

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 IPR2025-00439
U.S. Patent No. 7,851,394

**DECLARATION OF DR. RICHARD BROW IN SUPPORT OF
PATENT OWNER DISCRETIONARY DENIAL BRIEF**

Mail Stop "PATENT BOARD"

Patent Trial and Appeal Board
U.S. Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

Corning Incorporated EX2006
IPR2025-00439
U.S. Patent No. 7,851,394

TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	MY BACKGROUND AND QUALIFICATIONS	2
III.	SUMMARY OF OPINIONS	4
IV.	LIST OF DOCUMENTS CONSIDERED.....	4
V.	PERSON OF ORDINARY SKILL IN THE ART (“POSA”).....	5
VI.	THE EXAMINER WOULD HAVE APPRECIATED THE TOTALITY OF MIWA’S DISCLOSURE BASED ON THE COPY OF MIWA AND THE MACHINE TRANSLATION OF MIWA SUBMITTED DURING PROSECUTION.....	6
VII.	CONVERTING FROM WEIGHT PERCENTAGE TO MOLE PERCENTAGE IS A ROUTINE SKILL THAT A POSA WOULD HAVE BEEN WELL-EQUIPPED TO PERFORM.	13
VIII.	A POSA WOULD HAVE FULLY APPRECIATED THE GLASS COMPOSITIONS OF MIWA WHEN CONSIDERING PATENTABILITY OF THE ’394 PATENT.	14
IX.	CONCLUSION	15

I, Richard Brow, hereby declare as follows.

I. INTRODUCTION

1. I have been retained as an expert 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 the Patent Owner Discretionary Denial Brief for U.S. Patent No. 7,851,394 (“the ’394 patent”) (EX1001), which resulted from U.S. Patent Application No. 11/478,493 (“the ’493 application”), filed on June 28, 2006. I understand that this patent claims priority to Provisional Application No. 60/694,478, filed on June 28, 2005. I understand that the June 28, 2005 filing date for this provisional application is the effective priority date for the ’394 patent. I refer to this date throughout this declaration.

3. In preparing this Declaration, I have reviewed the ’394 patent 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 § 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) and 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 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 US patents, four international patents, and four more patent applications pending, on glasses

for a variety of engineering applications, including U.S. Pat. No. 9,530,991 B2, directed towards alkali-free, alkaline earth borosilicate glasses.

6. 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.

7. 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.

8. 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.

9. 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 “international renown contributions 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

10. I have been asked to consider whether a POSA would have been able to fully understand what was taught in Miwa (JP 2004-189535A) when reviewing the English translation and the original Japanese-language document submitted during prosecution (EX2005). In my opinion, the full teachings of Miwa were squarely in front of the Examiner during prosecution.

IV. LIST OF DOCUMENTS CONSIDERED

Exhibit No.	Description
1001	U.S. Patent No. 7,851,394 (“the ’394 Patent”)
1002	Prosecution History of the ’394 Patent
1003	Declaration of Dr. Frank Ernst
1007	A.K. Varshneya, Fundamentals of Inorganic Glasses, Chapter 5: Glass Compositions and Structures, Academic Press (1994)

Exhibit No.	Description
2005	English-Language Translation and Japanese-Language Original Copies of Miwa Submitted by Patent Owner during Prosecution of the '394 Patent

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

11. 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 patent (and skills required of those doing such testing).

12. For purposes of this declaration, I have assumed a POSA has the qualifications discussed on pages 15-16 of the Petition filed in IPR2025-00439. That said, I reserve the right to set forth a different definition of a POSA and/or contest Petitioner’s definition during this proceeding.

13. Based on my education and experience, I meet the criteria for a POSA as defined by the Petitioner.

VI. THE EXAMINER WOULD HAVE APPRECIATED THE TOTALITY OF MIWA'S DISCLOSURE BASED ON THE COPY OF MIWA AND THE MACHINE TRANSLATION OF MIWA SUBMITTED DURING PROSECUTION.

14. I reviewed the prosecution history of the '394 patent and understand that Patent Owner submitted a Japanese-language copy of the prior art document JP 2004-189535A (Miwa), as well as a machine translation of Miwa, in an Information Disclosure Statement filed August 4, 2008. EX1002, 194-226. Exhibit 2005 is the machine translation and Japanese-language copy of Miwa submitted by Patent Owner. I further understand that the Examiner who reviewed the '493 application, Examiner Hoban, initialed the Miwa reference as cited on the August 4th Information Disclosure Statement on November 24, 2008. EX1002, 164. I understand that the Examiner's initials on the August 4th Information Disclosure Statement indicates that the Examiner considered the Miwa reference submitted by Patent Owner.

