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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte SOOGHANG IHN, WONJOON SON, HOSUK KANG, MYUNGSUN SIM, SUNGHAN KIM, MASAKI NUMATA, HIROSHI MIYAZAKI, SAEYOUN LEE, and SOONOK JEON

Appeal 2021-004552
Application 15/908,150
Technology Center 1700

Before TERRY J. OWENS, KAREN M. HASTINGS, and BRIAN D. RANGE, *Administrative Patent Judges.*

OWENS, *Administrative Patent Judge.*

DECISION ON APPEAL

STATEMENT OF THE CASE

Pursuant to 35 U.S.C. § 134(a), Appellant[1] appeals from the Examiner's decision to reject claims 1, 3–5, and 7–22. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM IN PART.

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[1] "Appellant" refers to "applicant" as defined in 37 C.F.R. § 1.42. The Appellant identifies the real party in interest as SAMSUNG ELECTRONICS CO., LTD. (Appeal Br. 2).

CLAIMED SUBJECT MATTER

The claims are directed to an organic light-emitting device. Claim 1, reproduced below, is illustrative of the claimed subject matter:

1. An organic light-emitting device comprising:

a first electrode;

a second electrode facing the first electrode; and

an organic layer that is disposed between the first electrode and the second electrode,

wherein the organic layer comprises an emission layer,

wherein the emission layer comprises a thermally activated delayed fluorescence (TADF) emitter and a host and the TADF emitter is different from the host, wherein the host does not comprise DPEPO, and wherein the TADF emitter is a compound represented by Formula l,

the TADF emitter satisfies Condition 1-1 or Condition 1-2:

Condition 1-1

a condition that nl is one, and

Condition 1-2

a condition that, when nl is two or more, $(I_1/I_2) \times 100(\%)$ is less than 110%,

wherein, in Condition 1-1 and Condition 1-2,

I_1 (arbitrary units) is emission intensity at the shortest peak emission wavelength in a photoluminescence spectrum 1,

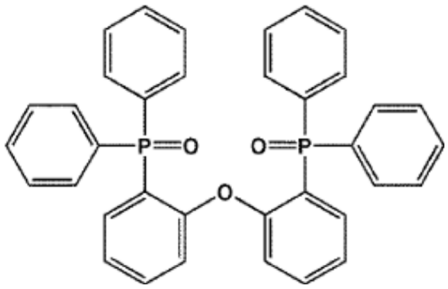
1) when n2 is one, I_2 (arbitrary units) is emission intensity at the same emission wavelength as the shortest peak emission wavelength of the photoluminescence spectrum 1 in the photoluminescence spectrum 2, and 2) when n2 is two or more, I_2 (arbitrary units) is emission intensity at the shortest peak emission wavelength in a photoluminescence spectrum 2,

the photoluminescence spectrum 1 is a photoluminescence spectrum of a film 1 that is doped with 15

percent by volume of the TADF emitter in a matrix with the host comprised in the emission layer and has a thickness of 50 nanometers, and

the photoluminescence spectrum 2 is a photoluminescence spectrum of a film 2 that is doped with 15 percent by volume of the TADF emitter in a matrix with DPEPO and has a thickness of 50 nanometers:

DPEPO



wherein nl is the number of distinguishable emission peaks in the photoluminescence spectrum 1, and n2 is the number of distinguishable emission peaks in the photoluminescence spectrum 2,

Formula 1

R_1-$(D_2)_{d1}$-D_1-$(L_1)a_1$-A_1,

wherein, in Formula l,

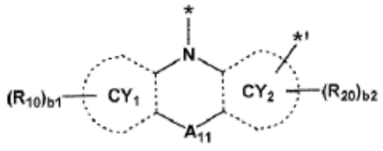
L_1 is selected from:

a cyclopentane group, a cyclohexane group, a cycloheptane group, a cyclooctane group, a cyclopentene group, a cyclohexene group, a cycloheptene group, a benzene group, a naphthalene group, a fluorene group, a phenanthrene group, an anthracene group, a fluoranthene group, a triphenylene group, a pyrene group, a chrysene group, a pyrrole group, a thiophene group, a furan group, an isoindole group, an indole group, an indazole group, a purine group, a benzofuran group, a benzothiophene group, a dibenzofuran group, a dibenzothiophene group, a benzocarbazole group, and a dibenzocarbazole group; and

