Paper No. 41
Paper No. 38

THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

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Ex parte FAIRCHILD CAMERA & INST. CORPORATION

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Appeal Nos. 97-2505 and 97-2506
Reexamination Nos. 90/003,566
and 90/003,869[1]

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HEARD: AUGUST 28, 1997

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Before JOHN D. SMITH, WEIFFENBACH and OWENS, *Administrative Patent Judges*.

OWENS, *Administrative Patent Judge*.

DECISION ON APPEAL

This is an appeal from the examiner's rejection of claim 2 of U.S. Patent No. 4,325,984 to Galfo et al. (Galfo patent) in

[1] Merged reexamination proceeding for U.S. Patent No. 4,325,984, issued April 20, 1982, based on Application 06/172,745, filed July 28, 1980. A reexamination certificate for this patent was issued on August 6, 1991, based on Reexamination Request No. 90/002,138, filed September 17, 1990.

this merged reexamination proceeding. The patentability of the other claims of the patent, claims 1 and 3-9, has been confirmed by the examiner. Claim 2 reads as follows:

> 2. A method for preventing the post-etch corrosion of aluminum or aluminum alloy film which has been etched in a reaction chamber containing chlorinated plasma comprising:
>
> a. evacuating the reaction chamber of chlorinated plasma;
>
> b. while maintaining a vacuum in the reaction chamber, introducing fluorinated gas to the chamber;
>
> c. applying suitable RF power to the chamber to generate a fluorinated plasma for passivation of the etched aluminum film.

THE REFERENCES

Reference relied upon by the examiner:

Irving et al. (Irving) 3,615,956 Oct. 26, 1971

References relied upon by the Board:

Lemons et al. (Lemons)[2] 4,213,818 Jul. 22, 1980

Richard L. Bersin, "Programmed Plasma Processing: The Next Generation", *in Kodak Microelectronics Seminar Proceedings* 21-28 (San Diego, California, October 1-3, 1978) (Bersin).[3]

THE REJECTION

[2] Lemons was provided in the request for reexamination in Control No. 90/003566.

[3] Bersin was provided in the request for reexamination in Control No. 90/003896.

Claim 2 stands rejected under 35 U.S.C. § 102(b) as being anticipated by Irving.

OPINION

We have carefully considered all of the arguments advanced by the patent owner and the examiner and agree with the patent owner that the aforementioned rejection is not well founded. Accordingly, this rejection will be reversed. We will enter new grounds of rejection of claim 2 under 37 CFR § 1.196(b) and introduce a new ground of rejection of claims 1 and 3-9 for consideration by the examiner under 37 CFR § 1.196(d).

The invention recited in claim 2 is a method for preventing post-etch corrosion of an aluminum or aluminum alloy film which has been etched by use of a chlorinated plasma in a reaction chamber. The method includes evacuating the chlorinated plasma from the reaction chamber, introducing a fluorinated gas in to the chamber while the chamber is maintained under vacuum, and generating a fluorinated plasma in the chamber by use of RF power such that the etched film is passivated.

Irving discloses a plasma etching method wherein, in one embodiment, scribe lines are formed in a semiconductor wafer

(col. 3, lines 33-34).[4] Prior to the beginning of this method, a layer of silicon dioxide has been formed over circuit elements on the wafer and a thin layer of aluminum has been applied over the silicon dioxide (col. 3, lines 35-52). According to Irving's method, photoresist is applied to the aluminum, exposed through a mask having the pattern of the scribe lines, and then developed so that the aluminum is uncovered where the scribe lines are to be formed (col. 3, lines 53-60). The wafer then is subjected to a chlorinated plasma which attacks the aluminum at the scribe lines such that a volatile chloride of aluminum is produced (col. 3, lines.[5] This chloride of aluminum is evacuated through a roughing pump which is provided for continuously evacuating the chamber (col. 2, lines 26-33; col. 3, lines 65-72). As soon as the aluminum has been removed by etching it using the chlorinated plasma, thereby uncovering the silicon dioxide at the scribe lines, the chamber is purged and a fluorine-containing gas is metered into the chamber (col. 3, line 72 - col. 4, line 7). A plasma is formed from the fluorine-containing gas and this plasma is used to etch through the silicon dioxide at the scribe lines

[4] Scribe lines are lines at which the wafer will be broken by mechanical stress to form individual circuit chips or dice (col. 1, lines 4-5; col. 4, lines 60-74).

