

The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.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. 44

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte GREGORY C. SMITH

Appeal No. 2004-0859
Application 08/866,456

ON BRIEF

Before PAK, OWENS and PAWLIKOWSKI, *Administrative Patent Judges*.
OWENS, *Administrative Patent Judge*.

DECISION ON APPEAL

This appeal is from the final rejection of claims 29-47. Claims 48-52, which are all of the other claims pending in the application, stand withdrawn from consideration by the examiner as being directed toward a nonelected invention.

THE INVENTION

The appellants claim a structure for electrically connecting levels of a semiconductor device. Claim 39 is illustrative:

39. An electrical connection structure for an integrated circuit device, comprising:

a first conductive layer;

an insulating layer overlying the first conductive layer, the insulating layer having an upper surface and an opening exposing a region of the first conductive layer, the opening being defined by a side-wall of the insulating layer and having a lower diameter adjacent the first conductive layer and a larger, upper diameter at a top portion thereof adjacent the upper surface of the insulating layer, the lower and upper diameter portions having been made using the same mask and being self-aligned with respect to each other and thus assured of having their respective centers aligned with each other;

a thin barrier layer covering the side-wall of the insulating layer within the opening and the first conductive layer region exposed within the opening;

a conductive plug overlying the barrier layer and filling the opening in the insulating layer, the plug having a lower diameter adjacent the first conductive layer and a larger, upper diameter adjacent the upper surface of the insulating layer, the upper diameter of the plug being larger than the lower diameter of the opening and the barrier layer being of a material that is selectively etchable with respect to the plug such that the upper portion of the plug is an etch stop that prevents etching of the barrier layer adjacent the bottom portion of the contact opening during any subsequent anisotropic etches; and

a second conductive layer overlying at least a portion of the plug and being of material that is selectively etchable with respect to the plug.

THE REFERENCES

Liou et al. (Liou)	5,070,391	Dec. 3, 1991
Liu et al. (Liu)	5,180,689	Jan. 19, 1993
Sato	5,284,799	Feb. 8, 1994
Lur et al. (Lur)	5,364,817	Nov. 15, 1994
Kim	5,530,294	Jun. 25, 1996

THE REJECTIONS

The claims stand rejected under 35 U.S.C. § 103 as follows:
claims 29-31, 33-37, 39-42 and 44-47 over Lur in view of Sato and
Liu, claims claim 32 over Lur in view of Sato, Liu and Liou,
claims 38 and 43 over Lur in view of Sato, Liu and Kim, and
claims 29-31, 33-37, 39-42 and 44-47 over Sato in view of Liu.¹

OPINION

We reverse the aforementioned rejections. We need to
address only the independent claims, i.e., claims 29, 39 and 44.

Each of the independent claims requires a conductive layer
and an insulating layer overlying the conductive layer, wherein
the insulating layer has therein an opening having a lower
portion and a larger-diameter upper portion. In claim 29 the
lower portion has generally straight side walls extending

¹ Rejections under 35 U.S.C. § 103 of claims 29-31, 33-37,
39-42 and 44-47 over Lur in view of Sato and Wolf
(U.S. 4,495,220), claim 32 over Lur in view of Sato, Wolf and
Liou, claims 38 and 43 over Lur in view of Sato, Wolf and Kim,
and claims 29-31, 33-37, 39-42 and 44-47 over Sato in view of
Wolf are withdrawn in the examiner's answer (page 3).

upwardly from the first conductive layer and the upper portion is bowled upwardly and outwardly from the lower portion to the upper surface of the insulating layer. In claim 39 the lower portion has a diameter adjacent the conductive layer which is smaller than the diameter of the upper portion at the surface of the insulating layer. In claim 44 the lower portion has a steeper side wall than the upper portion.

For the appellant's claim requirement of an insulating layer having an opening with a lower portion and a larger-diameter upper portion, the examiner relies (answer, pages 5-8) upon Sato which discloses a first conductive layer (lower wire 12) having thereover an insulating layer (13) with an opening therethrough (col. 4, line 67 - col. 5, line 45). The opening has a lower portion adjacent the substrate and a larger-diameter upper portion (figure 4D). These portions are formed by two successive lithographic processes which are not described (col. 5, lines 2-7). The disclosed benefit of these portions is that even if an adhesion layer (15) which lines the opening, and a blanket tungsten layer (16) which fills the opening, are overetched when they are etched back, the overetching does not extend downwardly beyond the upper, wider portion of the opening (col. 5, lines 39-42). Hence, "[t]he metal plug 16A thus formed is highly

reliable, and does not adversely affect the step coverage of the subsequently formed upper wire 17, with resultant good multilayer wires" (col. 5, lines 42-45; figure 4D).

