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July 11, 2018

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APPLICATION NUMBER: 62/662,262
FILING DATE: *April 25, 2018*

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS US62/662,262



Certified by

Andres Ibarra

Under Secretary of Commerce
for Intellectual Property
and Director of the United States
Patent and Trademark Office

Provisional Application for Patent Cover Sheet

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c)

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All Inventors Must Be Listed – Additional Inventor Information blocks may be generated within this form by selecting the **Add** button.

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Title of Invention

Inorganic Paint for Low CTE Glass Substrates

Attorney Docket Number (if applicable)

1511.26500

Correspondence Address

Direct all correspondence to (select one):

☒ The address corresponding to Customer Number

☐ Firm or Individual Name

Customer Number

130961

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒ No.

Yes, the invention was made by an agency of the United States Government. The U.S. Government agency name is:

Yes, the invention was under a contract with an agency of the United States Government. The name of the U.S. Government agency and Government contract number are:

Entity Status

Applicant asserts small entity status under 37 CFR 1.27 or applicant certifies micro entity status under 37 CFR 1.29

- ☐ Applicant asserts small entity status under 37 CFR 1.27
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- ☒ No

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Signature

Please see 37 CFR 1.4(d) for the form of the signature.

Signature	Joseph L. Morales/		Date (YYYY-MM-DD)	2018-04-25
First Name	Joseph	Last Name	Morales	Registration Number (If appropriate)
				58835

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1511.26500
		Application Number	
Title of Invention	Inorganic Paint for Low CTE Glass Substrates		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

Secrecy Order 37 CFR 5.2

☐	Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)
--------------------------	---

Inventor Information:

Inventor	1				Remove
Legal Name					
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Residence Information (Select One) US Residency ● Non US Residency Active US Military Service					
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Postal Code		Country ⁱ	PE		

Inventor	3				Remove
Legal Name					

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1511.26500
		Application Number	
Title of Invention	Inorganic Paint for Low CTE Glass Substrates		

Prefix	Given Name	Middle Name	Family Name	Suffix
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Residence Information (Select One) US Residency ☒ Non US Residency Active US Military Service				
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All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button. Add				

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☐ An Address is being provided for the correspondence information of this application.			
Customer Number	130961		
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Application Information:

Title of the Invention	Inorganic Paint for Low CTE Glass Substrates		
Attorney Docket Number	1511.26500	Small Entity Status Claimed	☐
Application Type	Provisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)		Suggested Figure for Publication (if any)	

Filing By Reference :

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country ⁱ

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1511.26500
		Application Number	
Title of Invention	Inorganic Paint for Low CTE Glass Substrates		

Publication Information:

☐	Request Early Publication (Fee required at time of Request 37 CFR 1.219)
☐	Request Not to Publish. I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application has not and will not be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

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Prior Application Status		Remove
Application Number	Continuity Type	Prior Application Number
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Application Number	Country ⁱ	Filing Date (YYYY-MM-DD)	Remove
			Access Code ⁱ (if applicable)

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1511.26500
		Application Number	
Title of Invention	Inorganic Paint for Low CTE Glass Substrates		

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Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.

NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1511.26500
		Application Number	
Title of Invention	Inorganic Paint for Low CTE Glass Substrates		

Applicant	1	Remove
If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.		
Clear		
☒ Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.		Person who shows sufficient proprietary interest
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:		
Name of the Deceased or Legally Incapacitated Inventor :		
If the Applicant is an Organization check here. ☒		
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Email Address		
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1511.26500
		Application Number	
Title of Invention	Inorganic Paint for Low CTE Glass Substrates		

Prefix	Given Name	Middle Name	Family Name	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1				
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Signature:

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Signature	/Joseph L. Morales/		Date (YYYY-MM-DD)	2018-04-25
First Name	Joseph	Last Name	Morales	Registration Number
			58835	

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INORGANIC PAINTS FOR LOW CTE GLASS SUBSTRATES

Cross-References to Related Applications

None

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Abstract of the disclosure

The present invention discloses inorganic paints that comprises a Coefficient of Thermal Expansion (CTE) lower or equal to the glasses where the inorganic paint is being applied. The inorganic paint can be painted over any glass substrate, where the inorganic paint has a chemical formulation tailoring the CTE of the paint that does not significantly affect the stress profiles of the glass, does not generate fracture, and provides adequate aesthetic properties to the glass substrate. The inorganic paint comprises the same or lower CTE than the glaze. A glass including the inorganic paint of the invention is also described.