[5] The aluminum also could be removed by wet etching (col. 3, lines 59-63). Since wet etching is not relevant to the patent owner's method, we do not discuss it further.

and into the silicon (col. 4, lines 22-31). Silicon tetra-fluoride formed during this etching is evacuated through the roughing pump (col. 4, lines 22-27). Irving states that "it can be seen that when vapor etching is utilized for etching the aluminum and also for etching the scribe lines in the silicon dioxide and the silicon that both vapor etching steps can be carried out one after the other while the semiconductor wafers are in situ which greatly expedites the process" (col. 4, lines 54-59).

The patent owner does not challenge the examiner's assertion (answer, page 7) that the etching with fluorinated plasma in the Irving process passivates aluminum. The patent owner's sole argument is that the step disclosed by Irving of purging the chamber of chlorinated plasma (col. 3, lines 74-75) is not an evacuation step as recited in claim 2 of the Galfo patent (brief, pages 4-5). The patent owner argues that "purge" and "evacuating" had definite and non-overlapping meanings in the art as of the filing date of the Galfo patent (brief, page 7). According to the patent owner, a purge was considered to be a gradual displacement of one gas in a chamber by another gas wherein the unwanted gas is diluted out through the constant flow of the purge gas, and an evacuation was considered to be the removal of an unwanted gas using vacuum as the essential

mechanism (brief, pages 10-15). This argument is supported by declarations by each of the two Galfo patent inventors and by three experts in the semiconductor processing field (brief, Appendices C-I).

The examiner considers the expression "evacuating the reaction chamber of chlorinated plasma" in claim 2 of the Galfo patent to relate "only to the removal of the chlorine gas, chlorinated ions and reaction byproducts, not any carrier gas which may continue to flow" (answer page 4). The examiner states (answer, page 5) that

> the term evacuating the chamber of chlorinated plasma does not, in the examiner's determination, mean a lowering of the pressure, but merely the maintenance of a vacuum condition or status due to the operation of the vacuum pump which continues to operate to remove chlorinated plasma and while continuing to introduce nitrogen gas into the chamber. This fits the classic definition of a purge as set forth in all of Professor Oldham's declarations.

The examiner further states (answer, page 10):

> If, as suggested by Professor Oldham's affidavits, there is a carrier gas in Irving during the chlorine etching step, it would continue to flow as only the inflow of chlorine gas is stopped, and the continuous flow of the carrier gas would act as a purge and assist in "evacuating the reaction chamber of chlorinated plasma". This would be an "evacuation" step as understood by Galfo.

Thus, in the examiner's view, Galfo's evacuation can be considered to be a purge and Irving's purge can be considered to be an evacuation.

The deficiency in the examiner's argument is that the examiner has not established that the term "evacuating" as of the filing date of the Galfo patent application was considered by the inventors in that application or considered in the art to encompass removing gas from a chamber while another gas, such as a purge gas, is being introduced into the chamber.

The examiner points out (answer, page 3) that in the only example in the Galfo patent, the chlorinated plasma includes carbon tetrachloride and nitrogen as well as chlorine. The examiner argues (answer, page 12) that in this example the chlorine flow could be stopped while the nitrogen continues to flow. If this were the technique used in the example, then the example would support the examiner's argument that "evacuating", as that term was used in the Galfo patent application, included using vacuum and a purge in combination. The examiner, however, has not established that the nitrogen flow actually was continued after the chlorine flow was stopped in the Galfo example. The examiner's assertion regarding the continuation of the nitrogen flow during evacuation appears to be mere speculation. Furthermore, the examiner has provided no evidence that

"evacuating", as that term was known in the art as of the filing date of the Galfo patent application, encompassed introducing a purge gas into a chamber while gas is removed from the chamber.

