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**Datasheet for the decision
of 13 February 2014**

Case Number: T 0023/11 - 3.3.05

Application Number: 04725542.7

Publication Number: 1608599

IPC: C03C3/06, C03B19/14

Language of the proceedings: EN

Title of invention:

SILICA GLASS CONTAINING TIO₂ AND OPTICAL MATERIAL FOR EUV
LITHOGRAPHY

Patent Proprietor:

Asahi Glass Company, Limited

Opponent:

Corning Incorporated

Headword:

EUVL GLASS/ASAHI

Relevant legal provisions:

EPC Art. 54, 56, 83

Keyword:

Sufficiency of disclosure (yes) - measurement methods of
parameters sufficiently disclosed
Novelty (yes) - non-enabling disclosures
Inventive step (yes) - improvement not obvious from the state
of the art

Decisions cited:

G 0001/92, T 0815/07

Catchword:



**Beschwerdekammern
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Chambres de recours**

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Case Number: T 0023/11 - 3.3.05

**D E C I S I O N
of Technical Board of Appeal 3.3.05
of 13 February 2014**

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Decision under appeal: **Interlocutory decision of the Opposition
Division of the European Patent Office posted on
25 October 2010 concerning maintenance of the
European Patent No. 1608599 in amended form.**

Composition of the Board:

Chairman: H. Engl
Members: J.-M. Schwaller
D. Prietzel-Funk

Summary of Facts and Submissions

- I. The present appeal lies from the interlocutory decision of the opposition division maintaining European patent No. 1 608 599 on the basis of claims 1 to 4 of the third auxiliary request dated 5 October 2010.

Independent claims 1, 2 and 3 thereof read as follows:

"1. A silica glass for EUV lithography containing TiO₂, characterized in that the fluctuation of the refractive index (Δn) is at most 2×10^{-4} within an area of 30 mm x 30 mm in each of two orthogonal planes.

2. A silica glass for EUV lithography containing TiO₂, characterized in that the TiO₂ concentration is at least 1 mass%, and the difference between the maximum value and the minimum value of the TiO₂ concentration is at most 0.06 mass% within an area of 30 mm x 30 mm in each of two orthogonal planes.

3. A silica glass for EUV lithography containing TiO₂, characterized in that the TiO₂ concentration is at least 1 mass%, and the striae pitch is at most 10 μm ."

- II. The following documents known from the opposition proceedings are of importance for the present decision:

D1: K. E. Hrdina et al., "Characterization and Characteristics of a ULE[®] Glass Tailored for EUVL Needs", Proceedings of SPIE, vol. 4688 (2002), pages 454 to 461;

D5: K. E. Hrdina et al., "*Measuring and tailoring CTE within ULE[®] Glass*", Proceedings of SPIE, vol. 5307 (2003), pages 227 to 235;

D5A: Copy of the slides of the above presentation by K. E. Hrdina at SPIE 28th Annual Microlithography Conference, February 23-28th, 2003;

D9: WO 03/077038 A2;

D13: WO 02/088036 A1.

III. In the contested decision, the opposition division decided as follows:

The requirements of Article 83 EPC were met because the patent gave sufficient information for the measurement of refractive index Δn , ΔTiO_2 and the striae pitch of the claimed silica-titania glass.

Document D9 was not enabling with respect to silica-titania glasses having the properties as claimed over the whole range, as process factors which influenced the striae level were not sufficiently disclosed.

Starting from document D1 as the closest state of the art and concerning claims 1 and 2, the technical problem was defined as the provision of an alternative silica-titania glass for EUV lithography (EUVL) having homogeneous optical properties. The subject-matter of these claims involved an inventive step because none of the prior-art documents hinted at a glass having the required homogeneity within an area of 30 x 30 mm in two orthogonal planes.

Concerning claim 3, the technical problem was to provide an ultra-smooth silica-titania glass for EUV

lithography. The solution as proposed in this claim was inventive because none of the prior-art documents taught how to decrease the striae pitch in order to obtain such a smooth glass after polishing.

- IV. The opponent (hereinafter "the appellant") lodged an appeal against the above decision and filed five additional documents, of which the following one is of importance for the present decision:

D24/D24a: Affidavit by William R. Rosch and Annexes.

A further submission of the appellant was filed by letter dated 16 January 2014.

- V. The submissions of the patentee (hereinafter the "respondent") were received by letters dated 29 August 2011 and 10 January 2014, the latter being accompanied by a new auxiliary request consisting of four claims.

