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**Datasheet for the decision  
of 1 December 2023**

**Case Number:** T 0034/22 - 3.3.05

**Application Number:** 09730854.8

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**IPC:** C03C3/085, C03C3/087,  
C03C10/00, C03C4/00, A61K6/02,  
A61K6/027

**Language of the proceedings:** EN

**Title of invention:**  
LITHIUM SILICATE GLASS CERAMIC AND METHOD FOR FABRICATION OF  
DENTAL APPLIANCES

**Patent Proprietor:**  
James R. Glidewell Dental Ceramics, Inc.

**Opponent:**  
Ivoclar Vivadent AG

**Headword:**  
Glass ceramic/GLIDEWELL

**Relevant legal provisions:**  
EPC Art. 56, 83  
RPBA 2020 Art. 12(6), 13(2)

**Keyword:**

Late-filed evidence - should have been submitted in first-  
instance proceedings (yes)

Sufficiency of disclosure - (yes)

Inventive step - main request (yes) - non-obvious alternative

**Decisions cited:**

T 2002/13, T 0044/20

**Catchword:**



**Beschwerdekammern**

**Boards of Appeal**

**Chambres de recours**

Boards of Appeal of the  
European Patent Office  
Richard-Reitzner-Allee 8  
85540 Haar  
GERMANY  
Tel. +49 (0)89 2399-0  
Fax +49 (0)89 2399-4465

Case Number: T 0034/22 - 3.3.05

**D E C I S I O N**  
**of Technical Board of Appeal 3.3.05**  
**of 1 December 2023**

**Appellant:** Ivoclar Vivadent AG  
(Opponent) Bendererstrasse 2  
9494 Schaan (LI)

**Representative:** Uexküll & Stolberg  
Partnerschaft von  
Patent- und Rechtsanwälten mbB  
Beselerstraße 4  
22607 Hamburg (DE)

**Respondent:** James R. Glidewell Dental Ceramics, Inc.  
(Patent Proprietor) 4141 Macarthur Boulevard  
Newport Beach, CA 92660 (US)

**Representative:** WP Thompson  
8th Floor  
1 Mann Island  
Liverpool L3 1BP (GB)

**Decision under appeal:** **Decision of the Opposition Division of the  
European Patent Office posted on 20 October 2021  
rejecting the opposition filed against European  
patent No. 2282978 pursuant to Article 101(2)  
EPC.**

**Composition of the Board:**

**Chairwoman** O. Loizou  
**Members:** T. Burkhardt  
S. Besselmann

## Summary of Facts and Submissions

I. The opponent's (appellant's) appeal lies from the opposition division's decision to reject the opposition against European patent No. 2 282 978 B1.

II. The following documents were among those discussed at the opposition stage:

- D1 EP 1 688 398 A1  
D2 EP 1 505 041 A1  
D3 S. T. Gulati, J. D. Helfinstine, "Fatigue Behavior of GeO<sub>2</sub>-SiO<sub>2</sub> Glasses", Materials Research Society Symposium Proceedings, 1998, vol. 531, 133-41  
D4 H. Darwish et al., "Contribution of germanium dioxide to the thermal expansion characteristics of some borosilicate glasses and their corresponding glass-ceramics", Key Engineering Materials, 2002, vol. 206-213, 2077-80  
D5 DE 197 50 794 A1

III. The independent claims of the main request read as follows, with claims 2 and 6 being the same as in the patent as granted:

"1. A lithium metasilicate glass ceramic comprising in weight percent:

SiO<sub>2</sub> from 53.0 to 59.0;

Al<sub>2</sub>O<sub>3</sub> from 2.5 to 3.4

K<sub>2</sub>O from 3.5 to 4.1

CeO<sub>2</sub> from 0 to 2.0

Li<sub>2</sub>O from 14.0 to 16.0;