For the above reasons, we find that the examiner has not carried his burden of establishing a *prima facie* case of anticipation by Irving of claim 2 of the Galfo patent. Accordingly, the rejection of this claim under 35 U.S.C. § 102(b) is reversed.

We introduce the following new grounds of rejection under the provisions of 37 CFR § 1.196(b).

Claim 2 is rejected under 35 U.S.C. § 102(b) as being anticipated by or, in the alternative, under 35 U.S.C. § 103 as being obvious over Bersin.

Bersin discloses a method for using plasmas to preclean, etch and passivate aluminum (page 27). Since the article pertains to forming microelectronic devices and VLSI circuits (page 22), it appears that the aluminum which is etched can be in the form of an aluminum film. Alternatively, given the teaching that the method is used to form microelectronic devices and VLSI circuits, it would have been *prima facie* obvious to one of ordinary skill in the art to apply the method to aluminum in any form used in these devices, such as a film. The precleaning,

etching and passivating steps discussed on page 27 of Bersin are considered to be, respectively, the pre-etch, etch and post-etch steps in Figure 16 on page 26. Based on this interpretation of the reference, Bersin discloses evacuating a chamber after aluminum has been etched therein using a chlorinated plasma (page 26, Figure 17, step 8), and then passivating the aluminum using a fluorinated plasma formed using RF power (page 26, Figure 16). The lower pressure for the passivation is 400 mm Hg (page 26, Figure 16). Since the passivation is carried out under vacuum, it appears that the fluorine-containing gas is introduced into the chamber while the chamber is under vacuum. Alternatively, it would have been *prima facie* obvious to one of ordinary skill in the art to introduce the fluorine-containing gas into the chamber under vacuum to reduce the contamination of the fluorine-containing gas by other gases in the chamber.

Claim 2 is rejected under 35 U.S.C. § 103 as being unpatentable over Irving in view of Bersin.

Irving discloses a process wherein aluminum is etched away at scribe lines using a chlorinated plasma in a chamber, the chamber is purged of the chlorinated plasma, and a fluorinated plasma is formed in the chamber and used to etch through a silicon dioxide layer and into silicon at the scribe lines (col.

3, line 66 - col. 4, line 27). A continuously operating roughing pump maintains a vacuum during this process (col. 2, lines 27-35; col. 3, lines 70-71; col. 4, lines 26-27 and 54-59). The plasmas are formed using RF power (col. 2, lines 36-52; col. 2, line 73 - col. 3, line 6). Irving does not state that the fluorinated plasma passivates aluminum. However, because the RF power used to form Irving's plasma (300 watts maximum, col. 2, lines 45-46) falls within the range of RF power disclosed in the Galfo patent (10-500 watts, col. 2, line 60), and because Irving's exemplified range of etching times (3-10 min., col. 4, lines 45-46) includes one of the times disclosed as being suitable in the Galfo process (5 min., col. 3, Table 1, Case C), it appears that the fluorinated plasma in the Irving process necessarily passivates uncovered aluminum. Irving does not disclose evacuating, rather than purging, the chamber of the chlorinated plasma. However, it would have been *prima facie* obvious to one of ordinary skill in the art to use evacuation to remove the chlorinated plasma from the chamber in the Irving process because Bersin teaches that evacuation is an effective method for removing a chlorinated plasma, which has been used to etch aluminum in a chamber, prior to subsequent treatment of the workpiece with a fluorinated plasma in the chamber (page 26, Figures 16 and 17). Although the

treatment with a fluorinated plasma removes silicon dioxide and silicon in the Irving process (col. 4, lines 4-27) and passivates aluminum in the Bersin process (page 26, Figure 16 and page 27), the teachings of these references, taken together, would have indicated to one of ordinary skill in the art that purging and evacuation are alternative processes for removing chlorinated plasma, which has been used to etch aluminum in a chamber, prior to treatment of the workpiece in the chamber with a fluorinated plasma.

