

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 No.: IPR2025-00937

U.S. Patent No. 8,640,498

PETITION FOR INTER PARTES REVIEW

OF U.S. PATENT NO. 8,640,498

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PETITIONER’S EXHIBIT LIST

EX1001	U.S. Patent No. 8,640,498 (the “’498 Patent”)
EX1002	Prosecution History of the ’498 Patent
EX1003	Declaration of Dr. Frank Ernst
EX1004	JP2003192377 (“Miwa ‘377”)-certified English translation
EX1005	JP2004189535 (“Miwa ‘535”)-certified English translation
EX1006	JP1998059741 (“JP ‘741”)-certified English translation
EX1007	US20050101469 (“Peuchert ‘469”)
EX1008	U.S. Patent No. 6,319,867 (“Chacon”)
EX1009	JP2004299947 (“Takase”)-certified translation
EX1010	US20010034293 (“Peuchert ‘293”)
EX1011	<i>Curriculum Vitae</i> of Dr. Frank Ernst

I. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8

A. Real Party-in-Interest

Caihong Display Devices Co., Ltd. (“Caihong”) is the Petitioner and a real party-in-interest.

B. Related Matters

U.S. Patent No. 8,640,498 (“the ’498 Patent”) is presently the subject of a patent infringement lawsuit filed against Petitioner in the United States District Court for the Eastern District of Virginia and captioned *Corning Incorporated v. Caihong Display Devices Co., Ltd. et al*, Case No. 1-24-cv-02328. The ’498 Patent is also asserted in the investigation captioned *Certain Glass Substrates for Liquid Crystal Displays, Products Containing the Same, and Methods for Manufacturing the Same II*, Investigation No. 337-TA-1441, at the U.S. International Trade Commission. This is the first case in which the ’498 Patent was litigated. The ’498 Patent has not been subjected to post-grant review by the Patent Trial & Appeal Board.

C. Lead and Back-up Counsel and Service Information

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II. FEE AUTHORIZATION

The PTO is authorized to charge any fees due during this proceeding to Deposit Account No. 132725.

III. GROUNDS FOR STANDING

Petitioner certifies that the '498 Patent is available for *inter partes* review and that Petitioner is not barred or estopped from requesting *inter partes* review challenging the patent claims on the grounds identified in this Petition.

IV. REQUESTED RELIEF

Petitioner requests review and cancellation of Claims 1-11 as unpatentable based on the following grounds, supported by a declaration from Dr. Frank Ernst. EX1003.

Ground	Challenged Claims	Asserted Prior Art
1	1, 2, 7, 10 and 11	Miwa '377
2	1, 3-11	Miwa '535 in view of JP '741 and Peuchert '469
3	1 and 4-11	Chacon in view of Takase
4	1-2, 4, and 9	Peuchert '293

V. REASONS FOR THE REQUESTED RELIEF

As set forth in detail below in Grounds 1-4, the asserted prior art anticipates and/or renders obvious each of the claims of the '498 Patent.

The '498 Patent is directed to alkali-free glasses suited for use as substrates in flat panel display devices, such as active-matrix liquid crystal displays (AMLCDs). It addresses the fining (refining) process of such glasses to achieve the desired physical and chemical properties. The '498 Patent alleges that the claimed glasses are dimensionally stable, have specific thermal and expansion characteristics, and can undergo semiconductor type processes without degradation. EX1003, ¶¶ 31-37.

The Challenged Claims, however, are neither novel nor unobvious. For example, Miwa '377 alone, the combination of Miwa '535 in view of JP '741 and Peuchert '469, the combination of Chacon and Takase, and Peuchert '293 – all of which also relate to alkali-free glasses suitable for use as substrates in flat panel display devices – render all of the Challenged Claims anticipated and/or obvious, as discussed in more detail below.

This Petition's showing that the cited art renders the Challenged Claims unpatentable is fully supported by the Declaration of Dr. Frank Ernst (EX1003). Dr. Ernst is an expert in material sciences, including the composition and manufacture of alkali-free glasses for use as substrates in flat panel display devices, and fully agrees with and supports the showing herein that the claims at issue merely recite long-known aspects of such glasses and processes for making the same.

Accordingly, the Board should institute the trial and cancel the Challenged Claims.

A. Summary of the '498 Patent

The '498 Patent focuses on the development of alkali-free boroaluminosilicate glasses intended for use as substrates in flat panel displays, such as AMLCDs. EX1001, Abstract. The Applicant alleges that the invention has improved the fining (or refining) process of these glasses to achieve desirable physical and chemical properties suitable for high-quality display manufacturing. *Id.* at 1:16-222.

Specifically, the Applicant claims that the specified glass composition is tailored for a thermal expansion coefficient suitable for stress-balancing with deposited films, high liquidus viscosity, high strain point, low (mass) density, and low density of defects (“blisters” or “bubbles”), accomplished by fining with components of reduced toxicity. *Id.*, at 3:55-66. EX1003, ¶¶ 37, 41.

Traditionally, As_2O_3 and Sb_2O_3 have been used as fining agents during glass manufacturing. *Id.*, at 12:1-26. However, since both of these fining agents are toxic, special handling is needed. *Id.* To solve this issue, the '498 Patent proposes to use SnO_2 as the fining agent. *Id.*, at 12:27-42. EX1003, ¶¶ 31, 32, 33.

Further, the '498 Patent requires the liquidus temperature of the glass to be lower than 1170°C and the liquidus viscosity to be no less than 100,000 P (poise). *Id.*, at 14:33-46. EX1003, ¶¶ 32.

The '498 Patent indicates that it is critical to the glass performance, meltability, and fining to control the MgO fraction and the ratio $\Sigma[\text{RO}]/[\text{Al}_2\text{O}_3]$, where $\Sigma[\text{RO}]$ denotes the sum of the mole fractions X_i of $\text{RO} = \text{MgO}, \text{CaO}, \text{SrO}, \text{BaO}$ (*i.e.* all earth-alkaline metal oxides). $[\text{Al}_2\text{O}_3]$ denotes the mole fraction X_i of Al_2O_3 . *Id.*, at 7:24-29. In the notation used in the patent, brackets “[...]” are used to indicate “concentration.” “Concentration” can be a confusing concept, as it is sometimes used with reference to a volume, *e.g.* as the number of molecules (or moles thereof) per liter. Also, the bracket notation does not make it explicit that the

concentration that is meant here refers to the *number* of molecules or atoms, not their masses. More clearly, the ratio $\Sigma[\text{RO}]/[\text{Al}_2\text{O}_3]$ can be written as $\Sigma_R X_i/X_{\text{Al}_2\text{O}_3}$, where $R = \{\text{MgO}, \text{CaO}, \text{SrO}, \text{BaO}\}$ is the set of the earth-alkaline oxides without BeO (toxic) and RaO (radioactive). So, $\Sigma_R X_i/X_{\text{Al}_2\text{O}_3}$ is a shorthand for

$$\frac{X_{\text{MgO}} + X_{\text{CaO}} + X_{\text{SrO}} + X_{\text{BaO}}}{X_{\text{Al}_2\text{O}_3}}$$

EX1003, ¶¶ 36.¶

Further, the '498 Patent indicates that the MgO mole fraction X_{MgO} of should be within the range $X_{\text{MgO}} = 1$ to 3 mol%, in order to reduce the liquidus temperature, and thereby increase the liquidus viscosity. EX1001, at 10:19-44. In addition, $\Sigma[\text{RO}]/[\text{Al}_2\text{O}_3]$ (or, preferably, $\Sigma_R X_i/X_{\text{Al}_2\text{O}_3}$) should be greater than 1.00 to avoid inclusions (blisters) in the glasses and maintain high viscosity during the fining process. *Id.*, Abstract, FIG. 3. EX1003, ¶ 37.

B. The Prosecution History of the '498 Patent

Miwa '535 (EX1005), original Japanese language publication, machine translation of the same, and a professional translation were cited and considered by the Examiner. EX1002 at 000033, 000034, 000044, 000049. Miwa was used in a rejection and specifically addressed by the Applicant during prosecution. EX1002, at 000060, 000065, 000072.

Chacon (EX1008) was cited in the ‘498 Patent at col. 2, line 48, and in an Information Disclosure Statement (EX1002 at 000156). Although the Examiner initialed Form 1449, it is not clear whether the Examiner actually considered Chacon. EX1002 at 000080. *See, e.g., Fox Factory, Inc. v. SRAM, LLC*, IPR2016-01876, Paper 8 at 7–9 (PTAB Apr. 3, 2017) (refusing to deny institution for grounds based on a prior art reference that was simply cited in an IDS); *Praxair Distribution, Inc. v. INO Therapeutics LLC*, IPR2015-00893, Paper 14 at 8 (PTAB Sept. 22, 2015) (granting institution even though references were previously cited in an IDS because patent owner failed to identify where those references were considered); *HyperBranch Medical Technology, Inc. v. Confluent Surgical, Inc.*, IPR2018-01099, Paper 14 at 17 (PTAB Nov. 27, 2018) (instituting IPR because, inter alia, “[t]he Examiner does not appear to have considered the combined teachings of [the references] during examination of the [challenged] patent.”).