ZrO<sub>2</sub> from 2.5 to 6.0

TiO<sub>2</sub> from 0.5 to 1.8

P<sub>2</sub>O<sub>5</sub> from 2.7 to 4.0

Er<sub>2</sub>O<sub>3</sub> from 0 to 2.0

V<sub>2</sub>O<sub>5</sub> from 0 to 1.0

GeO<sub>2</sub> from 7 to 8.4

MnO<sub>2</sub> from 0 to 1.0

Tb<sub>4</sub>O<sub>7</sub> from 0 to 2.0

Ta<sub>2</sub>O<sub>5</sub> from 0 to 1.0

Dy<sub>2</sub>O<sub>3</sub> from 0 to 1.0

Pr<sub>2</sub>O<sub>3</sub> from 0 to 1.0

Sm<sub>2</sub>O<sub>3</sub> from 0 to 6.0

Eu<sub>2</sub>O<sub>3</sub> from 0 to 1.0;

wherein the molar ratio of Si/Li is between 1.8 and 1.9 wherein after nucleation only lithium metasilicate is formed and after complete crystallisation only lithium metasilicate crystals are formed."

"2. A lithium metasilicate glass ceramic made from a composition mixture comprising

about 54.3% wt SiO<sub>2</sub>

about 15.2% wt Li<sub>2</sub>O; and

about 7.6% wt GeO<sub>2</sub>."

"6. A method of fabricating dental restorations made of a lithium metasilicate glass-ceramic; the method comprising the steps of:

(a) blending a mix of precursors, wherein one of said precursors is germanium oxide;

(b) ball milling the mix to homogenize components of the mix;

(c) melting the resultant mix of step (b) for about 1 to 3 hours at a temperature of about 1400°C to 1500°C;

(d) pouring the melt of step (c) into graphite molds to form shaped blanks and cooling such blanks to room temperature;

(e) heating the blanks of step (d) at a temperature of 625°C to 650°C for 10 to 60 minutes;

(f) milling the blanks of step (e) into dental restorations; and

(g) heating the restorations of step (f) at a temperature of 760°C to 830°C."

Dependent claims 3 to 5 relate to particular embodiments.

IV. With its statement setting out the grounds of appeal the appellant additionally filed the following document:

D9 WO 2004/076369 A2

V. The opponent's (appellant's) arguments at the appeal stage relevant to the present decision can be summarised as follows.

The invention was insufficiently disclosed.

The subject-matter of claims 2 to 6 was rendered obvious by the following combinations of documents:

- D1 alone and in combination with each of D3 and D4 on the one hand, and with D5 on the other hand
- D2 alone and in combination with each of D3 and D4 on the one hand, and with D5 on the other hand
- D5 alone and in combination with each of D3 and D4

The combination of each of D1, D2 and D5 with D9 also rendered the claimed subject-matter obvious.

VI. The patent proprietor's (respondent's) arguments at the appeal stage are reflected in the reasons below.

VII. At the end of the oral proceedings on 1 December 2023, the requests were as follows.

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

The respondent requested that the patent be maintained in amended form on the basis of the claims of the main request previously filed as auxiliary request 3 with the reply to the statement setting out the grounds of appeal, alternatively, that the patent be maintained in amended form on the basis of one of auxiliary requests 4 to 6 submitted with the reply to the appeal.

## **Reasons for the Decision**

### 1. Admissibility of D9

Allegedly in response to hints by the opposition division, the appellant filed D9 to show that it was known to add GeO<sub>2</sub> to glasses and/or glass ceramics and that doing so had advantages.

However, the board notes that the first summons to oral proceedings at the opposition stage already indicated that "the prior art does not appear to suggest a composition as claimed, in particular not with the amount of GeO<sub>2</sub> in the starting mixture". D9 does not help to refine an existing line of argument; rather, it constitutes a fresh secondary document in support of an

objection that the claims as granted lack inventive step.

Hence, as D9 could and should have been filed earlier, it is not taken into consideration (Article 12(6) RPBA 2020).

