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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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*Ex parte* PAUL GANITZER, ARNO ZECHMANN,  
and MICHAEL JACOB

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Appeal 2018-000058  
Application 14/171,839  
Technology Center 2800

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Before ADRIENE LEPIANE HANLON, TERRY J. OWENS, and  
MONTÉ T. SQUIRE, *Administrative Patent Judges*.

SQUIRE, *Administrative Patent Judge*.

DECISION ON APPEAL<sup>1</sup>

Appellant<sup>2</sup> appeals under 35 U.S.C. § 134(a) from the Examiner’s decision to finally reject claims 1–30, which constitute all the claims pending in this application. We have jurisdiction under 35 U.S.C. § 6(b).

We REVERSE.

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<sup>1</sup> In explaining our Decision, we refer to the Specification filed February 4, 2014 (“Spec.”); Final Office Action dated November 10, 2016 (“Final Act.”); Advisory Action dated January 3, 2017 (“Adv. Act.”); Appeal Brief filed April 18, 2017 (“Appeal Br.”); Examiner’s Answer dated August 11, 2017 (“Ans.”); and Reply Brief filed October 2, 2017 (“Reply Br.”).

<sup>2</sup> Appellant is Applicant Infineon Technologies AG (Bib Data Sheet 1), which is also identified as the real party in interest (Appeal Br. 3).

*The Claimed Invention*

Appellant's disclosure relates to a wafer based BEOL (back end of line) process for chip embedding. Spec. ¶ 1. The Specification describes a semiconductor device, including a semiconductor body with a drift region and a gate electrode arranged adjacent to the drift region; a contact structure provided over the drift region of the semiconductor body and having a first metal layer, an adhesion layer over the first metal layer and a second metal layer over the adhesion layer; and a method for manufacturing the semiconductor device. *Id.* ¶¶ 6, 85; *see also* Abstract.

Claim 1 is illustrative of the claimed subject matter on appeal and is reproduced below from the Claims Appendix to the Appeal Brief:

1. A semiconductor device, comprising:
  - a semiconductor body having a front side and a back side opposite to the front side, the semiconductor body comprising a semiconductor layer, a drift region and a gate electrode arranged adjacent to the drift region, wherein the drift region and the gate electrode are incorporated within the semiconductor layer; and
  - a contact structure provided over the semiconductor body at a position located over the drift region of the semiconductor body and having a first metal layer, an adhesion layer over the first metal layer and a second metal layer over the adhesion layer, wherein the contact structure electrically and mechanically contacts the drift region at the front side of the semiconductor body, and wherein the first metal layer does not extend over the gate electrode; and
  - a back side metal layer disposed on the back side of the semiconductor body, wherein the back side metal layer electrically contacts the drift region at the back side of the semiconductor body.

Appeal Br. 22 (Claims App.).

*The References*

The Examiner relies on the following prior art references as evidence in rejecting the claims on appeal:

Wieczorek et al., ("Wieczorek")	US 2002/0056879 A1	May 16, 2002
Chang et al., ("Chang")	US 2007/0075360 A1	Apr. 5, 2007
Wu	US 2007/0075362 A1	Apr. 5, 2007
Hayashi	US 2008/0073706 A1	Mar. 27, 2008
Hsieh	US 2009/0315106 A1	Dec. 24, 2009

*The Rejections*

On appeal, the Examiner maintains (Ans. 1–2) the following rejections:

1. Claims 1–8, 13, 14–18, and 26–30 rejected under 35 U.S.C. § 103 as being unpatentable over Wu in view of Hsieh ("Rejection 1"). Final Act. 3.
2. Claims 9 and 19 rejected under 35 U.S.C. § 103 as being unpatentable over Wu and Hsieh as applied to claims 1 and 14, respectively above, and further in view of Hayashi ("Rejection 2"). Final Act. 11.
3. Claims 10–12 and 20–23 rejected under 35 U.S.C. § 103 as being unpatentable over Wu and Hsieh as applied to claims 1 and 14, respectively above, and further in view of Wieczorek ("Rejection 3"). Final Act. 12.
4. Claims 24 and 25 rejected under 35 U.S.C. § 103 as being unpatentable over Wu in view of Chang and Hsieh ("Rejection 4"). Final Act. 15.

OPINION

Rejection 1

Having considered the respective positions advanced by the Examiner and Appellant in light of this appeal record, we reverse the Examiner's Rejection 1 for principally the same reasons provided by Appellant at pages 14–18 of the Appeal Brief and pages 3–8 of the Reply Brief. We add the following.

The Examiner determines that the combination of Wu and Hsieh suggests a semiconductor device satisfying all of the limitations of claim 1 and thus, concludes that the combination would have rendered the claim obvious. Final Act. 3–5 (citing Wu, Figs. 3A–3G, ¶¶ 21, 25–27; Hsieh, Fig. 3, ¶¶ 14, 35, and 44).

The Examiner concludes that

it would have been obvious to one having ordinary skill in the art at the time the invention was made to use the back side metal layer disposed on the back side of the semiconductor body, wherein the back side metal layer electrically contacts the drift region at the back side of the semiconductor body of Hsieh with the structure of Wu to provide lower resistance drain ohmic contacts.

