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**Datasheet for the decision
of 8 August 2012**

Case Number: T 2094/08 - 3.4.02

Application Number: 01987139.1

Publication Number: 1364231

IPC: G02B1/10, G21K1/06

Language of the proceedings: EN

Title of invention:
A SELF-CLEANING OPTIC FOR EXTREME ULTRAVIOLET LITHOGRAPHY

Patentee:
EUV Limited Liability Corporation

Opponent:
Carl Zeiss SMT GmbH

Headword:

Relevant legal provisions:
EPC 1973 Art. 56

Keyword:
Inventive Step - Claims 1 and 8 (yes)

Decisions cited:

Catchword:



**Beschwerdekammern
Boards of Appeal
Chambres de recours**

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Case Number: T 2094/08 - 3.4.02

D E C I S I O N
of the Technical Board of Appeal 3.4.02
of 8 August 2012

Appellant: EUV Limited Liability Corporation
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Respondent: Carl Zeiss SMT GmbH
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Representative: Rapp, Josef Max
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Decision under appeal: **Interlocutory decision of the Opposition
Division of the European Patent Office posted 2
September 2008 concerning maintenance of the
European Patent No. 1364231 in amended form.**

Composition of the Board:

Chairman: A. Klein
Members: M. Rayner
B. Müller

Summary of Facts and Submissions

- I. Both the patent proprietor and the opponent appealed against the interim decision of the opposition division according to which the patent as amended according to the first auxiliary request of the patent proprietor was found to meet the requirements of the Convention. The opponent subsequently withdrew its appeal and declared that it would not take any part in further proceedings. The patent concerns an extreme ultraviolet lithography system.
- II. During oral proceedings before the opposition division, the division expressed its view that the subject matter of independent claims 1 and 8 of the main request before it had not been impermissibly amended and was clear and sufficient. Moreover, with respect to documents presented, other than documents D8 and D4, the subject matter of independent claims 1 and 8 of the main request was considered patentable.
- III. In the decision under appeal, the opposition division considered claim 1 of the main request before it to lack an inventive step in view of documents D8 and D4 because a ruthenium capping layer disposed on a mirror surface transmitting 90% of incident EUV radiation, which was not known from document D8 concerning a self cleaning mirror to which oxygen is added to remove carbon contamination, would obviously be applied to the teaching of that document in the light of the teaching of document D4 to solve the problem of preventing oxidation.
- IV. The sole remaining appellant (=patent proprietor) requested that the patent in dispute be maintained in amended form according to a main, first or second

subsidiary request filed with the statement of grounds for appeal. The arguments of the appellant in relation to its main request can be summarised briefly as follows.

Claims 1 to 13 are substantively the same as the claims of the main request presented before the opposition division.

The problem to be solved by the ruthenium capping layer is to preserve the reflectivity of the mirror.

According to document D8, a controlled amount of oxygen is added to remove carbon while maintaining oxidation of the mirror to a level preserving reflectivity. A capping layer is not suggested. Had a skilled person, nevertheless, wished to investigate a capping layer, document D6 teaching a carbon capping layer to protect the mirror from oxidation would have been an obvious choice. Even were document D4 to have been considered, it would have been dismissed for not giving figures consistent with "greater than 90% of incident EUV radiation to the reflective surface" and only dealing with ambient oxidation. Unlike ambient oxidation, which can lead to native oxide limited to at most 2nm thickness in silicon, radiation-induced oxidation can oxidise the entire sample.

V. The wording of claims 1 and 8 according to the main request of the appellant is as follows.

"1. An extreme ultraviolet (EUV) lithography system including a self-cleaning reflective optical element comprising an underlying optic that comprises a mirror and a capping metal layer that is disposed on an EUV reflective surface of the mirror and that protects that

reflective surface against oxidation and transmits greater than 90% of incident EUV radiation to the reflective surface characterized in that said system further includes at least one deliberately added gaseous reactant;
said capping metal layer is a ruthenium layer; and
said capping metal layer and the at least one deliberately added reactant are configured such that electrons are generated, in combination with said incident EUV radiation by the capping layer and react with the at least one deliberately added gaseous reactant to remove carbon contaminants deposited on the capping metal layer surface and to continuously clean said carbon contaminants from the capping metal layer surface.

