

The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

Paper No. 40

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte PEIJUN DING
and
TONY CHIANG

Appeal No. 2001-2461
Application No. 08/855,059

ON BRIEF

Before WALTZ, DELMENDO, and MOORE, Administrative Patent Judges.
DELMENDO, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on an appeal under 35 U.S.C. § 134 (2002) from the examiner's final rejection of claims 1 through 10, 12 through 18, and 20 through 23, which are all of the claims pending in the above-identified application.¹

¹ In reply to the final Office action of Apr. 12, 2000 (paper 22), the appellants submitted an amendment pursuant to 37 CFR § 1.116 (2000) on Jun. 2, 2000 (paper 23), proposing changes to claims 1 and 13. The examiner indicated in the advisory

The subject matter on appeal relates to a method for providing a complete copper fill of a trench, via, or other feature upon a surface of a semiconductor workpiece. Further details of this appealed subject matter are recited in representative claims 1 and 5, the only independent claims on appeal, reproduced below:

1. A method for providing a complete copper fill of a trench or via or other feature upon a surface of a semiconductor workpiece, said method comprising the steps of:

- a) providing a semiconductor workpiece including a feature to be filled with copper, wherein a surface of said feature is covered with at least one wetting layer or barrier layer, or a combination of wetting and barrier layers, and wherein said wetting layer or barrier layer or combination of wetting and barrier layers does not include CVD copper;
- b) adjusting said feature surface temperature within a range from about 200°C to about 600°C; and
- c) while said feature surface is within said temperature range, applying at least one layer of copper to said feature surface using a sputtering technique.

5. A method of providing a complete copper fill of a trench or via or other feature upon a surface of a semiconductor workpiece, said method comprising the steps of:

sputter depositing at least one wetting layer of copper to wet and bond to said surface while said surface is at a temperature ranging from about 20°C to about 250°C, followed by sputter depositing at least one fill layer of copper over said surface while said surface is at a temperature ranging between about 200°C and about 600°C.

action of Jun. 16, 2000 (paper 24) that the amendment will be entered for purposes of this appeal.

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The examiner relies on the following prior art references as evidence of unpatentability:

Demaray et al. (Demaray)	5,330,628	Jul. 19, 1994
Ho et al. (Ho)	5,354,712	Oct. 11, 1994
Blackwell et al. (Blackwell)	5,372,848	Dec. 13, 1994

Shyam P. Murarka and Steven W. Hymes, "Copper Metallization for ULSI and Beyond," 20(2) Critical Reviews in Solid State and Materials Sciences 87-93, 199-120 (1995) (Murarka).

Claims 1 through 4, 12 through 14, and 21 through 23 on appeal stand rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement.

(Examiner's answer of Jan. 30, 2001, paper 33, page 3; final Office action, pages 2-3.) Further, appealed claims 1 through 10 and 20 through 23 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Demaray in view of Blackwell and Murarka.

(Answer, page 3; final Office action, pages 3-5.) Separately, appealed claims 12 through 18 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Demaray in view of Blackwell, Murarka, and Ho. (Answer, page 3; final Office action, page 5.)

We affirm the rejection under 35 U.S.C. § 112, first paragraph, but reverse both rejections under 35 U.S.C. § 103(a).²

Rejection under 35 U.S.C. § 112, ¶ 1

The examiner's basic position is that the specification, as originally filed, lacks adequate written description for the invention recited in appealed claim 1. (Answer, pages 4-5.) Specifically, the examiner held that the originally filed specification does not support the limitation "wherein said wetting layer or barrier layer or combination of wetting and barrier layers does not include CVD copper." We agree with the examiner's ultimate conclusion.

To satisfy the written description requirement of 35 U.S.C. § 112, first paragraph, the disclosure of the application as originally filed must reasonably convey to those skilled in the relevant art that the applicants, as of the filing date of the original application, had possession of the claimed invention. In re Alton, 76 F.3d 1168, 1172, 37 USPQ2d 1578, 1581; In re Kaslow, 707 F.2d 1366, 1375, 217 USPQ 1089, 1096 (Fed. Cir. 1983). The applicants, however, do not have to describe exactly

² In the final Office action (p. 2), the examiner also objected to the specification under 35 U.S.C. § 132. However, our jurisdiction under 35 U.S.C. § 134 is limited to review of rejections. Moreover, it appears to us that the dispositive issue raised by this objection is the same as that raised in the rejection under 35 U.S.C. § 112, first paragraph.

the subject matter claimed. Union Oil Co. of Cal. v. Atlantic Richfield Co., 208 F.3d 989, 997, 54 USPQ2d 1227, 1232, 1233 (Fed. Cir. 2000).

Here, the originally filed specification states: "The copper deposition method used for application of the thin, continuous, wetting layer of copper in the two step process may be one of the sputtered copper techniques listed above or may be chemical vapor deposition (CVD) copper..." (Page 6, lines 1-18.) In addition, the originally filed specification describes the use of wetting layers other than a copper wetting layer. (Page 11, line 26 to page 12, line 1.) That is, the wetting layer may be, but does not have to be, CVD copper. Accordingly, we find nothing wrong in the appellants' amendment excluding the disclosed wetting layer species of CVD copper from the disclosed genus of wetting layer.

