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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte CHUANJUN XIA, TING-CHIH WANG, and CHUN LIN

Appeal 2019-002618
Application 14/838,874
Technology Center 1700

Before MICHAEL P. COLAIANNI, SHELDON M. McGEE, and JANE E. INGLESE, *Administrative Patent Judges*.

COLAIANNI, *Administrative Patent Judge*.

DECISION ON APPEAL

Pursuant to 35 U.S.C. § 134(a), Appellant[1] appeals from the Examiner's decision to reject claims 1–19, 23, and 43–45. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM IN PART.

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

Appellant's invention is directed to a mixture of compounds useful for performing triplet-triplet annihilation upconversion, and devices, such as organic light emitting diodes, including the mixture (Spec. ¶ 3). Appellant's invention also is directed to a compound comprising a sensitizer group, an acceptor group, and an emitter group wherein the compound is capable of triplet-triplet annihilation (Spec. ¶ 29; claim 23).

Claim 1 is representative of the subject matter on appeal:

1. A formulation comprising a mixture of:

a sensitizer;

an acceptor; and

an emitter;

wherein the acceptor has a first triplet energy lower than a first triplet energy of the sensitizer;

wherein the emitter has a first singlet energy lower than a first singlet energy of the acceptor; and

wherein the sensitizer, the acceptor, and the emitter are jointly capable of performing triplet-triplet annihilation upconversion of light incident on the formulation to emit a luminescent radiation comprising a radiation component from the first singlet energy of the emitter.

Appellant appeals the following rejections:

1. Claims 1–15, 17, 18, 44, and 45 are rejected under 35 U.S.C. § 103 as unpatentable over Aziz (US 6,392,250 B1; issued May 21, 2002) in view of Oh (EP 1 437 395 A2; published July 14, 2004).
2. Claim 19 is rejected under 35 U.S.C. § 103 as unpatentable over Aziz in view of Oh and Burrows (US 5,917,280; issued June 29, 1999).
3. Claims 1–18, 44, and 45 are rejected under 35 U.S.C. § 103 as

unpatentable over Hieda (US 2004/0232830 A1; published Nov. 25, 2004) in view of Oh.

4. Claim 19 is rejected under 35 U.S.C. § 103 as unpatentable over Hieda in view of Burrows.
5. Claims 23 and 43 are rejected under 35 U.S.C. § 103 as unpatentable over Tokito (US 7,250,226 B2; issued July 31, 2007) in view of Mori (US 5,281,489; issued Jan. 25, 1994) and Oh.

FINDINGS OF FACT & ANALYSIS

Rejection (1)

The Examiner finds that Aziz teaches the subject matter of claim 1, except for the specific pyrene derivatives recited by Appellant in claim 8 (Final Act. 2–3). The Examiner finds that Oh teaches using modified pyrene as recited in claim 8 as a fluorescent dopant (Final Act. 3). The Examiner concludes that it would have been obvious to select Oh's pyrene as a fluorescent dopant in Aziz's mixed layer as the substitution of one known functional material for another (Final Act. 3). The Examiner finds that based on the identity of Aziz's and Oh's compounds to those recited in the claims, the compounds would inherently function as a sensitizer, an acceptor, and an emitter as recited in the claims (Final Act. 4).

Appellant argues that although Aziz teaches that "at least one selected dopant" may be added to the mixed region 38, Aziz does not instruct how to select the dopants to affect upconversion of light based on their singlet/triplet energies (Appeal Br. 5–6). Appellant argues that Aziz and Oh fail to motivate a person of ordinary skill in the art to create a formulation of a sensitizer, an acceptor, and an emitter having the excited energy state

relationship recited in claim 1 (Appeal Br. 7–8). Although Appellant does not disagree with the Examiner's finding that it would have been within the skill of a person of ordinary skill in the art to make an emitting layer of Aziz of three dopants, Appellant contends that the recited energy characteristics depend on a precise selection which is not taught or suggested by the prior art (Appeal Br. 10 n.6). Appellant argues that Aziz provides no direction on which three dopants to select (Appeal Br. 15). Appellant contends that having more than one dopant in a single emitting layer of an organic light emitting diode (OLED) can result in quenching of excited states between dopants, which can lead to a decrease in quantum efficiency (Appeal Br. 15). Appellant argues that a combination of old elements in the absence of motivation to modify is not, without more, prima facie obvious (Appeal Br. 16). Appellant argues that the Examiner engaged in impermissible hindsight because Aziz does not expressly teach using three dopants and the only teaching to use three dopants is in Appellant's claims (Appeal Br. 18–19).

