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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte RUIQING MA, JULIA J. BROWN, CHAOYU XIANG, MICHAEL HACK, and JASON PAYNTER

Appeal 2019-002562
Application 15/173,109
Technology Center 2800

Before JEFFREY B. ROBERTSON, BRIAN D. RANGE, and JANE E. INGLESE, *Administrative Patent Judges.*

ROBERTSON, *Administrative Patent Judge.*

DECISION ON APPEAL[1]

STATEMENT OF THE CASE

Pursuant to 35 U.S.C. § 134(a), Appellant[2] appeals from the Examiner's decision to reject claims 1–3, 6–13, 17–19, 21, and 23–26. Appeal Br. 1. We have jurisdiction under 35 U.S.C. § 6(b).

We REVERSE.

CLAIMED SUBJECT MATTER

Appellant states the invention relates to arrangements and techniques for improving the efficiency of organic light emitting device (OLED) based displays using outcoupling components disposed close to the OLEDs. Spec. ¶¶ 3, 4. The Specification defines "outcoupling component" as "a component that outcouples light from an OLED," and lists microlens arrays as an example of an outcoupling component. *Id.* at ¶ 102. Claims 1 and 26, reproduced below, are illustrative of the claimed subject matter (Appeal Br. 10, 13, Claims Appendix):

> 1. An organic light emitting display comprising:
> a first emissive region having a width across a substrate of 2*r*; and
> an outcoupling component disposed over the emissive region and having a horizontal base surface, the base surface

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[1] This Decision includes citations to the following documents: Specification filed June 3, 2016 ("Spec."); Final Office Action mailed July 26, 2018 ("Final Act."); Appeal Brief filed September 26, 2018 ("Appeal Br."); Examiner's Answer mailed December 10, 2018 ("Ans."); and Reply Brief filed February 5, 2019 ("Reply Br.").

[2] We use the word Appellant to refer to "applicant" as defined in 37 C.F.R. § 1.42(a). Appellant identifies the real party in interest as Universal Display Corporation. Appeal Br. 1.

disposed a vertical distance *t* from the first emissive region and optically coupled to the first emissive region, the outcoupling component having an index of refraction n_{lens} and a width across the base surface of 2*R*;

wherein $[0 \leq t < \sqrt{n^2_{lens} - 1} * (r + R)]$.

26. An organic light emitting display comprising:

a first emissive region having a width across a substrate of 2r; and

a scattering layer disposed over the emissive region and having a width of 2R; and

a spacing layer with a thickness oft and an average refractive index of n_{sp}, the spacing layer being disposed between and optically coupled to the first emissive region and the scattering layer;

wherein $[0 \leq t < \sqrt{n^2_{sp} - 1} * (r + R)]$.

REFERENCES

The prior art relied upon by the Examiner is:

Name	Reference	Date
Nakajima	US 2006/0214093 A1	September 28, 2006
Segawa et al. hereinafter "Segawa"	US 2006/0139758 A1	June 29, 2006
Xue et al. hereinafter "Xue"	US 2010/0201256 A1	August 12, 2010
Ichinose et al. hereinafter "Ichinose"	US 2013/0002690 A1	January 3, 2013
Seki et al. hereinafter "Seki"	US 2004/0021762 A1	February 5, 2004
Cok	US 2007/0069635 A1	March 29, 2007
Park et al. hereinafter "Park"	US 2010/0045576 A1	February 25, 2010
Chu et al. hereinafter "Chu"	US 2008/0142814 A1	June 19, 2008

REJECTIONS

1. The Examiner rejected claim 3 under 35 U.S.C. § 112(a) or 35 U.S.C. § 112 (pre-AIA), first paragraph, as failing to comply with the enablement requirement. Final Act. 3.
2. The Examiner rejected claims 1, 7, 24, and 25 under 35 U.S.C. § 103 as obvious over Nakajima and Segawa. Final Act. 4–6.
3. The Examiner rejected claim 6 under 35 U.S.C. § 103 as obvious over Nakajima, Segawa, and Xue. Final Act. 6–7.
4. The Examiner rejected claim 8 under 35 U.S.C. § 103 as obvious over Nakajima, Segawa, and Ichinose. Final Act. 7.

