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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte AYA MIKI, SHINYA MORITA, HIROSHI GOTO, TOSHIHIRO KUGIMIYA, HIROAKI TAO, and KENTA HIROSE[1]

Appeal 2018-002441
Application 14/416,927
Technology Center 2800

Before JOSEPH L. DIXON, JAMES R. HUGHES, and ERIC S. FRAHM, *Administrative Patent Judges*.

HUGHES, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Appellant seeks our review under 35 U.S.C. § 134(a) of the Examiner's decision finally rejecting claims 1–5 and 7–15. Claim 6 has been canceled.[2] *See* Final Act. 1; Appeal Br. 1, 20. We have jurisdiction under 35 U.S.C. § 6(b). An Oral Hearing was held on August 21, 2019.

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[1] Kabushiki Kaisha Kobe Seiko Sho (Kobe Steel, LTD.) ("Appellant") is the applicant as provided in 37 C.F.R. § 1.46 and is identified as the real party in interest. Appeal Br. 2.

[2] We refer to Appellant's Specification ("Spec.") filed Jan. 23, 2015 (claiming benefit of PCT/JP2013/073371, filed Aug. 30, 2013; JP2012/192667, filed Aug. 31, 2012; and JP2013/094088, filed April 26,

We reverse.

Appellant's Invention

The "invention relates to a thin-film transistor (TFT) to be used in display devices such as liquid crystal displays." Spec. ¶ 1. More specifically, a TFT with a laminated gate insulator film comprising a first layer in direct contact with an oxide semiconductor layer, and the first layer having a hydrogen concentration of 4 atomic percent (%) or less is described. *See* Abstract; Spec. ¶ 12; *see also* Spec. ¶¶ 11, 13–19.

Representative Claim

Independent claim 1, reproduced below, further illustrates the invention:

> 1. A thin film transistor comprising;
>
> a gate electrode,
>
> an oxide semiconductor layer, and
>
> a gate insulator film,
>
> wherein:
>
> the oxide semiconductor layer is configured as a channel layer, and the oxide semiconductor layer comprises at least one metal selected from the group consisting of In, Ga, Zn, and Sn, with the proviso that an oxide semiconductor consisting of Sn and at least one of In and Zn is excluded,
>
> the gate insulator film is interposed between the gate electrode and the channel layer,

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2013; Appeal Brief ("Appeal Br.") filed May 25, 2017; and Reply Brief ("Reply Br.") filed Jan. 2, 2018. We also refer to the Examiner's Final Office Action ("Final Act.") mailed Dec. 9, 2016; and Answer ("Ans.") mailed Nov. 1, 2017.

> the gate insulator film is a laminate structure comprising a first layer, which is in direct contact with the oxide semiconductor layer, and one or more other layers,
>
> the first layer of the gate insulator film has a hydrogen concentration of 4 atomic% or lower, and
>
> the one or more other layers of the gate insulator film have a hydrogen concentration higher than the first layer.

Appeal Br. 18 (Claim App.).

Rejections on Appeal[3]

1. The Examiner rejects claims 1, 2, and 7–15 under 35 U.S.C. § 103(a) as being unpatentable over Sakama *et al*. (US 6,521,912 B1; issued Feb.18, 2003 (filed Nov. 2, 2000)) ("Sakama") and Yang *et al*. (US 2012/0256176 A1; published Oct. 11, 2012 (filed Mar. 8, 2012)) ("Yang"). *See* Final Act. 2–5.

2. The Examiner rejects claims 1, 3–5, and 7–15 under 35 U.S.C. § 103(a) as being unpatentable over Sakama and Iwasaki *et al*. (US 2009/0189153 A1; published July 30, 2009) ("Iwasaki"). *See* Final Act. 7–10.

ISSUE

Based upon our review of the record, Appellant's contentions, and the Examiner's findings and conclusions, the issue before us follows:

[3] The Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112-29, 125 Stat. 284 (2011), amended 35 U.S.C. § 103, e.g., to rename 35 U.S.C. § 103's subsections. Because the present application has an effective filing date (Aug. 31, 2012) earlier than the AIA's effective date for applications (March 16, 2013), this decision refers to the pre-AIA versions of 35 U.S.C. § 103 (i.e., § 103(a)).

Did the Examiner err in concluding that Sakama (in combination with either Yang or Iwasaki) would have taught or suggested a "thin film transistor" with an "oxide semiconductor layer, and a gate insulator film" that has "a laminate structure comprising a first layer, which is in direct contact with the oxide semiconductor layer, and one or more other layers," and "the first layer of the gate insulator film has a hydrogen concentration of 4 atomic% or lower, and the one or more other layers of the gate insulator film have a hydrogen concentration higher than the first layer," as recited in Appellant's claim 1?

