], [0058],

Fig. 6. Kobori also explains that the conversion layer 23 “absorb[s] a blue wavelength component and emit[s] green light” *Id.*, [0045]. Thus, the ISA apparently concluded that even though Kobori’s filter 22B transmits the blue light used to generate the green light and even though the blue component is part of the light emitted by 10M, 22B still does not meet the requirement that it be “transparent to the electromagnetic radiation 15 having the first wavelength spectrum.”

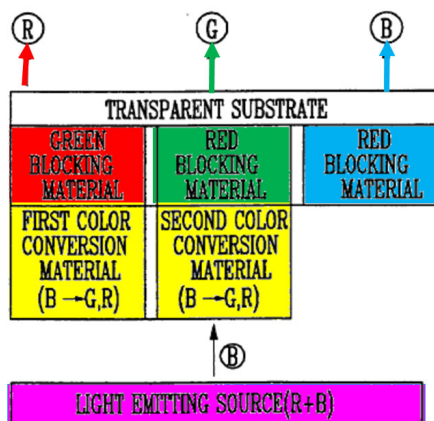


(EX1008, Fig. 1 annotated)

Similarly, even though the ISA was aware of Petitioner’s EP1804092 reference, it still concluded that then pending claims 2-13 (corresponding to issued claims 1-12) were novel and non-obvious. EX1002, 477, 480. Like Kobori, EP1804092 discloses a light source including red and blue wavelengths. *See* EX2024, Fig. 2. Also like Kobori, in a region with no wavelength conversion layers, EP1804092’s filter blocks red but not blue light. *Id.* The ISA apparently

again viewed that such a filter, although transmitting blue light of the excitation source, is not one that is “transparent to the electromagnetic radiation 15 having the first wavelength spectrum.” EX1002, 477, 480.

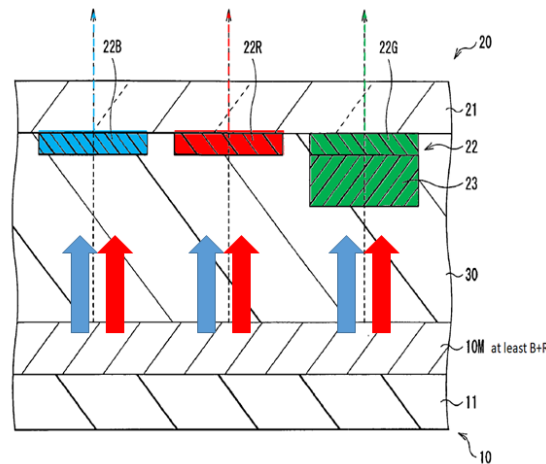
FIG. 2



The search report and the ISA opinion⁹ were before the examiner as part of the entry into the national stage. EX1002, 466-69, 475-83, 497 (required item for entering into national stage includes “Copy of the International Search Report”).

⁹ The ISA opinion also mentions WO2007051499, but the alleged filter layer 330A in WO2007051499 apparently blocks the blue light allegedly having the first wavelength spectrum. See EX1002, 481-82, ¶3.1 (stating “the first wavelength spectrum (blue ...)” and that in the alleged filter layer 330A, “only R+G emerges from the R+G+B ... spectrum,” indicating that the alleged filter does not transmit the blue light allegedly having the first wavelength spectrum).

The examiner also specifically relied on Kobori to reject then pending claims. *Id.*, 508-09, 513. Nevertheless, like the ISA, the examiner found that the subject matter of the originally filed claim 2 allowable. *Id.*, 513. The originally filed claim 2 requires the filter layer in the second regions be “transparent to the electromagnetic radiation having the first wavelength spectrum,” (*id.*, 16), where the “the electromagnetic radiation having the first wavelength spectrum” is that emitted by the organic layer sequence (OLED stack) during operation (*id.*).



Notably, like the ISA, the examiner ***did not*** find that the blue filter 22B simultaneously satisfied the requirement that it be “at least partially opaque to an electromagnetic radiation having a third wavelength spectrum which corresponds to at least one part of the [green] second wavelength spectrum” (1[d]) and the requirement that the filter be “transparent to the electromagnetic radiation having the first wavelength spectrum” (element 1[f]), even though the blue filter is transparent to the blue component of the emission by 10M. EX1002, 513.

As explained in Sections IV.A above, Igarashi relied on by Petitioner uses BCzVBi in DPVBi as the emitter (*see* EX1004, [0107]), whose emission spectrum with the “first wavelength spectrum” shows significant emissions in the 500-540nm green light range that the filter is allegedly opaque to (*see* Pet. 22):

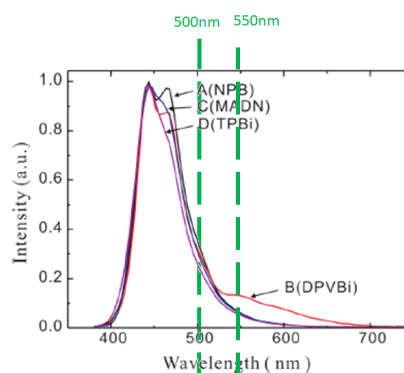
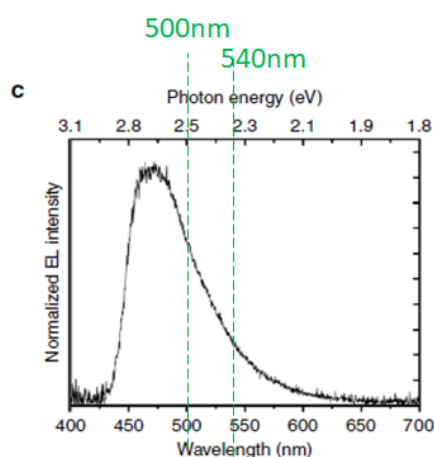


FIG. 3. (Color online) Normalized electroluminescence spectra from the present devices A, B, C, and D. See text for more details.