The USPTO has not, however, previously considered Miwa ‘377, JP ‘741, Peuchert ‘469, Takase, or Peuchert ‘293. And, more importantly, the Office has not previously considered any of the combinations of these references that form the grounds for this Petition. Thus, this Petition presents substantially new arguments that were not previously considered during prosecution in the UPSTO.

C. Priority Date

The '498 Patent was filed on December 10, 2010, and claims priority to Provisional Application No. 60/694,478 filed on June 28, 2005. EX1001, cover page. Thus, the earliest possible effective U.S. filing date for the '498 Patent is June 28, 2005.

While Petitioner does not accede to an invention date of June 28, 2005, for the '498 Patent, it will be assumed, solely for purposes of this Petition, that the '498 Patent is entitled to that date. Accordingly, any patent or printed publication published before June 28, 2005, is prior art under § 102(a), any patent or printed publication published before June 28, 2004, is prior art under § 102(b), and any patent granted on an application filed before June 28, 2005, is prior art under § 102(e). *See* 35 U.S.C. § 102 (pre-AIA). All of the references cited in the instant Petition qualify as prior art.

VI. DISCRETIONARY DENIAL UNDER § 325(d) or § 314 IS NOT WARRANTED

Petitioner has not been involved in any previous review of the '498 Patent.

A. § 325(d)

While Miwa '535 and Chacon were cited during prosecution of the '498 Patent, the Office has not previously considered Miwa '377, JP '741, Peuchert '469, Takase, or Peuchert '293. And, more importantly, the Office has not previously

considered any of the combinations of these references that form the grounds for this Petition. Additionally, this Petition provides the analysis of Dr. Ernst, an expert in the field, which has likewise not been considered by the Office before.

As the same, or even similar, arguments have not been previously considered by the Office, discretionary denial under § 325(d) is not warranted here. *See, e.g., Amgen Inc. v Alexion Pharmaceuticals, Inc.*, IPR2019-00740, Paper 15 at 65 (PTAB Aug. 30, 2019) (“The Board has consistently declined exercising its discretion under Section 325(d) when the only fact a Patent Owner can point to is that a reference was disclosed to the Examiner during the prosecution.”); *Amneal Pharms. LLC v. Alkermes Pharma Ireland Ltd.*, IPR2018-00943, Paper 8 at 40 (PTAB Nov. 7, 2018) (declining to deny institution where the reference was listed on the face of the patent, but Patent Owner provided no evidence “about the extent to which the Examiner evaluated” the reference during prosecution); *Digital Check Corp. d/b/a ST Imaging v. E-Imagedata Corp.*, IPR2017-00178, Paper 6 at 12–13 (PTAB Apr. 25, 2017) (granting institution because there was no indication that the Examiner substantively considered those references during prosecution); *Fox Factory, Inc. v. SRAM, LLC*, IPR2016-01876, Paper 8 at 7–9 (PTAB Apr. 3, 2017) (refusing to deny institution based on Section 325(d) for grounds based on a prior art reference that was simply cited in an IDS); *Praxair Distribution, Inc. v. INO Therapeutics LLC*, IPR2015-00893, Paper 14 at 8 (PTAB Sept. 22, 2015) (granting institution even though

references were previously cited in an IDS because patent owner failed to identify where those references were considered); *HyperBranch Medical Technology, Inc. v. Confluent Surgical, Inc.*, IPR2018-01099, Paper 14 at 17 (PTAB Nov. 27, 2018) (instituting IPR because, inter alia, “[t]he Examiner does not appear to have considered the combined teachings of [the references] during examination of the ’021 patent.”).

B. § 314

The filing of this Petition is not abusive, neither the Office nor the Board has previously addressed the grounds raised in this Petition, and instituting this proceeding would be an efficient use of the Board’s resources. Accordingly, denial under § 314(a) is not warranted. *General Plastic Industrial Co. v. Canon Kabushiki Kaisha*, IPR2016-01357 (PTAB Sept. 6, 2017) (precedential).

C. *Fintiv*

Although there are two co-pending proceedings involving the ‘498 Patent – *Certain Glass Substrates for Liquid Crystal Displays, Products Containing the Same, and Methods for Manufacturing the Same (II)*, Inv. No. 337-TA-1441 and *Corning Inc. v. Caihong Display Devices Co., Ltd.*, Case No. 1-24-cv-02328 (EDVA) – this Petition should not be denied under the discretionary factors set forth in *Apple v. Finitiv, Inc.*, IPR2020-00019, Paper 11, at 6 (PTAB Mar. 20, 2020), for at least the following reasons.

1. Whether the court granted a stay

The co-pending district court litigation involving the ‘498 Patent has been stayed and that stay will remain in place until the completion of the ITC’s investigation and any subsequent appeals. *See* Case No. 1-24-cv-02328, Dkt. No. 14.

Although the co-pending ITC investigation has not been stayed, that investigation does not involve all of the claims of the ‘498 Patent. Moreover, because the ITC does not permit the filing of a counterclaim for invalidity, the co-pending ITC investigation cannot and will not address all of the claims of the ‘498 Patent, including independent claim 1. It is only through this IPR proceeding that Petitioner can possibly obtain complete relief.

This factor weighs against discretionary denial.

2. Proximity of the court’s trial date

The district court action is currently stayed and that stay will remain in place until at least August 2026, when the ITC is scheduled to issue a Final Determination in the co-pending investigation. Accordingly, it is highly unlikely that the district court action will be tried before the Board’s projected statutory deadline for a FWD.

Although a Final Determination is scheduled to be issued in the co-pending ITC investigation in August 2026, that FD will necessarily not involve all of the claims of the ‘498 Patent, including independent claim 1.

This factor weighs against discretionary denial.

3. Investment in parallel proceedings

The district court action is still in the pleading stage and some of the defendants have not yet even been served with a copy of the Complaint. Investment in that action has therefore been *de minimus*.

Fact discovery has commenced in the co-pending ITC investigation but is still in the early stages. None of the respondents has answered the Complaint, nor have they served any infringement or invalidity contentions or exchanged claim terms for construction.

This factor weighs against discretionary denial.

4. Overlap of issues

Because the co-pending district court action will remain stayed until after the Board's statutory deadline for a FWD, there will be no overlap of issues in the two proceedings due to the estoppel provisions of 35 U.S.C. § 315(e)(2).

With respect to the ITC investigation, "the ITC does not have the authority to invalidate a patent." *Wirtgen Am., Inc. v. Caterpillar Paving Prods. Inc.*, IPR2018-01201, Paper 13 at 12 (PTAB Jan. 8, 2019); *see also Emerson Elec. Co. v. SIPCO, LLC*, Case No. IPR2019-00545, Paper 16 at 13 (PTAB Aug. 30, 2019). Thus, Petitioner will not be free of threats of litigation from Patent Owner even if it prevails in the ITC investigation. *See INVT SPE LLC v. Int'l Trade Comm'n*, 46 F.4th 1361,

1370 (Fed. Cir. 2022) (“ITC determinations of patent infringement and validity do not have preclusive effect on district courts, even when affirmed by the Federal Circuit.”); *see also Bio-Tech. Gen. Corp. v. Genentech, Inc.*, 80 F.3d 1553, 1563–64 (Fed. Cir. 1996) (ITC decisions do not bind a subsequent federal court under the doctrine of claim preclusion); *Texas Instruments, Inc. v. U.S. Int’l Trade Comm’n*, 851 F.2d 342, 344 (Fed. Cir. 1988) (“[T]his court has stated that the ITC’s determinations regarding patent issues should be given no *res judicata* or collateral estoppel effect.”). Consequently, the Board has frequently declined to deny IPR petitions in view of parallel ITC proceedings.

Moreover, Patent Owner has studiously not asserted all of the claims of the ‘498 Patent in the ITC investigation, including independent claim 1 (from which all of the claims being asserted depend). This stratagem provides additional grounds for the Board to decline to exercise its discretion here. *See Samsung Electronics Co. v. Dynamics, Inc.*, IPR2020-00499, Paper 41 at 13 (PTAB Aug. 12, 2020) (declining to exercise discretion after determining claim limitations at issue before the Board were not at issue in the ITC proceeding); *3Shape A/S v. Align Technology, Inc.*, IPR2020-00223, Paper 12 at 33-34 (PTAB May 26, 2020) (declining to exercise discretion after finding that the ITC investigation would not resolve all claims at issue in the IPR proceeding). Indeed, while the ITC’s decision in the co-pending investigation may be informative, in this case, because the ITC will not be

considering all of the claims of the '498 Patent, that investigation “does not render our proceeding duplicative or amount to a waste of the Board's resources.” *Wirtgen*, Paper 13 at 11. Accordingly, instituting trial here would be a more efficient alternative to the stayed district court litigation and the co-pending ITC investigation. *See Samsung*, Paper 41 at 13.