5. The Examiner rejected claims 9, 10, and 23 under 35 U.S.C. § 103 as obvious over Nakajima, Segawa, and Seki. Final Act. 7–10.
6. The Examiner rejected claims 11–13, 17–19, and 21 under 35 U.S.C. § 103 as obvious over Nakajima, Segawa, and Cok. Final Act. 10–13.
7. The Examiner rejected claim 13 under 35 U.S.C. § 103 as obvious over Nakajima, Segawa, and Park. Final Act. 13.
8. The Examiner rejected claim 26 under 35 U.S.C. § 103 as obvious over Chu and Segawa. Final Act. 13–15.

OPINION

Rejection 1

The Examiner rejected claim 3 as failing to comply with the enablement requirement because, according to the Examiner, one of ordinary skill in the art would not know how to make a spacing layer according to the recitation of "the spacing layer comprises a material having an index of refraction within 0.02 of n_{lens}." Final Act. 3. The Examiner stated:

> Para. 62 of the instant application recites $n_{1ens} = 1.52$. Therefore, Claim 3 requires the spacing layer comprises a material having an index of refraction within 0.02 x 1.52 = 0.03, which is much less 1, the index of refraction of vacuum. One of ordinary skill in the art would not understand how to make a spacing layer having an index of refraction within 0.03. *Id.*

Appellant argues that the Examiner does not provide sufficient support for this position, and that one of ordinary skill in the art would understand "within 0.02" to be an index of refraction that is greater than or less than n_{lens} by no more than 0.02. Appeal Br. 4.

We agree with Appellant and reverse the Examiner's rejection for the reasons expressed by Appellant. The Examiner has not provided sufficient support for the position that "within 0.02 of n_{lens}" as recited in claim 3 means to multiply the index of refraction of the lens by 0.02.

Rejection 2

We limit our discussion to independent claim 1, which is sufficient for disposition of this rejection.

The Examiner's Rejection

The Examiner found Nakajima discloses an organic light emitting display including an emissive region and outcoupling component as recited in claim 1. Final Act. 4. The Examiner found Nakajima fails to disclose $0 \leq t < \sqrt{n^2_{lens} - 1} * (r + R)$ ("the outcoupling component arrangement") recited in claim 1. *Id.* The Examiner found that it is well known in the art that internal reflection occurs when a propagated wave strikes a medium boundary at an angle larger than a particular critical angle with respect to the normal surface. *Id.* The Examiner then determined, using Snell's Law and Figure 4 of Nakajima, that for optimizing light extraction, it would have been obvious to modify the device of Nakajima to satisfy the outcoupling component arrangement of claim 1, because the mathematical manipulation required involves only routine skill in the art. *Id.* at 4–5. The Examiner found Segawa discloses a requirement for a microlens array sheet of $Sr \geq 2t * \tan(\theta) + R$, where Sr is the size of the microlens, t is the thickness of the substrate, and R is the diameter of the light emitting region, which according to the Examiner, can be rewritten as $t \leq \sqrt{(n^2-1)} * (Sr - R)/2$.

Id. at 5. The Examiner found the ordinary artisan would have been motivated to modify Nakajima in the above manner for the purpose of obtaining a required quantity of light. *Id.*

Appellant's Contentions

Appellant argues Nakajima merely discloses an arrangement such that the quantity of light can be uniform and does not disclose the outcoupling component arrangement recited in claim 1. Appeal Br. 4–6. Appellant argues Segawa discloses microlenses formed on a first surface of a lens substrate along with a light-shielding layer having a circular or square light-emitting section formed on a second surface of the substrate. *Id.* at 6. Thus, Appellant argues Segawa fails to make up for the deficiencies in Nakajima of not disclosing the outcoupling component arrangement recited in claim 1. *Id.*

