

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CAIHONG DISPLAY DEVICES CO., LTD.,
Petitioner

v.

CORNING INCORPORATED,
Patent Owner

Case IPR2025-00937
U.S. Patent No. 8,640,498

DECLARATION OF DR. RICHARD BROW

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Corning Incorporated EX2009
Caihong Display Devices v. Corning
IPR2025-00937

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I, Dr. Richard Brow, hereby declare as follows.

I. INTRODUCTION

1. I have been retained as an expert witness on behalf of Patent Owner Corning Incorporated (“Patent Owner”) for the above-captioned *inter partes* review (IPR). I am being compensated for my time in connection with this IPR at my standard consulting rate, which is \$200.00 per hour.

2. I understand that this Declaration accompanies a Patent Owner Preliminary Response involving U.S. Patent No. 8,640,498 (“the ’498 patent”) (EX1001), which resulted from U.S. Application No. 12/965,004 (“the ’004 application”), filed on December 10, 2010. I understand that U.S. Application No. 12/965,004 is a divisional application of U.S. Application No. 11/478,493, now U.S. Patent No. 7,851,394 (“the ’394 patent”). I understand that the ’498 patent ultimately claims priority to U.S. Provisional Application No. 60/694,478, filed on June 28, 2005. I understand that the effective priority date for the ’498 patent is no later than June 28, 2005, which is the filing date for this provisional application. I refer to this date throughout for purposes of this declaration.

3. In preparing this Declaration, I have reviewed the ’498 patent, the Petition filed in the above-captioned *inter partes* review, and each of the documents cited herein, in light of general knowledge in the art as of June 28, 2005. In formulating my opinions, I have relied upon my experience, education,

and knowledge in the relevant art. In formulating my opinions, I have also considered the viewpoint of a person of ordinary skill in the art (“POSA”), as defined further below in Section V, as of June 28, 2005, in light of general knowledge in the art.

II. MY BACKGROUND AND QUALIFICATIONS

4. I am currently the Curators’ Distinguished Professor Emeritus of Ceramic Engineering in the Department of Materials Science and Engineering at Missouri University of Science and Technology (Missouri S&T). I first joined Missouri S&T in 1998 as a Professor of Ceramic Engineering. At the same time, I became a Senior Investigator in the Materials Research Center, and I continue to hold that position today. In 2008, I became a Research Investigator in the Center for Biomedical Research (CBR). I was CBR Interim Director, then Director, from 2018 until 2021.

5. My research at Missouri S&T involves characterizing the structure and properties of oxide glasses and glass-ceramic materials used for a wide range of engineering applications. The research that I have directed, performed, and advised on has been sponsored by the National Science Foundation, the National Institutes of Health, the Department of Energy, the Department of Education, the Federal Highway Administration, the Department of Transportation, Lawrence Livermore National Lab, Pacific Northwest National Lab, Sandia National Labs,

and a variety of industrial companies, among others. I have published over 185 papers in peer-reviewed archival journals and 74 conference proceedings. I have supervised 18 completed doctoral theses and 20 master-of-science theses. I hold 17 U.S. patents, four international patents, and four pending patent applications on glasses for a variety of engineering applications, including U.S. Patent No. 9,530,991 B2, directed towards alkali-free, alkaline earth borosilicate glasses.

6. My *curriculum vitae* is submitted herewith as EX2010.

7. I have developed and taught undergraduate courses at Missouri S&T on glass science and technology, materials processing and characterization, glass engineering, ceramic engineering, and kinetics of materials, and graduate-level courses on glass science, biomedical materials, and optical materials.

8. I attended Alfred University in Alfred, NY, where I received a Bachelor of Science degree in ceramic engineering in 1980, and a Master of Science degree in glass science in 1982. I received a Doctor of Philosophy degree in ceramic science from The Pennsylvania State University in 1985.

9. After earning my doctorate, I worked for nearly 13 years as a member of the Technical Staff at Sandia National Laboratories in Albuquerque, New Mexico before joining the faculty at Missouri S&T.

10. I have received several honors and awards throughout my career. For instance, in 1994, I received the Karl Schwartzwalder Professional Achievement in

Ceramic Engineering Award from the American Ceramic Society (“ACerS”). This is an award given annually to “the nation’s outstanding young ceramic engineer.” In 1996, I became the first American recipient of the International Commission on Glass’s Gottardi Prize, for “outstanding contributions to the field of glass science.” In 2004, I was awarded the George W. Morey Award for “new and original work in the field of glass science and technology” by ACerS. In 2016, I received the N.F. Mott Award “for outstanding contributions to the science of non-crystalline solids” from the *Journal of Non-Crystalline Solids*. In 2021, I was elected to the World Academy of Ceramics for “making an internationally renown significant contribution to the advancement of ceramics culture, science, and technology.” I have been named an ACerS Fellow (1997) and Distinguished Life Member (2020), and a Fellow of the Society for Glass Technology (2005). And I served as President of ACerS from 2012-13.