However, the exclusion of CVD copper barrier layer from the disclosed genus of barrier layer stands on different footing. While the originally filed specification describes the chemical vapor deposition of the barrier layer (page 13, lines 5-9), it does not contain any description of the use of copper as the barrier layer material. Under these circumstances, we hold that the amendment excluding CVD copper as the barrier layer

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introduces a new concept that lacks adequate written description in the specification as originally filed. Ex parte Grasselli, 231 USPQ 393 (Bd. Pat. App. & Int. 1983), aff'd mem., 738 F.2d 453 (Fed. Cir. 1984).

The appellants argue that CVD copper was not used as the barrier layer in the working examples of the present specification and that it is therefore appropriate to exclude CVD copper as the barrier layer. (Substitute appeal brief filed Dec. 26, 2000, paper 31, page 7.) This argument lacks merit. While the working examples might support the concept that TaN_x or sputtered aluminum may constitute the barrier layer, it does not support the concept that the barrier layer excludes CVD copper.

The appellants cite Animal Legal Defense Fund v. Quigg, 932 F.2d 920, 923, 18 USPQ2d 1677, 1679-80 (Fed. Cir. 1991) as controlling legal authority. (Substitute appeal brief filed Dec. 26, 2000, pages 7-8.) In our view, the appellants' reliance on this case is misplaced. The issue of whether a negative limitation not supported by the originally filed specification violates 35 U.S.C. § 112, first paragraph, was not before the court in Animal Legal Defense Fund. The court merely reproduced a U.S. Patent and Trademark Office Official Gazette notice relating to an interpretation of 35 U.S.C. § 101.

The appellants argue that they "are seeking to narrow the scope of their claims, in a manner which is consistent with their description of the disadvantages of using CVD copper..." (Substitute appeal brief filed Dec. 26, 2000, page 8; reply brief filed Mar. 23, 2001, paper 34, pages 2-5.) The problem with this argument, however, is that the specification lacks any hint, much less adequate written description, indicating that the use of CVD copper as the barrier layer is disadvantageous.

For these reasons, we uphold the examiner's rejection on this ground.

Rejection under 35 U.S.C. § 103(a) of Claims 1-10 and 20-23:
Demaray, Blackwell, and Murarka

Demaray, the principal prior art reference, describes a method in which a wafer is preheated to a temperature on the order of 100-125°C, sputtering a material such as aluminum at a rate of 1000 Angstroms for one minute, sputtering 1000 Angstroms over 15 minutes, and then sputtering 8000 Angstroms over a period of about 12 minutes at 260-360°C. (Column 7, lines 59-68.) According to Demaray, the resulting coating "fills the holes completely and exhibits good planarization above the holes at both the center and the edge of the wafer." (Column 7, line 68 to column 8, line 2.)

The examiner admits that Demaray does not disclose the use of copper as recited in the appealed claims. (Answer, page 4.) In an attempt to account for this difference, the examiner relies on the teachings of Blackwell and Murarka. (Id.) Specifically, it is the examiner's position that "[i]t would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Demaray et al. to utilize copper instead of aluminum motivated by the desire to utilize a component with a lower resistivity and higher electrical conductivity [as taught by Murarka]." (Id. at page 5.)

We cannot agree with the examiner's analysis. As pointed out by the appellants (substitute appeal brief filed Dec. 26, 2000, page 10), the evidence shows that aluminum and copper have vastly different properties and, therefore, one of ordinary skill in the art would have expected different deposition characteristics. (Declaration under 37 CFR § 1.132 of Tony Chiang filed Sep. 21, 1998, paper 10.) The examiner, however, has not presented any pertinent countervailing evidence. Although Blackwell does teach the sputtering of copper onto a free-standing polyimide film at a substrate temperature of about $20 \pm 5^\circ\text{C}$ (Example 1), Blackwell prefers and, in fact, teaches

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away from substrate temperatures higher than about 60°C (column 3, line 65 column 4, line 2.)

The examiner argues that the determination of workable copper sputtering temperatures is within the level of the ordinary skill in the art. (Answer, page 4.) The examiner, however, has failed to show any reasonable expectation, or some predictability, that Demaray's method would be effective for copper deposition at the temperatures recited in the appealed claims. In re Shetty, 566 F.2d 81, 86, 191 USPQ 753, 756-57 (CCPA 1977).

For these reasons, we cannot uphold the examiner's rejection on this ground.

Rejection under 35 U.S.C. § 103(a) of Claims 12-18:
Demaray, Blackwell, Murarka, and Ho

Ho is cited merely for the use of tantalum as a barrier layer material. (Answer, page 5.) Accordingly, the examiner has not explained how Ho cures the fundamental deficiency in the combination of Demaray, Blackwell, and Murarka.

It follows then that we also cannot uphold this rejection.

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Summary

In summary, our disposition of this appeal is as follows:
the rejection under 35 U.S.C. § 112, first paragraph, of
appealed claims 1 through 4, 12 through 14, and 21 through 23 is
affirmed;

the rejection under 35 U.S.C. § 103(a) of appealed claims 1
through 10 and 20 through 23 is reversed; and

the rejection under 35 U.S.C. § 103(a) of appealed claims
12 through 18 is reversed.

Accordingly, the decision of the examiner is affirmed in
part.

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No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED IN PART

Thomas A. Waltz)	
Administrative Patent Judge)	
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)	BOARD OF PATENT
Romulo H. Delmendo)	
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