Finally, to reduce the potential for even a partial overlap of issues, if the Board institutes trial on this Petition, Petitioner will not assert in the ITC investigation and the parallel District Court action the same prior art combinations or any grounds that could have reasonably been raised on which trial is instituted. The most efficient course is for the Board to address the issues before it and the ITC to address only the issues that would remain.

This factor weighs against discretionary denial. *See Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 (PTAB Dec. 1, 2020) (precedential as to § II.A).

5. Identity of the parties

Patent Owner is the plaintiff in the district court action and complainant in the ITC investigation. Petitioner is one of five defendants named in the district court action and one of several respondents in the ITC investigation. That fact, however, is also true of a great many patent owners and petitioners in IPR proceedings and is fully consistent with the purpose of IPRs providing a process for accused infringers

to challenge patents being asserted against them in litigation. This factor should therefore not be a basis for denying institution, particularly given that all of the other factors here weigh against discretionary denial.

6. Other circumstances, including the merits

As discussed in more detail below, the patents and published applications relied upon in this Petition demonstrate that at least independent claim 1 and dependent claims 2, 4, 7, 9, and 11 of the '498 Patent are unpatentable as anticipated by at least two prior art references – neither of which was considered by the Office – and the remaining claims are obvious over those references and/or combinations of others, which were also not considered by the Office. Petitioner's arguments are strong and are well supported by expert testimony. This factor should therefore weigh against discretionary denial.

For at least the reasons above, the Board should decline to exercise its discretion in this case.

E. Secondary Considerations

At this stage of these proceedings, Petitioner has no burden to identify and rebut any possible secondary considerations. Rather, Patent Owner must first present a *prima facie* case for such consideration, which Petitioner should then have the chance to rebut. *Sega of Am., Inc. v. Uniloc USA, Inc.*, IPR2014-01453, Paper 11, at 20 (PTAB Mar. 10, 2015). For that reason, the Board typically rejects arguments

against institution based on objective indicia so that Petitioner can have a fair opportunity to address any secondary indicia evidence on reply. *Petroleum Geo-Services, Inc. v. WesternGeco LLC*, IPR2014-01478, Paper 18, at 36 (Mar. 17, 2015).

VII. CLAIM CONSTRUCTION

In *inter partes* review, claims are “construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b).” 37 C.F.R. § 42.100(b). Claims must therefore be given their ordinary and customary meaning as understood by a POSITA at the time of the invention in light of the specification and the prosecution history pertaining to the patent. *Id.*; *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312-13 (Fed. Cir. 2015) (*en banc*); *see also* 83 Fed. Reg. 51340, Vol. 83, No. 197 (Oct. 11, 2018). As such, this Petition and Dr. Ernst’s declaration construe claim terms consistent with the understanding a POSITA would have in view of the ’498 Patent’s intrinsic evidence and, where appropriate, extrinsic evidence. *Phillips*, 415 F.3d at 1312. EX1003, ¶¶ 38-41.

Terms for which a specification construction is not provided below have been given their plain and ordinary meaning, as discussed in more detail for particular terms. Petitioner, however, may pursue constructions of additional claim terms in the related litigation(s) concerning the ’498 Patent to help the Administrative Law

Judge and/or jury understand the relevant technical terms and expressly reserves the right to assert that certain claim terms are indefinite.

VIII. STATUTORY GROUNDS FOR CHALLENGES AND REFERENCES USED

Claims 1, 2, 7, 9 and 11 are anticipated by and Claim 10 is either anticipated by or obvious over Miwa '377 (EX1004), which constitutes Ground 1. Claims 1 and 3-11 are obvious in view of Miwa '535 (EX1005) combined with JP '741 (EX1006) and further combined with Peuchert '439 (EX1007), which constitutes Ground 2. Claims 1 and 4-11 are obvious over Chacon (EX1008) and Takase (EX1009), which constitutes Ground 3. Claims 1, 2, 4, and 9 are anticipated by and Claim 10 is obvious over Peuchert '293 (EX1010), which constitutes Ground 4.

Miwa '377 was made public in the United States no later than July 9, 2003; Miwa '535 was made public in the United States no later than July 8, 2004; JP '741 was made public in the United States no later than March 3, 1998, Peuchert '469 was made public in the United States no later than May 12, 2005; Chacon was made public in the United States no later than June 27, 2001; Takase was made public in the United States no later than October 28, 2004; and Peuchert '293 was made public in the United States no later than October 25, 2001. EX1003, ¶¶ 47, 50, 57, 61, 63, 69, 72.

Accordingly, each piece of prior art relied upon in this petition qualifies as prior art to the '498 Patent under at least 35 U.S.C. 102(a) and 35 U.S.C. 102(b) (pre-AIA).

IX. LEVEL OF ORDINARY SKILL IN THE ART

The person of ordinary skill in the art ("POSITA") with respect to the '498 Patent would have had knowledge of and experience with the concepts of glass science relevant to '498 Patent. For example, a POSITA 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.

X. THE PRIOR ART IN THE APPLIED INVALIDITY GROUNDS

A. Miwa '377 (EX1004)

Miwa '377 was filed on December 21, 2001, and published on July 9, 2003. Similar to the '498 Patent, Miwa '377 also relates to glass articles particularly useful for an LCD glass substrate that does not substantially contain arsenic oxide or alkali

metal oxides and can be formed using the downdraw method. EX1004, ¶0073; EX1003, ¶ 47.

Miwa '377 includes a number of embodiments specifying glass compositions on an oxide basis including the fractions of SiO₂, Al₂O₃, B₂O₃, MgO, and CaO, such as in Embodiment 8. EX1004, Table; EX1003, ¶ 48.

Miwa '377 also describes that “the liquidus temperature of the glass must be below 1200°C, more preferably below 1150°C, and the liquidus viscosity must be 10⁵ dPa·s or higher, more preferably 10^{5.5} dPa·s or higher.” EX1004, ¶ 0012; EX1003, ¶ 0012.

B. Miwa '535 (EX1005)

Miwa '535 was filed on December 11, 2002, and published on July 8, 2004. EX1005, cover page; EX1003 ¶ 50.

Similar to the '498 Patent, Miwa '535 also relates to alkali-free boroalumino-silicate glass compositions suitable for flat-panel displays and thin-film photovoltaic technologies. EX1005, at summary, ¶¶ 0001-0008. More specifically, Miwa '535, filed by Nippon Electric Glass Co Ltd (a Japanese glass manufacturer of glass for flat panel displays), discloses an alkali-free glass substrate. That glass can be used in various flat panel displays, such as liquid crystal displays (LCDs), electroluminescence displays (ELDs), field emission displays (FEDs), sensors, and cover glass for solid-state imaging devices. *Id.* Miwa '535 addresses the need for

glass substrates that do not contain alkali-metal oxides since uptake of alkali ions can degrade the electronic properties of the structured semiconductor layers that serve as the active components of the displays. More specifically, deposition and structuring of semiconductor layers require elevated temperatures, at which alkali ions from the glass substrate can readily diffuse in and destroy them. Therefore, alkali-free glasses are essential to prevent diffusion of alkali ions into the structured semiconductor layers that serve as the active components of the displays on the backside of the display glass sheet. *Id.* EX1003, ¶ 51.

Similar to the '498 Patent, Miwa '535 specifies a continuous range of glass compositions that achieve favorable properties. Different from the '498 Patent, however, Miwa indicates the respective glass compositions by providing ranges for the *mass* (or weight – not mole) fractions of SiO₂, B₂O₃, Al₂O₃, MgO, CaO, SrO, and BaO. *Id.* at ¶ 0022. Glasses within the specified range of compositions are shown to possess high thermal shock resistance, high chemical resistance, high transparency across the visible-to-ultraviolet range of the electromagnetic spectrum, low mass density, and a thermal-expansion coefficient matching that of deposited semiconductor layers. The glasses demonstrate excellent mechanical stability and resistance to hydrochloric acid etching, making them ideal for TFT (thin-film transistor) displays, thin-film photovoltaics, and hard-disk substrates, while addressing disadvantages found in prior art related to mechanical stability and

meltability. *Id.* at ¶ 0055. In summary, Miwa teaches alkali-free glass substrates with similar compositions and similar physical and chemical properties as the '498 Patent that are suitable for flat panel display applications. EX1003, ¶¶ 54, 126.

Miwa '535 teaches specific alkali-metal-free glasses with mass fractions W_i . EX1005, Table 4. One example, Embodiment 15, when converted to mole fractions, has the following composition:

SiO₂: 67.2 mol%

Al₂O₃: 10.2 mol%

B₂O₃: 10.3 mol%

MgO: 2.1 mol%

CaO: 9.3 mol%

SrO: 0.63 mol%

BaO: 0.21 mol%

SnO₂: 0.04 mol%

As₂O₃: 0.0 mol%

Sb₂O₃: 0.02 mol%

Fe₂O₃: 0.00 mol%

$\sum X_R / X_{Al_2O_3} = 1.20$

EX1003, ¶ 56.