### *Main request*

The respondent filed the main request as auxiliary request 3 with the reply to the statement setting out the grounds of appeal. This request is identical to auxiliary request 3 submitted at the opposition stage.

#### 2. Article 83 EPC

For the reasons set out below, the main request meets the requirements of Article 83 EPC.

##### 2.1 In the appellant's view, the invention is not sufficiently disclosed.

The skilled person would understand the term "molar ratio of Si/Li" in claim 1 as clearly meaning the elemental ratio and would not consider the description.

However, even the highest claimed SiO<sub>2</sub> concentration (59% wt) in claim 1 and the lowest Li<sub>2</sub>O concentration (14% wt) resulted in too low an elemental Si/Li molar ratio of 1.048 mol/mol.

For reasons of legal certainty, a corrective interpretation of this feature was not allowable, as confirmed by T 2002/13 and T 0044/20.



2.2 However, these arguments are not convincing.

The skilled person with a mind willing to understand recognises that the claimed range of the "molar ratio of Si/Li" in claim 1 has to mean the molar ratio of the oxides  $\text{SiO}_2$  and  $\text{Li}_2\text{O}$ . This is the only way that the claimed  $\text{SiO}_2$  and  $\text{Li}_2\text{O}$  concentration ranges are compatible with the claimed range of molar Si/Li ratios. By contrast, if the elemental molar ratio were considered, the  $\text{SiO}_2$  and  $\text{Li}_2\text{O}$  concentration ranges in claim 1 would be incompatible with the claimed range of molar Si/Li ratios.

Had the skilled person understood the term "molar ratio of Si/Li" in claim 1 as the elemental ratio, they would have noticed this incompatibility and considered the description, more particularly the examples. They would have realised that if the elemental Si/Li ratio were used, none of the examples would have a ratio in the claimed range. On the other hand, they would deduce from all the examples of the patent in suit - apart from Test #2 - that they satisfy the ratio on an oxide basis. Test #2 is an exception since it is not an embodiment of the claimed invention, with both the molar ratio and the  $\text{Li}_2\text{O}$  content being outside the claimed range.

For the sake of completeness, the board notes that the skilled person would readily know how to determine the molar ratio on an oxide basis.

The decisions cited by the appellant do not deal with the interpretation of a claim feature in view of Article 83 EPC. In particular:

- T 2002/13, reasons 6, deals with the question of whether disregarding a claimed illogical or technically

inaccurate feature is acceptable in view of Article 123(2) EPC.

- T 0044/20, reasons 1.2, deals with the question of whether an inconsistent and unclear claim complies with Article 84 EPC.

Hence, these cases do not apply to the case in hand.

Consequently, the requirements of Article 83 EPC are met.

### 3. Article 56 EPC: claim 6

The subject-matter of claim 6 involves an inventive step (Article 56 EPC) for the following reasons.

- 3.1 At the oral proceedings at the appeal stage, the appellant argued that, although being very similar to D1 in disclosure, D2 appeared to be slightly closer to the subject-matter of claim 6 of the main request than D1 because of Example 11 of Table IV.

D2 discloses a method of fabricating dental restorations involving a step in which a lithium metasilicate glass ceramic is produced (e.g. paragraphs [0001] and [0002] as well as claim 2).

Paragraph [0033] indicates that to obtain "a particularly high degree of homogeneity", the starting mixture is melted twice with a quenching step in between.

Paragraph [0040] further discloses heating lithium metasilicate to 700°C to 950°C to form lithium disilicate.

Since D2 discloses a method of fabricating dental restorations involving the formation of lithium metasilicate and has several features in common with claim 6, it is a suitable starting point for assessing inventive step.

3.2 Even if the problem to be solved were merely to provide an alternative method of fabricating dental restorations, an inventive step can be acknowledged.