III. SUMMARY OF OPINIONS

11. For Grounds 1 and 4, I have been asked to consider whether Embodiment 8 of Miwa ’377 (Ground 1) or Example 7 of Peuchert ’293 (Ground 4) anticipates claim 1 of the ’498 patent. As discussed below, the Petition and Dr. Ernst fail to show that Miwa ’377’s Embodiment 8 or Peuchert ’293’s Example 7 expressly or inherently discloses a liquidus viscosity of greater than or equal to 100,000 poise, which I understand means the Petition fails to establish that Miwa

'377 or Peuchert '293 anticipates the claimed invention.

12. For Ground 2, I have been asked to consider Petitioner's proposed combination of Miwa '535 and JP '741. In view of the state of the art as of June 28, 2005, it is my opinion that the Petition and Dr. Ernst fail to show that a POSA would have found the claimed invention obvious over Miwa '535 in view of JP '741. First, the Petition and Dr. Ernst fail to show that Miwa '535, or its combination with JP '741, discloses a liquidus viscosity greater than or equal to 100,000 poise. Second, the Petition and Dr. Ernst fail to articulate a technically sound argument for why a POSA would have been motivated to modify Miwa '535 in view of JP '741 to arrive at claim 1 of the '498 patent, with any reasonable expectation of success.

13. For Ground 3, I have been asked to consider Petitioner's proposed combination of Chacon and Takase. In view of the state of the art as of June 28, 2005, it is my opinion that the Petition and Dr. Ernst fail to provide any reason why a POSA would have selected a particular glass composition allegedly taught by Chacon for modification in view of Takase. Further, the Petition and Dr. Ernst fail to substantiate the allegedly obvious substitution of fining agents (SnO_2 , As_2O_3 , Sb_2O_3) to create a modified glass composition that would have an MgO content (mol%) and liquidus viscosity as recited in claim 1 of the '498 patent.

IV. LIST OF DOCUMENTS CONSIDERED

Exhibit No.	Description
1001	U.S. Patent No. 8,640,498 (“the ’498 Patent”)
1002	Prosecution History of the ’498 Patent
1003	Declaration of Dr. Frank Ernst
1004	JP2003192377 (“Miwa ‘377”)-certified English translation
1005	JP2004189535 (“Miwa ‘535”)-certified English translation
1006	JP1998059741 (“JP ‘741”)-certified English translation
1007	US20050101469 (“Peuchert ‘469”)
1008	U.S. Patent No. 6,319,867 (“Chacon”)
1009	JP2004299947 (“Takase”)-certified translation
1010	US20010034293 (“Peuchert ‘293”)
1011	<i>Curriculum Vitae</i> of Dr. Frank Ernst
2011	Kim, K.D., “Influence of BaO/(SrO+BaO) on melt properties in R2O-RO-SiO2 glasses for plasma display panel substrates,” <i>Glass Technol.</i> , 41(5):161-164 (2000)
2012	Shelby, J.E., “Introduction to Glass Science and Technology,” <i>The Royal Society of Chemistry</i> , 2nd Ed. (2005)
2013	Dejneka, M. & Kiczenski, T.J., “Display Glass,” <i>Springer Handbook of Glass</i> , 1519-51 (2019)

V. PERSON OF ORDINARY SKILL IN THE ART (“POSA”)

14. As an expert, I have offered opinions throughout this Declaration from the perspective of a POSA. I understand that a POSA is a hypothetical person who is presumed to be aware of all pertinent art, who thinks along conventional wisdom in the art, and is a person of ordinary creativity. I also understand that the following factors are pertinent to the determination of the level of ordinary skill:

(1) educational level and any specialties of the inventor(s), (2) types of problems encountered in the art, (3) prior-art solutions to those problems, (4) rapidity with which innovations are made, (5) sophistication of the technology, (6) educational level of active workers in the field, and (7) nature of any testing described in the patent (and skills required of those doing such testing).

15. I understand that Dr. Ernst's definition of a POSA is a person who "would have comprehensive knowledge and deep understanding of the materials science aspects and the underlying physical, chemical, and mathematical concepts of the science of glasses, as relevant to the '498 patent. For example, this would include (but is not limited to) the concepts of liquidus temperature, viscosity, density, coefficient of thermal expansion, strain point, and fining. Further, a POSITA would have considerable understanding of and experience with design, synthesis, and characterization of silicate, borosilicate, aluminosilicate, and boroaluminosilicate glasses." EX1003, ¶24.