Issue

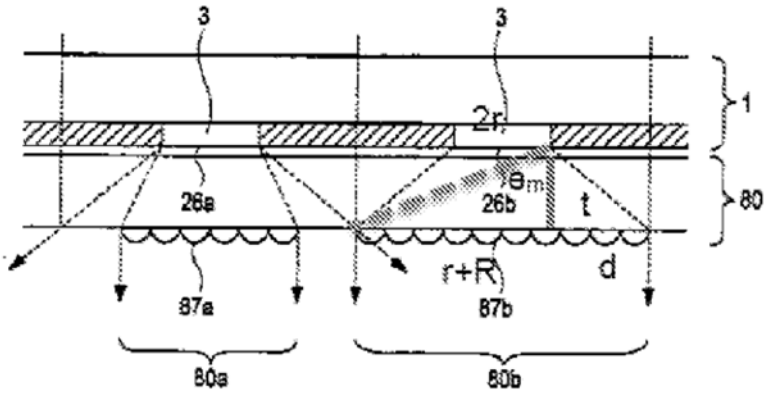
The dispositive issue is:

Has Appellant identified reversible error in the Examiner's determination that the outcoupling component arrangement in claim 1 would have been obvious to one of ordinary skill in the art?

Discussion

We are persuaded by Appellant's arguments that the prior art does not disclose or suggest the outcoupling component arrangement recited in claim 1. In particular, as Appellant argues, there is insufficient support for the Examiner's position that Figure 4 of Nakajima discloses the cotangent of the

maximal angle between the light striking the lens and the line normal to the emission surface equals t/(r+R). Appeal Br. 5. The Examiner's annotated version of Nakajima's Figure 4 is reproduced below (Final Act. 5):



Annotated Figure 4 of Nakajima reproduced above depicts an explanatory view of correspondence of electroluminescent (EL) elements 3 to beam-condensing element groups 80a and 80b including pluralities of microlenses 87a and 87b disposed near light-emitting surfaces 26a and 26b. Nakajima, ¶¶ 6, 57–59. The Examiner has annotated Figure 4 with a dashed line and label "t" corresponding to the thickness of optical unit 80, "r+R" under the plurality of microlenses 87b and "θm" corresponding to the maximal angle. *See* Final Act. 4–5.

It is unclear to us what portion of the microlens array 87b corresponds to "r+R" and how the Examiner arrived at designating the particular portion to be "r+R." In the Final Action, the Examiner merely states the "cotangent of the maximal angle θm between the light striking the lens and the line normal to the emission surface equals t/(r+R)." Final Act. 4. Yet, the Examiner does not explain what distance is equated to "R" and how the annotation under microlens array 87b "r+R" flows from the disclosure in

Nakajima and Snell's Law. Accordingly, we agree with Appellant that the Examiner's position regarding Nakajima is not sufficiently supported.

The Examiner's findings with respect to Segawa do not make up for this deficiency, because the rewritten equation of $t \leq \sqrt{(n^2-1)} * (Sr - R)/2$ and in particular the "(Sr – R)/2" does not correspond to the "(r+R)" outcoupling component arrangement recited in claim 1. The Examiner does not provide sufficient explanation as to why these two expressions might be equivalent.

Accordingly, we reverse the Examiner's rejection of claim 1, and claims 7, 24, and 25, dependent therefrom.

Rejections 3–7

The claims subject to Rejections 3–7 all depend from claim 1, and the rejections rely on the same reasoning with respect to Nakajima and Segawa. Final Act. 6–13. The Examiner's citations to Xue, Ichinose, Seki, Cok, and Park fail to remedy the deficiencies identified above with respect to the combination of Nakajima and Segawa. Accordingly, we reverse the Examiner's decision to reject the claims subject to Rejections 3–7 for similar reasons discussed above with respect to Rejection 1.