C. JP ‘741 (EX1006)

JP ‘741 was filed on August 21, 1996, and published on March 3, 1998. EX1006, cover page; EX1003, ¶ 57.

Similar to the ‘498 Patent, JP ‘741 also relates to “an alkali-free glass that does not use As_2O_3 as a fining agent and is free from bubbles that cause display defects, as well as a method for manufacturing such glass. In this way, an alkali-free glass of the present invention can be obtained, which has a composition in weight percent of 40–70% SiO_2 , 6–25% Al_2O_3 , 5–20% B_2O_3 , 0–10% MgO , 0–15% CaO , 0–30% BaO , 0–10% SrO , 0–10% ZnO , and 0.05–2% SnO_2 , and essentially contains no alkali metal oxides.” EX1006, ¶0006, 0019; EX1003, ¶¶ 58, 142.

JP ‘741 discloses that because “ As_2O_3 is highly toxic and may contaminate the environment during glass production and waste glass treatment, its use is being restricted.” EX1006, ¶ 0005; EX1003, ¶¶ 59, 142.

D. Peuchert ‘469 (EX1007)

Peuchert ‘469 was filed on March 6, 2002, and published on May 12, 2005, and has a priority claim to a German application, DE 10114581.0, filed on March 24, 2001. EX1007, cover page; EX1003, ¶ 61.

Similar to the ‘498 Patent, Peuchert ‘469 also relates to alkali-free aluminoborosilicate glass. EX1007, ¶0001. Peuchert ‘469 discusses the benefits of low fractions of BaO – preferably the complete absence of BaO – as well as the

similar roles that SrO and BaO play in the properties of the glass. EX1007, ¶¶ 0024, 0025, 0026; EX1003, ¶ 62.

E. Chacon (EX1008)

Chacon was filed on November 22, 1999, and issued on November 20, 2001, and has a priority claim to provisional application No. 60/110,220 filed on November 30, 1998. EX1008, cover page; EX1003, ¶ 63.

Similar to the '498 Patent, Chacon also relates to alkali-free, aluminosilicate glasses exhibiting desirable physical and chemical properties for use as substrates in flat panel display devices. EX1008, col. 1, lines 7-10; EX1003, ¶ 64.

Chacon describes the production of these glass articles by a fusion downdraw process with compositions including SiO₂, Al₂O₃, B₂O₃, MgO, CaO, and SrO. EX1008, col. 3, lines 32-36; EX1003, ¶ 65.

Chacon further discusses processing parameters, additional oxides, such as fining agents, and properties of glass articles that are substantially the same properties as described in the '498 Patent. EX1008, col. 4, lines 11-19; col. 5, lines 20-29; EX1003, ¶ 66.

For instance, Chacon discloses that “[a]lthough substrates made from glass of the present invention can be made using other manufacturing processes such as the float process, the fusion process is preferred for several reasons.” EX1008, col. 4, lines 29-32; EX1003, ¶ 67.

Chacon further discloses “[t]he glass of the present invention has a composition consisting essentially of the following composition as calculated in mole percent on an oxide basis: ..., and essentially free of BaO. More preferably, the glass of the present invention has a composition consisting essentially of the following composition as calculated in mole percent on an oxide basis: 67-73 SiO₂, 8-11.5 Al₂O₃, 8-12 B₂O₃, 0-1 MgO, 5.5-11 CaO, and 0-5 SrO. EX1008, col. 3, lines 32-40; EX1003, ¶ 68.

F. Takase (EX1009)

Takase was filed on March 31, 2003, and published October 28, 2004. EX1009, cover page; EX1003, ¶ 69.

Similar to the ‘498 Patent, Takase also relates to “alkali-free glass comprising 40 to 70 mass% SiO₂, 6 to 25 mass% Al₂O₃, 5 to 20 mass% B₂O₃, 0 to 10 mass% MgO, 0 to 15 mass% CaO, 0 to 30 mass% BaO, 0 to 10 mass% SrO, 0 to 10 mass% ZnO, 0.0001 to 0.03 mass% SO₃, 0.05 to 2 mass% SnO₂, the glass being substantially free of alkali metal oxides.” EX1009, ¶0010; EX1003, ¶ 70.

Takase describes “using a sulfate and stannic oxide instead of As₂O₃ as clarifying agents.” EX1009, ¶0009. Takase discloses that the mass fraction of the SnO₂ fining agent is 0.05–2 ms%, corresponding to a mole fraction of at least 0.02 mol%. EX1009, ¶ 0017; EX1003, ¶ 71.

E. Peuchert '293 (EX1010)

Peuchert '293 was filed on January 11, 2001, and published on October 25, 2001, and has a priority claim to a German application, DE 10000837.2-45, filed on January 12, 2000. EX1010, cover page; EX1003, ¶ 72.

Similar to the '498 Patent, Peuchert '293 also relates to alkali-free aluminoborosilicate glass produced by down-draw and/or fusion methods. EX1010, ¶¶ 1010, 0064; EX1003, ¶ 73.

Peuchert '293 discloses a number of examples, including Example 7. EX1010, Page 4, Table. Converting the mass fractions W_i of Example 7 to mole fractions X_i yields:

Component	X (mol%)
SiO ₂	65.3
Al ₂ O ₃	10.2
B ₂ O ₃	7.6
MgO	6.6
CaO	8.2
SrO	2.2
BaO	0
ZnO	0
SnO ₂	0.1
As ₂ O ₃	0

EX1003, ¶ 74.

Peuchert '293 further discloses processing parameters, additional oxides, such as fining agents, and properties of glass articles with substantially the same properties as described in the '498 Patent. EX1010, Table at page 4 and ¶¶ 0005, 0064; EX1003, ¶ 75.

A. Motivation to combine

As set forth below in more detail with respect to certain specific limitations, a POSITA would have found it obvious to combine the prior art described above as applied in this Petition. In particular, all of the references are in the same technical field as the '498 Patent and each other: alkali-free glasses developed primarily for use as substrates in flat panel display technologies. Thus, the prior art references are analogous references, and a POSITA would have found combining those references as described herein to be a small set of a finite number of identified means for obtaining the desired non-alkali low-density glass useful as substrates in display technologies and would have had a reasonable expectation of success in making such combinations. EX1003, ¶ 76.

XI. CLAIMS 1-11 ARE UNPATENTABLE.

A. Ground 1: Claims 1, 2, 7, 9, and 11 are Anticipated by Miwa '377 and Claim 10 is Either Anticipated by or Would Have Been Obvious Over Miwa '377

1. Independent Claim 1

Each and every limitation in Claim 1 of the '498 Patent is described by Miwa

‘377. EX1003, ¶¶ 78-96. More specifically, Miwa ‘377 discloses that:

the glass in the present invention satisfies all of the[] required characteristics for use as a glass substrate[] for TFT-LCD’s [and furthermore, because it] is substantially free of arsenic oxide and alkali metal oxides, and can be formed using the downdraw method [it offers] high-quality glass substrates with low environmental impact and low cost can be obtained that are particularly suitable for use as glass substrates for liquid crystal displays.

EX1004, ¶ 0073; EX1003 ¶ 78.

One of the specific examples disclosed in Miwa ‘377 is Embodiment 8, which has the composition shown in the following Table:

Sample	No. 7		No. 8		No. 9	
	mass%	mol%	mass%	mol%	mass%	mol%
SiO ₂	62.0	68.62	61.2	66.61	60.0	67.72
Al ₂ O ₃	16.0	10.44	17.0	10.90	14.0	9.31
B ₂ O ₃	10.5	10.03	8.0	7.52	11.0	10.72
MgO	-	-	2.0	3.24	-	-
CaO	8.0	9.49	6.0	7.00	6.5	7.86
SrO	0.8	0.51	4.0	2.52	2.3	1.51
BaO	0.5	0.22	0.5	0.21	1.5	0.66
ZnO	-	-	-	-	0.7	0.58
ZrO ₂	0.4	0.22	0.15	0.08	0.45	0.25
TiO ₂	-	-	-	-	0.	0.42
SnO ₂	0.3	0.13	0.15	0.07	0.05	0.02
P ₂ O ₅	-	-	-	-	1.0	0.48
Sb ₂ O ₃	1.5	0.34	-	-	2.0	0.47
Cl	-	-	1.0	1.84	-	-
MCSB	9.3	10.22	12.5	12.97	10.3	10.03
0.13 x X-1		0.33		0.69		0.30
Density (g/cm ³)	2.39		2.44		2.45	
Thermal Expansion Coefficient (x 10 ⁻¹ /°C)	33		35		34	
Stress Point	669°C		693°C		650°C	
10 ^{2.5} dPa · s	1603°C		1619°C		1539°C	
Liquid Phase Temperature	1042°C		1089°C		1065°C	
SnO ₂ Opacity	No		No		No	
HCl Resistance						
Amount of Corrosion	1.8 μm		0.1 μm		0.8 μm	
Appearance	○		○		○	
BHF Resistance						
Amount of Corrosion	0.7 μm		0.6 μm		0.7 μm	
Appearance	○		Δ		○	
Bubble Retention	○		○		○	

EX1004, page 10, Table; EX1003, ¶ 80.

