

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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*Ex parte* PANAYOTIS ANDRICACOS,  
STEVEN H. BOETTCHER, SANDRA G. MALHOTRA,  
MILAN PAUNOVIC, and CRAIG RANSOM

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Appeal 2008-0082  
Application 10/309,123  
Technology Center 2800

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Decided: March 28, 2008

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Before CHARLES F. WARREN, PETER F. KRATZ, and  
JEFFREY T. SMITH, *Administrative Patent Judges*.

KRATZ, *Administrative Patent Judge*.

**DECISION ON APPEAL**

This is a decision on an appeal from the Examiner's final rejection of claims 1-7, 9-12, 29, and 30. We have jurisdiction pursuant to 35 U.S.C. § 6.

Appellants' invention is directed to an electronic structure including a substrate dielectric layer having a via opening that includes an underlayer on

the via sidewall and bottom surfaces with a barrier layer located on the underlayer. The underlayer includes cobalt, nickel and/or a mixture thereof. The barrier layer includes an alloy including cobalt and/or nickel, and tungsten. The alloy includes 15-20 atomic percent of tungsten. Claim 1 is illustrative and reproduced below:

1. An electronic structure comprising:

a substrate having a dielectric layer having a via opening therein; the via opening have an underlayer of cobalt, nickel or both deposited on sidewalls and bottom surfaces of the via opening; and

a barrier layer on the underlayer on the sidewalls and bottom surfaces of the underlayer; wherein the barrier layer comprises an electrodeposited layer of an alloy comprising at least one member selected from the group consisting of cobalt, nickel and mixtures thereof, and tungsten; wherein the alloy comprises about 15 atomic percent to about 20 atomic percent of tungsten.

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

Bengston	5,235,139	Aug. 10, 1993
Lopatin (Lopatin '096)	6,144,096	Nov. 7, 2000
Nakano	2001/0030366 A1	Oct. 18, 2001
Ueno	2004/0126548 A1	Jul. 1, 2004

S. Lopatin & Y. Shacham-Diamond (Lopatin I), *Electrochemical Society Proceedings*, Vol. 97-8 (1997) 186-195.

Claims 1-3, 6, 7, 9, 10, 12, and 29 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Lopatin '096 in view of Nakano. Claim 4 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Lopatin '096 in view of Nakano, and Lopatin I. Claim 5 stands rejected under 35

U.S.C. § 103(a) as being unpatentable over Lopatin ‘096 in view of Nakano and Bengston. Claim 11 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Lopatin ‘096 in view of Nakano and Ueno. Claim 1 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Ueno.<sup>1</sup>

We affirm all of the above-maintained rejections for substantially the reasons and factual findings set forth by the Examiner in the Answer and as further discussed below.

We begin with the Examiner’s obviousness rejection of claims 1-3, 6, 7, 9, 10, 12, and 29. These commonly rejected claims are argued together as a group. Hence, we select claim 1 as the representative claim on which we decide this appeal as to this grounds of rejection.

Under 35 U.S.C. § 103, the factual inquiry into obviousness requires a determination of: (1) the scope and content of the prior art; (2) the differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) any secondary considerations (e.g., the problem solved). *Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966). “[A]nalysis [of whether the subject matter of a claim is obvious] need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ.” *KSR Int’l Co. Teleflex, Inc.*, 127 S. Ct. 1727, 1740-41 (2007), quoting *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006); see also *DyStar Textilfarben GmbH & Co. Deutschland KG v. C.H. Patrick Co.*, 464 F.3d 1356, 1361 (Fed. Cir. 2006)

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<sup>1</sup> The Examiner has withdrawn a rejection of claims 1-3, 12, and 29 under 35 U.S.C. § 102(e) as being anticipated by Ueno (Ans. 10). Accordingly, this anticipation rejection is not before us for review.

(“The motivation need not be found in the references sought to be combined, but may be found in any number of sources, including common knowledge, the prior art as a whole, or the nature of the problem itself.”); *In re Bozek*, 416 F.2d 1385, 1390 (CCPA 1969) (“Having established that this knowledge was in the art, the examiner could then properly rely, as put forth by the solicitor, on a conclusion of obviousness ‘from common knowledge and common sense of the person of ordinary skill in the art without any specific hint or suggestion in a particular reference.’”).