16. When applying the pertinent factors to the determination of the level of ordinary skill, it is my opinion that a POSA would have had a bachelor's degree in materials science, geology, chemistry, or a comparable field of study, and at least two to three years of research or industrial experience with the design, manufacturing, characterization, and testing of glasses, including oxide glasses.

Alternatively, a POSA would have had a master's degree or higher in the same fields of study.

17. Based on my education and experience, I meet the criteria for a POSA, under either Dr. Ernst's or my own definition.

18. Upon my review of Dr. Ernst's *curriculum vitae* (EX1011), it is my opinion that Dr. Ernst does not meet his own definition of a POSA. Specifically, there is no indication that Dr. Ernst has "considerable ... experience with design, synthesis, and characterization of silicate, borosilicate, aluminosilicate, and boroaluminosilicate glasses," as described by Dr. Ernst in his declaration. EX1003, ¶24. Dr. Ernst appears to have experience with oxide materials, particularly interfaces of oxides with metals, for example, based on some studies of Cu_2O . *See* EX1011, 16 (#74). That said, there is no evidence that Dr. Ernst has ever performed research on, written about, spoken on, or taught classes with topics on silicate, borosilicate, aluminosilicate, and boroaluminosilicate glasses. Indeed, the word "glass" does not appear once on his CV. His lack of experience in the field of glass compositions would manifest itself in a lack of appreciation of: (i) the viscosities of glass melts, which are many, many orders of magnitude greater than slag or metal melts, (ii) the influence of glass structure on glass properties, and (iii) the importance of particular oxide concentrations (*e.g.*, MgO , $\Sigma[\text{RO}]/[\text{Al}_2\text{O}_3]$, SnO_2 , As_2O_3 , and Sb_2O_3) and raw materials (*e.g.*, boric acid, carbonates, and oxides) on

the evolution of batch reactions, melt viscosity, and fining.

VI. LEGAL BASIS FOR MY ANALYSIS

19. In formulating my opinions set forth in this Declaration, I applied the following legal principles.

A. Claim Construction

20. I understand that in an IPR, patent claim terms are given their ordinary and customary meanings as understood by a POSA at the time of the invention, in view of the patent's specification and its prosecution history—unless the patent explicitly defines the claim term. I also understand that when a patent explicitly defines a claim term in the specification, the patent's definition controls.

21. I understand that claim 1 is the independent claim in the '498 patent, and that claims 2-11 depend directly from claim 1. I understand that a dependent claim contains all limitations of the claim from which it depends. Thus, I understand that claims 2-11 contain all of the limitations of claim 1.

B. Obviousness

22. I understand that an obviousness analysis involves comparing a claim to the prior art to determine whether the claimed subject matter would have been obvious to a POSA in view of the prior art and general knowledge in the prior art at the time of the patent's priority date (here, June 28, 2005). I understand that obviousness must be assessed from the viewpoint of a POSA at the time of the invention. I further understand that to establish obviousness, a party must perform

the following factual inquiries: (a) determining the scope and content of the prior art; (b) ascertaining the differences between the claimed invention and the prior art; and (c) resolving the level of skill in the art. I understand that, in determining the scope and content of the prior art and ascertaining the differences between the claimed invention, a patent challenger must specify where each element of the claim is found in the prior art.

23. I understand that one way of establishing obviousness is by establishing that a POSA would have had both (i) a reason to modify or combine the teachings of the prior art to achieve the claimed invention and (ii) a reasonable expectation of success in doing so. I understand that the reason to combine prior-art references can come from a variety of sources, not just the prior art itself or the specific problem the patentee was trying to solve. And I understand that the references themselves need not provide a specific hint or suggestion of the alteration needed to arrive at the claimed invention; the analysis may include recourse to logic, judgment, and common sense available to a person of ordinary skill that does not need to be explicit in any reference.

24. I understand that a “reasonable expectation of success” is assessed in view of the prior art and general knowledge in the art from the viewpoint of a POSA at the time of the patent’s priority date, and it does not require an absolute certainty of success. Furthermore, I understand that determining whether the prior

art would have suggested to those of ordinary skill in the art to carry out the claimed invention with a reasonable expectation of success must be done after determining that the claimed elements are present in the prior art.

25. I also understand that, before reaching a conclusion that the claimed invention would have been obvious, one must consider any objective evidence of non-obviousness if it is available. The objective evidence of non-obviousness can include evidence of commercial success attributable to the claimed invention, evidence of industry praise for the claimed invention, evidence of a long-felt need that was solved by the claimed subject matter, evidence that others copied the claimed subject matter, or evidence that the claimed subject matter achieved an unexpected, superior result relative to the closest prior art. I understand that such evidence must have a nexus, or causal relationship, to the claimed subject matter beyond what was available in the prior art, and must be commensurate in scope with the patent claim(s) at issue.