The Examiner finds that Aziz teaches using at least one dopant, which includes one or more dopants, such as three dopants (Ans. 4). The Examiner finds that Aziz teaches preferred dopants that are identical to those recited in the claims (Ans. 4–5). The Examiner finds that Aziz teaches using pyrenes as dopants but does not teach the particular pyrene-amine recited in claim 8 (Ans. 3–4). The Examiner relies on Oh to teach the particular pyrene-amine recited in the claims as a pyrene dopant in an OLED (Ans. 3–4). The Examiner finds that because the same compounds as disclosed by Appellant and recited in the claims are used in Aziz, then the recited excited singlet-triplet energy state along with triplet-triplet annihilation would have flowed naturally from using the same materials (Ans. 14–15). We agree.

Appellant concedes that it would have been obvious in light of Aziz's teaching to form composition having three dopants (Appeal Br. 10, n.6). Appellant contends that there is no reason, absent hindsight, to select the three particular dopants having the recited energy properties based on the teachings of Aziz and Oh (Appeal Br. 18–19). Appellant's arguments do not contest that Aziz teaches dopants such as fac tris (2-phenylpyridine)iridium (i.e., $Ir(ppy)_3$) and anthracene that are identical to those claimed and disclosed by Appellant (Appeal Br. *generally*). Aziz further teaches that pyrene can be used as a dopant but Aziz does not teach the pyrene-amine recited in claim 8[2] (Final Act. 3). The Examiner finds that Oh teaches the particular pyrene-amine recited in claim 8 that is used as a dopant in an OLED device (Final Act. 3). In other words, the Examiner reasonably concludes that it would have been obvious to use Aziz's preferred dopants in the OLED device. Although Appellant contends that there is no reason except for hindsight to select only three dopants having the triplet/singlet energy properties recited in the claims, we determine that Aziz's teaching to use anthracene, pyrene, and $Ir(ppy)_3$ as dopants among the disclosed dopants, in combination with Oh's teaching of a pyrene-amine suitable as a dopant for an OLED, would have rendered obvious their use. *Merck v. Biocraft Laboratories, Inc.*, 874 F.2d. 804, 807 (Fed. Cir. 1989) ("That the '813 patent discloses a multitude of effective combinations does not render any particular formulation less obvious.").

Appellant's arguments concerning the lack of a reason for the particular dopant selections is misplaced because the Examiner finds that

[2] Claim 8 depends from claim 1 and further limits the acceptor limitation in claim 1 by reciting specific acceptors.

Aziz teaches using each of the disclosed dopants and Oh teaches an acceptable pyrene-amine material for use as a dopant in an OLED (Final Act. 2–3). The Examiner finds that the substitution of Oh's pyrene-amine for Aziz's pyrene is merely a substitution of one known functional material for another (Final Act. 3). Appellant argues that the office provides little or no reason why a person of ordinary skill would have created the claimed formulation with the dopant of Aziz and the pyrene dopant of Oh, other than that each component was previously known (Appeal Br. 13). Appellant does not, however, dispute the Examiner's reason for the modification based upon the predictable substitution of one known dopant for another (Appeal Br. 12–20). The Examiner additionally determines that based on the disclosures of Aziz and Oh of a limited number of effective solutions, it would have been obvious to try the various disclosed dopants that are effective for use in an OLED, including Aziz's disclosed anthracene, $Ir(ppy)_3$ and pyrene, and Oh's pyrene-amine dopant (Ans. 18–19). Appellant does not specifically dispute the Examiner's obvious to try rationale (Reply Br. 2–6). *See also In re Kubin*, 561 F.3d 1351, 1359 (Fed. Cir. 2009) ("[W]here a skilled artisan merely pursues 'known options' from a 'finite number of identified, predictable solutions,' obviousness under § 103 arises." (quoting *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007)).