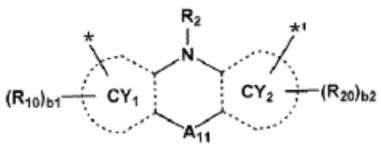
a cyclopentane group, a cyclohexane group, a cycloheptane group, a cyclooctane group, a cyclopentene group, a cyclohexene group, a cycloheptene group, a benzene group, a naphthalene group, a fluorene group, a phenanthrene group, an anthracene group, a fluoranthene group, a triphenylene group, a pyrene group, a chrysene group, a pyrrole group, a thiophene group, a furan group, an isoindole group, an indole group, an indazole group, a purine group, a benzofuran group, a benzothiophene group, a dibenzofuran group, a dibenzothiophene group, a benzocarbazole group, and a dibenzocarbazole group, each substituted with at least one selected from deuterium, $-CD_3$, $-CD_2H$, $-CDH_2$, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a (C_1-C_{20} alkyl)phenyl group, a di(C_1-C_{20} alkyl)phenyl group, a tri(C_1-C_{20} alkyl)phenyl group, a (C_6-C_{20} aryl)phenyl group, a di(C_6-C_{20} aryl)phenyl group, a tri(C_6-C_{20} aryl)phenyl group, a (C_3-C_{20} heteroaryl)phenyl group, a di(C_3-C_{20} heteroaryl)phenyl group, a pyridinyl group, a (C_1-C_{20} alkyl)pyridinyl group, a di(C_1-C_{20} alkyl)pyridinyl group, a (C_6-C_{20} aryl)pyridinyl group, a di(C_6-C_{20} aryl)pyridinyl group, a (C_3-C_{20} heteroaryl)pyridinyl group, a di(C_3-C_{20} heteroaryl)pyridinyl group, a pyrimidinyl group, a (C_1-C_{20} alkyl)pyrimidinyl group, a di(C_1-C_{20} alkyl)pyrimidinyl group, a (C_6-C_{20} aryl)pyrimidinyl group, a di(C_6-C_{20} aryl)pyrimidinyl group, a (C_3-C_{20} heteroaryl)pyrimidinyl group, a di(C_3-C_{20} heteroaryl)pyrimidinyl group, a triazinyl group, a (C_1-C_{20} alkyl)triazinyl group, a di(C_1-C_{20} alkyl)triazinyl group, a (C_6-C_{20} aryl)triazinyl group, a di(C_6-C_{20} aryl)triazinyl group, a (C_3-C_{20} heteroaryl)triazinyl group, and a di(C_3-C_{20} heteroaryl)triazinyl group,

al is an integer from 1 to 5,

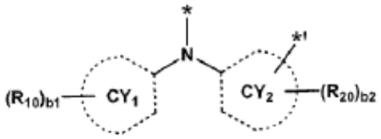
D_1 and D_2 are each independently selected from groups represented by Formulae 11-1 to 11-4:



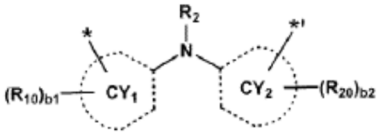
Formula 11-1



Formula 11-2



Formula 11-3



Formula 11-4

wherein, in Formulae 11-1to11-4,

CY_1 and CY_2 are each independently a C_5-C_{6o} carbocyclic group or a C_2-C_{60} heterocyclic group,

A_{ll} is a single bond,

R_{10}, and R_{20} are each independently selected from:

hydrogen, deuterium, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a cyclopentyl group, a cyclohexyl group, a cycloheptyl group, a cyclopentenyl group, a cyclohexenyl group, a phenyl group, a biphenyl group, a terphenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-bifluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a furanyl group, a thiophenyl group, an indolyl group, a benzofuranyl group, a benzothiophenyl group, a carbazolyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a naphthobenzofuranyl group, a naphthobenzothiophenyl group, a dibenzocarbazolyl group, a dinaphthofuranyl group, a

dinaphthothiophenyl group, an indolocarbazolyl group, an indolodibenzofuranyl group, and an indolodibenzothiophenyl group; and

a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a cyclopentyl group, a cyclohexyl group, a cycloheptyl group, a cyclopentenyl group, a cyclohexenyl group, a phenyl group, a biphenyl group, a terphenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spirobifluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a furanyl group, a thiophenyl group, an indolyl group, a benzofuranyl group, a benzothiophenyl group, a carbazolyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a naphthobenzofuranyl group, a naphthobenzothiophenyl group, a dibenzocarbazolyl group, a dinaphthofuranyl group, a dinaphthothiophenyl group, an indolocarbazolyl group, an indolodibenzofuranyl group, and an indolodibenzothiophenyl group, each substituted with at least one selected from deuterium, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a dimethylfluorenyl group, a diphenylfluorenyl group, a carbazolyl group, a phenylcarbazolyl group, a biphenylcarbazolyl group, a dibenzofuranyl group, and a dibenzothiophenyl group,