*Id.* at 4–5 (citing Hsieh ¶ 25). The Examiner finds and acknowledges that, from a structural standpoint, the proposed combination of Wu and Hsieh would result in “the modification of the contact structure of Wu to include the source contact plugs of Hsieh.” Ans. 3.

Appellant argues that the Examiner's rejection should be reversed because “one skilled in the art would not have a reason or have been motivated to combine the teachings of *Wu* and *Hsieh* as proposed.” Appeal Br. 15; *see also* Reply Br. 3–8. In particular, Appellant contends that it

would not make sense to introduce the contact plug 222 of Hsieh into the device of Figure 3G of Wu because the structure of Wu's device is specifically designed for planar contacts and not for contact plugs. *Id.* at 16–17 (citing Wu, Fig. 3G; Hsieh, Fig. 3). Appellant argues that, in effect, the Examiner's proposed combination would result in Wu's device, which is based and designed around planar contacts exposed at the surface of the semiconductor body, being modified and replaced to include the trench contact plugs of Hsieh. Reply Br. 3.

Appellant maintains that

it would be illogical to replace Wu's planar structures (e.g., elements 210/211), which are located above the semiconductor body (201), with contact plugs from Hsieh positioned above said semiconductor body for the reason that Hsieh specifically discloses replacing planar structures with contact plugs that extend into and within a semiconductor body.

*Id.* at 7 (formatting omitted).

The weight of the evidence supports Appellant's argument. We agree that the Examiner has not established by a preponderance of the evidence that one of ordinary skill in the art would have combined the teachings of Wu and Hsieh to arrive at the claimed invention for the reasons proposed by the Examiner. *In re Oetiker*, 977 F.2d 1443, 1445 (Fed. Cir. 1992) (holding that the examiner bears the initial burden of establishing a prima facie case of obviousness).

As Appellant correctly points out (Appeal Br. 16; Reply. Br. 3), Wu's device is specifically designed for planar contacts (210/211) located above the semiconductor body 201, and not for contact plugs. Wu, Fig. 3G, ¶ 27 (disclosing that the "source metal layer 211 is formed over a formed

structure surface”). As shown in Figure 3G of Wu, the p-base diffusion ring 204b and the heavily-doped n<sup>+</sup> source diffusion ring 205b are both designed to extend to and be exposed at the surface of the semiconductor body 201. *Id.* ¶ 28.

In contrast, as shown in Figure 3 of Hsieh, Hsieh’s device requires contact plugs 222 that extend down into the semiconductor layer to reach and contact the n<sup>+</sup> region 212 and p region 204. Hsieh ¶ 35 (“Trench contacts are penetrating through source region 212 and into the body region 204 with an area of P<sup>+</sup> doped area 240 at the bottom of each trench to reduce the resistance between trench contact metal plug 222 and body region in the trench MOSFET device portion.”). As further contrast to Wu’s device with planar contacts, Hsieh explicitly discloses at paragraph 12 that in its invention “the planar contact for both the MOSFET devices and Schottky barrier rectifier devices are replaced by the trench Schottky structure.”

The Examiner does not identify evidence or provide reasoning sufficient to support a finding that one of ordinary skill would have had reason to modify Wu’s device to replace planar contacts exposed at the surface of the semiconductor body with trench contact plugs that extend down into the semiconductor body, as would be required to arrive at the claimed invention. *See KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007) (requiring “reasoning with some rational underpinning to support the legal conclusion of obviousness”) (quoting *In re Kahn*, 441 F.3d at 988). In particular, at pages 3–5 of the Answer, the Examiner does not persuasively respond to Appellant’s principal argument that one of ordinary skill would have had no reason to modify Wu’s device in the manner claimed. For example, the Examiner does not direct us to any teaching or suggestion in

the prior art regarding the technical feasibility of substituting planar contacts with trench contact plugs; or why one of ordinary skill in the art would have had a reasonable expectation of success in modifying Wu's device in such a manner.

The Examiner's assertions that "[A]ppellant's approach to forming the claimed contact structure is commonly known" (Ans. 4) and that Wu's device and the prior art "produce the same result, a common source electrode" (*id.* at 5) are not persuasive because they are conclusory and, without more, insufficient to sustain the Examiner's rejection. *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (holding that rejections "cannot be sustained by mere conclusory statements").

We, therefore, cannot sustain the Examiner's rejection.

Accordingly, we reverse the Examiner's rejection of claims 1–8, 13, 14–18, and 26–30 under 35 U.S.C. § 103 as obvious over the combination of Wu and Hsieh.

Rejections 2, 3, and 4

The foregoing deficiencies in the Examiner's analysis and conclusion regarding Rejection 1 and flawed reasoning for combining Wu and Hsieh are not remedied by the Examiner's findings regarding the additional references or combination of references cited in support of the second, third, and fourth grounds of rejection (Rejections 2, 3, and 4 stated above).

Accordingly, for principally the same reasons discussed above in reversing the Examiner's Rejection 1, we also reverse the Examiner's Rejections 2, 3, and 4.

Appeal 2018-000058  
Application 14/171,839

DECISION

The Examiner's rejections of claims 1–30 are reversed.

It is ordered that the Examiner's decision is reversed.

REVERSED