We do not find that the Examiner engaged in impermissible hindsight. Rather, the Examiner applied the teachings of the references in arriving at the conclusion that the subject matter of claim 1 would have been obvious. Appellant argues for the first time in the Reply Brief that the Examiner's proposed combination would have changed Aziz's principle of operation because Aziz's dopants would not function as emitters or as a final energy

receiver (Reply Br. 4). We will not consider this untimely argument because there is no reason that this argument could not have been made earlier in prosecution. *See* 37 CFR 41.41(b)(2). We find that the preponderance of the evidence favors the Examiner's findings and conclusions of the obviousness of claims 1, 4–10, 12, 14, 15, 18, and 45 over Aziz and Oh.

Claims 11, 17, and 44

Appellant argues that claims 11, 17, and 44 require the acceptor to comprise at least 50 wt.% of the total mass of the mixture of the sensitizer, the acceptor, and the emitter combined (Appeal Br. 22). Appellant contends that the Examiner's rejection of these claims is conclusory and based on hindsight (Appeal Br. 22). Appellant argues that a person of ordinary skill would have had to select the three dopants from Aziz's list of dopants and then select one of the three to function as an acceptor and use that dopant in an amount of 50% of the total composition (Appeal Br. 22).

Appellant's arguments regarding the selection of the particular three dopants are not persuasive for the reasons discussed above in this decision. We are unpersuaded by Appellant's argument that the Examiner's rejection is conclusory and based on hindsight. The Examiner's rejection is based upon Aziz's teaching that anthracene may be used as the electron transport material in the mixed region 38 (Final Act. 4). The Examiner further finds that Aziz teaches that the mixed region may include mixtures of any of the suitable exemplary hole transport materials, electron transport materials, and dopant materials described (Final Act. 4). The Examiner finds that the amount of the electron transport material may be 95 to 5 wt.% of the mixed region (Final Act. 4). The Examiner concludes that it would have been

obvious to have formed a mixed region having at least 50 wt.% of anthracene material of the total emitter, acceptor, and sensitizer materials in the mixed region because Aziz teaches a range that includes anthracene in that proportional amount (Final Act. 4). Appellant's broad arguments do not address the Examiner's specific findings based on Aziz's teachings.

We affirm the § 103 rejection of claims 11, 17, and 44 over Aziz in view of Oh.

Claims 2, 3, and 13

Appellant argues that the emitter component of claim 2 must have both a "first singlet energy lower than a first singlet energy of the acceptor" as recited in claim 1, and a "first triplet energy higher than the first triplet energy of the acceptor" as recited in claim 2 (Appeal Br. 23). Appellant contends that there is a technical reason for this respective ordering of the two singlet/triplet energy states which is not taught or suggested by Aziz and Oh (Appeal Br. 23).

Claim 3 requires that the emitter has a first triplet energy higher than the first triplet energy of the sensitizer, and wherein the emitter has the first singlet energy higher than the first singlet energy of the sensitizer. Appellant argues that the three-component formulation was designed to minimize competing pathways for the generated singlet state of the sensitizer (Appeal Br. 23–24).

The Examiner finds that the claims do not require the very specific triplet-triplet annihilation upconversion (TTA-UC) (Ans. 24, 25). The Examiner finds that claim 1 and claim 2 by its dependency on claim 1 only require that the emitter, acceptor, and sensitizer be "capable of" the TTA-UC

(Ans. 12). We agree that the claims only require materials capable of performing the TTA-UC process.

The Examiner finds that Aziz and Oh teach materials identical to the claimed acceptor and emitter (Ans. 24, 25). The Examiner explains that Aziz's and Oh's identical materials would have the same properties including the TTA-UC (Ans. 25).

Appellant's argument does not show reversible error with the respect to these findings. Because Aziz and Oh teach materials identical to those disclosed and claimed by Appellant it is reasonable to determine that these materials would have been capable of performing the TTA-UC. *In re Spada*, 911 F.2d 705, 708 (Fed. Cir. 1990) ("Products of identical composition cannot have mutually exclusive properties.").

We affirm the Examiner's § 103 rejection of claims 2, 3, and 13 over Aziz and Oh.

Rejection (3): § 103 Hieda in view of Oh

Appellant argues that the rejection of claim 1 should be reversed for the same reason that the rejection of claim 1 over Aziz and Oh should be reversed (Appeal Br. 24). As discussed above, we did not find that Appellant has established reversible error with the Examiner's § 103 rejection over Aziz and Oh. We are unpersuaded by Appellant's argument.