Based on the values shown in the Table above and the relevant disclosures in

Miwa '377, Embodiment 8 has the same $\alpha \Sigma[\text{RO}]/[\text{Al}_2\text{O}_3]$ ratio as the claimed invention, the same production processes (EX1004, ¶¶ 0072, 0073) as the claimed invention, the same compositional limitations as the glass produced by the claimed method: MgO content greater than or equal to 1.0 mole percent (Embodiment 8 includes 3.24 mol% of MgO), no more than 0.005 mole percent of As_2O_3 (Embodiment 8 includes 0 mol% of As_2O_3), and satisfies the claimed requirement that $0.01 \leq \text{SnO}_2$ (Embodiment 8 includes 0.07 mol% SnO_2). EX1003, ¶¶ 48, 81, 85, 87, 89, 93, 98.

In addition, Miwa '377 discloses the same liquidus viscosity as found in Claim 1 of the '498 Patent Claim 1. EX1004, ¶ 0012; EX1003, ¶¶ 95, 101, 117.

Thus, all the limitations in Claim 1 are described in Miwa '377. EX1003, ¶¶ 77-96.

2. Dependent Claim 2

Claim 2 depends from Claim 1 and further limits the SnO_2 content, *i.e.*, $\text{SnO}_2 \leq 0.15$. As shown in the Table above, Embodiment 8 of Miwa '377 includes 0.07 mol% of SnO_2 . EX1003, ¶ 98.

Thus, Claim 2 is disclosed by Miwa '377. EX1003, ¶ 99.

3. Dependent Claim 7

Claim 7 also depends from claim 1 and recites that the glass has a liquidus temperature less than or equal to 1170°C . Embodiment 8 of Miwa '377 has a

liquidus viscosity of 1089 °C, which is less than 1170 °C. EX1003, ¶ 101.

Thus, Claim 7 is disclosed by Miwa '377. EX1003, ¶ 102.

4. Dependent Claim 8

Claim 8 also depends from claim 1 and recites that the glass has a strain point that is greater than or equal to 650° C. Embodiment 8 of Miwa '377 has strain point of 693 °C, which is less than 650 °C. EX1003, ¶ 104.

Thus, Claim 8 is disclosed by Miwa '377. EX1003, ¶ 105.

5. Dependent Claim 9

Dependent Claim 9 further defines the process of Claim 1 as being a fusion process. Miwa '377, especially Embodiment 8, describes that glasses are made using a downdraw process, such as an overflow downdraw method, which includes fusion of two downward-moving glass sheets. EX1004, ¶ 0012; EX1003, ¶ 107.

Thus, Claim 9 is described by Miwa '377. EX1003, ¶ 108.

6. Dependent Claim 10

Claim 10 is ambiguous with respect to the requirement that “*a population of 50 sequential glass sheets...has an average gaseous inclusion level of less than 0.05 gaseous inclusions/cubic centimeter.*” EX1003, ¶¶ 109-113. Nevertheless, even though Miwa '377 does not provide experimental data on glass quality under the insufficient and arbitrary “conditions” of Claim 10, Embodiment 8 is prepared by the same fusion downdraw process as disclosed in the '498 Patent and satisfies

all of the relevant production parameters given in the '498 Patent. This includes the level of fining agent and resulting meltability, and the requisite liquidus temperature and liquidus viscosity. EX1003, ¶ 114. Since the '498 Patent does not specify any additional process parameters that might be required to achieve the limit for defects recited in Claim 10, a POSITA would reasonably expected that Embodiment 8 of Miwa '377 would inherently produce glass sheets of at least equivalent quality in terms of blister/bubble defects. *Id.* This includes necessarily producing populations of 50 sequential glass sheets produced by the fusion downdraw process from the melted and fined batch materials with “an average gaseous inclusion level of less than 0.05 gaseous inclusions per cm³, where each glass sheet in the population has a volume of at least 500 cm³.” EX1003, ¶¶ 114-115.

If not anticipated, Claim 10 would at least have been obvious over Miwa '377 as requiring no more than routine optimization of the parameters disclosed therein. EX1003, ¶¶ 114-115.

7. Dependent Claim 11

Dependent Claim 11 also depends from Claim 1 and recites that the glass has a liquidus viscosity that is greater than or equal to 200,000 poise. Miwa '377 describes that “the liquidus viscosity must be 10⁵ dPa·s or higher, more preferably 10^{5.5} dPa·s or higher.” EX1004, ¶ 0012; EX1003, ¶ 117. The preferred viscosity of 10^{5.5} dPa·s specified by Miwa corresponds to 316,000 P (±36,000), which is greater than or

equal to 200,000 poise. EX1003, ¶ 119.

Thus, Miwa '377 discloses Claim 11. EX1003, ¶ 120.

B. Ground 2: Claims 1 and 3-11 Would Have Been Obvious in View of Miwa '535, JP '741 and Peuchert '469

1. Independent Claim 1

Each and every limitation in Claim 1 of the '498 Patent is taught by the combination of Miwa '535 in view of JP '741. EX1003, ¶¶ 121-155.

More specifically, Miwa '535 discloses:

The present invention relates to substrates such as flat panel displays and sensors including liquid crystal displays, electroluminescent displays, field emission displays, etc., and non-alkali glass substrates used in cover glass of solid state imagers. ...First, the raw materials for the non-alkaline glass are selected while taking into consideration the amount of Fe contained as an impurity, and the raw materials are used to make a mixture that falls within the above-mentioned glass composition range. The raw materials thus prepared are then melted in a continuous melt furnace at a temperature of 1520 to 1680°C. After that, by forming molten glass into a sheet using methods such as the slot-die draw method, overflow-die draw method, float method, and roll-out method can be used and the glass is then slowly cooled to obtain an alkali-free glass substrate.

EX1005, ¶¶ 0001, 0036; EX1003, ¶ 122.

Miwa '535 also discloses a continuous range of alkali-free glass compositions by specifying ranges for the mass (or weight) fractions of components on an oxide basis. EX1005 at [Claim 3], Tables 1-5. Tables 4 and 5 of Miwa '535 illustrate various examples of alkali-free glasses defined by weight percentages of each listed oxide. EX1003, ¶ 123.

One of the specific examples disclosed in Miwa '535 is Embodiment 15, which has an alkali-free composition that is characterized in terms of mass fractions (EX1005, Table 4). When those mass fractions are converted to mole fractions, Embodiment 15 has the following composition:

Component	X (mol%)
SiO ₂	67.19
Al ₂ O ₃	10.22
B ₂ O ₃	10.29
MgO	2.10
CaO	9.29
SrO	0.63
BaO	0.21
SnO ₂	0.04
As ₂ O ₃	0.0
Sb ₂ O ₃	0.02
Fe ₂ O ₃	0.00
$\sum X_R / X_{Al_2O_3} = 1.21$	

EX1003, ¶ 128.

Based on the values above, Embodiment 15 of Miwa '535 includes a $\Sigma[RO]/[Al_2O_3]$ ratio greater than or equal to 1.0, i.e., 1.21, an MgO content greater than or equal to 1.0 mole percent, i.e., 2.1 mol%; and no As₂O₃, i.e., less than 0.005 mole percent. EX1005, Table 4; EX1003, ¶¶ 127-134, 136, 141.

JP '741, which is similar to the '498 Patent and Miwa '535 in terms of relating

to alkali-free glasses, describes the need to reduce the use of As_2O_3 . EX1006, ¶¶ 0005, 0006, 0019; EX103, ¶¶ 142-143.

Thus, Miwa '535 in view of JP '741 provides ample reason for a POSITA to reduce the concentration of As_2O_3 in an alkali free glass to an amount of “at most 0.05 mole percent As_2O_3 ” *vix.*, 0 mole percent As_2O_3 . EX1003, ¶¶ 127-134, 136, 141-143.

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 %. EX1004, ¶ 0014; EX1003, ¶ 145. As described above, a mass fraction of 0 to 1 overlaps with “at most 0.005 [*i.e.*, 0-0.005] mole percent Sb_2O_3 ” as recited in Claim 1 of the '498 Patent. EX1003, ¶ 146.

Embodiment 15 has an SnO_2 mole fraction of $X_{\text{SnO}_2}=0.04$ mol%, which overlaps with “at least 0.01 mole percent SnO_2 .” Miwa '535 also discloses that the glass can comprise a mass (or weight) fraction of $W_{\text{SnO}_2}=0.01$ to 0.3 ms%. EX1005, ¶ 0017; EX1003, ¶ 149.