EX2023, Fig. 3 (device B(DPVBi))

EX2020, Fig. 2c; EX2010, ¶ (35-40% of emission above 500 nm).

Thus, like Kobori’s blue filter that is transparent to the blue component of the emission by the OLED layer 10M but is opaque to the red wavelength of OLED emission, Igarashi’s “blue filter” is also transparent to the blue range of the emission spectrum by the emitter but is admittedly opaque to green light (*see* Pet. 22) that is a significant fraction of the BCzVBi’s emission spectrum. Petitioner does not explain how Igarashi differs from Kobori with respect to the last element. *See also* EX1001, 10:36-42 (filter 4 is ***transparent to electromagnetic radiation 15***

emitted by organic layer sequence 1 *having a first wavelength* by passing electromagnetic radiation 15 through “in an unimpeded manner and *substantially without any alteration of its spectral components*”).

Shiotani also used BCzVBi in DPvBi as the emitter. EX1005, [0022] (cited on Pet. 50 for mapping of the “first wavelength range” limitation). Petitioner contends that the filter 25C “transmits only the C component’ by “allowing transmission of green and blue light, but not red light.” Pet. 55. Petitioner does not contend that Shiotani’s filter 22C would be transparent to yellow-green or yellow light, even though Shiotani’s organic layer’s emission spectrum includes a significant fraction of emissions above 540nm (*see* EX2022, Fig. 6 & EX2023, Fig. 3 (device B)). Thus, again Petitioner has failed to explain how Shiotani differs from Kobori with respect to 1[f] in view of 1[d].

Because Petitioner has not shown how Igarashi or Shiotani differs from Kobori and because it is not relying on other references for simultaneously satisfying [1d] and 1[f], discretionary denial under 325(d) is proper as has already considered substantially the same issue in the context of substantially similar art.

VII. The Board Should Exercise Its Discretion Under 314(a)

The Board should also exercise its discretion to deny institution under 35 U.S.C. § 314(a) and *Apple Inc. v. Fintiv, Inc.*, IPR2020-0019, Paper 11 (PTAB, Mar. 20, 2020) (precedential).

First, there is no stay requested and there is no evidence that Judge Gilstrap would grant a stay if a trial is instituted. In fact, Judge Gilstrap frequently denies stays in such cases. *Netlist, Inc. v. Micron Tech., Inc.*, Civ. No. 2:22-cv-00294-JRG, Dkt. 72 (E.D. Tex., Mar. 12, 2024) (denying motion to stay pending instituted IPRs); *Netlist, Inc. v. Samsung Elec. Co., Ltd.* Civ. No. 2:22-cv-00293-JRG, Dkt. 180 (E.D. Tex., Oct. 17, 2023) (denying motion to stay pending instituted IPRs); *Id.*, Dkt. 689 (E.D. Tex., Mar. 11, 2024) (same).

Second, as Petitioner acknowledges, trial is scheduled for August 4, 2025, (Pet. 79; EX1029), more than three months before the projected statutory deadline of mid-to-late November 2025 for a final written decision (“FWD”) in this proceeding. August 4, 2025 is about 21.6 months, which corresponds to the median time-to-trial in the Eastern District of Texas, from October 19, 2023, the date when Pictiva filed its complaint against Samsung. *See* EX2025 at 35.

Third, by the projected institution date, the parties would have filed their joint claim construction statement and have invested in claim construction discovery. *See* EX1029 at 5.

Fourth, there is significant overlap between this proceeding and the parallel district court action given that Samsung has also asserted the same art in the district court (*see* EX2026 at 34), and has not filed any stipulation regarding the

use of the references that it has raised or could have reasonably raised in the district court.

Fifth, Petitioner admits that the named defendants in the parallel district court case—its parent company, Samsung Electronics Co., Ltd., and its sibling company, Samsung Electronics America, Inc.—are real parties-in-interest. Pet. 1.

Sixth, Grounds 1-3 would involve complicated swear-behind analysis, and Patent Owner does not have access to the inventors who are all based in Germany. Given (1) the compressed timeline, (2) the time it takes for international discovery (even if the Board could authorize such discovery), and (3) the word limit, Patent Owner's ability to both thoroughly distinguish the prior art and to lay out the full facts to swear behind Igarashi would be severely compromised. The fair and just course is thus to allow the parties to resolve validity before the district court.

Additionally, as demonstrated above, the petition lacks compelling merits. For these reasons, the Board should exercise its discretion to deny institution.

Dated: August 22, 2024

Respectfully submitted,

By: /Hong Zhong/

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I hereby certify, pursuant to 37 C.F.R. section 42.24, that the foregoing Patent Owner Preliminary Response contains 13,797 words, excluding the words in the table of contents, table of authorities, exhibit list, this certificate of word count, signature block and certificate of service. The word count is based on the word count of the Microsoft Word program used to prepare the Patent Owner Preliminary Response.

/Susan M. Langworthy/
Susan M. Langworthy

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I hereby certify, pursuant to 37 C.F.R. section 42.6, that on August 22, 2024,
a complete copy of the foregoing document **PATENT OWNER'S
PRELIMINARY RESPONSE and EXHIBITS 2001-2049** were served by
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