- VI. At the oral proceedings, which took place on 13 February 2014, the issues of sufficiency of disclosure, novelty and inventive step were discussed. As regards in particular novelty, the question arose as to whether the skilled person using common general knowledge would be able to reproduce the glasses disclosed in documents D1, D5a and in the alleged prior uses. The appellant argued that the teaching of document D13 would suffice to manufacture these glasses. This was contested by the respondent.

- VII. Appellant's arguments can be summarised as follows:

The contested patent did not meet the requirements of Article 83 EPC, because although claim 1 required the

fluctuation of the refractive index (Δn) to be measured in each of two orthogonal planes, the patent did not specify which planes were to be selected for said measurements.

Claim 1 lacked novelty over the disclosure of documents D1 or D5a, or alternatively over the silica glasses designated as "Boule 93113" and "Boule 84107" which were on the market before the priority date of the patent, as evidenced by document D24/D24a.

The claimed subject-matter also lacked an inventive step over document D5a taken in combination with document D1.

VIII. Respondent's arguments can be summarised as follows:

The skilled person knew that the measurements of Δn were to be made in the plane perpendicular to the striae layers.

The documents and the prior uses alleged to be novelty-destroying were not enabling disclosures of the presently claimed glasses.

Regarding inventive step, none of the documents gave a hint as to how to reduce Δn , ΔTiO_2 and striae pitch to the values defined in the claims. The claimed subject-matter was therefore inventive.

IX. Requests

After closing the debate, the chairman established the parties' requests as follows:

The appellant requested that the contested decision be set aside and the patent revoked.

The respondent requested that the appeal be dismissed or, alternatively, that the contested decision be set aside and that the patent be maintained on the basis of the claims of the auxiliary request filed with letter dated 10 January 2014.

Reasons for the Decision

1. Disclosure of the invention
 - 1.1 According to the case law of the boards of appeal, in order to establish insufficiency of disclosure, the burden of proof is upon the opponent to show that the skilled reader of a disputed patent, using his common general knowledge, is unable to carry out the invention. As a rule, showing that requires the demonstration of gaps of information.
 - 1.2 In the present case, the patent specification provides extensive details, in particular in its examples, regarding the process features to be used in the preparation of the claimed silica glass. As explained in paragraphs [0029] and [0030], the rotational speed of the target at the step of obtaining the porous TiO₂-SiO₂ glass body is preferably adjusted to at least 25 rpm, because it has been found that a high rotational speed reduces the striae pitch and the fluctuation of TiO₂ concentration in the TiO₂-SiO₂ glass body.

The board notes that the appellant did not attempt to rework at least one of the examples of the contested patent. Thus there is no experimental evidence that the claimed silica glass could not be reproduced.

Furthermore, the alleged gap of information is not evident from the description.

- 1.3 In this regard, the appellant cited decision T 815/07 and argued that the patent did not provide sufficient information regarding the measurement of the parameters appearing in the claims. As a consequence, the skilled person producing ultra-low expansion silica-titania glasses did not know for sure whether these glasses fell under the scope of protection of the claims.
- 1.4 T 815/07 (see catchword) states that "*the purpose of a parameter contained in a claim is to define an essential technical feature of the invention. [...]. The method specified for determining the parameter should therefore be such as to produce consistent values, so that the skilled person will know when he carries out the invention whether what he produces will solve the problem or not.*"
- 1.5 The question thus arises whether the methods specified for determining the different parameters defined in the claims produce consistent values.
 - 1.5.1 As explained in paragraph [0035] of the patent, the "*difference between the maximum value and the minimum value of the TiO_2 concentration within an area of 30 mm x 30 mm in each of two orthogonal planes*" (i.e. the parameter in claim 2) can be calculated from the "*fluctuation of the refractive index (Δn) within an area of 30 mm x 30 mm in each of two orthogonal planes*", which is the parameter defined in claim 1 at issue. These two parameters being thus mathematically linked, it suffices to verify that the measurement of the one parameter which is measured directly, i.e. that

of claim 1, will give consistent values.

- 1.5.2 In this respect, the board cannot accept the appellant's arguments regarding the inconsistency of the method for measuring the fluctuation of the refractive index, because from the affidavit D24 and its annexes (D24a) - which were supposed to provide evidence of a prior use of a product sold by the appellant itself - it is clear that the appellant itself did not experience difficulties in the measurement method described in the patent. In fact, very precise values of Δn with up to one digit after the comma were obtained. In view of this precision in the measurement method, the board is not convinced that the method leads to inconsistent results.