b1 and b2 are each independently an integer from 0 to 3, and

* and *' each indicate a binding site to a neighboring atom,

dl is an integer from 0 to 5,

A_1 is an electron acceptor group, and

R_1 is selected from:

hydrogen, deuterium, a C_1-C_{60} alkyl group, a C_2-C_{60} alkenyl group, a C_2-C_{60} alkynyl group, a C_1-C_{60} alkoxy group, a C_5-C_{6o} carbocyclic group, and an electron-depleted nitrogen-free C_2-C_{60} heterocyclic group; and

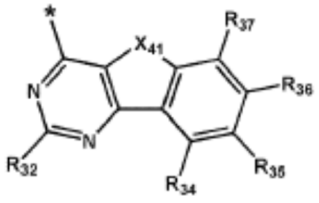
a C_1-C_{60} alkyl group, a C_2-C_{60} alkenyl group, a C_2-C_{60} alkynyl group, a C_1-C_{60} alkoxy group, a C_5-C_{6o} carbocyclic group, and an electron-depleted nitrogen-free C_2-C_{60} heterocyclic group, each substituted with at least one selected from deuterium, a C_1-C_{60} alkyl group, a C_2-C_{60} alkenyl group, a C_2-C_{60} alkynyl group, a C_1-C_{60} alkoxy group, a C_5-C_{6o} carbocyclic group, a (C_1-C_{10} alkyl)C_5-C_{60} carbocyclic group, a di(C_1-C_{10} alkyl) C_5-C_{6o} carbocyclic group, a (phenyl) C_5-C_{6o} carbocyclic group, a di(phenyl) C_5-C_{6o} carbocyclic group, a (biphenyl) C_5-C_{6o} carbocyclic group, a di(biphenyl) C_5-C_{6o} carbocyclic group, an electron-depleted nitrogen-free C_2-C_{60} heterocyclic group, a (C_1-C_{10} alkyl) n electron-depleted nitrogen-free C_2-C_{60} heterocyclic group, a di(C_1-C_{10} alkyl) n electron-depleted nitrogen-free C_2-C_{60} heterocyclic group, a (phenyl) n electron-depleted nitrogen-free C_2-C_{60} heterocyclic group, a di(phenyl) n electron-depleted nitrogen-free C_2-C_{60} heterocyclic group, a (biphenyl) n electron-depleted nitrogen-free C_2-C_{60} heterocyclic group, and a di(biphenyl) n electron-depleted nitrogen-free C_2-C_{60} heterocyclic group,

provided that,

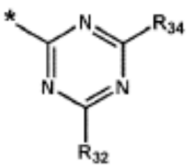
i) dl is an integer from 1 to 5; or

ii) when dl is zero, A_1 is selected from groups represented by Formulae 3-6(1), 3-10(8),

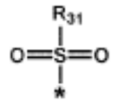
and 3-12(24):



Formula 3-6(1)



Formula 3-10(8)



Formula 3-12(24)

wherein, in Formulae 3-6(1), 3-10(8), and 3-12(24),

X_{41} is $N(R_{41})$, $C(R_{42})(R_{43})$, O, or S,

R_{31}, R_{32}, R_{34} to R_{37} and R_{41} to R_{43} are each independently selected from hydrogen, deuterium, -F, -Cl, -Br, -I, $-CD_3$, $-CD_2H$, $-CDH_2$, $-CF_3$, $-CF_2H$, $-CFH_2$, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a (C_1-C_{20} alkyl)phenyl group, a di(C_1-C_{20} alkyl)phenyl group, a tri(C_1-C_{20} alkyl)phenyl group, a (C_6-C_{20} aryl)phenyl group, a di(C_6-C_{20} aryl)phenyl group, a tri(C_6-C_{20} aryl)phenyl group, a (C_3-C_{20} heteroaryl)phenyl group, a di(C_3-C_{20} heteroaryl)phenyl group, a pyridinyl group, a (C_1-C_{20} alkyl)pyridinyl group, a di(C_1-C_{20} alkyl)pyridinyl group, a (C_6-C_{20} aryl)pyridinyl group, a di(C_6-C_{20} aryl)pyridinyl group, a (C_3-C_{20} heteroaryl)pyridinyl group, a di(C_3-C_{20} heteroaryl)pyridinyl group, a pyrimidinyl group, a (C_1-C_{20} alkyl)pyrimidinyl group, a di(C_1-C_{20} alkyl)pyrimidinyl group, a (C_6-C_{20} aryl)pyrimidinyl group, a di(C_6-C_{20} aryl)pyrimidinyl group, a (C_3-C_{20} heteroaryl)pyrimidinyl group, a di(C_3-C_{20} heteroaryl)pyrimidinyl group, a triazinyl group, a (C_1-C_{20} alkyl)triazinyl group, a di(C_1-C_{20} alkyl)triazinyl group, a (C_6-C_{20} aryl)triazinyl group, a di(C_6-C_{20} aryl)triazinyl group, a (C_3-C_{20} heteroaryl)triazinyl group, and a di(C_3-C_{20} heteroaryl)triazinyl group, and