15. I understand that the Petition alleges "all the specific parameters that form the bases for either obviousness or anticipation of the Challenged Claims in this Petition are only disclosed by Miwa in the Tables, not in the text." Pet., 8-9.

16. I disagree with this premise of the Petition.

17. The English translation of Miwa provided by Patent Owner during prosecution, EX2005, 2-20, repeatedly and consistently describes that oxide concentrations are weight percentages. EX2005, 2 ("The alkali-free glass substrate

according to the present invention contains substantially no alkali metal oxide, and comprises, **by weight**, 0.01-0.3% SnO₂, 0-0.1% As₂O₃, and 0-1.0% Sb₂O₃, and the Fe content of the glass, converted to Fe₂O₃, is 0.005-0.03% **by weight**.”); *see also* EX2005, 2-3 (reciting the claimed invention by weight percentage), 7 (“The alkali-free glass substrate . . . **comprises, by weight** . . .”), 11 (describing an example alkali glass composition with 55-70% SiO₂, 12-20% Al₂O₃, 5-15% B₂O₃, 0-5% MgO, 0-12% CaO, 0-10% SrO, 0-10% BaO, 0-5% ZnO, 0-5% ZrO₂, and 0-0.5% Cl “**as a percentage of the total weight**”) (all emphasis added). Miwa does not describe the composition in terms of mole percentage, and indeed, it would be unusual to switch between weight and mole percentages when describing glass compositions without explicitly signaling to the reader that both weight and mole percentages are described. Thus, based on the English translation of Miwa submitted in the August 4th Information Disclosure Statement, a POSA would have known that Miwa describes glass compositions using weight percentage. And Examiner Hoban would have been certain of the same.

18. Although Tables 1-5 are not shown in the English machine translation submitted during prosecution, it is indisputable that Tables 1-5 are referenced in the English translation. EX2005, 15 (“Tables 1-4 show examples of the present invention (samples 1-20), and Table 5 shows comparison examples (samples 21 and 22).”). From at least this excerpt, it would be clear to a POSA, and thus the

Examiner, that not only were Tables 1-5 present in the original document, but that they were critical for the evaluation of patentability, as they contained the actual glass compositions that Miwa disclosed.

19. What is more, in the original Japanese-language copy of Miwa submitted by Patent Owner, the glass compositions of 20 examples and 2 comparative examples are disclosed in Tables 1-5, just as described in-text by the English translation. In these tables, the metal oxides (SiO_2 , Al_2O_3 , B_2O_3 , MgO , CaO , SrO , BaO , ZnO , ZrO_2 , SnO_2 , As_2O_3 , and Sb_2O_3), and Cl, their respective weight percentages, and sample numbers are all listed in Roman letters and numerals. I provide an annotated version of a portion of Miwa's Table 1 below, annotated the way a POSA would understand, and thus how Examiner Hoban would have understood. The annotations show the elements of Miwa Table 1 that a POSA and Examiner Hoban would have understood in light of the machine translation submitted in tandem with the original reference.

POSA would understand that these numbers are the given sample's composition by weight percentage

POSA would understand this refers to the compounds SiO₂ through Cl

組成 (質量%)	実施例				
	1	2	3	4	5
SiO ₂	63.0	63.0	63.0	63.0	63.0
Al ₂ O ₃	16.0	16.0	16.0	16.0	16.0
B ₂ O ₃	11.0	11.0	11.0	11.0	10.0
MgO	—	—	—	—	—
CaO	7.0	7.0	7.0	7.0	8.0
SrO	1.5	1.5	1.5	1.5	1.0
BaO	0.5	0.5	0.5	0.5	1.0
ZnO	—	—	—	—	—
ZrO ₂	—	—	—	—	—
SnO ₂	0.1	0.1	0.1	0.1	0.1
As ₂ O ₃	—	—	—	—	—
Sb ₂ O ₃	0.9	0.9	0.9	0.9	0.9
Cl	—	—	—	—	—
全 Fe ₂ O ₃	0.008	0.010	0.012	0.015	0.020

POSA would understand that these numbers are sample numbers 1-5

EX2005, 27 (annotations in color).