Finally, regarding the limitation in Claim 1 of the '498 Patent that requires a liquidus viscosity of greater than or equal to 100,000 poise, it is well-known in the field that the liquidus viscosity should be greater than or equal to 100,000 P (poise) – equivalent to $10^{5.0}$ dPa·s (decipascal–seconds) in SI units – for an alkali-free glass substrate to be fabricated using downdraw technique. EX1003, ¶ 158. The liquidus viscosity of a glass is a direct consequence of the glass composition. *Id.* The

preferred viscosity of $10^{5.5}$ dPa · s specified by Miwa corresponds to 316,000 P ($\pm 36,000$), which is greater than or equal to 200,000 poise. *Id.*, ¶ 119. Moreover, the liquidus temperature of 1120°C also indicates a viscosity of higher than 100,000 poise as demonstrated in the specification of the ‘498 patent.

Thus, all the limitations in Claim 1 are disclosed by Miwa ‘535 in view of JP ‘741. EX1003, ¶¶ 122-159.

2. Dependent Claim 3

Claim 3 depends from Claim 1 and further limits the MgO content to between 1.2 and 2.8 mole percent. Embodiment 15 of Miwa ‘535 contains 2.1 mol% of MgO. EX1003, ¶ 161. Thus, Claim 3 is described by Miwa ‘535 in view of JP ‘741. EX1003, ¶ 162.

3. Dependent Claim 4

Claim 4 depends from Claim 1 and recites that the glass is substantially free of BaO. Peuchert ‘469 teaches that BaO can be replaced by a corresponding fraction of SrO, as the role of SrO is similar to that of BaO. EX1003, ¶¶ 163-164. As a result, when the disclosures of Miwa ‘535 and Peuchert ‘469 are combined, they teach a glass as defined in claim 4 of the ‘498 Patent. *Id.*

4. Dependent Claim 5

Claim 5 depends from Claim 1 and requires the glass to have a density that is less than or equal to 2.41 grams/cm³. Embodiment 15 of Miwa ‘535 is a glass with

a density of 2.39 g/cm^3 , which satisfies the requirement for “a density that is less than or equal to 2.41 g/cm^3 ” recited in dependent claim 5. EX1005, Table 4; EX1003, ¶ 166.

Thus, Claim 5 is disclosed by Miwa ‘535 in view of JP ‘741. EX1003, ¶ 167.

5. Dependent Claim 6

Claim 6 depends from Claim 1 and recites that the glass has a linear coefficient of thermal expansion (CTE) over the temperature range $0\text{-}300^\circ \text{C}$ which satisfies the relationship: $28 \times 10^{-7}/^\circ \text{C} \leq \text{CTE} \leq 34 \times 10^{-7}/^\circ \text{C}$.”

Miwa ‘535 discloses “a linear coefficient of thermal expansion (CTE) over the temperature range $30\text{-}380^\circ \text{C}$ which satisfies the relationship: $28 \times 10^{-7}/^\circ \text{C} \leq \text{CTE} \leq 34 \times 10^{-7}/^\circ \text{C}$. EX1005, at [0047]; EX1003, ¶ 169. Embodiment 15 of Miwa ‘535 reports a coefficient of thermal expansion (CTE) of $34 \times 10^{-7} \text{C}^{-1}$ measured over a temperature range of 30 to 380°C , which is in the range of $28 \times 10^{-7} \text{C}^{-1} \leq \text{CTE} \leq 34 \times 10^{-7} \text{C}^{-1}$ as in limitation 7[c]. EX1005, Table 4; EX1003, ¶¶ 171-177.

The CTE reported in Miwa ‘535, measured for $[T_3, T_4] = [30, 380]^\circ \text{C}$, is *greater* than it would have been if measured for $[T_1, T_2] = [0, 300]^\circ \text{C}$, the temperature interval used in the ‘498 Patent. EX1003, ¶ 178. As the two temperature intervals $[T_1, T_2]$ and $[T_3, T_4]$ overlap by 71%, measuring the CTE of the Miwa ‘535 glass over $[T_1, T_2] = [0^\circ \text{C}, 300^\circ \text{C}]$ instead of $[T_3, T_4] = [30^\circ \text{C}, 380^\circ \text{C}]$ will *slightly* decrease the value of $34 \cdot 10^{-7} \text{C}^{-1}$ Miwa ‘535 reported for $[T_3, T_4] = [30, 380]^\circ \text{C}$.

EX1003, ¶ 179.

Accordingly, for the temperature interval $[T_1, T_2] = [0, 300] ^\circ\text{C}$ recited in the ‘498 Patent, the CTE of the glass in Miwa ‘535 satisfies the requirement that the CTE fall within the range $28 \times 10^{-7} \text{C}^{-1} \leq \text{CTE} \leq 34 \times 10^{-7} \text{C}^{-1}$. EX1003, ¶ 180.

Thus, Claim 6 would have been obvious over Miwa ‘535 in view of JP ‘471. EX1003, ¶ 181.

6. Dependent Claim 7

Claim 7 depends from claim 1 and requires the glass to have a liquidus temperature less than or equal to 1170°C . Embodiment 15 of Miwa ‘535 has a liquidus temperature of 1120°C (EX1005, Table 4), which is within the range of less than or equal to 1170°C , as in Claim 7. EX1003, ¶ 183.

Thus, Claim 7 would have been obvious over Miwa ‘535 in view of JP ‘471.

7. Dependent Claim 8

Claim 8 depends from claim 1 and requires the glass to have a strain point that is greater than or equal to 650°C . Embodiment 15 of Miwa ‘535 has a strain point of 673°C (EX1005, Table 4), which is within the range of greater than or equal to 650°C as recited in Claim 8. EX1003, ¶ 185.

Thus, Claim 8 would have been obvious over Miwa ‘535 in view of JP ‘471.

8. Dependent Claim 9

Dependent Claim 9 further defines the process of Claim 1 as being a fusion

process. Miwa '535 describes (emphasis added):

First, the raw materials for the non-alkaline glass are selected while taking into consideration the amount of Fe contained as an impurity, and the raw materials are used to make a mixture that falls within the above-mentioned glass composition range. The raw materials thus prepared are then melted in a continuous melt furnace at a temperature of 1520 to 1680°C. After that, by forming molten glass into a sheet using methods such as the **slot-die draw method, overflow-die draw method**, float method, and roll-out method can be used and the glass is then slowly cooled to obtain an alkali-free glass substrate.

EX1005, ¶ 0036; EX1003, ¶ 187.

It is well-known that the slot-die draw method and overflow-die draft method are fusion processes. Thus, Claim 9 would have been obvious over Miwa '535 in view of JP '471. EX1003, ¶ 188.

9. Dependent Claim 10

Claim 10 is ambiguous with respect to the requirement that “*a population of 50 sequential glass sheets...has an average gaseous inclusion level of less than 0.05 gaseous inclusions/cubic centimeter.*” EX1003, ¶¶ 190-192. Nevertheless, even though Miwa '535 does not provide experimental data on glass quality under the insufficient and arbitrary “conditions” of Claim 10, Embodiment 15 is prepared by the same fusion downdraw process as disclosed in the '498 Patent and satisfies all of the relevant production parameters given in the '498 Patent. This includes the level of fining agent and resulting meltability, and the requisite liquidus temperature and liquidus viscosity. EX1003, ¶ 194. Since the '498 Patent does not specify any

additional process parameters that might be required to achieve the limit for defects recited in Claim 10, a POSITA would reasonably expect that Embodiment 15 of Miwa ‘535 would inherently produce glass sheets of at least equivalent quality in terms of blister/bubble defects. *Id.* This includes necessarily producing populations of 50 sequential glass sheets produced by the fusion downdraw process from the melted and fired batch materials with “an average gaseous inclusion level of less than 0.05 gaseous inclusions per cm³, where each glass sheet in the population has a volume of at least 500 cm³.” EX1003, ¶ 194.

Thus, Claim 10 would have been obvious over Miwa ‘535 in view of JP ‘471. EX1003, ¶ 195.

10. Dependent Claim 11

Dependent Claim 11 depends from Claim 1 and recites that the glass has a liquidus viscosity that is greater than or equal to 200,000 poise. It is known in the field that for an alkali-free glass substrate to be fabricated using a downdraw method, the liquidus viscosity should be greater than or equal to 100,000 P (poise), which is equivalent to 105.0 dPa·s (decipascal–seconds) in SI units. Ex. 1003, ¶ 197. Moreover, the liquidus viscosity of a glass is a direct consequence of the glass composition and Miwa ‘535 discloses glasses having the same composition as those disclosed in the ‘498 Patent. *Id.*

Thus, Claim 11 would have been obvious over Miwa ‘535 in view of JP ‘471.

EX1003, ¶ 197.

