

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

NVIDIA CORPORATION,
Petitioner,

v.

SAMSUNG ELECTRONICS CO., LTD.,
Patent Owner.

Case IPR2015-01062
Patent 7,056,776 B2

Before KEVIN F. TURNER, BEVERLY M. BUNTING, and
JON B. TORNQUIST, *Administrative Patent Judges*.

TURNER, *Administrative Patent Judge*.

DECISION
Institution of *Inter Partes* Review
37 C.F.R. § 42.108

I. INTRODUCTION

A. *Background*

NVIDIA Corporation (“Petitioner”) filed a Petition (Paper 2, “Pet.”) requesting *inter partes* review of claims 1, 2, 4, 19, 20, and 22 (“the challenged claims”) of U.S. Patent No. 7,056,776 B2 (Ex. 1001, “the ’776 Patent”). Samsung Electronics Co., Ltd. (“Patent Owner”) filed a Preliminary Response (Paper 6, “Prelim. Resp.”) to the Petition.

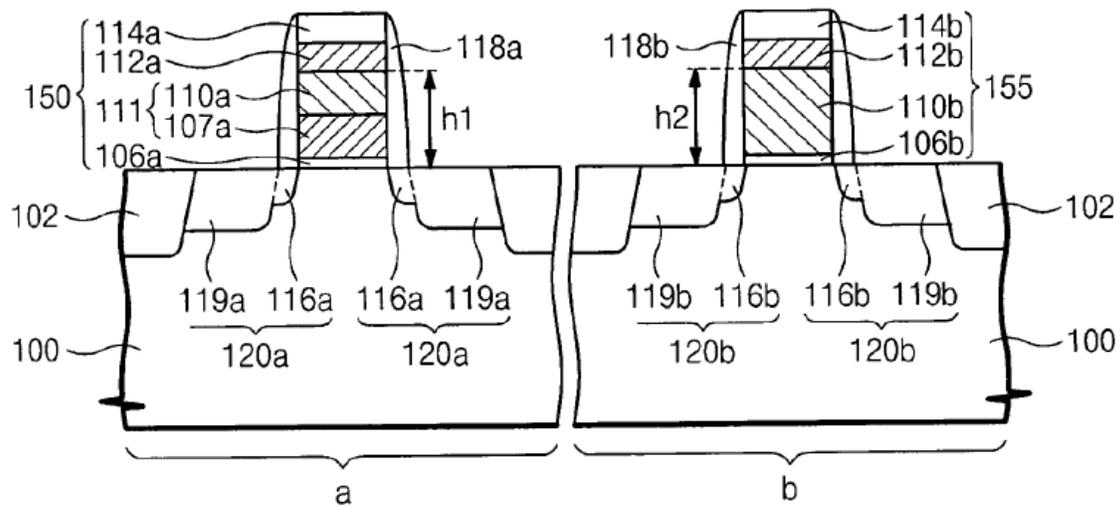
We have jurisdiction under 35 U.S.C. § 314(a), which provides that an *inter partes* review may not be instituted “unless . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” For the reasons given below, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing with respect to claims 1, 2, 4, 19, 20, and 22 of the ’776 Patent. Accordingly, we authorize an *inter partes* review to be instituted as to these claims on the ground set forth below.

B. *Related Proceedings*

The parties inform us that the ’776 Patent is the subject of an investigation before the International Trade Commission: *Certain Graphics Processing Chips, Systems on a Chip, and Products Containing the Same*, 337-TA-941 (USITC). Pet. 2; Paper 5, 2. Petitioner has filed additional petitions requesting *inter partes* review of the following related patents: U.S. Patent No. 6,147,385 (IPR2015-01065); and U.S. Patent No. 7,804,734 (IPR2015-01068 and IPR2015-01135). *Id.*

C. The '776 Patent

The '776 Patent is directed to semiconductor devices and methods of forming the same, where those devices have different gates. Ex. 1001, 1:13–16. The resulting devices are illustrated in Fig. 1 of the '776 Patent, reproduced below:



The method begins with semiconductor substrate 100 having NMOS region a and PMOS region b, each having field oxide layers 102. *Id.* at 6:57–7:3. NMOS metal 107 is deposited on insulation layer 104, and a portion of the NMOS metal is etched in the b region to form opening 108. *Id.* at 9:44–64, Figs. 2–3. Thereafter, PMOS metal 110 is deposited over the substrate and fills the opening, and low-resistance conductive layer 112 and hard mask layer 114 are also deposited, and subsequently etched, using photoresists 115a & 115b, to form gate pattern 150, containing first gate electrode 111, and to form gate pattern 155, containing second gate electrode 110b. *Id.* at 11:16–50, Figs. 4–5.

The first gate electrode 111 consists of a lower metal-containing conductive pattern 107a and an upper metal-containing conductive pattern

110a, and the second gate electrode 110b is a single-layered structure consisting of a metal-containing conductive pattern 110b. The first and second gate electrodes have substantially the same heights h_1 and h_2 relative to the substrate 100, including gate insulation layers 106a and 106b. *Id.* at 7:4–50, Fig 1. In particular embodiments, the second gate electrode 110b may have a higher work function than the lower metallic conductive pattern 107a, with the former having a work function ranging from about 4.8 eV to about 5.2 eV, and the latter having a work function ranging from about 4.0 eV to about 4.4 eV. *Id.* at 7:51–67.

D. Illustrative Claim

Of the challenged claims, claims 1 and 19 are independent. Claim 1 is illustrative of the challenged claims and is reproduced below:

1. A semiconductor device having at least two different gate electrodes, the at least two different gate electrodes, comprising:

a first gate electrode on a first gate insulation layer, the first gate electrode comprising a first metal-containing conductive pattern on the first gate insulation layer and a second metal-containing conductive pattern on the first metal-containing conductive pattern opposite the first gate insulation layer, the second metal-containing conductive pattern having a surface opposite the first gate insulation layer;

a second gate electrode on a second gate insulation layer, the second gate electrode comprising a third metal-containing conductive pattern on the second gate insulation layer, wherein the third metal-containing conductive pattern has a surface opposite the second gate insulation layer that is substantially planar with the surface of the second metal-containing conductive pattern; and

wherein *the first metal-containing conductive pattern and the third metal-containing conductive pattern have different work*

functions from each other and wherein the second metal-containing conductive pattern and the third metal-containing conductive pattern comprise a same metal-containing conductive material.

Ex. 1001, 13:60–14:17 (emphasis added).

E. The Asserted Grounds of Unpatentability

Petitioner asserts that the challenged claims are unpatentable on the following grounds (*see* Pet. 30–56):

Claims Challenged	Basis	Reference(s)
1, 2, 4, 19, 20, and 22	§ 102(e)	Park ¹
1, 2, 4, 19, 20, and 22	§ 103	Park and Doris ²

II. ANALYSIS

A. Claim Construction

In an *inter partes* review, “[a] claim in an unexpired patent shall be given its broadest reasonable construction in light of the specification of the patent in which it appears.” 37 C.F.R. § 42.100(b); *In re Cuozzo Speed Tech., LLC*, 793 F.3d 1268, 1275–79 (Fed. Cir. 2015). In determining the broadest reasonable construction, we presume that claim terms carry their ordinary and customary meaning. *See In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). This presumption may be rebutted when a patentee, acting as a lexicographer, sets forth an alternate definition of a term in the specification with reasonable clarity, deliberateness, and precision. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

¹ U.S. Patent No. 7,316,950 (Ex. 1003, “Park”).

² U.S. Patent No. 6,838,695 (Ex. 1011, “Doris”).