Appellant argues that Hieda's disclosure is similar to that in Aziz in that Hieda is an OLED with a phosphorescent emitter within an organic host material(s) (Appeal Br. 25). Appellant contends that Hieda does not disclose anything about making or creating a formulation from a precise selection of

dopants, nor an emitting layer of an OLED from such dopants (Appeal Br. 24). Appellant argues that the Examiner dismissed or discounted the critical relative ordering of the lower singlet/triplet energy levels of the three recited components in claim 1 (Appeal Br. 26).

The Examiner finds that Hieda teaches an OLED having a luminescent layer comprising a host material and dopant material (Final Act. 7). The Examiner finds that Hieda teaches the luminescent layer may contain anthracene or rubrene as the host material with pyrene derivatives and tris(2-phenylpyridine) iridium or a platinum porphyrin as dopants (Final Act. 7). The Examiner finds that Oh teaches a pyrene-derivative used as a fluorescent dopant in an OLED (Final Act. 7). The Examiner concludes that it would have been obvious to use Oh's pyrene-derivative fluorescent dopant as the pyrene-derivative dopant in Hieda's device because Hieda and Oh are directed to similar OLEDs (Final Act. 8).

Appellant's arguments do not establish reversible error with the Examiner's stated rejection. Although Hieda may not disclose that the particular dopants or host material possess the singlet/triplet energy characteristics, Hieda and Oh teach the same materials used by Appellant in the luminescent layer (Final Act. 7–8). Because the same materials are used, Hieda's composition would have the same singlet/triplet energy levels and triplet-triplet annihilation properties as recited in the claim. *In re Spada*, 911 F.2d at 708.

Appellant argues the first time in the Reply Brief that the Examiner's proposed combination would have changed Hieda's principle of operation because Hieda's dopants would not function as emitters (Reply Br. 4-5). We will not consider this untimely argument because there is no reason that this

argument could not have been made earlier in prosecution. *See* 37 CFR 41.41(b)(2).

On this record, we affirm the Examiner's § 103 rejection of claims 1–18, 44, and 45 over Hieda and Oh.

Rejections (2) and (4): Claim 19

Claim 19 depends from claim 12 and further recites "wherein the first device comprises an organic light emitting device comprising an emissive material having an emissive spectrum; and the first organic layer is disposed adjacent to the organic light emitting device such that light emitted by the organic light emitting device is incident on the first organic layer."

The Examiner finds that Aziz does not teach using multiple devices together (Final Act. 5). The Examiner finds that Burrows teaches that individual light emitting elements may be stacked wherein light emitted from an upper placed OLED is incident upon a lower placed OLED (Final Act. 5). The Examiner concludes that it would have been obvious to have formed stacked devices and to have placed a device over another device comprising a mixed region as taught by Aziz and Oh because a person of ordinary skill would have expected that a stacked structure of devices to provide multi-colored emission for a full color display device for a variety of applications with a predictable result and reasonable expectation of success (Final Act. 5).

Appellant argues that the Examiner's determination that stacking an OLED atop of Aziz's OLED is not taught or suggested by the prior art and the only suggestion to provide such an arrangement is based upon impermissible hindsight (Appeal Br. 21).

Contrary to Appellant's argument, the Examiner's reason for the modification is based upon Burrow's teaching that it was known to stack OLEDs producing different colors atop one another to provide a consolidated structure capable of producing and blending different colors (e.g., a pixel) (Final Act. 5; Burrows col. 1, ll. 15–22). Burrows teaches that the stacked OLED arrangement may be used in a wide variety of applications including computer displays, informational displays in vehicles, television monitors, telephones, printers, illuminated signs, large-area screens, and billboards (Burrows, col. 2, ll. 13–17). Similarly, Aziz teaches the OLED may be used in displays in automobiles and other types of vehicles, computer monitors, televisions, and other electronic devices (Aziz, col. 16, ll. 3–6).

Based upon the similarity of use, we find that the Examiner's rejection is not based on impermissible hindsight as argued by Appellant, but rather what the teachings of the references would have suggested using a stacked arrangement to provide a full color display in a variety of applications as stated by the Examiner (Final Act. 5). Once combined, the Examiner reasonably finds that because Aziz uses the same dopants, the up-conversion of light emitted from a neighboring OLED would have resulted.