C. Anticipation

26. My understanding is that a patent claim is invalid as anticipated if each and every limitation of that claim: (1) is disclosed, either explicitly or inherently, in a single prior-art reference; (2) is already in practice in the industry in a single process or method; (3) is already in a single marketed product; or (4) is otherwise previously invented. For a step or limitation to be inherent in a reference,

I understand that the step or limitation must necessarily always occur or be present when one follows the teachings of the reference. I am informed that for a reference to be considered as anticipating it must disclose the relevant technology in a manner such that a person of ordinary skill in the art would be able to carry out or utilize the technology that the reference describes without having to undertake undue experimentation.

VII. THE PETITION AND DR. ERNST HAVE NOT ESTABLISHED THAT MIWA '377 EXPRESSLY OR INHERENTLY DISCLOSES THE CLAIMED LIQUIDUS VISCOSITY IN CLAIM 1.

27. Miwa '377, cited in Ground 1 of the Petition, does not disclose at least the liquidus viscosity limitation of claim 1. Miwa '377 does not expressly disclose the liquidus viscosity of any of its glasses. Further, the Petition and Dr. Ernst fail to establish that the claimed liquidus viscosity is an inherent feature of the cited glass composition in Miwa '377.

A. Miwa '377 does not expressly disclose a liquidus viscosity for any of its embodiments.

28. Miwa '377's disclosure does not include reported values for the liquidus viscosities of any of its embodiments, including Embodiment 8 cited by the Petition and Dr. Ernst. Miwa '377 only mentions the concept of liquidus viscosity once—in reference to some unidentified “prior art” in paragraph [0012]. Paragraph [0012] in Miwa '377 generally describes prior art characteristics of “[g]lass substrates [] widely used as flat display substrates for liquid crystal

displays, EL displays, and other devices.” EX1004, ¶[0002]. But this general discussion of the prior art is not specifically linked to any of Miwa ’377’s embodiments. Miwa ’377 never explicitly explains that its embodiments have a liquidus viscosity consistent with the prior art or specifies what such liquidus viscosities would necessarily be.

B. The Petition and Dr. Ernst do not show that a liquidus viscosity of greater than or equal to 100,000 poise is inherent to Miwa ’377’s Embodiment 8.

29. I have been informed by counsel that, for a prior art reference to inherently anticipate a patent claim, a Petitioner must provide conclusive proof that the reference necessarily discloses every limitation of the claimed invention. Here, Dr. Ernst and the Petition do not conclusively show that Miwa ’377’s Embodiment 8 necessarily has a liquidus viscosity of greater than or equal to 100,000 poise. In fact, neither the Petition nor Dr. Ernst present any evidence to show that Miwa ’377’s Embodiment 8 necessarily has a liquidus viscosity of greater than or equal to 100,000 poise.

VIII. CLAIM 1 WOULD NOT HAVE BEEN OBVIOUS IN VIEW OF MIWA ’535 AND JP ’741.

30. The combination of Miwa ’535 and JP ’741 fails to render claim 1 obvious for at least the following reasons. The Petition and Dr. Ernst fail to show that the prior-art combination discloses the claimed liquidus viscosity limitation of independent claim 1. Further, the Petition and Dr. Ernst do not articulate a

technically sound argument for why a POSA would have modified the Sb_2O_3 mol% in Miwa '535 to arrive at claim 1 of the '498 patent, much less with any reasonable expectation of success.

A. Neither Miwa '535 nor JP '741 expressly disclose liquidus viscosity for any of their embodiments.

31. Miwa '535 does not disclose or discuss liquidus viscosity at all, much less does Miwa '535 report liquidus viscosity values for any of its embodiments. The Petition and Dr. Ernst mistakenly argue the “preferred viscosity of $10^{5.5}$ [sic] dPa·s specified by Miwa corresponds to 316,000 P ($\pm 36,000$), which is greater than or equal to 200,000 poise.” Pet., 36-37 (citing paragraph 119 of Dr. Ernst’s declaration discussing Miwa '377 in support of Ground 1). This appears to be an accidental (and incomplete) reference to Miwa '377 because Miwa '535 does not discuss the concept of liquidus viscosity at all. Similarly, JP '741 does not disclose or discuss the liquidus viscosity of any of its embodiments.

B. The Petition and Dr. Ernst have not shown that a liquidus viscosity of greater than or equal to 100,000 poise is inherent to the combination of Miwa '535 and JP '741.

