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D E C I S I O N
of 21 June 1995

Case Number: T 0772/92 - 3.4.1

Application Number: 85307443.3

Publication Number: 0180373

IPC: H01J 37/20

Language of the proceedings: EN

Title of invention:

Automated single slice powered load lock plasma reactor

Applicant:

TEXAS INSTRUMENTS INCORPORATED

Opponent:

-

Headword:

Plasma reactor/TEXAS INSTRUMENTS

Relevant legal provisions:

EPC Art. 56

Keyword:

"Late filed request - not clearly allowable and not admitted into the proceedings"

"Relevant skilled person - not a user but a development engineer"

Decisions cited:

T 0095/83, T 0153/85

Catchword:

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Case Number: T 0772/92 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 21 June 1995

Appellant: TEXAS INSTRUMENTS INCORPORATED
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Texas 75265 (US)

Representative: Abbott, David John
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Decision under appeal: Decision of the Examining Division of the European Patent Office dated 20 March 1992 refusing European patent application No. 85 307 443.3 pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: G. D. Paterson
Members: R. K. Shukla
H. J. Reich

Summary of Facts and Submissions

- I. European patent application No. 85 307 443.3 was refused by a decision of the Examining Division on the ground of lack of inventive step as required by Articles 52 and 56 EPC, having regard to the prior art documents:
- D1= US-A-4 341 582 and
D3= US-A-4 318 767.
- II. According to the above decision, document D3 describes an apparatus for processing semiconductor wafers, having an entry chamber, a main chamber, an exit chamber and means for transporting the wafer between the chambers, and document D1 discloses means for plasma treatment of the wafer before and after the main plasma etching of the wafer. The Examining Division therefore held that in view of the disclosure in document D1, it was obvious for a skilled person to provide in the apparatus disclosed in document D3 means for plasma treatment of the wafers in the entry and/or exit chamber.
- III. The Applicant lodged an appeal against the decision. An amended independent Claim 1 was submitted with a letter dated 16 June 1995, and the grant of a patent was requested on the basis of this claim.

Amended Claim 1 under consideration has the following wording:

"Apparatus for processing semiconductor wafers, the apparatus having components including:

a main plasma chamber (31), for receiving a wafer to be processed, provided with a first ionized reactive gas generation means comprising means (45) for feeding reactive gases to the main plasma chamber (31) and parallel plate radio frequency plasma generation means (51, 53) for generating, by the use of radio frequency excitation, a radio frequency plasma in the main plasma chamber (31) to carry out a main processing step of plasma etching on the wafer located between the parallel plates of the first ionized reactive gas generation means;

load lock chamber means (21, 59) with means enabling said load lock chamber means (21, 59) to be evacuated, the load lock chamber means (21, 59) being portedly coupled to the main plasma chamber (31);

further ionized reactive gas generation means (781), including electrodes for ionizing reactive gases, for providing ionized reactive gases to provide supplementary wafer processing within the load lock chamber means (21, 59) in addition to the main wafer processing step carried out in the main plasma chamber (31);

wafer transporting means (441, 541) for transporting wafers between the load lock chamber means (21, 59) and the main plasma chamber (31); and

control means (10, Fig. 9) for operating the components so that wafers are passed through the main plasma chamber (31) and undergo a particular process when in the main plasma chamber (31);

characterized in that:

the further ionized reactive gas generation means is constituted by further parallel plate radio frequency plasma generation means (51, 53) located within and arranged to carry out within said load lock

chamber means (21, 59) an additional step of radio frequency plasma etching on the wafer between the parallel plates of the further parallel plate radio frequency plasma generation means (51, 53) before and/or after the main processing step in the main plasma chamber (31)."

IV. The Appellant's arguments in support of its request can be summarized as follows:

Document D3 discloses entry and exit load lock chambers 13, 13' which are connected to a main plasma etching chamber 1. However, the entry and exit chambers have no facilities for plasma treatment of the wafers.

Document D1 discloses a main plasma etching chamber 21 which is located within an outer chamber 20. According to document D1 some pre- and post-treatment of the wafers can be done in the outer chamber by feeding ionized gas into the chamber by means of a tube 71 having electrodes 38, 39 disposed thereon. This kind of treatment provides general etching (i.e. isotropic etching) of the surface of the wafer and is very different from the high precision vertical etching (i.e. anisotropic etching) achieved in a parallel plate radio frequency (RF) plasma etching system of the claimed apparatus of the present invention. There is thus no incentive in the prior art documents for the skilled person to replace the general etching system provided in the outer chamber of the apparatus of document D1 by a parallel plate RF plasma etching system.

Even if the disclosures of documents D1 and D3 were combined, the person skilled in the art would not

arrive at an apparatus as claimed requiring a parallel plate RF plasma generating means in the load lock chamber. Consequently, the claimed subject matter cannot be considered to be obvious.

The present invention is based on the realisation that (i) in the prior art plasma etching system such as known from document D1 or D3, the main chamber may be contaminated with the reactive gases, so that there is a risk of cross- contamination if the same chamber is used in a further plasma etching requiring different reactive gases, and that (ii) such cross-contamination can be avoided by using the outer load module of the apparatus such as known from document D1 , in addition to the main chamber, for precision vertical etching. The present invention thus provides a versatile plasma etching apparatus with multiple menu capability (for etching) and low particulate contamination.