The examiner is to consider, under the provisions of 37 CFR § 1.196(d), the following rejection of claims 1 and 3-9, the patentability of which has been confirmed by the examiner.

Claims 1 and 3-9 are rejected under 35 U.S.C. § 103 as being unpatentable over Irving in view of Bersin and Lemons.

Claims 1, 3 and 4: The above discussion of Irving and Bersin in the rejection of claim 2 over these references is incorporated herein. Irving does not disclose using a plasma formed from sulfur hexafluoride to etch the silicon dioxide and silicon at the scribe lines. However, in view of the teaching by Irving that "[a]ny number of gases can be utilized for etching the silicon dioxide and also the silicon to form the scribe lines of the wafer" (col. 4, lines 4-7) and that fluorine compounds are suitable (col. 4, lines 6-7), it would have been *prima facie*

obvious to one of ordinary skill in the art to use any fluorine compound known in the art to be effective, when formed into a plasma, for etching both silicon dioxide and silicon. Such a fluorine compound is sulfur hexafluoride as taught by Lemons (col. 7, lines 12-27).

Claim 5: Lemons indicates that suitable pressures for use during the process disclosed therein include 200 millitor (col. 3, lines 21-23).

Claims 6 and 7: Lemons does not disclose the reaction chamber temperature. However, the absence of any teaching that heating is required to carry out the disclosed process indicates that no heating is necessary. Thus, it would have been *prima facie* obvious to one of ordinary skill in the art to carry out the process at room temperature, or about 20°C, in order to avoid the expense of heating.

Claim 8: Lemons does not disclose the RF current. However, the fact that the RF power values of 200 and 300 watts disclosed by Lemons (col. 3, line 38; col. 8, line 15) fall within the range of 10 to 500 watts disclosed in the Galfo patent indicates that the corresponding RF currents in the Lemons process include 0.5 amps as disclosed in the Galfo patent (col. 3, line 9).

Claim 9: Irving does not disclose exposing aluminum to a fluorinated plasma for about 1.5 minutes. The etching times which Irving states are exemplary are 3-10 minutes (col. 4, lines 45-47). Lemons does not disclose the time the substrates therein are subjected to the sulfur hexafluoride plasma. However, in view of the teachings by Irving that etching rates vary from gas to gas and are dependent on the reactor geometry (col. 4, lines 47-48), and that the wafer can be etched to various depths (col. 4, lines 40-43), it would have been *prima facie* obvious to one of ordinary skill in the art to determine, through no more than routine experimentation, etching times other than those exemplified by Irving, such as about 1.5 minutes, which produce a desired depth of etching when using a particular reactor geometry and sulfur hexafluoride as the etching gas.

DECISION

The rejection of claim 2 under 35 U.S.C. § 102(b) as being anticipated by Irving is reversed. Claim 2 is rejected based on new grounds of rejection under 37 CFR § 1.196(b). The examiner is to consider the new ground of rejection of claims 1 and 3-9 introduced herein under 37 CFR § 1.196(d).

A period of two months is set in which the appellant may submit to the Primary Examiner an appropriate amendment, or a showing of facts or reasons, or both, in order to avoid the grounds set forth in the statement of the Board of Patent Appeals and Interferences under the provisions of 37 CFR § 1.196(d) and/or prosecute further before the Primary Examiner by way of amendment or showing of facts, or both, not previously of record with respect to the new rejection under 37 CFR § 1.196(b) if the appellant so elects.

Upon conclusion of the proceedings before the Primary Examiner on remand, this case should be returned to the Board by the Primary Examiner so that the Board may either adopt its decision as final or render a new decision on all of the claims on appeal, as it may deem appropriate. Such return for this purpose is unnecessary if a reexamination certificate is issued or a rejection is again appealed.

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

REVERSED

37 CFR §§ 1.196(b)&(d)

John D. Smith Administrative Patent Judge	)	
Cameron Weiffenbach Administrative Patent Judge	)	BOARD OF PATENT APPEALS AND INTERFERENCES
Terry J. Owens Administrative Patent Judge	)	

Michael J. Pollock &
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Appeal Nos. 97-2505
97-2506

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