Petitioner proffers claim constructions for five terms: (1) “gate electrode,” (2) “metal-containing conductive pattern,” (3) “the third metal-containing conductive pattern has a surface . . . that is substantially planar with the surface of the second metal-containing conductive pattern,” (4) “work function,” and (5) “the first metal-containing conductive pattern and the third metal-containing conductive pattern have different work functions from each other.” Pet. 18–29. Patent Owner disputes Petitioner’s constructions for terms (1) and (5), and argues that the remaining terms do not need specific constructions. Prelim. Resp. 21–12.

Upon review of the record, we determine that claim terms (2)–(4) need not be construed for purposes of this decision. *See Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (“only those terms need be construed that are in controversy and only to the extent necessary to resolve the controversy”). We address the constructions of terms (1) and (5) below.

1. gate electrode

Independent claims 1 and 19 recite “gate electrode” in the context of “a first gate electrode” and “a second gate electrode.” Petitioner asserts that the broadest reasonable construction of the term is “a conductive structure distinct from any low-resistance conductive pattern, which controls the flow of current through the channel of a transistor.” Pet. 18 (citing Ex. 1007 ¶ 67). Petitioner rationalizes that the claims and Specification of the ’776 Patent distinguish gate electrodes from low-resistance conductive patterns and this distinction is important as the claims require that the top surfaces of the gate electrodes, and not other patterns on the devices, must be

substantially planar with each other. *Id.* at 18–21 (citing Ex. 1007 ¶¶ 67–73).

Patent Owner disputes this construction, and argues that “[n]o support exists for Petitioner’s construction,” and that the term “gate electrode” should be construed consistent with its plain and ordinary meaning as used in the Specification. Prelim. Resp. 8. Patent Owner continues that the Specification describes embodiments where the low-resistance conductive pattern is part of the gate electrode, and that “gate electrode” should be construed as an “electrode that controls the flow of current through a channel of a transistor.” *Id.* at 9–11 (citing Ex. 1001, 11:29–36, 12:58–60, Fig. 5). We generally agree with Patent Owner.

A plain reading of the claims does not require that the gate electrode be distinct from any low-resistance conductive pattern. Although the Specification of the ’776 Patent does disclose that the gate electrodes and the low-resistance conductive patterns are distinct, we are not persuaded that any construction of “gate electrode” must recite that distinction. Additionally, while a portion of the Specification does refer to elements 150 and 155 as “first and second gate electrodes” (Ex. 1001 12:59), the same paragraph, as well as the rest of the Specification, refers to elements 150 and 155 as first and second gate *patterns*. *Id.* at 12:58–13:11. Therefore, we are not persuaded that the Specification, overall, recites that the low-resistance conductive pattern is part of the gate electrode.

As such, we construe “gate electrode” as “a conductive structure that controls the flow of current through a channel of a transistor.”

2. *hav[ing] different work functions from each other*

Independent claims 1 and 19 recite the term “the first metal-containing conductive pattern and the third metal-containing conductive pattern have different work functions from each other.” Petitioner asserts that the broadest reasonable construction of the term is “the work function of the first metal-containing conductive pattern at its bottom surface is different from the work function of the third metal-containing conductive pattern at its bottom surface.” Pet. 28 (citing Ex. 1007 ¶ 88). Petitioner continues that one of ordinary skill in the art would have known that the work function of a structure refers to the work function at a particular surface, and that the work function would be determined from the bottom surface of the structure in the context of the Specification of the ’776 Patent. *Id.* at 28–29.

Patent Owner disputes this construction, and argues that Petitioner’s construction has no basis in the claim language or the Specification, and the claim language is clear and not in need of construction. Prelim. Resp. 5. Patent Owner continues that to extent that the claim term is construed, it should be construed as “the first metal-containing conductive pattern has a work function, and the third metal-containing conductive pattern has a work function that is different from the work function of the first metal-containing conductive pattern.” *Id.* at 7. We agree with Patent Owner that the claim term is not in need of construction.

A plain reading of the claims does not require that the work function be measured from the bottom of a structure. The broadest, reasonable construction, in view of the Specification, merely requires that the conductive patterns have different work functions, and the claim does not require that the work function be measured from a particular surface. As

such, we provide no specific construction for “the first metal-containing conductive pattern and the third metal-containing conductive pattern have different work functions from each other,” and rely on the clear language of the claim itself.