The same conclusion is to be drawn from document D5a, which is a public oral presentation made by an employee of the appellant and discloses (pages 7 and 9) that interferometry, which is the very method used in the contested patent for measuring the fluctuation of the refractive index, is of "*high precision (few ppm)*" and "*repeatability (<2 ppm)*". These statements, made by an employee of the appellant itself, quite clearly demonstrate that the method in question should normally lead to precise and consistent values.

- 1.5.3 Regarding the choice of the planes in which the interferometry measurements are to be made, it is true - as shown by document D24/D24a - that a wrong choice can generate inconsistent values. However, as established in documents D1 (page 458, paragraph 5.1 Metrology for striae) and D6a (page 2/4, first seven lines of the paragraph "Striae"), it is clear for the skilled person that the measurements are to be made in the plane wherein the fluctuation of the refractive

index is expected to be the highest (the so-called worst-case scenario), namely in the plane perpendicular to the striae layers.

1.5.4 The method for measuring the parameter in claim 3 - namely the "*striae pitch*" - is described at paragraph [0035]. The allegation that the method would be insufficiently disclosed because small striae could not be detected cannot be accepted, because any method has its detection limits. The board considers that, in the present context, the fact that Δn could not be measured simply means that the striae pitch was below the detection limit of the method, but not that the method, and so the invention, was insufficiently disclosed.

1.6 It follows from the above considerations that there are no gaps in information which would prevent the skilled person from performing the invention. The board is thus satisfied that the requirements of Article 83 EPC are met.

2. Main request - Novelty

2.1 In G 1/92, Headnote, the Enlarged Board of Appeal stated: "*The chemical composition of a product is state of the art when the product as such is available to the public and can be analysed and **reproduced** by the skilled person, irrespective of whether or not particular reasons can be identified for analysing the composition*". Further in point 1.4 of the Reasons, it stated that "*an essential purpose of any technical teaching is **to enable the person skilled in the art to manufacture or use a given product by applying such teaching**. Where such teaching results from a product put on the market, the person skilled in the art will have to rely on his general technical knowledge to*

*gather all information enabling him to prepare the said product. Where it is possible for the skilled person to discover the composition or the internal structure of the product and to **reproduce it without undue burden, then both the product and its composition or internal structure become state of the art.***" (emphasis added).

2.2 In the case at issue, one of the questions to be answered is whether the skilled person would have been able to reproduce the glasses whose properties were uncontestedly novelty-destroying and were - according to the appellant - put on the market before the priority date of the contested patent. The same question arises with regard to those glasses whose properties were investigated in documents D1 and D5a, without however disclosing, directly or by way of reference, the method of their manufacturing.

2.3 The appellant argued that document D13 in fact disclosed such a manufacturing method.

The board observes that D13 (page 3, lines 19 to 23) discloses a method for producing EUV lithography SiO₂-TiO₂ glass substrates with a very low variation in the coefficient of thermal expansion (CTE) of 0 ± 5 ppb/°C. However, as correctly pointed out by the respondent, the above CTE variation corresponds to a Δ CTE of 10 ppb/°C, i.e. to a Δn of about 400 ppm, i.e. two times higher than the upper limit of 2×10^{-4} defined in claim 1 at issue. It follows that D13 does not disclose a process for manufacturing a glass as now claimed.

2.4 The board notes from document D1 (see abstract and item 5.2) - which dates from 2002, i.e. about one year before the priority date of the contested patent - that there was a need for a glass manufacturing process

capable of reducing the small compositional variations and the striae area which occurred during the glass forming operation. According to D1 (see paragraph 5.2: "Striae reduction" and Figure 9), a process was found in order to minimise these variations and in particular to reduce the stress between striae layers to less than 0.24 MPa (according to the respondent's uncontested calculations this corresponds to a Δn of less than 200 ppm). No details of this process are however disclosed in document D1 and there is also no indication therein or in any other document which has come to the board's attention that the manufacture of a silica-titania glass with reduced striae was common general knowledge before the priority date of the contested patent.

The same is true for the alleged public prior uses according to D24/D24a, so that there was no need to hear the witness, and for the product disclosed in document D5a, for which there is also no corresponding disclosure of any manufacturing details. These samples were produced by the appellant in a proprietary process about which no information before the priority date of the patent in suit was available.

