

The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Ex parte FUSEN CHEN and LING CHEN

Appeal No. 2005-2014
Application No. 09/792,737

ON BRIEF

Before OWENS, JEFFREY T. SMITH and FRANKLIN Administrative Patent Judges.
JEFFREY T. SMITH, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal from the examiner's final rejection of claims 1, 4, 7, 34, 36, 37, and 40-44, which are all of the claims pending in this application. We have jurisdiction under 35 U.S.C. § 134.

BACKGROUND

The Appellants' invention relates to a process of filling copper into a thin, pre-formed interconnection hole. The process includes coating into the hole an insulating barrier layer which includes a sidewall portion and a bottom portion. The barrier layer may be composed of tantalum nitride and be deposited by chemical vapor deposition, preferably by atomic layer deposition (ALD). Subsequently, a conformal copper seed layer on the sidewall of the hole and the bottom barrier layer is removed. (Brief, pp. 2-3). A copy of representative claims 1 and 41 appear below:

1. A process of filling copper into a vertical interconnection hole extending through an inter-level dielectric layer formed in a substrate and having sides and a bottom, comprising the steps of:

 in a process comprising atomic layer deposition, coating sides and a bottom of said hole with a barrier layer comprising tantalum nitride to a thickness of no more than 2nm; and

 sputtering a copper target opposed to said substrate under conditions such that a copper layer is deposited on said sides of said hole while simultaneously said barrier layer is removed from said bottom of said hole.

41. A process of filling copper into a vertical interconnection hole extending through an inter-level dielectric layer formed in a substrate and having sides and a bottom, comprising the steps of:

 in a process comprising atomic layer deposition, coating at least sides of said hole with a barrier layer comprising tantalum nitride to a thickness of no more than 2nm; and

 sputtering a copper target opposed to said substrate under conditions such that a copper layer is deposited at least on said sides of said hole.

CITED PRIOR ART

As evidence of unpatentability, the Examiner relies on the following references:

Simon et al. (Simon)	5,933,753	Aug. 03, 1999
Nogami et al. (Nogami)	5,968,333	Oct. 19, 1999
Hong et al. (Hong)	6,008,117	Dec. 28, 1999
Gates et al. (Gates)	6,203,613	Mar. 20, 2001
Lim et al. (Lim)	6,284,589	Sep. 04, 2001

The Examiner entered the following rejections:

Claims 1, 7, 34, 36, 37, and 40-44 stand rejected under 35 U.S.C. 103(a) as obvious over the combination of Simon, Lim, Nogami and Hong; and claim 4 stands rejected under 35 U.S.C. 103(a) as obvious over the combination of Simon, Lim, Nogami, Hong and Gates. (Answer, pp. 3-7).

We have carefully reviewed the claims, specification and applied prior art, including all of the arguments advanced by both the Examiner and Appellants in support of their respective positions. This review leads us to conclude that the Examiner's rejections are well founded.

We initially note that Appellants assert that for purposes of appeal that the claims should stand or fall together except for claim 36. (Brief, p. 3). We note that Appellants' grouping of the claims is not exclusive to each stated rejection.¹ Accordingly, we will

¹ Claim 4 is not subject to the same rejection as claims 1, 7, 34, 36, 37, and 40-44.

address the rejections as presented by the Examiner and any claim that is separately argued.

Rather than reiterate the conflicting viewpoints advanced by the Examiner and the Appellants regarding the above-noted rejections, we make reference to Appellants' Brief filed February 17, 2004, Reply Brief, filed May 24, 2004, and the Examiner's answer mailed March 24, 2004.

OPINION

The Examiner has rejected claims 1, 7, 34, 36, 37, and 40-44 stand rejected under 35 U.S.C. 103(a) as obvious over the combination of Simon, Lim, Nogami and Hong. We select claim 41 as representative of the rejected claims. We affirm.

The Examiner determined that the claimed subject matter is unpatentable over the combined teachings of Simon, Lim, Nogami and Hong. (Answer, pp. 3-6).

Appellants argue that Simon describes copper seed deposition in the presence of a TaN liner, however, Simon does not mention the thickness or deposition technique for the TaN liner. (Brief, p. 3). The Examiner acknowledges these differences in the Simon disclosure on page 4 of the Answer. The Examiner asserts that the technique for applying the liner would have been obvious to a person of ordinary skill in the art because Simon discloses that the liner could be applied by any known technique, and Lim discloses that ALD is a conventional deposition method for depositing a TaN liner. (See Simon col. 4, ll. 15-19; and Lim col. 4, ll. 15-24). As to the thickness of the layer,

the Examiner asserts that the claimed thickness of 2 nm would have been obvious to a person of ordinary skill in the art because the purpose of the layer is to prevent the diffusion of atoms from one material into another and thus the thickness is a result effective variable. (Answer, p. 5). The Examiner cites the Hong reference for teaching that the claimed thickness for a barrier layer is recognized by persons of ordinary skill in the art. Hong discloses the thickness can range from 10-300 Angstroms (1-30 nm) (col. 4, ll. 32-35). A person of ordinary skill in the art would have sufficient skill to determine the appropriate thickness required to prevent the diffusion of atoms into adjacent layers. The Appellants have not directed us to evidence which establishes that the claimed thickness provides unexpected results.

Appellants argue that Nogami is not combinable with Simon or other art using TaN liners because Nogami strongly teaches against the use of tantalum-containing material, such as the claimed TaN, as a barrier material because of its tendency to oxidize. (Brief, p. 3). Appellants also argue that Nogami is silent on using ALD and does not provide motivation to use the claimed thickness for the barrier layer. (Brief, pp. 3-4).