The appellant's independent claims also require that the lower and upper opening portions are self aligned with each other. The examiner points out that this is a product-by-process limitation (answer, pages 17-20). The examiner, however, does not provide evidence or reasoning which shows that Sato's two successive lithographic processes produce a product which is identical or substantially identical to one having lower and upper opening portions which are self aligned. See *In re Fitzgerald*, 619 F.2d 67, 70, 205 USPQ 594, 596 (CCPA 1980); *In re Best*, 562 F.2d 1252, 1255, 195 USPQ 430, 433-34 (CCPA 1977); *In re Fessmann*, 489 F.2d 742, 745, 180 USPQ 324, 326 (CCPA 1974). Instead, the examiner relies upon Liu for a suggestion to make Sato's lower and upper opening portions self aligned (answer, pages 6 and 8). Liu discloses a method for making a tapered opening through an insulating layer (20) to an underlying source/drain region (12) (col. 4, lines 42-55). Liu sequentially 1) anisotropically etches the insulating layer through an opening in a resist mask to form an opening in the insulating layer, 2) using the same mask, isotropically etches the insulating layer

to substantially uniformly enlarge and taper the opening in the insulating layer, and 3) anisotropically etches the opening in the insulating layer through to the source/drain regions (col. 2, line 61 - col. 3, line 4; col. 4, line 66 - col. 5, line 27). Liu states that this method forms a tapered opening with a metal step coverage improvement over the state of the art of about 20-60%, where metal step coverage is "the ratio of thickness of the thinnest metal in the contact hole to the metal thickness on the horizontal area" (col. 3, lines 5-9). This step coverage is shown in Liu's figures 4-6 wherein metal layer 36 fills the lower portion of the opening and covers metal layer 34 which lines the opening, but does not fill the opening's upper portion.

The examiner argues that it would have been obvious to one of ordinary skill in the art to use Liu's method to form the lower and upper portions of Sato's opening to improve step coverage of a metal wiring layer at the opening (answer, pages 6, 8, 13 and 15-16). Unlike Liu, however, Sato completely fills the opening with metal and then etches back the metal to the insulating layer upper surface (col. 5, lines 10-17). The examiner has not established that one of ordinary skill in the art would have been led by the applied references to use Liu's technique, which only partially fills the opening with metal, to

Appeal No. 2004-0859
Application 08/866,456

obtain the complete filling of the opening with metal desired by Sato.² The record indicates that the motivation for doing so relied upon by the examiner comes from the appellant's disclosure rather than coming from the applied prior art and that, therefore, the examiner used impermissible hindsight when rejecting the claims. See *W.L. Gore & Associates v. Garlock, Inc.*, 721 F.2d 1540, 1553, 220 USPQ 303, 312-13 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984); *In re Rothermel*, 276 F.2d 393, 396, 125 USPQ 328, 331 (CCPA 1960). Accordingly, we reverse the examiner's rejections.

² The examiner does not rely upon Lur, Liou or Kim for any disclosure that remedies the above-discussed deficiency in Sato and Liu as to the independent claims.

Appeal No. 2004-0859
Application 08/866,456

DECISION

The rejections under 35 U.S.C. § 103 of claims 29-31, 33-37, 39-42 and 44-47 over Lur in view of Sato and Liu, claims claim 32 over Lur in view of Sato, Liu and Liou, claims 38 and 43 over Lur in view of Sato, Liu and Kim, and claims 29-31, 33-37, 39-42 and 44-47 over Sato in view of Liu, are reversed.

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CHUNG K. PAK)	
Administrative Patent Judge)	
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TERRY J. OWENS)	
Administrative Patent Judge)	APPEALS AND
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)	INTERFERENCES
)	
BEVERLY A. PAWLIKOWSKI)	
Administrative Patent Judge)	

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Appeal No. 2004-0859
Application 08/866,456

Stmicroelectronics, Inc.
Mail Station 2346
1310 Electronics Drive
Carrollton, TX 75006