C. Ground 3: Claims 1 and 4-11 would have been obvious in view of Chacon and Takase

1. Independent Claim 1

Each and every limitation in Claim 1 of the '498 patent is disclosed by the combination of Chacon and Takase. Ex. 1003, ¶¶ 198-222.

More specifically, Chacon describes the production of alkali-free glass by a downdraw process (EX1008, col. 4, lines 29-32; EX1003, ¶¶ 199-200) that includes melting and fining batch materials (EX1005, col. 5, lines 42-49; EX1003, ¶¶ 202, 203), wherein the glass has a composition, as calculated in mole percent on an oxide basis, of: 67-73 SiO₂, 8-11.5 Al₂O₃, 8-12 B₂O₃, 0-1 MgO, 5.5-11 CaO, and 0-5 SrO. EX1008, col. 3, lines 32-41; EX1003, ¶ 202.

Chacon also discloses that the glass produced by the disclosed process has a $\Sigma[\text{RO}]/[\text{Al}_2\text{O}_3]$ ratio greater than or equal to 1.0:

The RO/Al₂O₃ ratio is in the range 0.9-1.2. Within this range local minima in liquidus temperature can be found, corresponding to cotectics and/or eutectics in the base system CaO—Al₂O₃—SiO₂. The viscosity curves of the glasses in this series do not vary significantly, thus these changes in liquidus temperatures are the primary drivers for increases in liquidus viscosity.

EX1008, col. 5, lines 13-19; EX1003, ¶ 205.

Chacon further discloses that the glass has an MgO content greater than or equal to 1.0 mole percent, *i.e.*, “MgO is present in the glasses of the present invention in

an amount of 0-3 mol %, preferably 0-1 mol %.” EX1005, col. 5, lines 1-6; EX1003, ¶ 208.

Takase, which is similar to both the ‘498 Patent and Chacon, discloses ranges for the components that include the values found in Chacon’s examples, making it merely the selection of one of a limited set of possibilities to use the same type and mass fraction of fining agent. EX1003, ¶ 215. Takase discloses that the mass fraction of the SnO₂ fining agent is 0.05–2 ms%, which overlaps with a mole fraction of at least 0.02 mol%. EX1009, ¶¶ 0009, 0010, 0014, and 0017; EX1003, ¶¶ 214-219.

It would thus have been obvious to modify the process in Chacon in view of Takase’s teaching to avoid the use of toxic fining agents and, instead, use SO₃ and SnO₂ as fining agents. EX1003, ¶ 215.

Finally, regarding the limitation in Claim 1 of the ‘498 patent that requires a liquidus viscosity of greater than or equal to 100,000 poise, Chacon describes “a liquidus viscosity (defined as the viscosity of the glass at the liquidus temperature) greater than about 200,000 poises, preferably greater than about 400,000 poises, more preferably greater than about 600,000 poises, and most preferably greater than about 800,000 poises.” EX1008, col. 3, lines 16-22; EX1003, ¶¶ 221-222.

Thus, all the limitations in Claim 1 are disclosed by and would have been obvious over the combination of Chacon and Takase. EX1003, ¶¶ 198-222.

2. Dependent Claim 4

Claim 4 depends from Claim 1 and recites that the glass is substantially free of BaO. Chacon discloses that “the glasses of the invention are essentially free of BaO. As used herein, **essentially free of BaO** means that the composition contains less than 0.1 mol % of BaO in the composition.” EX1008, col. 5, lines 27-30 (emphasis added); EX1003, ¶ 227. Thus, Claim 4 would have been obvious over the combination of Chacon and Takase. EX1003, ¶ 228.

3. Dependent Claim 5

Claim 5 depends from Claim 1 and recites that the glass has a density less than or equal to 2.41 grams/cm³. Chacon discloses that “[T]he preferred glasses in accordance with the present invention exhibit a density of less than about 2.45 gm/cm³, preferably less than about 2.40 gm/cm³. . .” EX1008, col. 4, lines 10-12; EX1003, ¶ 230. Because Chacon discloses glasses having the same density as recited in Claim 5, Claim 5 would have been obvious over the combination of Chacon and Takase. EX1003, ¶ 231.

4. Dependent Claim 6

Claim 6 depends from Claim 1 and requires the glass to have a linear coefficient of thermal expansion (CTE) over the temperature range 0-300° C which satisfies the relationship: $28 \times 10^{-7}/^{\circ} \text{C} \leq \text{CTE} \leq 34 \times 10^{-7}/^{\circ} \text{C}$. Chacon discloses that “[t]he preferred glasses in accordance with the present invention exhibit...a CTE over the

temperature range of 0-300° C. between about $28-35 \times 10^{-7}/^{\circ}\text{C.}$, preferably between about $28-33 \times 10^{-7}/^{\circ}\text{C....}$ ” EX1008, col. 4, lines 12-16; EX1003, ¶ 233. Because Chacon discloses glasses having the same CTE as required by Claim 6 of the ‘498 patent, Claim 6 would have been obvious over the combination of Chacon and Takase. EX1003, ¶ 234.

5. Dependent Claim 7

Claim 7 depends from claim 1 and recites that the glass has a liquidus temperature less than or equal to 1170° C. Chacon discloses a number of examples having including liquidus temperatures that are less than or equal to 1170 °C as required by Claim 7. EX1008, Table 1; EX1003, ¶ 236. Since Chacon describes glasses having a liquidus temperature within the range required by Claim 7, Claim 7 would have been obvious over the combination of Chacon and Takase. EX1003, ¶ 236.

6. Dependent Claim 8

Claim 8 depends from claim 1 and requires the glass to have a strain point that is greater than or equal to 650° C. Chacon discloses that “the glasses of the present invention . . . [have] strain points higher than about 650° C.” EX1008, col. 3, lines 22-28. EX1003, ¶ 238. Because Chacon discloses glasses having a strain point within the range required by Claim 8, Claim 8 would have been obvious over the combination of Chacon and Takase. EX1003, ¶ 239.

7. Dependent Claim 9

Dependent Claim 9 depends from Claim 1 and recites that the process is a fusion process. Chacon discloses:

Although substrates made from glass of the present invention can be made using other manufacturing processes such as the float process, the fusion process is preferred for several reasons. First, **glass substrates made from the fusion process** do not require polishing. Current glass substrate polishing is capable of producing glass substrates having an average surface roughness greater than about 0.5 nm (Ra), as measured by atomic force microscopy. **Glass substrates produced according to the present invention and using the fusion process** have an average surface roughness as measured by atomic force microscopy of less than 0.5 nm.

EX1008, col. 4, lines 20-40 (emphasis added); EX1003, ¶ 241.

Because Chacon describes a fusion process as recited in Claim 9, Claim 9 would have been obvious over the combination of Chacon and Takase. EX1003, ¶ 242.

8. Dependent Claim 10

Claim 10 is ambiguous with respect to the requirement that “*a population of 50 sequential glass sheets...has an average gaseous inclusion level of less than 0.05 gaseous inclusions/cubic centimeter.*” EX1003, ¶¶ 244-247. Nevertheless, even though neither Chacon nor Takase provides experimental data on glass quality under the insufficient and arbitrary “conditions” of Claim 10, the glasses in Chacon are prepared by the same fusion downdraw process as disclosed in the ‘498 Patent and satisfies all of the relevant production parameters given in the ‘498 Patent. EX1003,

¶ 248. This includes the use of a fusion downdraw process, the specified conditions for the glass composition – including a sufficient level of a fining agent and resulting meltability – as well as the condition for the liquidus temperature and liquidus viscosity. *Id.* Moreover, Chacon describes the same manner of making the glass sheets. *Id.* Since the '498 Patent does not specify any additional process parameters that might be required to achieve the limit for defects recited in Claim 10, a POSITA would reasonably expect that Chacon would inherently produce glass sheets of at least equivalent quality in terms of blister/bubble defects. *Id.* This includes necessarily producing populations of 50 sequential glass sheets produced by the fusion downdraw process from the melted and fined batch materials with “an average gaseous inclusion level of less than 0.05 gaseous inclusions per cm³, where each glass sheet in the population has a volume of at least 500 cm³.” *Id.*

Thus, Claim 10 would have been obvious over Chacon in view of Takase. EX1003, ¶ 248.

9. Dependent Claim 11

Dependent Claim 11 depends from claim 1 and recites that the glass has a liquidus viscosity that is greater than or equal to 200,000 poise. Chacon describes:

The present invention is founded in the discovery of glasses exhibiting densities less than 2.45 g/cm³ and a liquidus viscosity (defined as the viscosity of the glass at the liquidus temperature) greater than about 200,000 poises, preferably greater than about 400,000 poises, more preferably greater than about 600,000 poises, and most preferably greater

than about 800,000 poises.

EX1008, col. 3, lines 16-22; EX1003, ¶ 250.

Because Chacon discloses glasses having the liquidus viscosity of Claim 11, Claim 11 would have been obvious over Chacon in view of Takase. EX1003, ¶ 251.