20. In my opinion, it is clear that, upon reviewing the submitted Japanese version of Miwa along with the machine translation of Miwa, a POSA would have understood and appreciated that Miwa disclosed 22 glass compositions in Tables 1-5, and that these glass compositions were described in weight percentage. It is also my opinion that a POSA would have understood and appreciated the weight percentages of SiO₂, Al₂O₃, B₂O₃, MgO, CaO, SrO, BaO, ZnO, ZrO₂, SnO₂, As₂O₃, Sb₂O₃, and Cl for each of glass samples 1-22. I believe Examiner Hoban would also have understood and appreciated how to interpret the glass compositions of Miwa during prosecution.

21. Further, it is my opinion that a POSA would have been able to understand the other metrics listed below the glass compositions in Tables 1-5 of

the Japanese-language copy of Miwa submitted by Patent Owner for the following reasons.

22. First, each of the non-English material properties in Tables 1-5 were listed, in order, in the machine translation submitted by Patent Owner: “Transmittance (%), Density (g/cm²¹), Thermal Expansion Coefficient, Strain Point, Liquid Phase Temperature, Acid Resistance, [and] Buffered Hydrofluoric Acid Resistance.” EX2005, 16. The only header that was missing from this list was the log η header, which was already in English. A relevant excerpt from the machine translation for Table 1 is copied below adjacent to Table 1. A comparison of the translated text and the Japanese-language tables makes it clear that the translation refers to the material properties listed in Tables 1-5.

¹ I note that the translated unit for density was incorrectly listed as “g/cm².” A POSA would recognize the term “g/cm²” as an obvious transcription error and would understand that the common unit of density, g/cm³, was intended. In the original Japanese copy of Miwa, it was correctly listed as “g/cm³” in at least Miwa’s tables. EX2005, 27-31.

	実施例				
	1	2	3	4	5
組成 (質量%)					
SiO ₂	63.0	63.0	63.0	63.0	63.0
Al ₂ O ₃	16.0	16.0	16.0	16.0	16.0
B ₂ O ₃	11.0	11.0	11.0	11.0	10.0
MgO	—	—	—	—	—
CaO	7.0	7.0	7.0	7.0	8.0
SrO	1.5	1.5	1.5	1.5	1.0
BaO	0.5	0.5	0.5	0.5	1.0
ZnO	—	—	—	—	—
ZrO ₂	—	—	—	—	—
SnO ₂	0.1	0.1	0.1	0.1	0.1
As ₂ O ₃	—	—	—	—	—
Sb ₂ O ₃	0.9	0.9	0.9	0.9	0.9
Cl	—	—	—	—	—
全Fe ₂ O ₃	0.008	0.010	0.012	0.015	0.020
透過率 (%)					
300nm	74	71	69	66	60
400nm	92	91	91	91	90
600nm	92	91	91	91	90
800nm	92	92	92	92	91
密度 (g/cm ³)	2.38	2.38	2.38	2.38	2.40
熱膨張係数 [30-380℃] (×10 ⁻⁷ /℃)	32	32	32	32	33
変点 (℃)	675	675	675	675	676
log η at 10 ^{2.5} (℃)	1610	1610	1610	1610	1595
液相温度 (℃)	1095	1095	1095	1095	1105
耐酸性	○	○	○	○	○
耐バッファードフッ酸性	○	○	○	○	○

[0039]

[Table 1]

Example

Composition (%)

Total Fe₂O₃

Transmittance (%)

Density (g/cm²)

Thermal Expansion Coefficient

Strain Point

Liquid Phase Temperature

Acid Resistance

Buffered Hydrofluoric Acid Resistance

EX2005, 16, 27.

23. Second, each of these material properties was discussed in the following portion of the English translation provided by Patent Owner.

The characteristics of each of these samples were then evaluated. The results are given in the tables. As the tables make clear, samples 1 to 20 (which were examples of the present invention) had *transmittance* of 55% or more for a *wavelength of 300nm*, and *transmittance* of 90% or more *for wavelengths of 400-800nm*. The *density* was low (no more than 2.43g/cm²), allowing for a more lightweight substrate. The *thermal expansion coefficient* was 30-34 x 10⁻⁷/° C. The *strain point* was high (665° C or more), allowing a glass substrate exhibiting little thermal contraction to be obtained. Further, the *temperature corresponding to 10^{2.5} poise* [referred to in the tables as the “log η at 10^{2.5}” value] was no greater than 1610° C, and the *liquid phase*

temperature was no greater than 1120° C, so that these samples had excellent meltability and moldability. *Acid resistance* and *BHF resistance* (buffered hydrofluoric acid resistance) were also excellent. EX2005, 17-18 (emphasis added).