* indicates a binding site to a neighboring atom.

REFERENCES

The prior art relied upon by the Examiner is:

Name	Reference	Date
Hwang	US 2006/0115680 A1	June 1, 2006
Tsai	US 2007/0262704 A1	Nov. 15, 2007
Endo	US 2012/0241732 A1	Sept. 27, 2012

REJECTIONS

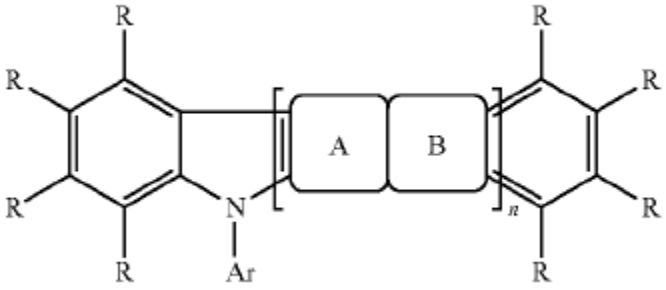
Claim(s) Rejected	35 U.S.C. §	Reference(s)/ Basis
1, 4, 5, 7–17, 20–22	103	Endo
18	103	Endo, Hwang
19	103	Endo, Tsai
1, 3–5, 7–15, 17–22	112(a)	Nonenablement

OPINION

Rejections under 35 U.S.C. § 103

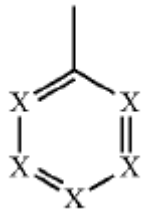
Although additional references are applied in the rejections of claims 18 and 19, the Appellant argues the claims as a group (Appeal Br. 12). We therefore limit our discussion to one claim, i.e., claim 1, which is the sole independent claim. *See* 37 C.F.R. § 41.37(c)(1)(iv) (2013).

Endo discloses an organic light-emitting element comprising an organic light-emitting material including a compound represented by formula (1) (¶ 15):



The image is Endo's formula 1 showing the structure of a compound that is included in Endo's organic light-emitting material and has a substituent Ar that represents an aromatic hydrocarbon group or an aromatic heterocyclic group and is attached by a single bond to a nitrogen atom of an indolocarbazole skeleton

Endo prefers that "Ar" is represented by formula 2 (¶ 18):



The image is Endo's formula 2 showing the preferred Ar structure

In formula 2 (*id.*):

> X's each independently represent N, C—H, or C—Ar_1 and at least one of X's represents N; and Ar_1's each independently represent an aromatic hydrocarbon group or an aromatic heterocyclic group, provided that when X represents C—Ar_1, Ar_1 and a ring including X may have a side in common to form a fused ring.

Endo prefers that at least one X represents N to possibly improve delayed fluorescence emission efficiency and provide an appropriate positional relationship for intermolecular conformation (¶ 34).

In most of Endo's exemplified formula 1 structures in which an aromatic heterocyclic group is attached to a nitrogen atom of an indolocarbazole skeleton, that attachment is direct attachment by a single bond (¶¶ 40, 44, 46). However, in many of the exemplified formula 1 structures, that attachment is indirect attachment by way of an intervening hydrocarbon group (e.g., structures 307–376). When Endo expresses a preference for an aromatic heterocyclic group as the Ar group, Endo does not limit that preference to an aromatic heterocyclic group whose attachment to a nitrogen atom of an indolocarbazole skeleton is direct attachment by a single bond (¶ 34).

The Appellant argues, in reliance upon Endo's paragraph 34, that one of ordinary skill in the art would not have introduced a divalent spacer

between Endo's aromatic heterocyclic group and indolocarbazole skeleton N atom because Endo teaches that doing so would disrupt the organic light-emitting material's desirable electronic state and intermolecular forces, thereby causing loss of efficiency of light emission properties (Appeal Br. 11; Reply Br. 7).