B. Anticipation by Park, Claims 1, 2, 4, 19, 20, and 22

Petitioner contends that claims 1, 2, 4, 19, 20, and 22 of the '776 Patent are unpatentable under 35 U.S.C. § 102(e) as being anticipated by Park. Pet. 30–48. In support of its contentions, Petitioner relies on the declaration testimony of Dr. Jack Lee (Ex. 1007). For the reasons that follow, we determine Petitioner has demonstrated a reasonable likelihood of prevailing as to claims 1, 2, 4, 19, 20, and 22 of the '776 Patent.

1. Park (Ex. 1003)

Park discloses a method of constructing a dual metal gate complementary metal-oxide semiconductor (“CMOS”) structure having an ultrathin aluminum nitride buffer layer between the metal gate and the gate dielectric during processing. Ex. 1003, Abs. Figure 2G is illustrative and reproduced below:

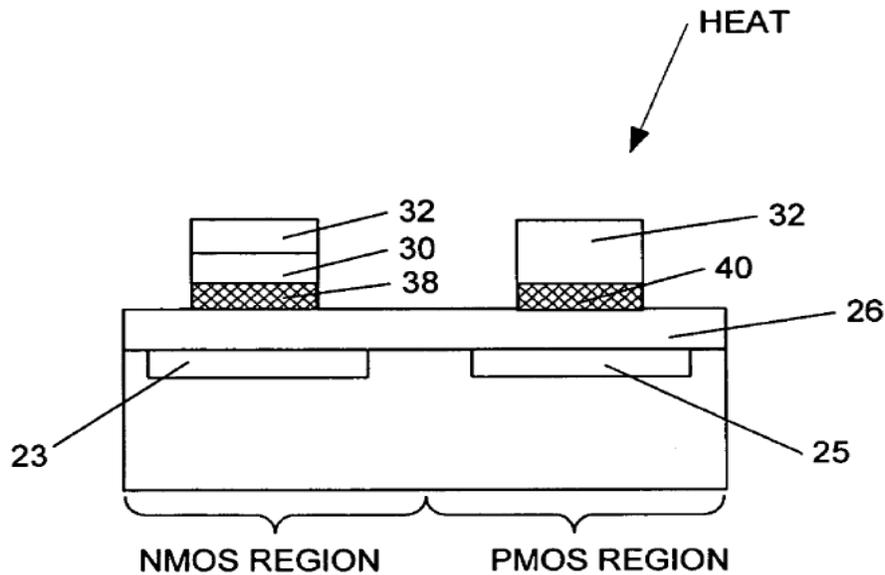


Fig. 2G of Park illustrates the dual metal gate structure.

Park discloses that its devices are formed on semiconductor substrate 22, having gate dielectric layer 26 over NMOS p-well 23 and PMOS n-well 25. *Id.* at 3:56–65, Fig. 2A. Park also discloses that the first gate electrode, in the NMOS region, is formed from NMOS metal 30, NMOS metal alloy 38, and an upper structure 32 containing PMOS metal. *Id.* at 4:51–59. The second gate electrode, in the PMOS region, is formed from PMOS metal 32 and PMOS metal alloy 40. *Id.*

Park also discloses that the use of the buffer layer prevents the gate dielectric layer from being exposed to the metal etching process and also determines the work functions at the metal/dielectric interface. *Id.* at 3:66–4:4. Based on the gate metal chosen, the Hf-AlN_x alloy has a work function of 4.4 eV, that is optimal for NMOS, and a Ta-AlN_x alloy has a work function of 4.9 eV, that is optimal for PMOS. *Id.* at 3:21–24.