Appellants do not contest that Lopatin ‘096 discloses or suggests an electronic structure including a substrate dielectric layer, with a via having sidewall and bottom surfaces covered by an underlayer, then a tungsten-containing barrier layer, as called for in representative claim 1, but for the claim requirement for about 15-20 atomic percent of tungsten in the barrier layer (Br. 10; Reply Br. 7-8; Ans. 6).<sup>2</sup> In this regard, Lopatin ‘096 discloses or suggests that a barrier layer (204, Fig. 4), which can comprise a mixture of Group VIII B element (for example, cobalt or nickel) with a Group VI B element (for example, tungsten), is deposited on an adhesion layer (underlayer) (208, Fig. 4), which underlayer includes a Group VIII B metal element (col. 4, ll. 18-19, col. 4, l. 49- col. 5, l. 40). Lopatin ‘096 further discloses that cobalt tungsten (CoW) and nickel tungsten (NiW) are preferred combinations for the barrier layer (col. 4, ll. 58-65).

Lopatin ‘096 discloses that an optimal amount of the Group VI B element is from about 0.2 weight percent to about 4 weight percent of the Group VIII B element (col. 5, ll. 5-8), which represents a smaller amount of

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<sup>2</sup> Arguments not made in the Briefs are considered to be waived. See 37 C.F.R. § 41.37(c)(vii) (2006).

tungsten than called for in representative claim 1. However, Lopatin ‘096 further suggests that the varying proportion of Group V B or Group VI B material (tungsten) employed in the barrier layer can have different degrees of effect. *Id.* In other words, the relative amount of tungsten utilized in the barrier layer would have been recognized as a result effective parameter by one of ordinary skill in the art based on the disclosure of Lopatin ‘096. Moreover, the Examiner further relies on the teachings of Nakano with regard to the prior art use of 20 atomic weight percent tungsten in a cobalt alloy used as a barrier layer for a semiconductor device (¶ 0071). Based on the combined teachings of Lopatin ‘096 and Nakano, we agree with the Examiner that the applied prior art evidence establishes a *prima facie* case of obviousness for the claimed subject matter. The applied references reasonably suggest that one of ordinary skill in the art would have been led to employ an amount of tungsten in the barrier layer, such as the barrier layer of Lopatin ‘096, which amount falls within the claim 1 scope of about 15-20 atomic weight percent of tungsten based on the combined teachings of the applied references. Determining an amount of tungsten for the barrier layer corresponding to the here-claimed amount would have reasonably been expected to be arrived at by an ordinarily skilled artisan upon routine experimentation for purposes of determining the workable or operable amounts of tungsten that can be used in the barrier layer.

Appellants contend that there is a lack of suggestion or motivation for one of ordinary skill in the art to employ the barrier material alloy of Nagano comprising 20 atomic percent tungsten as the barrier material in Lopatin ‘096. In Appellants’ opinion, this is so because Nagano employs a different underlayer than used by Lopatin ‘096 and Nagano is not limited to only

using 20 atomic percent tungsten barrier material alloy materials (Br. 10, Reply Br.7-8). Moreover, Appellants point to another U.S. Patent of record (Nogami, U.S. Pat. No. 6,010,960) in urging that the fact that barrier material including an amount of tungsten, as claimed, was known prior in time to Lopatin ‘096 establishes a lack of motivation to employ such a barrier material having this higher relative amount of tungsten as the barrier layer of Lopatin ‘096 (Reply Br. 8). As best understood, this argument is premised on the notion that Lopatin ‘096 did not furnish a description or suggestion of using such known materials containing higher tungsten amounts therein.

Of course, it is manifest that an anticipatory disclosure is not required to make out a prima facie case of obviousness. Moreover, the arguments presented and the additional evidence relied upon in support thereof are not persuasive of reversible error in the Examiner’s obviousness rejection of representative claim 1. Like Appellants, both Lopatin ‘096 and Nakano are concerned with furnishing a barrier layer for copper interconnects (Specification 1-2; Lopatin ‘096, col. 2, ll. 8-54 and col. 5, l. 41; Nakano, ¶¶ 0013, 0015, 0117, Table 5). In this regard, it is our view that one of ordinary skill in the art would have been led to select known barrier materials for copper interconnects, such as taught by Nakano, as a material for use in the barrier material layer of Lopatin ‘096 with a reasonable expectation of success in so doing. As the Examiner has pointed out, that the rejection is based on the combined teachings of the applied references, not each applied reference as if applied alone (Ans. 12). After all, in considering the question of the obviousness of the claimed invention in view of the prior art relied upon, we are further guided by the basic principle that the question under 35

U.S.C. § 103 is not merely what the references expressly teach but what they would have suggested, in combination, to one of ordinary skill in the art at the time the invention was made. *See Merck & Co. v. Biocraft Labs., Inc.*, 874 F.2d 804, 807 (Fed. Cir. 1989) and *In re Keller*, 642 F.2d 413, 425 (CCPA 1981). Moreover, the question of obviousness cannot be approached on the basis that an artisan having ordinary skill would have known only what they read in the references, because such artisan is presumed to know something about the art apart from what the references disclose. *See In re Jacoby*, 309 F.2d 513, 516 (CCPA 1962). Nor is it necessary that suggestion or motivation be found within the four corners of the references themselves.