Endo's exemplification of many structures wherein an aromatic heterocyclic group is indirectly attached by way of a hydrocarbon group to an indolocarbazole skeleton (e.g., structures 307–376) would have indicated to one of ordinary skill in the art that those structures provide the possibly improved delayed fluorescence emission efficiency and appropriate positional relationship for intermolecular conformation Endo desires from the compounds within formula 1 (¶ 34). Consequently, Endo would have suggested, to one of ordinary skill in the art, use of those structures to make formula 1 compounds.

Accordingly, we affirm the rejection under 35 U.S.C. § 103.

Rejection under 35 U.S.C. § 112(a)

Regarding enablement, a predecessor of our appellate reviewing court stated in *In re Marzocchi*, 439 F.2d 220, 223–24 (CCPA 1971):

> [A] specification disclosure which contains a teaching of the manner and process of making and using the invention in terms which correspond in scope to those used in describing and defining the subject matter sought to be patented must be taken as in compliance with the enabling requirement of the first paragraph of § 112 unless there is reason to doubt the objective truth of the statements contained therein which must be relied on for enabling support. . . .
>
> . . . .
>
> . . . it is incumbent upon the Patent Office, whenever a rejection on this basis is made, to explain why it doubts the truth or accuracy of any statement in a supporting disclosure and to

> back up assertions of its own with acceptable evidence or reasoning which is inconsistent with the contested statement. Otherwise, there would be no need for the applicant to go to the trouble and expense of supporting his presumptively accurate disclosure.

Factors, which are illustrative, not mandatory, *see Amgen, Inc. v. Chugai Pharm. Co.*, 927 F.2d 1200, 1213 (Fed. Cir. 1991), to be considered in determining whether a disclosure would require undue experimentation "include (1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the predictability or unpredictability of the art, and (8) the breadth of the claims." *In re Wands*, 858 F.2d 731, 737 (Fed. Cir. 1988).

The Examiner concludes that the Appellant's Specification fails to provide an enabling disclosure because: 1) it provides no direction or working examples for any combination of thermally activated delayed fluorescence (TADF) emitter/host combinations other than TADF emitter compounds 1–3/host compound H19 or TADF emitter compound 3/host compound DPEPO; and 2) the claims encompass innumerable mutually structurally different TADF emitters, so the quantity of experimentation needed to reach a useable embodiment that meets claim 1's conditions 1-1 and 1-2, claim 3's condition 2-1, or claim 4's condition 2-2 would be great. (Final 3–4).

"[E]xtensive experimentation does not necessarily render the experiments unduly extensive where the experiments involve repetition of known or commonly used techniques." *Cephalon, Inc. v. Watson Pharm.,*

Inc., 707 F.3d 1330, 1338 (Fed. Cir. 2013). "[T]he focus 'is not merely quantitative, since a considerable amount of experimentation is permissible, if it is merely routine, or if the specification in question provides a reasonable amount of guidance. . . .'" *Id.* at 1339 (quoting *PPG Indus., Inc. v. Guardian Indus., Corp.*, 75 F.3d 1558, 1564 (Fed. Cir. 1996) (citation and quotation omitted).

The Examiner does not provide evidence that the examples in the Appellant's Specification in combination with Endo's examples, the synthesis examples in the references cited by Endo (¶¶ 43–45), any other available prior art, and the compositional and use similarities of the Appellant's compounds and their combinations, would have been insufficient to enable one of ordinary skill in the art, by no more than routine experimentation, to make and use the full scope of compounds and their combinations encompassed by the Appellant's claims. The Examiner's mere assertions to that effect are insufficient to establish a prima facie case of nonenablement. Consequently, we reverse the rejection under 35 U.S.C. § 112(a).

CONCLUSION

The Examiner's rejections are AFFIRMED IN PART.

DECISION SUMMARY

In summary:

Claim(s) Rejected	35 U.S.C. §	Reference(s)/ Basis	Affirmed	Reversed
1, 4, 5, 7–17, 20-22	103	Endo	1, 4, 5, 7–17, 20-22	
18	103	Endo, Hwang	18	
19	103	Endo, Tsai	19	
1, 3–5, 7–15, 17–22	112(a)	Nonenablement		1, 3–5, 7–15, 17–22
Overall Outcome			1, 4, 5, 7–22	3

TIME PERIOD FOR RESPONSE

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a). *See* 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED IN PART