8. A method for maintaining the surface of a reflective optical element used in extreme ultraviolet (EUV) lithography applications substantially free of carbon contamination wherein the optical element comprises an underlying optic that comprises a mirror and a capping metal layer that is disposed on an EUV reflective surface of the mirror and that protects the reflective surface against oxidation and transmits greater than 90% of incident EUV radiation to the reflective surface, the method including the steps of:
supplying a reactive gas; and
exposing the capping layer to EUV radiation;
characterised in that
said capping metal layer is a ruthenium layer;
the reactive gas is deliberately supplied; and
the metal capping layer and the deliberately added reactive gas are configured such that electrons are generated in combination with said EUV radiation by the capping layer and react with the deliberately supplied reactive gas to generate reactive atomic species that

react with the carbon contaminants deposited on the capping surface and remove said carbon contaminants and continuously clean said carbon contaminants from the capping surface."

- VI. Neither the text of the claims of the first and second subsidiary requests nor related arguments and submission is presented in this decision for the reason given in section 9 below.

Reasons for the Decision

1. The appeal is admissible.
2. Claims 1 and 8 of the main request correspond in substance to the claims of the main request before the opposition division. In particular, reference is made in both sets of claims to a ruthenium capping layer disposed on a mirror surface transmitting 90% of incident EUV radiation. The opposition division was satisfied in respect of clarity and added subject matter of the subject matter of claims 1 and 8. The board has no reason to question this view of the division.
3. Novelty of the subject matter of claim 1 with respect to document D8 was acknowledged by the opposition division by virtue of the claiming of a ruthenium capping layer disposed on a mirror surface transmitting 90% of incident EUV radiation. The opposition division saw the problem addressed by the novel subject matter as preventing oxidation whereas the appellant saw the problem as preserving reflectivity.
4. A skilled person learns from document D8 that an oxide film will form with time, but, at oxygen pressures

used, is reassured that the thickness over the time used had remained well within tolerance, i.e. 0.3 nm, where 3 nm might be tolerable. There is a proviso for long term exposures in the bulleted section of slide 13 "Little additional oxidation of MLM occurs at highest powers used", which proviso concerns the remark in the second heading "long term exposures required to complete data". Since the proviso is only that more data is needed, i.e. neutral, it does not cast doubt on the specific teaching of document D8 about an oxide film being tolerable in the method taught (see, for example, slide 3 "no extreme oxidation" and slides 11 and 13 showing the 0.3 and 3 nm figures). In this situation, the position of the opposition division that the problem to be addressed is oxidation prevention thus runs against the teaching of document D8 because the document has already allowed for it.

5. The approach of the appellant that the problem addressed is the more general one of maintaining reflectivity of the mirror does not run against the teaching of document D8 and is more persuasive because the proviso mentioned above leaves open the question of long term exposure, i.e. maintaining reflectivity.

6. It was part of the knowledge of the skilled person that addition of a capping layer reduces EUV radiation reaching and reflected from a mirror. Consequently, in starting from the teaching of document D8, where gas is added, and seeking to maintain reflectivity, an argument that it would be obvious that this skilled person would have applied a capping layer and thus reduced reflectivity is not feasible. Moreover, even if the skilled person were to have considered using a capping layer, the board has some sympathy with the view of the appellant that a disclosure of a capping

layer where gas is added, such as that used in document D6 (carbon capping layer), would have been preferred. On the other hand, selecting ruthenium from capping materials used in the teaching of document D4, where EUV induced oxidation is not discussed, is not considered so close by the board. For these reasons, the board is not persuaded that, absent the knowledge of what is claimed in the main request, the teaching of document D4 concerning capping layers would have been combined with that of document D8.

7. Since, in view of the foregoing, documents D8 and D4 do not fit together very well, the board was not convinced by the position of the opposition division as to lack of inventive step of the subject matter of independent claim 1 and, for corresponding reasons, of claim 8. With respect to the other documents in the file, the board has no reason to question the positive view of the opposition division.
8. The request of the appellant for maintenance of a patent based on the claims of its main request thus succeeds. A full set of documents for maintenance has not been specified by the appellant. While it can be assumed that the drawings correspond to those of the patent as granted, the description still has to be adapted to the claims, in particular concerning amendment relating to gaseous species in the environment. As part of the adaptation offered to the opposition division, such adaptation was made, for example in line 4 of page 4 or line 12 (second amendment) on page 8 of the documents according to the auxiliary request.
9. Since the main request succeeds, consideration of the appellant's first and second subsidiary requests is not

necessary in the present decision. An earlier request of the respondent for oral proceedings is deemed withdrawn by virtue of its declaration that it would not take part in further proceedings.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to maintain the patent on the basis of the following documents:-

Description

to be adapted

Claims

1-13 filed with the letter dated 09 January 2009

Drawings

Figures 1, 2, 3a, 3b of the patent specification.

The Registrar:

The Chairman:



M. Kiehl

A. Klein

Decision electronically authenticated