- V. Oral proceedings were held on 21 June 1995. After deliberation, the Board informed the Appellant that the application would not be granted in accordance with his request. Before the oral proceedings were closed, the Representative of the Appellant asked if he could file a new request according to which "and/or" on the penultimate line of Claim 1 is changed to "and", but the Board refused to admit this request. At the conclusion of the oral proceedings the decision was announced that the appeal is dismissed.

Reasons for the Decision

1. *Inventive step*

1.1 Document D1 constitutes, in the Board's view, the closest prior art and discloses (see in particular Figures 2 and 3) an apparatus for processing semiconductor wafers, the apparatus having an inner chamber (21) connected to three incoming lines (43, 44 and 45 in Figure 4) which may be used to supply different etching gases to the inner chamber. The inner chamber is provided with parallel plate electrodes (21c, 21d) connected to an RF source of voltage (49) for generating a plasma to perform the main processing step of plasma etching on the wafer which may be located between the parallel plate electrodes (see column 2, lines 63 to 66; column 4, lines 17 to 34). The apparatus also comprises an outer chamber 20, referred to as a load module which is evacuated after receiving a wafer. A tube (71) having one end communicating with the load module (21) and its other end connected with one or more gas sources is provided with electrodes (38, 39) so that on applying a potential difference between the electrodes, the gases entering the load chamber can be ionised to accomplish supplementary processing of the wafer either before or after the main plasma etching in the inner chamber (21). Wafer transporting means (22, 24, 25) transport the wafer between the load module and the inner chamber when a lid (21a) of the latter is open (see column 2, line 67 to column 3, line 14; column 3, lines 30 to 47). The document also discloses that the invention may be operated under the control of a microprocessor (see column 5, lines 31 to 35). In other words, the apparatus of the document includes "control means for operating the components so that wafers are passed through the main plasma chamber (31) and undergo a

particular process when in the main plasma chamber (31)" as claimed in Claim 1 of the application in suit.

From the above it is clear that document D1 discloses an apparatus for processing semiconductor wafers having all the features of the preamble of Claim 1. This has not been disputed by the Appellant.

- 1.2 The apparatus according to Claim 1 of the application in suit is thus distinguished over the apparatus disclosed in document D1 in that it is provided with parallel plate radio frequency plasma generating means in its load lock chamber means, so that the apparatus is capable of carrying out plasma etching before or after a similar plasma etching in the main plasma chamber. As submitted by the Appellant and as stated in the patent in suit (see column 2, lines 55 to 59), therefore, the apparatus according to the present invention provides multiple process capability by which multiple menus can be applied to a single wafer in situ to achieve special etch profiles without any risk of cross-contamination of the chambers.

In the manufacture of VLSI circuits, it is customary that multiple layers of photo resist, insulating materials and metallisation provided on a wafer are required to be etched in succession using the plasma etching technique employing different reactive gases for different materials to be etched. The Appellant submitted that in the anisotropic etching of a stack of films provided on a wafer, a skilled person concerned with the problem of particulate contamination would consider, for example, using two modules (13) of the kind disclosed in document D1 in succession, so that

each module (13) including a load module (20) and a process module (21) would carry out the etching processes as described therein without cross-contamination of the chambers. The Board, however, cannot accept this argument mainly because it is based on the assumption that the relevant skilled person is a **user** of the apparatus who considers using what is available on the market. In the present case, in the Board's view, the relevant skilled person is a development engineer in the field of plasma etching systems, concerned with providing a plasma etching apparatus which is capable of etching multiple films stacked on a wafer. The contamination of the plasma chambers by the corrosive gases and problems which may be caused by such a contamination in subsequent etching processes are notorious in the art, so that the skilled person concerned with avoiding cross-contamination would consider using different chambers for plasma etching processes employing different reactive gases. The skilled person also knows from document D1 that the wafer should not be exposed to the atmosphere between the etching treatments in the load module and the inner chamber respectively. The use of the load module in the apparatus of document D1 for an additional plasma etching processing, and consequently the provision of parallel plate electrodes in the load module, would therefore be regarded as obvious by him. In the Board's view, therefore, the subject-matter of Claim 1 is no more than a normal development of the plasma etching apparatus of document D1.

For the foregoing reasons, in the Board's judgement, the subject matter of Claim 1 does not involve an inventive step within the meaning of Article 56 EPC.

2. *Admissibility of a late auxiliary request*

In appeal proceedings claims constituting further auxiliary requests should normally be filed with the statement of grounds or soon thereafter. A number of decisions by the Boards of Appeal have made it clear that claims filed at a late stage of the proceedings may be rejected as inadmissible (see, for example, T 95/83, OJ 1985, 75 and T 153/85, OJ 1988, 1). In particular, if the late filed claims are not clearly allowable, then the Board, in the exercise of its discretion, may refuse to admit such claims. In the present case a request to file an auxiliary request containing a minor amendment to Claim 1 was made after the Board had deliberated upon the allowability of the previous sole request. The Board is unable to understand why this request was not put forward before the oral hearing, or at least at the beginning of the oral hearing. In any event, the Board did not consider that the suggested amendment to Claim 1 would have rendered the claimed subject-matter inventive. Consequently, amended Claim 1 as requested by the Appellant was rejected as inadmissible.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

M. Beer

G. D. Paterson