15 Inventors

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Field of the invention

This invention relates to the field of inorganic paints with a formulation that match the Coefficient of Thermal Expansion (CTE) of the glass substrate where the paint is applied.

20

Background of the invention

In response to the government regulatory requirements for increased automotive fuel economy, as well as the growing public awareness and demand for energy efficient

environmentally friendly products, automotive original equipment manufacturers, around the world, have been working to improve the energy efficiency of their vehicles.

One of the key elements of this strategy to improve efficiency has been the concept of
5 light weighting. Often, more traditional, less expensive, conventional materials and processes are being replaced by innovative new materials and processes which while sometimes being more expensive, still have higher utility than the materials and processes being replaced due to their lower weight and the corresponding increase in fuel efficiency. Sometimes, the new materials and processes bring with them added functionality as well
10 as lighter weight. Vehicle glazing has been no exception.

By reducing the weight of the vehicle, not only substantial improvements can be made in energy consumption, but additional challenges emerge in the mechanical properties point of view. This is especially important for electric vehicles where the reduction in weight
15 directly translates into an increase in the range of the vehicle which is a key consumer concern. However, when reducing weight in the windshield or roof glasses, mechanical and acoustic properties substantially decrease. For instance, the glass will break easily, or it would be difficult to reduce the noise outside the car.

20 Glass manufacturers are trying to change the mechanical conditions of the layers of laminate glasses, for instance, by using Borosilicate and or Boroaluminosilicates and or aluminosilicates glasses instead of Soda Lime glasses in automotive windshields. For example, borosilicate glasses can be 60 to 70% less in weight compared to a standard Soda-Lime glass with the same mechanical conditions. However, the problem nowadays
25 is the painting process during the fabrication of an automotive laminated glasses, since the glass has a Coefficient of Thermal Expansion (CTE) lower than the paint that is being used. Typically, the edges of automotive glasses are painted with glass frits or inorganic paints often referred as the black band, which serves both a functional and an aesthetic role. The substantially opaque black print on the glass serves to protect the poly-urethane
30 adhesive used to bond the glass to the vehicle from ultra-violet light and the degradation that it can cause. It also serves to hide the adhesive from view from the exterior of the vehicle.

Frits or paints available on the market usually have a CTE greater than that of the glass on which they are being painted on, that is the case for example of Borofloat glasses. When the glass is painted and then vitrified, due to the mismatch of CTE of the frit and the glass, both the glass and the frit are potentially weakened with different tension forces along the surface of the glass or frit, which then may be capable to breaking the glass laminates. The vitrification process consists of having a glass, painting the desired area with a frit, and then elevating the glass and paint temperature for a certain amount of time in order to obtain viscous flow and good adhesion of the frit to the glass.

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One approach of the prior art to solve this problem is to take ground glass of the same type of the glass that is going to be laminated, break that portion of glass, grind it and then form a composite paint. The ground glass in the frit may have a similar CTE of the glass substrate where the frit is going to be painted, however, the problem of doing this is that the temperature of vitrification of the frit will increase and will not allow the glass frit to flow, leaving a rough surface behind. Also, if the vitrification process gets too hot or too long, it will not yield the desired results and in fact most likely will produce a defects and poor adhesion. A wide variety of soda-lime based frits, with different properties, are available for the various applications, however, there is no available special glasses based frit compositions for low CTE glass substrates. This is especially true for thin (2 mm or less) specialty glass substrates.

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Accordingly, there is a need in the industry to develop a formulation of inorganic paints that have a lower CTE than existent frits that during the process create no surface tensions ending on breakings of the glass substrates where the paint is used. Specifically, there is the need to provide inorganic paints for glasses with low CTE.