3.3 It is proposed that this problem is solved by the process of claim 6, which is at least characterised by:

- (i) the dental restorations being made of a lithium metasilicate glass-ceramic
- (ii) a ball milling step (b) to homogenise the components of the mix
- (iii) the presence of  $\text{GeO}_2$  as a precursor in the mix to be blended in step (a)

Distinguishing features (ii) and (iii) were acknowledged by the appellant.

On the other hand, regarding feature (i), the appellant argued that when the lithium metasilicate was heated in accordance with paragraph [0040] of D2 to  $700^\circ\text{C}$  to  $950^\circ\text{C}$  (second crystallisation), not all the lithium metasilicate was transformed into lithium disilicate. This was confirmed since Table IV of D2 indicated the presence of lithium metasilicate "LS" after the second crystallisation step (besides lithium disilicate "LS2" and lithium phosphate "LP"). Such a situation was covered by claim 6.

However, Example 11 is the only example of Table IV of D2 that discloses residual metasilicate after the

second crystallisation step, and its amount is unknown. All the other examples exclusively contain lithium disilicate as the silicate phase. Hence, the possibility that traces of lithium metasilicate remain upon heating cannot be excluded in D2. However, such a situation, where only traces remain, does not fall under claim 6, which requires that the dental restorations are "made of a lithium metasilicate glass-ceramic" (emphasis added by the board).

Consequently, feature (i) is indeed a distinguishing feature, too.

3.4 For the reasons set out below, the skilled person would arrive at the subject-matter of claim 6 only with hindsight.

3.4.1 With regard to distinguishing feature (i), there are two possible situations. In the first, the skilled person starting from D2 carries out the additional heating step to 700°C and 950°C mentioned in paragraph [0040]. While this includes the temperature range required by step (g) of claim 6, the skilled person does not necessarily obtain dental restorations "made of lithium silicate glass-ceramic". As indicated, D2 explicitly associates this step with the formation of lithium disilicate (paragraph [0040]). The skilled person is thus instructed to carry out the heating step accordingly and would not work within that part of the broad range of D2 in which the lithium metasilicate phase is not transformed.

According to the second possible situation, the skilled person aims at a lithium metasilicate blank but would not carry out the heating step up to 700°C to 950°C. In this case, lithium metasilicate seems to be the main

crystal phase but there is no heating step as per step (g) of claim 6.

Already for this reason, D2 alone cannot lead to the claimed subject-matter.

3.4.2 With regard to distinguishing feature (ii), the skilled person seeking to provide an alternative method (i.e. a method also with comparable homogeneity of the components of the mix of precursors) would refrain from replacing the first melting step and the quenching step of paragraph [0033] of D2 with a ball milling step as per step (b) of claim 6. In fact, it is not merely a question of adding a ball milling step in D2 while retaining the melting steps with an intermediate quenching step. Despite the open wording ("comprising"), the sequence of process steps in claim 6 leaves no room for a further melting step (besides that of step (c)) since it is the ball-milled mix of step (b) that is melted in step (c) and, in turn, it is the melted mix of step (c) that is poured into a mould. Hence, process steps would need to be replaced to arrive at the subject-matter of claim 6.

Paragraph [0033] of D2 teaches away from replacing steps since it explains that the method steps of melting, quenching and melting allow for high homogeneity.

By contrast, the end of paragraph [0007] of the patent in suit explicitly indicates that, because of such a ball milling step, improved homogeneity is achieved even without the need for a second melting step.

In this regard, the appellant has not provided any evidence for its assertion that replacing the first

melting step and the quenching step of paragraph [0033] of D2 with a ball milling step reduced homogeneity.

In the appellant's view, that conclusion was implied by a comparison of page 3, lines 20 to 24 of D5 with Examples 21 and 22. D5 was mentioned in D2 (paragraph [0007]). The passage on page 3 of D5 indicated that particularly high homogeneity was obtained when the mix was melted twice with an intermediate quenching step, without any mention of a ball milling step. In Examples 21 and 22, on the other hand, ball milling was additionally disclosed prior to each of the two melting steps.