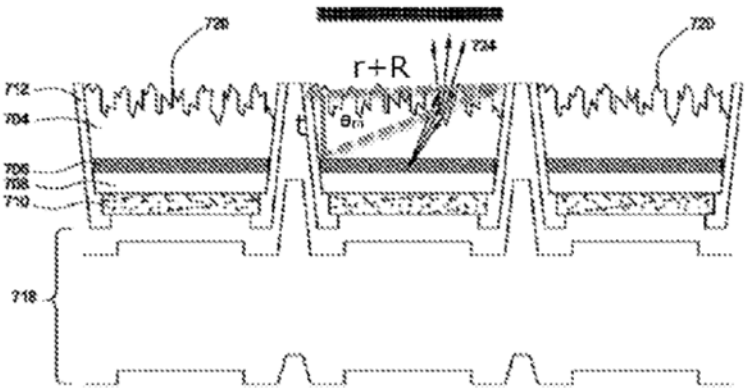
Rejection 8

Regarding claim 26, the Examiner found Chu discloses an organic light emitting display including an emissive region, a scattering layer, and a spacing layer being disposed between and optically coupled to the first emissive region and the scattering layer. Final Act. 14. The Examiner found Chu fails to disclose $0 \leq t < \sqrt{n^2_{sp} - 1} * (r + R)$ ("the spacing layer arrangement") recited in claim 26. *Id.* Similar to Rejection 1, the Examiner

found that Chu discloses the cotangent of the maximal angle θm between the light striking surface of the lens and the line normal to the emission surface equals t/(r+R). *Id.* The Examiner made similar determinations with respect to Snell's Law and Segawa as discussed above for claim 1 in order to determine that the spacing layer arrangement in claim 26 would have been obvious to one of ordinary skill in the art. *Id.* at 14–15.

Appellant argues Chu merely discloses a surface area of an n-doped layer that is roughened or textured to increase the surface area and increase light extraction, and similar to Rejection 1, that Segawa fails to make up for the deficiencies in Chu. Appeal Br. 7.

The Examiner's annotated version of Chu's Figure 10 is reproduced below (Ans. 9):



Annotated Figure 10 of Chu reproduced above depicts an LED wafer assembly including the surface area of an n-doped layer 704 after roughening an etched surface 720, an active layer 706 disposed above a p-doped layer 708. Chu ¶¶ 40, 66, 68. The Examiner has annotated Figure 10 with a dashed line, label "t", "r+R" over surface 720, and "θm" corresponding to the maximal angle. *See* Final Act. 14–15.

Similar to Rejection 1 above, it is unclear to us what portion of the etched surface 720 corresponds to "r+R" and how the Examiner arrived at designating the particular portion to be "r+R." Regarding Segawa, as explained above with respect to Rejection 1, the Examiner does not provide sufficient explanation as to how the rewritten expression satisfies the "r+R" expression recited in claim 26. Accordingly, there is insufficient support for the Examiner's position that the spacing layer arrangement in claim 26 would have been obvious to one of ordinary skill in the art in view of the relied-upon disclosures in the applied prior art references.

As a result, we reverse the Examiner's rejection of claim 26.

CONCLUSION

The Examiner's rejections of claims 1–3, 6–13, 17–19, 21, and 23–26 are reversed.

DECISION SUMMARY

In summary:

Claims Rejected	35 U.S.C. §	Reference(s)/Basis	Affirmed	Reversed
3	112	Enablement		3
1, 7, 24, 25	103	Nakajima, Segawa		1, 7, 24, 25
6	103	Nakajima, Segawa, Xue		6
8	103	Nakajima, Segawa, Ichinose		8
9, 10, 23	103	Nakajima, Segawa, Seki		9, 10, 23

11–13, 17–19, 21	103	Nakajima, Segawa, Cok		11–13, 17–19, 21
13	103	Nakajima, Segawa, Park		13
26	103	Chu, Segawa		26
Overall Outcome				1–3, 6–13, 17–19, 21, 23–26

REVERSED