Paper No. 22

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte PAUL KWOK KEUNG HO, THOMAS SCHULUE, RAYMOND JOY, WAI LOK LEE, RAMASAMY CHOCKALINGAM, BA TUAN PHAM and PREMACHANDRAN VAYALAKKARA

Appeal No. 2001-1662
Application No. 09/048,208

ON BRIEF

Before WILLIAM SMITH, WALTZ, and POTEATE, Administrative Patent Judges.

POTEATE, Administrative Patent Judge.

DECISION ON APPEAL

This is an appeal under 35 U.S.C. § 134 from the final rejection of claims 1-20, which are all of the claims pending in the application.

Claim 1 is representative of the subject matter on appeal and is reproduced below:

1. A method of forming metal lines without microloading in the fabrication of an integrated circuit comprising:

providing semiconductor device structures in and on a semiconductor substrate;

covering said semiconductor device structures with an insulating layer;

depositing a barrier metal layer overlaying said insulating layer;

depositing a metal layer overlaying said barrier metal layer;

covering said metal layer with a layer of photoresist;

exposing said photoresist layer to actinic light and developing and patterning said photoresist layer to form the desired photoresist mask wherein there are both wide spaces and narrow spaces between portions of said photoresist mask;

etching away said metal layer not covered by said photoresist mask wherein said barrier metal layer is reached within said wide spaces while some of said metal layer remains within said narrow spaces;

selectively etching away all of said metal layer remaining within said narrow spaces;

thereafter etching away said barrier metal layer not covered by said photoresist mask wherein said insulating layer is reached within said wide spaces while some of said barrier metal layer remains within said narrow spaces;

selectively etching away all of said barrier metal layer remaining within said narrow spaces; and

thereafter overetching said insulating layer not covered by said photoresist mask to complete said metal lines without microloading in said fabrication of said integrated circuit.

The reference relied upon by the examiner is:

Abraham et al.	5,883,007	Mar. 16, 1999

Ground of Rejection

Claims 1-20 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Abraham.

We Reverse

Background

In the manufacture of integrated circuits using a metal etching method, metal lines are formed by depositing a barrier layer over an oxide layer, followed by deposition of a metal layer. Specification, page 1. The middle layer is then etched away in those areas where it is not covered by a mask. Id. Thereafter, the barrier layer is etched followed by an oxide etcher over etched. Id.

A common problem which occurs in this conventional method is that of microloading. Id. Microloading refers to the situation where an etch rate is slower in areas where there is a high density of line spacings as compared with the etch rate in less dense areas. Abraham, column 2, lines 24-28. Microloading may result in one or more of severe resist loss, poor wafer planarization and metal shorts at narrow gap regions. Specification, page 1.

According to the inventors, they have developed a multi-step etch process having a particular sequence of etching steps which

unexpectedly provide improved etching uniformity and reduced microloading. Appeal brief, Paper No. 20, received November 20, 2000, pages 2-3, paragraph 5. In particular, the inventors have found that these unexpected results are achieved by completely removing the metal layer before beginning the barrier layer etch, and then completely removing the barrier layer before starting the over etch. id.

Discussion

In deciding patentability issues under 35 U.S.C. § 103, "[a]nalysis begins with a key legal question -- ***what*** is the invention ***claimed?***" Panduit Corp. v. Dennison Mfg. Co., 810 F.2d 1561, 1567-68, 1 USPQ2d 1593, 1597 (Fed. Cir.), ***cert denied***, 481 U.S. 1052 (1987). According to appellants,

> It is a key feature of Appellants' invention to completely remove all of the metal layer before beginning the barrier layer etch using an etch that is selective to the metal layer with respect to the barrier layer (see Claim 1, lines 25-28 and page 6 of the Specification, third paragraph) and to completely remove all of the barrier layer before beginning the overetch with an etch that is selective to the barrier layer with respect to the insulating layer (see Claim 1, lines 34-37 and page 7 of the Specification, second full paragraph).

Appeal brief, page 7, lines 3-12. Thus, appellants maintain that the invention as claimed distinguishes over Abraham which does not teach complete removal of the metal layer before

beginning the barrier layer etch or complete removal of the barrier layer before commencing the overetch. id., page 6. According to the examiner, this argument is unpersuasive since these features are not claimed. Examiner's answer, Paper No. 21, mailed January 19, 2001, page 6.[1]

In determining the patentability of claims, the PTO gives claim language its "broadest reasonable interpretation" consistent with the specification and claims. In re Morris, 127 F.3d 1048, 1054, 44 USPQ2d 1023, 1027 (Fed. Cir. 1997) (citations omitted). The terms of a claim are generally given their ordinary meaning unless it appears from the specification or file history that the inventor intended a special definition. Vitronics Corp. v. Conceptronic, Inc., 90 F.3d 1576, 1582, 39 USPQ2d 1573, 1576 (Fed. Cir. 1996).