- 2.5 It follows from the above that the silica-titania glasses of the allegedly novelty-destroying documents and of the alleged prior uses did not belong to the state of the art.

- 2.6 As none of the other documents cited in these proceedings discloses all the features of claims 1 to 4, in the version maintained by the opposition division, the subject-matter of these claims is considered to meet the requirements of Article 54(1) and (2) EPC.

3. Main request - inventive step

The board, applying the problem-solution approach, comes to the following conclusions as regards inventiveness of the claims of the main request:

3.1 The invention concerns a silica glass containing TiO_2 as an optical material for an exposure device to be used for EUV lithography (see paragraph [0001] of the contested patent).

3.2 For the board, the closest state of the art cannot be represented by the glasses described in documents D1 or D5a or, alternatively, by those allegedly rendered publicly available by prior use, since all these disclosures are non-enabling as to the manufacture of the glasses, such that these glasses thus do not belong to the state of the art (see items 2.1 to 2.5 above).

Among the remaining documents, document D9 also cannot be taken into consideration for inventive-step purposes since it belongs to the state of the art under Article 54(3) EPC.

In the board's view, therefore, document D13 is the most appropriate starting point for assessing the inventive step of the claimed invention, because it discloses a method for producing EUVL (extreme ultra-violet lithography) $\text{SiO}_2\text{-TiO}_2$ glass substrates with a very low variation of 0 ± 5 ppb/ $^\circ\text{C}$ in the coefficient of thermal expansion (CTE).

3.3 As to the problem to be solved, this is defined in the contested patent (paragraphs [0008] and [0011]) as the provision of improved EUVL $\text{SiO}_2\text{-TiO}_2$ glass substrates with reduced MSFR (mid-spatial frequency roughness) and

an ultra-smooth surface after polishing.

3.4 As a solution to this problem, the contested patent proposes silica-titania glasses according to independent claims 1, 2 and 3 at issue, characterised by three different parameters, namely:

- the fluctuation of the refractive index (Δn), which has to be at most 2×10^{-4} (i.e. 200 ppm) within an area of 30 mm x 30 mm in each of two orthogonal planes (claim 1);
- the difference between the maximum and minimum values of the TiO_2 concentration, which has to be at most 0.06 mass% within an area of 30 mm x 30 mm in each of two orthogonal planes (claim 2);
- the striae pitch, which has to be at most 10 μm (claim 3).

3.5 As to the success of the solution, the following is observed:

Example 4 - which is shown for comparative purposes in the contested patent - discloses a glass with a striae pitch of 60 μm and a Δn of 400 ppm. This Δn value corresponds to the one calculated for the glasses according to document D13 (see in this respect point 2.3 above), which represents the state of the art closest to the present invention.

The Δn and striae pitch values of the glasses according to examples 1, 2, 3 and 5 of the patent - which correspond to the claimed invention - are considerably lower than the respective striae pitch and Δn values known from D13. It follows that the glasses according

to the present invention can be considered as an improvement over those known from D13. As the glasses of examples 1, 2, 3 and 5 are furthermore described as exhibiting reduced MSFR and an ultra-smooth surface after polishing, the problem underlying the contested patent is thus successfully solved.

- 3.6 On the question of whether or not the different solutions proposed by the contested patent are obvious or not from the state of the art, the board considers that none of the prior-art documents discloses or points towards glasses having values of Δn proposed as a solution in claim 1 at issue, as a solution to the problem identified in point 3.3 above. It follows that the skilled person faced with the said problem cannot find the solution to this problem in the state of the art, with the consequence that the subject-matter of claim 1 is not derivable therefrom.

Concerning the inventiveness of the subject-matter of independent claims 2 and 3, the board observes, as explained in paragraph [0032] of the contested patent, that the striae observed in a $\text{SiO}_2\text{-TiO}_2$ glass are attributable to the fluctuation of the $\text{TiO}_2/\text{SiO}_2$ ratio, which in turn fluctuates in parallel with the absolute refractive index n of the glass. This means that the three different solutions in independent claims 1, 2 and 3 are *de facto* linked together such that the inventiveness of the subject-matter of claims 2 and 3, and by the same token that of dependent claim 4, which includes all the features of claim 3, derives directly from that of independent claim 1 at issue.

- 3.7 It follows from the above that the claims of the main request - i.e. the claims as maintained by the

opposition division - meet the requirements of Article 56 EPC.

4. As the main request is allowable, there is no need to consider the auxiliary request.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



C. Vodz

H. Engl

Decision electronically authenticated