D. Ground 4: Claims 1-2, 4 and 9 are anticipated by Peuchert ‘293

1. Independent Claim 1

Each and every limitation in Claim 1 of the ‘498 patent is described by Peuchert ‘293. EX1003, ¶¶ 252-277.

More specifically, Peuchert ‘293 discloses:

The invention relates to alkali-free aluminoborosilicate glasses. The invention also relates to uses of these glasses. The glasses can be produced as flat glasses by the various drawing methods, for example microsheet down-draw, up-draw or overflow fusion method.

EX1010, ¶¶ 0006, 0064; EX1003, ¶ 253.

Peuchert ‘293 also discloses several examples, the compositions of which are shown in the Table below:

TABLE

Examples: Compositions (in % by weight, based on oxide) and essential properties of glasses according to the invention.							
	1	2	3	4	5	6	7
SiO ₂	58.3	58.3	63.5	62.1	62.1	63.5	60.8
B ₂ O ₃	8.5	8.5	9.0	8.2	8.2	9.1	8.2
Al ₂ O ₃	21.5	21.5	16.5	19.0	19.0	17.3	16.1
MgO	4.5	6.0	4.5	6.0	7.5	6.0	4.1
CaO	3.4	1.9	3.0	1.5	1.5	1.8	7.0
SrO	3.5	3.5	3.2	2.0	1.0	2.0	3.5
BaO	—	—	—	0.4	0.4	—	—
ZnO	—	—	—	0.5	—	—	—
$\alpha_{20/300}$ [10 ⁻⁶ /K]	3.26	3.16	3.14	2.96	2.99	2.98	3.76
ρ [g/cm ³]	2.48	2.47	2.43	2.45	2.44	n.m.	2.49
T _g [° C.]	735	737	723	740	729	725	713
T4 [° C.]	1257	1273	1300	1283	1288	1289	1255
T2 [° C.]	1613	1621	1694	1657	1652	1653	1616
n _d	1.522	1.522	1.513	1.516	1.516	1.520	1.524
BHF [mg/cm ²]	0.71	0.77	0.58	0.65	0.66	0.60	0.60

EX1010, at page 4; EX1003, ¶ 256.

The components in Example 7 in the Table above are shown as mass (or weight) fractions, based on oxides and indicated as percentages. The following table shows the same composition, but this time with the amount of each component given in mole fractions:

Component	X (mol%)
SiO ₂	65.3
Al ₂ O ₃	10.2
B ₂ O ₃	7.6
MgO	6.6
CaO	8.2
SrO	2.2
BaO	0
ZnO	0
SnO ₂	0.1
As ₂ O ₃	0

EX1003, ¶ 257.

Based on the values shown above, $\sum X_R / X_{\text{Al}_2\text{O}_3} = 1.66$. EX1003, ¶¶ 257, 261-262.

It is well known by those of ordinary skill in the art that selecting, melting, and fining batch materials are mandatory steps conventionally used in the production of glass articles, such as glass sheets. EX1003, ¶ 258; *see also* Peuchert ‘293, EX1010, ¶ 0050.

Example 7 of Peuchert ‘293 discloses glasses having a $\Sigma[\text{RO}]/[\text{Al}_2\text{O}_3]$ ratio within the range recited in Claim 1, an MgO content of greater than or equal to 1.0 mole percent (Example 7 includes 6.6 mol% of MgO), an As₂O₃ content of less than 0.005 mole percent (Example 7 contains 0 mol% As₂O₃), no more than 0.005 mole percent Sb₂O₃ (Example 7 contains 0 mol% Sb₂O₃), and an amount of fining agent (SnO₂) that satisfies the relationship $0.01 \leq \text{SnO}_2$ in terms of mole percent (Example 7 includes 0.13 mol% SnO₂). EX1003, ¶¶ 257, 261, 262, 270, 272, 274.

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

composition. The '498 Patent describes certain glass compositions in Limitation 1[p] and Limitation 1[a]. As shown above, Peuchert '293 describes substantially similar compositions having the same properties and, consequently, a POSITA would expect that Example 7 of Peuchert '293 has a liquidus viscosity that is greater than or equal to 100,000 poise. EX1003, ¶ 276.

Thus, all the limitations in Claim 1 are described in Peuchert '293, particularly Example 7. EX1003, ¶¶ 252-277.

2. Dependent Claim 2

Claim 2 depends from Claim 1 and requires that the SnO₂ content satisfy the relationship $\text{SnO}_2 \leq 0.15$. As noted above, Example 7 in Peuchert '293 has an SnO₂ content of 0.1 mol%. EX1003, ¶ 279. This value satisfies the requirements of Claim 2. EX1003, ¶ 279.

3. Dependent Claim 4

Claim 4 depends from Claim 1 and requires that the glass be substantially free of BaO. As noted above, Example 7 in Peuchert '293 has a BaO content of 0 mol%. EX1003, ¶ 281. This value meets the requirement of Claim 4. EX1003, ¶ 281.

4. Dependent Claim 9

Claim 9 depends from Claim 1 and recites that the process is a fusion process. Peuchert '293 discloses that “[t]he glasses can be produced as flat glasses by the various drawing methods, for example microsheet down-draw, up-draw or overflow

fusion method....” EX1010, ¶0064; EX1003, ¶ 286. Thus, Peuchert ‘293 describes a fusion process as required by Claim 9 of the ‘498 Patent. EX1003, ¶ 286.

XII. CONCLUSION

Petitioner respectfully requests that a trial be instituted. Claims 1-11 should be cancelled.

Respectfully Submitted,

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CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. §42.24(d), Petitioner certifies that this Petition includes 10,095 words, as measured by Microsoft Word®, exclusive of the table of contents, mandatory notices under §42.8, certificates of service, word count, and exhibits.

CERTIFICATE OF SERVICE (37 C.F.R. § 42.6(e)(1))

The undersigned hereby certifies that the above document was served on April 28, 2025, by filing this document through the Patent Trial and Appeal Board P-TACTS System, as well as delivering a copy via express mail upon the following attorneys of record for the Patent Owner and Petitioner:

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APPENDIX A – CLAIM LISTING

U.S. Patent No. 8,640,498

Claim or Element #	Claim Language
1[p]	A method for producing alkali-free glass sheets by a downdraw process comprising:
1[a]	(A) selecting, melting, and fining batch materials so that the glass making up the sheets comprises SiO ₂ , Al ₂ O ₃ , B ₂ O ₃ , MgO, and CaO, and, on an oxide basis, has:
1[b]	(i) a $\Sigma[\text{RO}]/[\text{Al}_2\text{O}_3]$ ratio greater than or equal to 1.0, where [Al ₂ O ₃] is the mole percent of Al ₂ O ₃ and $\Sigma[\text{RO}]$ is the sum of the mole percents of MgO, CaO, SrO, and BaO; and
1[c]	(B) producing the glass sheets from the melted and fined batch materials; wherein:
1[d]	(a) on an oxide basis, the glass making up the glass sheets comprises at most 0.005 mole percent As ₂ O ₃ ;
	(b) on an oxide basis, the glass making up the glass sheets comprises at most 0.005 mole percent Sb ₂ O ₃ ;

	(c) SnO_2 is used in the fining and the glass making up the glass sheets has an SnO_2 content which in mole percent on an oxide basis satisfies the relationship: $0.01 \leq \text{SnO}_2$; and
	(d) the glass making up the glass sheets has a liquidus viscosity that is greater than or equal to 100,000 poise.
2	The method of claim 1 wherein the glass making up the glass sheets has an SnO_2 content which in mole percent on an oxide basis satisfies the relationship: $\text{SnO}_2 \leq 0.15$.
3	The method of claim 1 wherein the MgO content is between 1.2 and 2.8 mole percent.
4	The method of claim 1 wherein the glass making up the glass sheets is substantially free of BaO.
5	The method of claim 1 wherein the glass making up the glass sheets has a density that is less than or equal to 2.41 grams/cm ³ .

6	The method of claim 1 wherein the glass making up the glass sheets has a linear coefficient of thermal expansion (CTE) over the temperature range 0-300° C which satisfies the relationship: $28 \times 10^{-7}/^{\circ} \text{C} \leq \text{CTE} \leq 34 \times 10^{-7}/^{\circ} \text{C}.$
7	The method of claim 1 wherein the glass making up the glass sheets has a liquidus temperature less than or equal to 1170° C.
8	The method of claim 1 wherein the glass making up the glass sheets has a strain point that is greater than or equal to 650° C.
9	The method of claim 1 wherein the downdraw process is a fusion process.
10	The method of claim 1 wherein a population of 50 sequential glass sheets produced by the downdraw process from the melted and fined batch materials has an average gaseous inclusion level of less than 0.05 gaseous inclusions/cubic centimeter, where each glass sheet in the population has a volume of at least 500 cubic centimeters.

11	The method of claim 1 wherein the glass making up the glass sheets has a liquidus viscosity that is greater than or equal to 200,000 poise.
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