

The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.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. 16

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte GIRISH A. DIXIT, ANTHONY KONECNI,
and ROBERT H. HAVEMANN

Appeal No. 1999-1133
Application No. 08/766,199

ON BRIEF

Before HAIRSTON, KRASS, and BARRETT, Administrative Patent Judges.

KRASS, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal from the final rejection of claims 5-7. Claim 8 has been indicated as being directed to allowable subject matter.

The invention is directed to a method for forming an interconnect in a semiconductor structure

Appeal No. 1999-1133
Application No. 08/766,199

wherein a via is formed through an insulating layer to a first metal layer, the sidewalls and exposed metal bottom are cleaned with a nitrogen-containing plasma, a liner is formed on the via sidewall and bottom and the via is then filled with a second metal.

Independent claim 5 is reproduced as follows:

5. A method of forming an interconnect, comprising the steps of:
 - (a) forming a via through an insulating layer to a first metal layer over a substrate;
 - (b) clean the via sidewalls and exposed first metal bottom with a nitrogen-containing plasma;
 - (c) form a liner on the via sidewall and bottom; and
 - (d) fill the via with a second metal.

The examiner relies on the following references:

Ohtsuka et al. (Ohtsuka) 5,244,535 Sep. 14, 1993

Mizobuchi K. et al., "Application of Force Fill Al-Plug Technology to 64Mb DRAM and 0.35 Fm Logic," Symposium on VLSI Technology Digest of Technical Papers, 1995, pp. 45-46.

Claims 5 and 6 stand rejected under 35 U.S.C. 102(b) as anticipated by Ohtsuka. Claim 7 stands rejected under 35 U.S.C. 103 as unpatentable over Ohtsuka and Mizobuchi (abstract only).

Reference is made to the briefs and answer for the respective positions of appellants and the examiner.

OPINION

We reverse.

At the outset, we note that the examiner has applied Ohtsuka as an anticipatory reference against independent claim 5 and has pointed out where the various claimed elements are taught. The examiner identifies the step of cleaning the sidewalls and exposed metal bottom with a nitrogen-containing plasma as inherently being performed by Ohtsuka since the reference employs a nitrogen-containing plasma, with table 1 at column 4 of the reference disclosing similar ranges and conditions for the plasma as are recited in appellants' specification at page 12.

Appellants' only response to the examiner's identification of the cleaning step in the reference, as articulated in both the principal brief and the reply brief filed February 3, 1999, is that "No such step is found or even suggested in Ohtsuka" [principal brief-page 3] and that Ohtsuka "uses a nitrogen plasma for the purpose of suppressing the generation of $AlF_m(OH)_{3-m}$ as noted in the paragraph bridging columns 5 and 6. No mention is made of cleaning and clearly no mention is made of cleaning the via

sidewalls and exposed first metal bottom” [reply brief-page 2].

Appellants’ argument in this regard is not persuasive because the examiner has made a reasonable observation that if the nitrogen-containing plasma applied in the reference has similar properties and is within similar ranges of properties as that disclosed by appellants, it would appear that the nitrogen-containing plasma of the reference would also perform a cleaning function, as does appellants. Appellants have not addressed the examiner’s observation and so have not denied the examiner’s allegation. To merely say that the reference does not employ the word “cleaning,” is not a persuasive argument. Moreover, it is questionable whether there is even adequate support for the claimed cleaning “the via sidewalls and exposed first metal bottom.” Page 11 of the instant specification mentions that residue “must be cleansed from the cavity prior to further processing to avoid the formation of ‘open vias/contacts’ that establish non-ohmic (high resistance) contacts.” Page 12 of the specification indicates that a “pre-conditioning/cleansing of previously formed cavities, such as vias 28” is provided. The sentence bridging pages 12-13 even states that the “use of nitrogen also permits for nitridation of metallic surfaces exposed in the bottom of the cavity/via.” However, we find no clear disclosure of cleaning both the “via sidewalls and exposed first metal bottom with a nitrogen-containing plasma,” as now claimed. Thus, we are not persuaded by appellants’ argument regarding the cleaning by nitrogen-containing plasma step.

We are also not persuaded by appellants’ argument that the step of forming a liner on the via sidewalls and bottom is not taught or suggested by Ohtsuka. The examiner pointed to Ohtsuka’s

barrier underlayer, at column 3, lines 55-68, “which would correspond to a liner.” Appellants take issue with this characterization by the examiner because instant claim 5 calls for a “liner” and the portion of Ohtsuka identified by the examiner refers to a “barrier layer.” However, appellants’ argument on this point is not credible in view of appellants’ own specification describing the liner as a “liner or barrier layer” [page 4, line 8] and a “liner/barrier layer” [page 4-line 15].

Notwithstanding appellants’ unconvincing arguments, we will not sustain the rejection of the claims under 35 U.S.C. 102(b) and 103 because Ohtsuka clearly does not anticipate the subject matter of independent claim 5 and dependent claim 6 and Mizobuchi, relied on for a limitation in claim 7, does not provide for the deficiencies of Ohtsuka.

More specifically, while Ohtsuka does disclose the forming of a via, as claimed, and may be considered to clean the sidewalls and exposed first metal bottom with a nitrogen-containing plasma for the reasons expounded by the examiner and unanswered by appellants, it appears from the order of the steps in independent method claim 1 that the liner is formed after the cleaning step. However, if the liner, identified by the examiner as conduction layer 3, is formed first (see column 3, lines 59-64) and then the plasma treatment is performed (see column 4, lines 10-12), the order of the instant claimed method steps would not appear to be taught by Ohtsuka.

Further, even if we read independent claim 5 broadly, as not requiring any specific order to the claimed steps, the last step still calls for filling the via with a second metal. If the examiner is considering the via to be contact hole 2a of Ohtsuka, which contains the liner, or barrier, identified by the examiner

as conductive layer 3, then this via is filled with a second insulation layer 4 (see Figure 2). Thus, the via is not filled with a metal, as required by the claim.

Moreover, from Ohtsuka's disclosure, the nitrogen-containing plasma does not appear to be applied to this via but, rather to via 4a of Ohtsuka (see Figure 4). So, we could identify via 4a as the claimed via which is formed through insulation layer 4, with a nitrogen-containing plasma being applied thereto for "cleaning" the via sidewalls and metal bottom (conductor 3 is the bottom). The problem here is that there does not appear to be a liner, as claimed, applied to via

4a of Ohtsuka, the examiner having identified the liner as conductor 3 in via 2a. Moreover, even if we had a liner in via 4a of Ohtsuka, via 4a appears to be filled with an insulation-protector layer 7 (see Figure 6) which does not constitute a "second metal," as required by instant independent claim 5.

The examiner's decision rejecting claims 5 and 6 under 35 U.S.C. 102(b) and claim 7 under 35 U.S.C. 103 is reversed.

REVERSED

KENNETH W. HAIRSTON)
Administrative Patent Judge)
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Appeal No. 1999-1133
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