24. The English translation also goes into detail as to the methods used to obtain transmittance for wavelengths of 300 nm, 400 nm, 600 nm, and 800 nm, density, thermal expansion coefficients, strain point, liquid phase temperature, HCl resistance, and buffered hydrofluoric acid resistance. EX2005, 18-19. The $\log \eta$ at $10^{2.5}$ value is also further described in this section. EX2005, 18. This list of measured values, in the same order, and explicitly referenced as the values measured in Tables 1-5, would equip a POSA to understand exactly what the values mean.

25. Third, when looking at the Japanese-language version of Tables 1-5 themselves, a POSA would have been able to determine which values matched with those listed in the English-language version. The units listed in the tables correspond with the appropriate material property metrics. EX2005, 27-31.

26. In light of the discussion above, I provide the following annotated version of a portion of Miwa's Table 1, annotated the way a POSA would understand, and thus how Examiner Hoban would have understood.

% Transmittance for various wavelengths	透過率 (%)	300nm	74	71	69	66	60
		400nm	92	91	91	91	90
		600nm	92	91	91	91	90
		800nm	92	92	92	92	91
CTE values	密度 (g/cm ³)		2.38	2.38	2.38	2.38	2.40
	熱膨張係数 [30-380℃] (× 10 ⁻⁷ /℃)		32	32	32	32	33
log η values	変点 (℃)		675	675	675	675	676
	log η at 10 ⁻² s (℃)		1610	1610	1610	1610	1595
“Acid resistance”	液相温度 (℃)		1095	1095	1095	1095	1105
	耐酸性		○	○	○	○	○
	耐バッファードフッ酸性		○	○	○	○	○

Density values

Strain point values

Liquidus temperatures

“Buffered
hydrofluoric acid
resistance”

EX2005, 27 (annotation in color).

27. In my opinion, it is clear that upon reviewing the submitted Japanese version of Miwa along with the machine translation of Miwa, a POSA would have understood and appreciated that Miwa disclosed the transmittance (%), density (g/cm³), CTE (x 10⁻⁷/°C), strain point (°C), liquidus temperature (°C), acid resistance, and buffered hydrofluoric acid resistance of the 22 glass compositions in Tables 1-5. I believe Examiner Hoban would also have understood and appreciated how to interpret these measured values disclosed in Miwa Tables 1-5 during prosecution.

VII. CONVERTING FROM WEIGHT PERCENTAGE TO MOLE PERCENTAGE IS A ROUTINE SKILL THAT A POSA WOULD HAVE BEEN WELL-EQUIPPED TO PERFORM.

28. As established above, the compositions of Miwa are in weight percentages. This contrasts with the '394 patent, which describes compositions in mole percentage. *See, e.g.*, EX1001, Abstract, 21:1-3. Mole percentage and weight percentage, while presented differently, describe the same concept in this context:

the concentration of an oxide present in a glass composition. The conversion between mole percent and weight percent is a common calculation that a POSA would be well-equipped to perform, as described, for example, on pages 90-91 of Exhibit 1007.

29. Indeed, Dr. Ernst, writing from the perspective of a POSA, describes that “[i]t is *well-known* that glass compositions may be presented on a weight percent or a mole percent basis, *where weight% can be converted to mole% and vice-versa.*” EX1003, ¶62 (emphasis added). Dr. Ernst concedes, and I agree, that this calculation was routine for a POSA as of June 28, 2005.

30. Thus, a POSA would have been readily able to interconvert between mole and weight percentage for oxides in a glass composition, and so would have Examiner Hoban. Indeed, Examiner Hoban converted a weight percentage of tin oxide to a mole percentage of tin oxide during prosecution. EX1002, 267 (“For example, composition 9 in Table 5 [of Narita] contains .9 wt% or .42 mol% tin oxide.”).

VIII. A POSA WOULD HAVE FULLY APPRECIATED THE GLASS COMPOSITIONS OF MIWA WHEN CONSIDERING PATENTABILITY OF THE '394 PATENT.

31. As discussed in § VI, given the English translation and original Japanese-language copy of Miwa, a POSA would have been able to clearly understand Tables 1-5 as describing the glass compositions by weight percentage,

as well as having disclosed a variety of other notable glass properties. And as discussed in § VII, a POSA would have been able to convert weight percentages into mole percentages. A POSA would also have been able to compare those converted mole percentages directly to a claimed glass composition. It is therefore my opinion that Examiner Hoban would have been able to appreciate the disclosure of Miwa in its totality, and in doing so, properly evaluate the patentability of the '394 patent claims over Miwa.

IX. CONCLUSION

32. 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.

33. 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 10th day of May, 2025, in Rolla, MO, USA.



Dr. Richard Brow