However, it cannot be deduced from this teaching in D5 that the statement in paragraph [0007] of the patent in suit is not valid.

Furthermore, D2 mentions D5 as being disadvantageous because of the use of lithium disilicate (paragraph [0007] of D2). Even if D5 were nevertheless considered, the skilled person would not deduce from it that high homogeneity could be obtained by including a ball milling step without a second melting step, because D5 does not highlight the importance of ball milling for homogenisation.

The appellant further argued that the high homogeneity might only be achieved for the specific ball milling step disclosed in paragraph [0007], i.e. in combination with an alumina jar, using zirconia balls and carried out for a specific duration.

It is, however, not credible that these details of the ball milling step are necessary to obtain the effect described in paragraph [0007] of the patent in suit,

and the appellant has failed to provide any evidence in this regard.

- 3.4.3 There is no hint in D2 with regard to distinguishing feature (iii). Therefore, D2 alone cannot not render the claimed subject-matter obvious.

The appellant is of the opinion that D3 and D4 referred to broader fields and either of them would prompt the skilled person to add  $\text{GeO}_2$  to the glass ceramic of D2.

However, this argument is not convincing. For the following reasons, the skilled person would not consider these documents when starting from D2.

- D3 deals with binary oxide glasses used in the photonics industry, which only contain  $\text{GeO}_2$  and  $\text{SiO}_2$  (abstract and the first paragraph of the introduction on page 133). By contrast, the mixture of D2 has at least five components (claim 1) and D2 is directed to "dental restorative products" (paragraph [0002]). Moreover, there is no mention of lithium in D3, let alone of lithium metasilicate.

- D4 deals with borosilicate glasses whereas boron is not mentioned at all in D2.

- 3.5 Since its teaching is very similar to that of D2, the same reasoning applies to D1 as the closest prior art (see in particular paragraphs [0007] and [0041] as well as claim 3 of D1).

- 3.6 Lastly, the opposition division was right to consider D5 to be more remote from the subject-matter of claim 1 of the main request than D1 or D2 since D5 relates to lithium disilicate, not to lithium metasilicate (see

e.g. claim 1 or page 2, lines 3 to 6). In this regard, the appellant had no further comments.

4. Article 56 EPC: claims 2 to 5

Similarly, the subject-matter of claims 2 to 5 also involves an inventive step (Article 56 EPC).

In the appellant's view, the subject-matter of claims 2 to 5 as granted lacked inventive step for similar reasons as the subject-matter of claim 6 as granted (page 25 of the grounds of appeal: "Analog zu den oben genannten Gründen...").

However, it is unclear how the appellant's reasoning relating to the "method of fabricating dental restorations made of a lithium metasilicate glass-ceramic" in claim 6, without any concentration ranges of  $\text{SiO}_2$ ,  $\text{LiO}_2$  and  $\text{GeO}_2$ , could apply to composition claims 2 to 5, which contain precise concentrations of those components.

Moreover, the appellant argued that claim 6 as granted did not require a minimum amount of  $\text{GeO}_2$ . This reasoning cannot apply to claims 2 to 5, which specify "about 7.6% wt  $\text{GeO}_2$ ".

In addition, the skilled person would not consider D3 and D4 for the reasons set out above under point 3.4.3.



5. Consideration of objections under Articles 83 and 56 EPC and Article 13(2) RPBA 2020

The respondent argued that the appellant's objections under Articles 83 and 56 EPC were raised at a very late stage and were not to be considered under Article 13(2) RPBA 2020.

However, these objections have been taken into consideration by the board because they had been raised against the claims as granted and identically applied to the current claims. Since these objections, as reasoned above, are not convincing in substance, the board concludes that there is also no need to further elaborate on this matter.

## Order

### For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the department of first instance with the order to maintain the patent in amended form on the basis of the claims of the main request previously filed as auxiliary request 3 with the reply and a description to be adapted.

The Registrar:

The Chairwoman:



C. Vodz

O. Loizou

Decision electronically authenticated