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Brief summary of the invention

The present invention relates to inorganic paint compositions that overcome the CTE mismatch issue between the frit and the glass substrate. Specifically, the inorganic paint of the present invention comprises a Coefficient of Thermal Expansion (CTE) lower or equal to the glasses where the inorganic paint is being applied.

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The present invention also comprises a laminated glazing including the black band composition, which is sandwiched between a set of two additional sheets of interlayer plastic.

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Brief description of drawings

Figure 1	Cross section of a typical automotive laminate with black frit obscurations on surfaces number two and four.
Figure 2	Automotive laminate including the black band composition of the present invention

Reference numerals

2	Glass
4	Plastic Bonding Interlayer
6	Black Frit Obscuration
16	Opaque Plastic Interlayer
101	Surface one
102	Surface two
103	Surface three
104	Surface four
201	Outer glass layer
202	Inner glass layer

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Detailed description of the invention

The present invention is directed towards to an inorganic paint that has a Coefficient of Thermal Expansion (CTE) that matches the CTE of the glass substrate where the paint is being employed or is lower than the glass substrate.

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Generally, the inorganic paints or frits are comprised by a plurality of organic materials, such as pigments, carriers, binders and finely ground glass and fluxes. Other materials are also sometimes added to enhance certain properties: the firing temperate, anti-stick,

chemical resistance, etc. Each one of these materials add a correspondent multiplier to the CTE of the final paint, lowering or increasing the CTE of the inorganic paint.

5 The terminology used to describe the inorganic paint or frits composition will be exemplified using laminated glasses as an example. However, it should be noted that the following description can be also applied to any kind of glass on which an inorganic paint can be applied, as follows.

10 Black enamel paints or frit obscurations are commonly printed on laminated and/or tempered automotive glazing where they serve to hide the adhesive used to bond the glazing to the body and to protect the adhesive from exterior degradation generated, for instance, from ultraviolet light. However, frit has a number of drawbacks. The frit weakens the surface of the glass. It can create distortion in the glass due to thermal gradients. Printed frit obscurations are incompatible and cannot be used with many types
15 of coatings. Standard frit blocks ion exchange and so cannot be used with the chemical tempering process.

Obscurations have historically been black. One of the reasons for this comes from the limitations imposed by ceramic frits. It is difficult to produce frits, in colors other than
20 black, that have the durability needed and for which the color can be reliably replicated from run to run. The other reason is aesthetics and it is commonly called the “black band.” However, in the present invention as will be described, it should be understood that the inorganic paint can be of any color.

25 The black frit is applied to the glass using a silk screen or ink jet printing process prior to the heating and bending of the glass. As the flat glass is heated during the bending process, the powdered glass in the frit softens and melts, fusing to the surface of the glass. The frit becomes a permanent part of the glass. The frit is said to be “fired” when this takes place. This is a vitrification process which is very similar to the process used to
30 apply enamel finishes on bathroom fixtures, pottery and appliances.

The black frit interferes with the annealing process. Laminated glass, as required for windshields, must be annealed to meet safety requirements. Glass is annealed by heating the glass into the glass transition range to soften it, letting it soak for some period to allow any stress to be relieved, and then slowly cooling back down through the glass transition
5 range until the glass freezes. The ideal would be to have inorganic paints matching the CTE of the glass where it is going to be used. However, as stated before, the mismatch between the CTE of the laminated glass and the glass frit may result in residual stress in the laminate when the surfaces of the laminated glass are forced together during lamination.

10

Regarding the glass used for automotive applications, it should be noted that historically windows have been made from standard soda-lime glass, since this is the most common and economical formulation and accounts for a large percentage of the world's glass productions. Soda-lime glass is made from sodium carbonate (soda), calcium carbonate
15 (lime), silicon dioxide (silica), aluminum oxide (alumina), and small quantities of other substances added to alter the color and other properties. Other types of glass are known but have primarily been reserved for specialty applications. There they are used to provide for thinner and lighter glazing. While many types of paints are available for printing on soda-lime glass, to the best of our knowledge there is no inorganic paints for
20 non-soda lime glasses in the market today.