Regarding the Examiner's rejection (4) over Hieda in view of Burrows, Appellant relies on the arguments made regarding the rejection of Aziz in view of Oh and Burrows (Appeal Br. 26–27). We find those arguments unpersuasive for the same reasons discussed above.

We affirm the Examiner's § 103 rejections of claim 19 over Aziz in view of Oh and Burrows, and Hieda in view of Burrows.

Rejection (5): Claims 23 and 43

Appellant argues that there is no teaching or suggestion in Tokito, Mori, and Oh, either alone or collectively, to motivate a person of ordinary skill to create the compound of claim 23 having all three structure/function components in one compound, oligomer, or polymer (Appeal Br. 29). Appellant contends that the Examiner merely finds that each structure is known in the OLED art and then proceeds to stitch the functionalities together (Appeal Br. 29). Appellant contends that the Examiner has not provided the requisite motivation to add the third, emitter component, to Tokito's two component phosphorescent polymer (Appeal Br. 30). Appellant contends that Tokito's carrier group disclosure is quite limited to a class of compounds that may include groups of tertiary amine, but the Examiner has not explained why based on Tokito's generic disclosure a person of ordinary skill would have selected Oh's S-16 pyrene compound as the tertiary amine to add to Tokito's polymer structure (Appeal Br. 30). We agree.

The Examiner finds that Tokito teaches a phosphorescent compound comprising phosphorescent and carrier transporting units (Final Act. 6). The Examiner finds that Tokito teaches that the $Ir(ppy)_3$ may be part of the compound, which corresponds to the claimed sensitizer (Final Act. 6). The Examiner finds that Tokito teaches using spacer portions in the compound and hole carrier transport portion (Final Act. 6). The Examiner finds that Tokito does not teach using anthracene as the carrier transport material (Final Act. 6). The Examiner finds that Mori teaches using anthracene as a hole moving agent (i.e., carrier transport), which would correspond to the claimed acceptor group (Final Act. 6). The Examiner finds that Tokito

discloses a hole carrier transport group comprising an amine but does not exemplify a diaminopyrene derivative, which would correspond to the claimed emitter group (Final Act. 6). The Examiner finds that Oh teaches a tertiary amine compound S-16 for use in an electroluminescent device (Final Act. 6). The Examiner concludes that it would have been obvious to have formed Tokito's polymer compound including spacer groups, an $Ir(ppy)_3$ group, and known carrier transport type groups as disclosed by Mori and Oh, because "one would expect the groups disclosed by Mori and Oh to be useful as carrier transporting sites in a polymer according to Tokito" (Final Act. 7).

Tokito discloses a polymer containing phosphorescent units and carrier transporting units (Tokito, col. 2, ll. 33–39). Tokito discloses that the carrier transporting units may include hole and/or electron transporting units (Tokito, col. 3, ll. 47–50, col. 4, ll. 1–5). Tokito discloses that the carrier-transporting unit includes at least one kind of groups selected from monovalent groups of tertiary amines (Tokito, col. 4, ll. 47–67).

The Examiner finds that Oh teaches a tertiary amine that could be used as the carrier-transporting group in Tokito's polymer (Final Act. 6). Oh teaches a separate compound that is added to the blend to impart a blue emitting material to the mixture (¶¶ 15, 23, 34). In other words, Oh does not teach using the blue emitter compound S-16 as a functional group on a polymer in an emitter layer. The Examiner does not explain how a person of ordinary skill in the art would have modified Oh's distinct compound to a tertiary amine group that would become part of Tokito's polymeric compound. We find that the Examiner has not established a prima facie case

that the combined teachings of Tokito, Mori, and Oh would have rendered obvious the compound recited in claim 23 or the device of claim 43.

We reverse the Examiner's § 103 rejection of claims 23 and 43 over Tokito in view of Mori and Oh.

CONCLUSION

In summary:

Claims Rejected	35 USC §	Reference(s)/Basis	Affirmed	Reversed
1–15, 17, 18, 44, 45	103	Aziz, Oh	1–15, 17, 18, 44, 45	
19	103	Aziz, Oh, Burrows		
1–18, 44, 45	103	Hieda, Oh	1–18, 44, 45	
19	103	Hieda, Burrows	19	
23, 43	103	Tokito, Mori, Oh		23, 43
Overall Outcome			1–19, 44, 45	23, 43

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