2. *Analysis*

Petitioner notes that the top surfaces of the gate structures are formed from the same PMOS metal layer. Pet. 40–41. Petitioner also notes that “[b]ecause the gate patterning and annealing processes do not affect the relative heights of these surfaces, they remain planar with each other after surrounding material has been etched away.” *Id.* at 40. Petitioner finds correspondence as provided in the table below (Pet. 32, 43):

Claim Term	Park Equivalent
first metal-containing conductive pattern	NMOS metal 30 and NMOS metal alloy 38
second metal-containing conductive pattern	PMOS metal pattern 32
third metal-containing conductive pattern	PMOS metal 32 and PMOS metal alloy 40

Petitioner continues that “[t]he second and third metal-containing conductive patterns thus comprise a same metal-containing conductive material, namely, the same PMOS metal 32 such as tantalum.” Pet. 43. Upon review of Park, the Petition, the Preliminary Response, and Dr. Lee’s Declaration, we are persuaded that Petitioner has demonstrated a reasonable likelihood of prevailing as claims 1, 2, 4, 19, 20, and 22 of the ’776 Patent being anticipated by Park. We consider Patent Owner’s counter arguments against below.

Patent Owner points out that claims 1 and 19 recite “the first metal-containing conductive pattern and the third metal-containing conductive pattern have different work functions from each other.” Prelim. Resp. 12. Patent Owner argues that Petitioner and its declarant only compare the values of the work functions at the bottom surfaces of the patterns, and the ’776 Patent does not limit the work function to the bottom surfaces of the

patterns. *Id.* at 14. Patent Owner continues that Petitioner does not provide any analysis as to the work function at any other surface and “has no basis for asserting that the purported first and third metal-containing conductive patterns of [Park] have different work functions.” *Id.* at 15. Additionally, Patent Owner states:

[b]y only providing argument as to the work function of the NMOS metal alloy 38 and PMOS metal alloy 40—the “bottom surfaces” of the purported patterns—Petitioner has not carried its burden to demonstrate that the ’950 patent discloses a first and third metal-containing conductive pattern with different work functions.

Id. We do not agree with Patent Owner’s argument.

Per Section II.A.2 above, we construe the subject limitation with no special construction and rely on the clear language of the claim itself. We agree with Patent Owner’s assertion that the ‘776 Patent does not limit the work function of the first and third metal-containing conductive patterns to the bottom surface of those patterns. Nonetheless, Patent Owner’s argument regarding Petitioner’s lack of analysis of the work function at any other surface of the first and third metal-containing conductive pattern is misplaced. There is nothing in claims 1 and 19 that requires that the work functions of the first and third metal-containing conductive patterns be measured at any particular surface. We fail to understand how the first and third metal-containing conductive patterns can have different work functions on a single surface but yet not have different work functions. If Patent Owner is actually contending that the elements cited from Park as allegedly being equivalent to the claim elements are not equivalent, such a line of argument is not clear from the Preliminary Response. As such, we do not

find Patent Owner's argument to be persuasive that Petitioner has not demonstrated a reasonable likelihood of success with the instant ground.

3. Conclusion

Based on the foregoing, and on the arguments and evidence presented in the Petition, Petitioner has demonstrated a reasonable likelihood that claims 1, 2, 4, 19, 20, and 22 are anticipated by Park.

C. Obviousness Based on Park and Doris

Petitioner also challenges claims 1, 2, 4, 19, 20, and 22 as obvious under 35 U.S.C. § 103(a) over Park and Doris. Pet. 48–56. We exercise our discretion not to institute an *inter partes* review of this asserted ground for reasons of administrative necessity to ensure timely completion of the instituted proceeding. *See* 37 C.F.R. § 42.108(a).

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that pursuant to 35 U.S.C. § 314(a), an *inter partes* review is instituted as to claims 1, 2, 4, 19, 20, and 22 of the '776 Patent for the following ground of unpatentability: claims 1, 2, 4, 19, 20, and 22 as anticipated under 35 U.S.C. § 102(e) by Park; and

FURTHER ORDERED that no other grounds of unpatentability are authorized for this *inter partes review* other than those identified above; and

FURTHER ORDERED that pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial. The trial will commence on the entry date of this decision.

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