

The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.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. 11

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte RICHARD J. HUANG and ROBIN W. CHEUNG

Appeal No. 1997-3338
Application No. 08/402,252

ON BRIEF

Before PAK, KRATZ, and DELMENDO, Administrative Patent Judges.

DELMENDO, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on an appeal under 35 U.S.C. § 134 from the examiner's refusal to allow claims 4, 8, and 13 as amended subsequent to the final rejection. These are the only claims remaining in the application.¹

¹ The appellants canceled claim 9 in the "AMENDMENT UNDER 37 CFR § 1.116" filed December 19, 1995 (Paper 5). According to the advisory action of January 26, 1996 (Paper 6), this amendment was approved for entry subject to the filing of an appeal.

Claim 4 is illustrative of the claims on appeal and is reproduced below:

4. A process of forming a barrier titanium nitride layer in contact openings etched in a dielectric layer supported over a semiconductor substrate, said process comprising:

(a) etching said contact openings in said dielectric layer down to a titanium silicide layer, each of said contact openings having a bottom;

(b) forming said barrier titanium nitride layer at said bottom of said contact openings by converting at least a portion of said titanium silicide layer at said bottom of said contact openings into said barrier titanium nitride layer by exposing said titanium silicide layer to a rapid thermal anneal performed at a temperature of at least about 600°C in a nitrogen-containing atmosphere comprising a nitrogen-containing species selected from the group consisting of N₂, NH₃, and N₂O;

(c) providing blanket deposition of a metal by employing a process selected from the group consisting of high temperature metal sputtering, regular metal sputtering followed by high temperature reflow, and chemical vapor deposition of said metal, to form a layer thereof; and

(d) removing metal outside of said contact openings via chemical-mechanical polishing or plasma etchback of said layer of metal thereby forming a metal plug in each of said contact openings consisting essentially of a metal selected from the group consisting of aluminum, copper, and gold.

The subject matter on appeal relates to a process of forming a barrier titanium nitride layer in contact openings etched in a dielectric layer supported over a semiconductor

Appeal No. 1997-3338
Application No. 08/402,252

substrate. According to the appellants (appeal brief, page 2), the contact openings are etched in the dielectric layer down to the doped regions in a semiconductor (e.g., polysilicon or doped regions in a semiconductor substrate) which have a titanium silicide layer on top. A rapid thermal anneal of at least about 600°C in a nitrogen-containing atmosphere comprising the recited nitrogen-containing species is used to convert the top portion of the titanium silicide layer into a barrier titanium nitride layer. Next, the recited metal layer is deposited by high temperature metal sputtering, regular metal sputtering followed by high temperature reflow, or chemical vapor deposition. Then a metal plug is formed in each contact opening by chemical-mechanical polishing or plasma etchback.

As evidence of unpatentability, the examiner relies upon the following prior art references:

Koyanagi et al. (Koyanagi) 1987	4,701,349	Oct. 20,
Scovell et al. (Scovell) 20, 1988	4,772,571	Sep.
Sun et al. (Sun) 1991	4,994,410	Feb. 19,
Sandhu et al. (Sandhu) 1992	5,124,780	Jun. 23,

Appeal No. 1997-3338
Application No. 08/402,252

Shappir et al. (Shappir) 02, 1993	5,258,333	Nov.
Lee et al. (Lee) 1993	5,266,521	Nov. 30,
Tsang et al. (Tsang) 1993	5,272,666	Dec. 21,

Claims 4 and 8 stand rejected under 35 U.S.C. § 103 as unpatentable over the combined teachings of Koyanagi, Scovell, Lee, Sun, and Sandhu (examiner's answer, pages 4-6).

Similarly, claims 4 and 8 stand rejected under 35 U.S.C. § 103 as unpatentable over the combined teachings of Koyanagi, Scovell, Tsang, Shappir, Lee, Sun, and Sandhu (examiner's answer, pages 7-9). Additionally, claim 13 stands rejected under 35 U.S.C. § 103 as unpatentable over the combined teachings of Koyanagi, Scovell, Tsang, Shappir, Lee, Sun, and Sandhu (examiner's answer, pages 9-12).

We have carefully reviewed the entire record, including all of the arguments and evidence advanced by both the examiner and the appellants in support of their respective positions. This review leads us to conclude that the examiner's rejections are not well founded. Accordingly, we reverse all of the aforementioned rejections. The reasons for our determination follow.

Appeal No. 1997-3338
Application No. 08/402,252

In each of the rejections stated in the answer, the examiner has identified Koyanagi or Scovell as the closest prior art reference. The appellants, however, have pointed out that Koyanagi and Scovell do not teach or suggest chemical-mechanical polishing or plasma etchback of the metal layer outside the contact openings to form a metal plug, as recited in the appealed claims (appeal brief, page 4).

To remedy the deficiencies of Koyanagi and Scovell, the examiner has relied upon Tsang, Shappir, Lee, Sun, and Sandhu. Specifically, the examiner has repeatedly stated:

It would have been obvious to on[e] of ordinary skill in the art at the time the invention was made to modify the above references' teachings as taught by Sun et al., Lee et al., and Sandhu et al. because such use of planarized plugs by CMP [chemical-mechanical polishing] or etchback and the claimed deposition processes and materials are conventional and obvious as evidenced by Sun et al., Lee et al., and Sandhu et al. to enable the formation of a planarized plug for

Appeal No. 1997-3338
Application No. 08/402,252

contact. [Emphasis added; examiner's answer, pp. 6, 9, 11, and 12.]

We cannot agree.