ANALYSIS

Obviousness Rejection of Claims 1, 2, and 7–15

The Examiner rejects independent claim 1 (as well as dependent claims 2 and 7–15) as being obvious in view of Sakama and Yang based on claim 1. *See* Final Act. 2–5; Ans. 16–20. The Examiner cites Sakama as teaching most aspects of the claim, including a "first layer of the gate insulator film [that] has a hydrogen concentration of 4 atomic% or lower" (Final Act. 3), and relies on Yang to teach oxide semiconductor layer comprised of one or more of In, Ga, Zn, and Sn (Final Act. 3). *See* Final Act. 2–5; Ans. 16–20 (citing Sakama, col. 4, ll. 11–23; Fig. 3E (element 110), and Yang ¶ 44). The Examiner also finds "Sakama and Yang fail to teach" a laminated (multi-layer) gate insulator film where "the one or more other layer[s] of the gate insulator film has a hydrogen concentration higher than the first layer" (Final Act. 4).

Appellant contends that Sakama and Yang do not teach the disputed limitations of claim 1. *See* Appeal Br. 6–16; Reply Br. 1–5.[4] Specifically, Appellant contends that "Sakama teaches that . . . the hydrogen concentration of the gate insulating film on the semiconductor layer side must be high as compared with the hydrogen concentration on the gate electrode side" (Appeal Br. 9) and, therefore, "Sakama does not describe or suggest the claimed hydrogen concentration distribution in the gate insulator film. Indeed, the claimed hydrogen concentration distribution in the gate insulator film is *the exact opposite* of the hydrogen concentration distribution in the gate insulating film described in Sakama" (Appeal Br. 10). *See* Appeal Br. 9–13; Reply Br. 1–4.

We agree with Appellant's arguments that Sakama (in combination with Yang) does not teach or suggest the disputed limitation of a TFT with a laminated gate insulator film "comprising a first layer, which is in direct contact with the oxide semiconductor layer, and one or more other layers," and where "the first layer . . . has a hydrogen concentration of 4 atomic% or lower" (claim 1). *See* Appeal Br. 6–16; Reply Br. 1–5.

Although Sakama describes a TFT with a multi-layer gate insulator film including a layer with a hydrogen percentage less than four percent (4%)—*see* Sakama col. 4, ll. 16–20—Sakama also describes the hydrogen percentage being lower near the gate electrode (farther from the oxide semiconductor layer) and higher near the oxide semiconductor layer. *See* Sakama col. 4, ll. 4–24; Figs. 1A–1C, 3A–3F. At best, Sakama's disclosure

[4] Appellant's Reply Brief does not include page numbers. We reference the Reply Brief as if consecutively numbered beginning at page 1.

shows a hydrogen concentration meeting a portion of the disputed limitations—a concentration being 4% or less.

The Examiner does not sufficiently explain how the combination of Sakama and Yang at least suggests a multi-layer gate insulator film having the recited structure and hydrogen concentrations. Without further explanation, we are left to speculate as to how Sakama describes the disputed features of Appellant's claim 1.

Consequently, we are constrained by the record to find that the Examiner erred in concluding Sakama (in combination with Yang) teaches the requisite gate insulator film structure of Appellant's claim 1. Dependent claims 2 and 7–15 depend from and stand with claim 1. Accordingly, we do not sustain the Examiner's obviousness rejection of claims 1, 2, and 7–15.

Obviousness Rejections of Claims 1, 3–5, and 7–15

The Examiner also rejects independent claim 1 (and dependent claims 3–5, and 7–15) as being unpatentable over Sakama and Iwasaki. *See* Final Act. 7–10.

The Examiner has not established on this record that the alternately cited Iwasaki reference overcomes or cures the aforementioned deficiency of Sakama. Dependent claims 3–5 and 7–15 depend from claim 1. Accordingly, we do not sustain the Examiner's obviousness rejection of claims 1, 3–5, and 7–15 over Sakama and Iwasaki for the same reasons as claim 1 over Sakama and Yang (*supra*).

CONCLUSION

Appellant has shown that the Examiner erred in rejecting claims 1–5 and 7–15 under 35 U.S.C. § 103(a).

DECISION

We reverse the Examiner's rejections of claims 1–5 and 7–15.

REVERSED