As for the argued Nogami reference (U.S. Patent No. 6,010,960), Appellants have not satisfactorily explained how this additional cited reference, which also discloses the use of cobalt/tungsten barrier layers for a copper interconnect, supports Appellants' assertion respecting a lack of motivation to use known cobalt/tungsten barrier materials, such as taught by Nakano, as the barrier material for the barrier layer of Lopatin '096 (Reply Br. 8).

Upon reconsideration in light of all of the evidence and arguments of record that have been brought to bear on the question of obviousness before us, we determine that the evidence of record, on balance, weighs in favor of a determination of the obviousness of the representative claim 1 subject matter.

As for the separate rejections of dependent claims 4, 5, and 11, each involving additional prior art evidence as relied upon by the Examiner in these separately presented rejections, we note that Appellants only argument

with respect to the latter rejections is based on their arguments for the patentability of independent claim 1. However, the arguments concerning appealed claim 1 are not found persuasive of reversible error in the Examiner's rejection of claim 1, as explained above. It follows that, on this record, we shall also affirm the Examiner's separate obviousness rejections of dependent claims 4, 5, and 11.

Lastly, the Examiner has presented another obviousness rejection of claim 1 over the teachings of Ueno. Appellants do not contest the Examiner's determination that Ueno teaches or suggests an electrical device in accordance with the required features of claim 1 including a nickel or cobalt/tungsten barrier layer with amounts of tungsten corresponding to the claimed amounts but for the claimed underlayer requirements (Ans. 9-10; Br. 8-9; Reply Br. 8-9). In particular, Appellants argue against the propriety of this last presented rejection principally on the contention that Ueno would not have suggested or furnished a reasonable expectation of success for an underlayer of nickel and/or cobalt being used with the cobalt/tungsten barrier layer of Ueno.

This line of argument against the Examiner's obviousness rejection over Ueno is not persuasive of reversible error in the Examiner's obviousness rejection of claim 1 over Ueno for reasons set forth by the Examiner in the Answer (Ans. 9, 10, 14 and 15). As explained by the Examiner, Ueno does disclose the prior art use of cobalt (Co) adhesion or underlayer when using a tungsten-containing barrier layer (Ans. 15; Ueno, ¶ 0033). While Ueno indicates a preference for an organic silane monomolecular adhesion layer when employing a tungsten-containing barrier layer having amounts of tungsten corresponding to the here-claimed

amounts, we agree with the Examiner that one of ordinary skill would have recognized that the high tungsten content barrier layer could also be employed with the disclosed prior art cobalt underlayer (adhesion layer). This is so because Ueno merely indicates a preference, not a requirement, for the monomolecular organic silane underlayer (adhesion layer) when employing the use of a high tungsten-content barrier layer (Ueno, ¶ 0038).

All disclosure in reference must be evaluated for what it fairly teaches, not just the preferred embodiments. *In re Kaslow*, 707 F.2d 1366, 1373 (Fed. Cir. 1983); *In re Fracalossi*, 681 F.2d 792, 793-794 (CCPA 1982); *In re Lamberti*, 545 F.2d 747, 750 (CCPA 1976).

On this record, we affirm the Examiner's obviousness rejection of claim 1 over Ueno.

#### CONCLUSION

The decision of the Examiner to reject claims 1-3, 6, 7, 9, 10, 12, and 29 under 35 U.S.C. § 103(a) as being unpatentable over Lopatin '096 in view of Nakano; to reject claim 4 under 35 U.S.C. § 103(a) as being unpatentable over Lopatin '096 in view of Nakano, and Lopatin I; to reject claim 5 under 35 U.S.C. § 103(a) as being unpatentable over Lopatin '096 in view of Nakano and Bengston; to reject claim 11 under 35 U.S.C. § 103(a) as being unpatentable over Lopatin '096 in view of Nakano and Ueno; and to reject claim 1 under 35 U.S.C. § 103(a) as being unpatentable over Ueno is affirmed.

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No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv) (2006).

AFFIRMED

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CONNOLLY BOVE LODGE & HUTZ LLP  
1875 EYE STREET, N.W.  
SUITE 1100  
WASHINGTON, DC 20036