32. The Petition and Dr. Ernst fail to show that either Miwa '535’s Embodiment 15, or the combination of Miwa '535 and JP '741, necessarily has a liquidus viscosity of greater than or equal to 100,000 poise. Dr. Ernst asserts that Miwa '535 discloses a liquidus viscosity of greater than or equal to 100,000 poise because “[i]t is known in the field that for an alkali-free glass substrate to be

fabricated using downdraw technique [sic], the liquidus viscosity should be greater than or equal to 100,000 P (poise).” EX1003, ¶158. But even a general suggestion that the liquidus viscosity “should” be greater than or equal to 100,000 (poise) would not necessarily imply that Miwa ’535’s Embodiment 15, or the combination of Miwa ’535 and JP ’741, has a certain liquidus viscosity. Creditable technical evidence or data is needed to substantiate the liquidus viscosity of a glass composition. Here, Dr. Ernst’s opinions for why Miwa ’535’s Embodiment 15, or the combination of Miwa ’535 and JP ’741, must have a liquidus viscosity greater than or equal to 100,000 poise are deficient.

33. Dr. Ernst opines, without evidence, that “liquidus viscosity of a glass is a direct consequence” of Miwa ’535’s glass composition that allegedly satisfies limitation 1[p] and limitation 1[a]¹ of the ’498 patent. EX1003, ¶158. This is an unsupported, and demonstrably false, statement concerning the liquidus viscosity of a broad class of glass compositions that can be formed using any of a “slot-die draw method, overflow-die draw method, float method, and roll-out method”

¹ Limitation 1[p] and 1[a] recite a “method for producing alkali-free glass sheets by a downdraw process comprising: selecting, melting, and fining batch materials so that the glass making up the sheets comprises SiO₂, Al₂O₃, B₂O₃, MgO, and CaO.” EX1003, ¶¶121, 125; Pet., 56 (Appendix A).

according to Miwa '535's disclosure. EX1005, ¶[0036]. The fact that Miwa '535 discloses an alkali-free glass composition comprising SiO₂, Al₂O₃, B₂O₃, MgO, and CaO does not necessarily imply that the composition has a liquidus viscosity of greater than or equal to 100,000 poise.

34. For instance, each of the glass compositions discussed in U.S. Patent No. 6,319,867 to Chacon (EX1008), cited by Dr. Ernst, are alkali-free and contain SiO₂, Al₂O₃, B₂O₃, MgO, and CaO. Yet these compositions vary in liquidus viscosity by more than an order of magnitude—from 2.40×10^5 P (Embodiment 20) to 2.97×10^6 P (Comparative Example). EX1008, Table 1. While, in the case of Chacon's embodiments, the liquidus viscosity increases by an order of magnitude when comparing Embodiment 20 to the Comparative Example, it is possible that modifications in glass compositions could cause the opposite change—a reduction of liquidus viscosity by an order of magnitude. As evidenced by Chacon's embodiments, even small changes in glass composition can result in significant changes in resulting glass properties.

35. Further, examples in the '498 patent explicitly disprove Dr. Ernst's overly broad suggestion about the liquidus viscosity for alkali-free glass compositions comprising SiO₂, Al₂O₃, B₂O₃, MgO, and CaO. Examples 44, 45, and 46 in the '498 patent have liquidus viscosities less than 100,000 poises. EX1001, 14:52-53, 14:66-15:1, Table 1. As shown in Table 1, all three of these examples

are alkali-free and comprise SiO_2 , Al_2O_3 , B_2O_3 , MgO , and CaO , yet the liquidus viscosities are 52,000, 59,000, and 58,000 poises, respectively.

36. In another attempt to cure the liquidus viscosity deficiency of Ground 2, the Petition states, without evidence or support from Dr. Ernst, that a “liquidus temperature of 1120°C also indicates a viscosity of higher than 100,000 poise as demonstrated in the specification of the ‘498 patent.” Pet., 37. But liquidus viscosity and liquidus temperature are not always related in this simplistic, predictable way. Without more information, a POSA cannot accurately predict a glass composition’s liquidus viscosity from its liquidus temperature. Even small changes in composition can have a notable impact on the liquidus temperature and/or liquidus viscosity of a glass.

37. For example, Kim (EX2011) teaches that “the viscosity and the liquidus temperature show a continuous decrease with increase of BaO [with respect to SrO]” for a plasma display panel glass composition. EX2011, 164. And Kim shows that the ratio of BaO to SrO can have non-linear effects on the liquidus temperature, which do not necessarily follow a predictable pattern. Kim’s data reported in Figure 3 (reproduced below) shows that varying the ratio of BaO to $\text{BaO}+\text{SrO}$ between 0 and 1 creates a non-linear effect on liquidus temperature (T_1). EX2011, 162. The Petition and Dr. Ernst do not discuss any particular relationship between a glass composition and its liquidus temperature and viscosity, much less

do they address the potential changes in these properties based on glass composition. The Petition and Dr. Ernst's argument that a glass having a liquidus temperature of at least 1120 °C necessarily "indicates" a liquidus viscosity of over 100,000 poise is overly simplified, and wrong.