Appellants' arguments are not persuasive. A person of ordinary skill in the art would have recognized the properties associated with using a barrier layer comprising Ta component. Just because a reference discloses a disadvantage to using a particular component for the described invention does not prevent a person of ordinary skill in the

art from using that component along with its disadvantageous property. In the present case, a person of ordinary skill could use a barrier layer comprising Ta if he was willing to accept the oxide forming on the Ta. As to the thickness of the layer and the method of its application, the Examiner did not cite this reference for teaching these aspects of the claimed invention. The Examiner relies on Nogami for teaching the use of electroplating for applying copper to a via comprising a barrier layer to form an interconnect structure. Appellants have not challenged this position by the Examiner in their Brief.

Appellants' arguments regarding the Hong reference, Brief page 4, have been considered. However, the Examiner did not cite the reference for teaching the argued limitations. As stated above, the Examiner cited Hong for teaching the recognized property of the thickness of barrier layers.

Appellants argue that "Lim's TaN layer is not described as a barrier layer, as required for Simon or Hong and as claimed, but is described at col. 3, line 15, as an adhesion layer 50 to an overlying metal layer 60 of either a noble metal of Pt, Ru, or Ir or a conductive perovskite oxide (col. 4, ll. 41-43). These conductive materials listed by Lim present substantially different problems than the copper of Simon or the copper overlay of the claims." (Brief, p. 4).

These arguments are not persuasive. The Examiner cited Lim for disclosing known techniques for applying a TaN layer. Thus, the various methods of applying a

TaN layer would have been recognized by a person of ordinary skill in the art. A person of ordinary skill in the art would have reasonably expected that the TaN layer of Simon could have been applied by the techniques disclosed by Lim, including ALD. "For obviousness under § 103, all that is required is a reasonable expectation of success."

In re O'Farrell, 853 F.2d 894, 904, 7 USPQ2d 1673, 1681 (Fed. Cir. 1988).

Appellants argue that "it is general knowledge that a thicker barrier is more effective than a thinner barrier." (Brief, p. 5). Appellants also argue "the 2nm limit is not a mere optimization for a result effective variable, as argued by the examiner, . . . Instead, the 2nm limit represents the new found feasibility of an effective ultra-thin barrier layer grown by ALD. Such feasibility has not previously been demonstrated." (Reply Brief, p. 2).

While it may be true that a thicker layer is more effective than a thinner layer, a person of ordinary skill in the art would have sufficient skill to determine the appropriate thickness of a barrier layer so as to prevent the atoms from transferring to an adjacent layer. In the present case, the Examiner has established a *prima facie* case of obviousness because the cited prior art discloses ranges for suitable barrier layers which encompass the claimed thickness. Cf. *In re Peterson*, 315 F.3d 1325, 1329 (Fed. Cir. 2003). (When an invention, defined by a range, is encompassed by the prior art a *prima facie* case of obviousness exists. arises when the ranges of a claimed composition overlap the ranges disclosed in the prior art.) When the Examiner has

established a *prima facie* obviousness, the burden then shifts to the applicant to rebut.

In re Dillon, 919 F.2d 688, 692, 16 USPQ2d 1897, 1901 (Fed. Cir. 1990) (en banc).

Rebuttal may take the form of "a comparison of test data showing that the claimed compositions possess unexpectedly improved properties . . . that the prior art does not have, that the prior art is so deficient that there is no motivation to make what might otherwise appear to be obvious changes, or any other argument . . . that is pertinent."

Id. at 692-93, USPQ2d 1901. The Appellants have not directed us to evidence of unexpected results.

Regarding claim 36, the Appellants argue that "[t]he prior art fails to suggest that effective ultra-thin TaN barriers can be grown in such narrow vias, as defined in dependent Claim 36." (Brief, p. 5).

This argument is not persuasive because Appellants' description of the background art in the specification discloses that via widths having the claimed size have been contemplated in advance integrated circuits. (Page 3).

Appellants' arguments regarding the use of hindsight are not persuasive for the reasons stated above.

The Examiner has rejected claim 4 under 35 U.S.C. § 103(a) as obvious over the combined teachings of Simon, Lim, Nogami, Hong and Gates. We affirm.

The subject matter of claim 4 further limits the subject matter of claim 1 by describing the ALD process. The Examiner added the Gates reference to the

combination of Simon, Lim, Nogami and Hong to reject the subject matter of claim 4 under 35 U.S.C. 103(a). The Appellants have failed to specifically discuss this rejection.

The Examiner has presented factual determinations regarding the suitability of combining the teachings of the Gates reference with Simon, Lim, Nogami and Hong. The Examiner's determinations seem reasonable and are based upon the evidence of record. Since Appellants have failed specifically to challenge the factual determinations, we presume that he is in agreement with the Examiner. Thus, for the reasons presented above and the reasons presented by the Examiner we will uphold the rejection.

CONCLUSION

For the foregoing reasons and those set forth in the Answer, based on the totality of the record, we determine that the Examiner has established *prima facie* unpatentability under section 103 which has not been adequately rebutted by Appellants. Accordingly, the Examiner's rejections under 35 U.S.C. § 103 are affirmed.

The rejection of claims 1, 7, 34, 36, 37, and 40-44 under 35 U.S.C. 103(a) as obvious over the combination of Simon, Lim, Nogami and Hong; and the rejection of claim 4 under 35 U.S.C. 103(a) as obvious over the combination of Simon, Lim, Nogami, Hong and Gates are affirmed.

TIME FOR TAKING ACTION

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a)(iv)(effective Sep. 13, 2004; 69 Fed. Reg. 49960 (Aug. 12, 2004); 1286 Off. Gaz. Pat. Office 21 (Sep. 7, 2004)).

AFFIRMED

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