Under 35 U.S.C. § 103, the examiner carries the initial burden of establishing a prima facie case of obviousness. In re Piasecki, 745 F.2d 1468, 1471-72, 223 USPQ 785, 787-88 (Fed. Cir. 1984). As part of meeting this initial burden, the examiner must determine whether the differences between the subject matter of the claims and the prior art "are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art" (emphasis added). 35 U.S.C. § 103(a)(1999); Graham v. John Deere Co., 383 U.S. 1, 14, 148 USPQ 459, 465 (1966).

In the recent decision of In re Kotzab, 217 F.3d 1365, 1369-70, 55 USPQ2d 1313, 1316 (Fed. Cir. 2000), our reviewing court stated:

Most if not all inventions arise from a combination of old elements. See In re Rouffet, 149 F.3d 1350, 1357, 47 USPQ2d 1453, 1457 (Fed. Cir. 1998). Thus, every element of a claimed invention may often be found in the prior art. See *id.* However, identification in the prior art of each individual part claimed is insufficient to defeat

Appeal No. 1997-3338
Application No. 08/402,252

patentability of the whole claimed invention. See *id.* Rather, to establish obviousness based on a combination of the elements disclosed in the prior art, there must be some motivation, suggestion or teaching of the desirability of making the specific combination that was made by the applicant. See *In re Dance*, 160 F.3d 1339, 1343, 48 USPQ2d 1635, 1637 (Fed. Cir. 1998); *In re Gordon*, 733 F.2d 900, 902, 221 USPQ 1125, 1127 (Fed. Cir. 1984). [Underscoring added.]

Here, for the reasons set forth by the appellants (appeal brief, page 6), we conclude that the examiner has not identified any motivation, suggestion or teaching of the desirability of combining Koyanagi or Scovell with Tsang, Shappir, Lee, Sun, and Sandhu to arrive at the appellants' claimed invention. Our reviewing court has made it clear that "the best defense against the subtle but powerful attraction of a hindsight-based obviousness analysis is rigorous application of the requirement for a showing of the teaching or motivation to combine prior art references." *In re Dembiczak*, 175 F.3d 994, 999, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999) (citing *C.R. Bard, Inc. v. M3 Sys., Inc.*, 157 F.3d 1340, 1352, 48 USPQ2d 1225, 1232 (Fed. Cir. 1998)).

For these reasons, we reverse the examiner's (1) rejection of claims 4 and 8 under 35 U.S.C. § 103 as

Appeal No. 1997-3338
Application No. 08/402,252

unpatentable over the combined teachings of Koyanagi, Scovell, Lee, Sun, and Sandhu, (2) rejection of claims 4 and 8 under 35 U.S.C. § 103 as unpatentable over the combined teachings of Koyanagi, Scovell, Tsang, Shappir, Lee, Sun, and Sandhu, and (3) the rejection of claim 13 under 35 U.S.C. § 103 as unpatentable over the combined teachings of Koyanagi, Scovell, Tsang, Shappir, Lee, Sun, and Sandhu.

As a final point, we direct the examiner's attention to Lee's discussion of Japanese Laid-Open Publication No. 63-99546 (JP '546), which states:

Japanese Laid-Open Publication No. 63-99546 (by Shinpei Lijima et al.), discloses a method to improve wiring reliability and to enable the formation of a multilayer interconnection, wherein a metallic wiring layer is formed on a substrate having contact holes and steps, by means of heating and fusing the metallic wiring layer. More particularly, Shinpei Lijima et al. teaches a method for manufacturing a semiconductor device, which comprises the steps of forming multiple devices on a semiconductor substrate, depositing an insulation layer on the multiple devices, forming in the insulation layer contact holes reaching a predesignated portion of the device, forming a titanium nitride film on the surface of the insulation layer and contact holes, depositing a metallic wiring layer on the whole surface of the titanium nitride film and then heating the metallic layer so that it is fused and made to flow to

Appeal No. 1997-3338
Application No. 08/402,252

planarize the surface of the metallic layer, and etching the metallic layer and the titanium nitride film according to a predesignated wiring pattern to form at least the first wiring layer. [Col. 1, l. 62 to col. 2, l. 14).

Thus, it appears that JP '546 teaches a process which is similar to that recited in the appealed claims. Both the examiner and the appellants should obtain a complete English language translation of JP '546 and consider the reference in its entirety. Further, the examiner and the appellants should explore whether there is any motivation or suggestion to combine the teachings of JP '546 with Koyanagi or Scovell and, if so, whether the combination would result in the invention recited in the appealed claims. In this regard, we point out that Scovell teaches the benefits of using the TiSi/TiN layers as produced according to step (b) of appealed claim 4 (column 2, lines 4-38).

The decision of the examiner is reversed.

REVERSED

Appeal No. 1997-3338
Application No. 08/402,252

CHUNG K. PAK)	
Administrative Patent Judge)	
)	
)	
)	
)	BOARD OF PATENT
PETER F. KRATZ)	APPEALS
Administrative Patent Judge)	AND
)	INTERFERENCES
)	
)	
)	
ROMULO H. DELMENDO)	
Administrative Patent Judge)	

Appeal No. 1997-3338
Application No. 08/402,252

DAVID W. COLLINS
BENMAN COLLINS & SAWYER
711 WEST LOS ALTOS RD
TUCSON, AZ 85704-4105

RHD/jg

Jenine Gillis

Appeal No. 1997-3338

Application No. 08/402,252

APJ DELMENDO

APJ PAK

APJ KRATZ

DECISION: REVERSED

Panel Change: Yes No

Prepared: September 24, 2001

3 MEM. CONF. Y N

OB/HD

GAU: 2800

PALM

ACTS 2

BOOK

DISK (FOIA)

REPORT