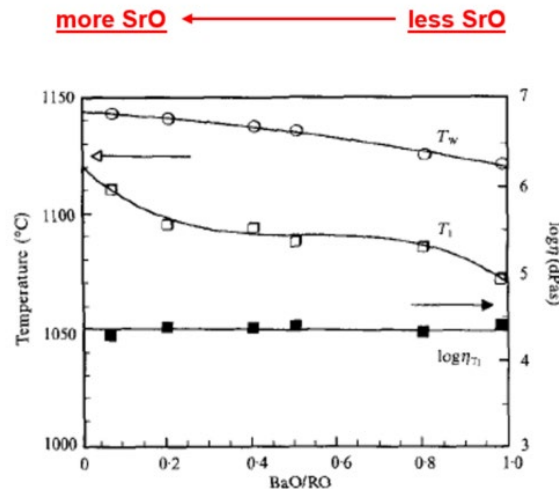


Figure 3. Liquidus temperatures (T_l), working temperature (T_w) and viscosity at liquidus temperature ($\log \eta_l$) as a function of BaO/RO

EX2011, 162, FIG. 3 (annotated).

C. The Petition and Dr. Ernst fail to establish that modifying Miwa '535's Embodiment 15 to have at most 0.005 mol% Sb_2O_3 would have been obvious.

38. The Petition and Dr. Ernst cite Miwa '535's Embodiment 15 and state that "Miwa '535 also describes that the glass can have an Sb_2O_3 mass fraction of $W_{\text{Sb}_2\text{O}_3} = 0$ to 1 mass %," implying that this mass fraction range overlaps with at most 0.005 mol% Sb_2O_3 , as recited in claim 1. Pet., 36; EX1003, ¶146. However, the Petition and Dr. Ernst do not discuss any motivation or reason for why a POSA

would have reduced the Sb_2O_3 content of Miwa '535's Embodiment 15, much less with any reasonable expectation of success. Nor do they address how Miwa '535's Embodiment 15 would be modified to remove the 0.02 mol% Sb_2O_3 in the composition. Without evidence or rationale establishing the final, modified version of Miwa's '535's composition, it is not possible to conclusively establish properties of that composition, such as liquidus viscosity. In fact, a close look at the Petition and Dr. Ernst's arguments reveals significant technical missteps.

39. First, the Petition states that "Embodiment 15 of Miwa '535 includes ... no As_2O_3 , *i.e.*, less than 0.005 mole percent." Pet., 35. Yet the Petition and Dr. Ernst cite JP '741 for motivation to reduce the amount of As_2O_3 in Miwa '535's Embodiment 15. Pet., 36; EX1003, ¶¶141-143. There is no reason why a POSA would have needed to reduce the amount of As_2O_3 in a composition that already has no As_2O_3 . The Petition and Dr. Ernst's argument here is unrelated to, and therefore cannot support, any alleged motivation for why a POSA would have reduced the Sb_2O_3 content of Miwa '535's Embodiment 15.

40. Second, the entirety of Dr. Ernst's motivation to combine analysis set forth in paragraph 76 of Exhibit 1003 is directed towards an argument touting the alleged similarity between Ba^{2+} and Sr^{2+} ions. However, Dr. Ernst does not cite JP '741 for anything related to interchanging BaO and SrO. Dr. Ernst's statement that "a POSITA would have found combining Miwa '535, JP '741 and Peuchert '469

... to constitute combining prior art elements where the combined fraction of SrO and BaO ($X_{\text{SrO}} + X_{\text{BaO}}$) can be optimized,” EX1003, ¶76, is completely irrelevant to any proposed modification of As_2O_3 or Sb_2O_3 in Miwa ’535 based on JP ’741’s disclosure. Without any relevant testimony as to why a POSA would have been motivated to modify Miwa ’535 in view of JP ’741 to arrive at the method of claim 1, much less with any reasonable expectation of success, the Petition and Dr. Ernst fail to show claim 1 is obvious in view of these two references.

IX. CLAIM 1 WOULD NOT HAVE BEEN OBVIOUS IN VIEW OF CHACON AND TAKASE.

41. The arguments presented by the Petition and Dr. Ernst for Ground 3 are flawed in multiple ways. First, Dr. Ernst selects an arbitrary glass composition “*chosen by [him]*” as a starting point allegedly taught by Chacon, but does not explain why a POSA would have selected such a composition. EX1003, ¶218 (emphasis in original). Second, the Petition and Dr. Ernst fail to set forth a reasonable modification of fining agents in Chacon’s glasses to arrive at a modified glass composition having the MgO mol% and liquidus viscosity recited in claim 1 of the ’498 patent.