Claim 1 recites a method of forming metal lines without microloading in the fabrication of an integrated circuit and sets forth a sequence of steps which are clearly intended to occur in

[1] The examiner concedes that Abraham does not "expressly disclose providing a semiconductor structure on or within the semiconductor substrate and a semiconductor structure include [sic, including] gate electrodes and source and drain regions" as required by claim 1. id., page 5. However, appellants do not dispute the examiner's position that it would have been obvious to one of ordinary skill in the art at the time of the invention to have modified Abraham to include these structures. See id.

chronological order. In other words, it is apparent that each step is intended to be completed prior to commencement of a subsequent step. For example, it is clear that the step of depositing a metal layer overlying said barrier metal layer can not occur until after the barrier metal layer has been deposited as recited in the prior step. Similarly, the step of "selectively etching away all of said metal layer remaining within said narrow spaces" can not occur until the step of etching away the metal layer, such that some of the metal layer remains in the narrow spaces, as recited in the prior step.

We do not find, nor has the examiner identified any teaching or suggestion in Abraham of a two step etching procedure for removal of the metal layer wherein, the first etching steps it leaves a portion of the metal layer within narrow spaces and the second step "selectively etches" away "all of said metal layer remaining within said narrow spaces." See claim 1. Abraham teaches an etching step which proceeds until the metalization layer has been "substantially etched away." See e.g., column 7, lines 22-24, column 8, lines 65-9, line 2. Abraham further teaches that the step of etching the metalization layer may be continued to ensure complete removal of the metalization layer. See column 9, lines 8-13. However, the examiner has not

demonstrated how continuation of the step of etching the metalization layer in any way discloses or suggest the claimed two step process wherein the portion of the metal layer remaining in the narrow spaces from the first etching step is removed in a subsequent selective etching step.

Similarly, the examiner has not identified any teaching or suggestion in Abraham which requires the two step etch and selective etch for removal or the barrier metal layer.

We further note that claim 1 requires that the step of etching the barrier metal layer does not commence until after all of the metal layer has been removed from the narrow spaces as required in the prior step. In particular, we note that the use of the word "thereafter" clearly signals a subsequent step. Similarly, the claims require that over etching the insulating layer does not commence until after the step of selectively etching away all of the barrier metal layer remaining in the narrow spaces, as again indicated by use of the word "thereafter." In fact, Abraham specifically states that "[a]lthough the second chemistry may [sic, be] extended to etch through the barrier layer, the third chemistry employed in step 405 may be better suited to etch through the remaining metalization layer and into an underlying layer." Column 9,

lines 23-27. We note that our interpretation of claims is consistent with the specification. In particular, the figures and description thereof, indicate that the recited etching away of the metal layer to reach the barrier metal layer within the wide spaces and etching away of the barrier metal layer to reach the insulating layer are intended to refer to a complete removal of these materials within the wide spaces. See Figures 2 and 4; Specification, page 6 ("it can be seen that the metal etch end point is reached in the wide spaces 33 while in the narrow spaces 32, some of the metal layer still remains.") Page 7 ("the barrier layer is etched completely through in the wider areas 33 while some of the barrier layer remains within the narrow spaces 32.").

Accordingly, we find that the examiner has failed to establish a prima facie case of obviousness.[2] The rejection is reversed.

[2] Having concluded that a prima facie case of obviousness does not exist, we need not consider appellants' evidence of unexpected results, i.e., the declaration of Paul Ho under 37 CFR § 1.132.

REVERSED

WILLIAM F. SMITH Administrative Patent Judge	)	
THOMAS A. WALTZ Administrative Patent Judge	)	BOARD OF PATENT APPEALS AND INTERFERENCES
LINDA R. POTEATE Administrative Patent Judge	)	

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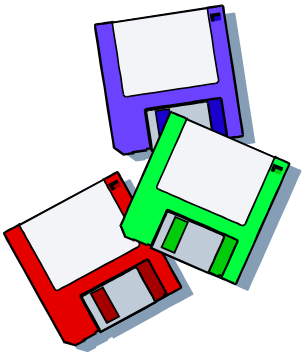

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APJ POTEATE

APJ WILLIAM SMITH

APJ WALTZ

DECISION: REVERSED

Prepared: September 12, 2003

Draft Final

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