A. Dr. Ernst does not substantiate why a POSA would have chosen the glass composition “*chosen by [him]*” in light of Chacon’s disclosure.

42. Dr. Ernst begins his analysis for combining Chacon and Takase by selecting an initial composition allegedly taught by Chacon. EX1003, ¶¶216-218.

This selected composition, however, is *not* one of the 32 glass compositions that Chacon discloses. Rather, Dr. Ernst selects an arbitrary glass composition from the broad concentration ranges of Chacon, characterizing the Chacon starting point as such: “Column ‘X’ shows one particular glass composition, *chosen by me*.” EX1003, ¶218 (emphasis added). Dr. Ernst describes this hypothetical composition as a “valid glass composition with oxide mole fractions within the ranges specified by Chacon.” EX1003, ¶219.

43. Dr. Ernst does not explain why a POSA would have selected the glass composition “*chosen by [him]*.” EX1003, ¶218 (emphasis in original). With the exception of B₂O₃, Dr. Ernst selects a composition that contains mol% values at the very extremes of Chacon’s ranges reported in the table in paragraph 218 of his declaration. The SiO₂ and SrO values are at the lower limit of the range (67 mol % and 0 mol %, respectively), while the Al₂O₃, MgO, and CaO values are at the upper limit (11.5 mol %, 1 mol %, and 11 mol %, respectively). EX1003, ¶218. Dr. Ernst does not attempt to justify picking values at the extreme endpoints of the ranges for any of the oxides, much less for all but one of them.

B. The Petition and Dr. Ernst fail to show the modified glass composition would have multiple features of claim 1, including the MgO mol% and liquidus viscosity.

44. The Petition and Dr. Ernst cite broad disclosures of ranges disclosed by Chacon that allegedly overlap with those of the claimed invention. Pet., 42-43;

EX1003, ¶¶198-209. After modifying the composition chosen by him to add 0.022 mol% SnO₂ in view of Takase, EX1003, ¶219, Dr. Ernst does not address the effect that the proposed modification would have on other features of the composition, including the MgO mol% and liquidus viscosity of the composition.

45. Dr. Ernst points to Chacon's disclosure that "MgO is present in the glasses of the present invention in an amount of 0-3 mol %, preferably 0-1 mol %," as evidence that Chacon's MgO concentration limitation overlaps with the claimed invention. EX1003, ¶208. Dr. Ernst then arbitrarily picks the lowest MgO concentration that still meets the claim limitation, 1 mol%, for his hypothetical starting point composition. EX1003, ¶218. Dr. Ernst then proposes adding two additional components, SnO₂ and SO₃, as fining agents, to this starting point composition. EX1003, ¶218. Even setting aside the arbitrary nature of Dr. Ernst's exercise, the addition of these two components suggested by Dr. Ernst would necessarily reduce the MgO concentration to below 1 mol%, because the additional components would dilute the concentration of MgO. The degree to which the MgO mol% would be reduced is left unaddressed by Dr. Ernst. This is particularly problematic because the addition of 0.022 mol% SnO₂ would not replace the at least 0.1 mol% As₂O₃ and/or Sb₂O₃ within Chacon's examples (the missing 0.078 mol% is left unaddressed).

46. In fact, a POSA would have believed that the addition of 0.022 mol%

SnO₂ would have been insufficient to replace the at least 0.1 mol% As₂O₃ and/or Sb₂O₃ within Chacon's compositions. For example, Shelby (EX2012) teaches that "[a]rsenic and antimony oxides are the most efficient and thoroughly studied chemical fining agents." EX2012, 43. A POSA would have understood that other less toxic fining agents, such as SnO₂, "are usually less efficient ... approaches to chemical fining." EX2012, 44. As another example, Dejneka (EX2013) explains that "SnO₂ is not as soluble as As₂O₅ in most glasses of interest, so its concentration is limited to a few tenths of a weight percent." EX2013, 1531. Dejneka further states that "if 1wt% As₂O₅ in the glass is replaced with 0.25 wt% SnO₂ (near the solubility limit for some display compositions) in lab melts, the bubble concentration increases by orders of magnitude." EX2013, 1531.

47. A POSA would have understood that As₂O₃ and Sb₂O₃ are generally better fining agents than SnO₂. And this means that, all else being equal, if a POSA were to consider substituting As₂O₃ and/or Sb₂O₃ with SnO₂, which Dr. Ernst fails to show, more SnO₂ would be added in an attempt to achieve suitable fining (bubble mitigation). Dr. Ernst fails to describe the amount of original fining agents (As₂O₃ and/or Sb₂O₃) present in Chacon that would be replaced by SnO₂ in his hypothetical composition. However, Chacon's glass compositions with the lowest amount of As₂O₃ (compositions 2, 5, and 20) use 0.3 mol% As₂O₃, which corresponds to about 0.9 wt% As₂O₃. EX1008, Table 1. Despite this, Dr. Ernst

proposes to replace approximately 0.9 wt% As_2O_3 with 0.05 wt% SnO_2 —nearly twenty times less than that in Chacon’s glasses. This amount of SnO_2 is far less than what a POSA would have believed reasonably possible to achieve successful glass fining in the absence of As_2O_3 . Accordingly, a POSA would not have been motivated to modify Chacon to include 0.022 mol% SnO_2 , as proposed by Petitioner and Dr. Ernst, at a minimum because a POSA would have expected such a modified composition to contain many more bubbles (inclusions).

48. Indeed, Dr. Ernst does not justify or explain how he arrived at the amount of SnO_2 and SO_3 “*chosen by [him]*.” EX1003, ¶ 218 (emphasis in original). And given the less effective nature of SnO_2 as a fining agent, a POSA would not have arrived at the 0.022 mol% for SnO_2 as suggested by Dr. Ernst. The amount of SnO_2 that a POSA would have been motivated to add in replacement of As_2O_3 and/or Sb_2O_3 in Chacon, to the extent a POSA would have attempted such a replacement at all, would have been significantly higher than 0.022 mol%. Higher levels of SnO_2 would have only further reduced the MgO concentration to below the claimed minimum value of 1.0 mol%. And without viable evidence or rationale establishing the final, modified version of Chacon’s glass composition, it is not possible to conclusively establish properties of that composition, such as liquidus viscosity.

X. THE PETITION AND DR. ERNST HAVE NOT ESTABLISHED THAT PEUCHERT '293 EXPRESSLY OR INHERENTLY DISCLOSES THE CLAIMED LIQUIDUS VISCOSITY IN CLAIM 1.

49. Ground 4 suffers from the same flaws as Ground 1. Peuchert '293 does not expressly disclose the liquidus viscosity limitation of claim 1. Further, the Petition and Dr. Ernst fail to establish that the claimed liquidus viscosity is an inherent feature of the cited example from Peuchert '293.

A. Peuchert '293 does not expressly disclose a liquidus viscosity for any of its examples.

50. Peuchert '293 does not discuss the concept of liquidus viscosity at all, much less does Peuchert '293 disclose the liquidus viscosity for any of its examples.

B. The Petition and Dr. Ernst do not show that a liquidus viscosity of greater than or equal to 100,000 poise is inherent to Peuchert '293's Example 7.

51. The Petition and Dr. Ernst do not conclusively show that Peuchert '293's Example 7 necessarily has a liquidus viscosity of greater than or equal to 100,000 poise. In fact, neither the Petition nor Dr. Ernst present evidence to show that Peuchert '293's Example 7 necessarily has a liquidus viscosity of greater than or equal to 100,000 poise. The only argument that the Petition and Dr. Ernst present regarding the liquidus viscosity of Peuchert '293's Example 7 is the following:

The liquidus viscosity of a glass is a direct consequence of the glass

composition. The 498 Patent specifies glass compositions in Limitation 1[p] and Limitation 1[a]. As shown above, Peuchert '293 describes Limitation 1[p] and Limitation 1[a].

Accordingly, Peuchert '293 discloses Limitation 1[h].
EX1003, ¶¶276-277.

Similar to the discussion above with respect to Miwa '535 and Ground 2, this is an unsupported, and demonstrably false, statement concerning the liquidus viscosity of a broad class of glass compositions that can be formed using any of a variety of methods including, “microsheet down-draw, up-draw or over-flow fusion methods, ... [and] the float process[es]” according to Peuchert '293's disclosure. EX1010, ¶[0064]. That Peuchert '293 discloses alkali-free glass compositions comprising SiO₂, Al₂O₃, B₂O₃, MgO, and CaO does not necessarily imply that the composition has a liquidus viscosity of greater than or equal to 100,000 poise.

XI. CONCLUSION

52. In signing this declaration, I recognize that the declaration will be filed as evidence in an *inter partes* review before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required, I will appear for cross-examination within the United States during the time allotted.

53. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed on this 27th day of August 2025, in Rolla, MO.

A handwritten signature in blue ink that reads "Richard K. Brow". The signature is written in a cursive style with a horizontal line underneath it.

Dr. Richard Brow