If a non-soda-lime glass is used, there is the need to find a compatible frit that matches the CTE of the non-soda-lime glass. Commonly soda-lime glasses use different methods for painting any of the layers of the laminate, for instance, a painted obscuration may be
25 printed and fired if needed in any face of the layers of the laminate. However, this cannot be done when the CTE of the frit does not match the CTE of the glazing.

In response to those needs, the present invention discloses inorganic paint compositions comprising the following formulation:

30

Ranges (wt%)	Oxide
Silicon oxides	8 to 50

Boron oxides	5 to 15
Bismuth oxides	0 to 45
Zinc oxides	0 to 20
Chrome oxides	10 to 40
Copper oxides	0 to 25
Iron oxides	0 to 5
Molybdenum oxides	0 to 1
Aluminum oxides	0 to 5
Tin oxides	0 to 5
Zirconium oxides	0 to 3
Sodium oxides	0 to 10
Total	100

The inorganic paint composition of the present invention may have additional metallic materials commonly found in inorganic paints. In embodiments where the composition is used as a frit over the surface of a laminated glass, the combination of the foregoing composition may result in a black band composition having a CTE lower or equal than the CTE of the laminated glass where the composition is applied. The formulation of the inorganic paint of the present invention lowers the CTE of the frit while maintains appropriate melting point of the frit during the vitrification process.

Using boron oxide in the composition, is advantageous since it has a negative CTE. That is, boron oxide contracts when heated, therefore helping the composition of the present invention to achieve a lower CTE than the glass substrate. The inorganic paint of the present invention may also comprise colorants in different ratios, for instance, the composition may include around 2-6% of a black colorant.

The resulting inorganic paints has a CTE between $30-65 \times 10^{-7}/^{\circ}\text{K}$, and a viscosity less or equal to 10^4 Poise at temperatures between 500 °C to 750 °C.

The claimed compositions melt at lower temperatures (i.e. lower glass melting point is achieved), achieves an adequate CTE (i.e. lower than the glass substrate or glaze) avoiding any significant tension on the glass.

5 A typical automotive laminate cross section is illustrated in Figure 1. The laminate is comprised of two layers of glass, the exterior or outer layer, 201 and interior or inner layer, 202 that are permanently bonded together by a plastic layer 4 (interlayer). The glass surface that is on the exterior of the vehicle is referred to as surface one 101 or the number one surface. The opposite face of the exterior glass layer 201 is surface two 102
10 or the number two surface. The surface of glass 2 that is in the interior of the vehicle is referred to as surface four 104 or the number four surface. The opposite face of the interior layer of glass 202 is surface three 103 or the number three surface. Surfaces two 102 and three 103 are bonded together by the plastic layer 4. An obscuration 6 may be also applied to the glass. Obscurations are commonly comprised of black enamel frit
15 printed on either the number two 102 or number four surface 104 or on both. The laminate may also comprise a coating 18 on one or more of the surfaces.

The types of glass 2 that may be used in either the exterior or interior glass layers include but are not limited to: the common soda-lime variety typical of automotive glazing as
20 well as aluminosilicates, lithium aluminosilicates, borosilicates, glass-ceramics, and the various other inorganic solid amorphous compositions which undergo a glass transition and are classified as glass included those that are not 100% transparent. These are generic families which can overlap, and which can be applied to a broad range of glass formulations. As an example, there is not a single specific formulation that comprises
25 aluminosilicate glass. Rather there are a broad range of glass formulation that can be classified as an aluminosilicate based upon containing aluminum compounds. Typical thickness used for the exterior and interior glass layers may range from 1 mm to 8 mm for the exterior glass layers and from 0.5 mm to 3 mm for the interior glass layers. However, it should be noted that the composition of the present invention may be used
30 over even lower ranges of glass thicknesses.

Usually in automotive glasses, annealed glass is used. Annealing is a process where the glass has been slowly cooled from the bending temperature down through the glass transition range. This process relieves any stress left in the glass from the bending process in a few minutes. Annealed glass breaks into large shards with sharp edges. When
5 laminated glass breaks, the shards of broken glass are held together, much like the pieces of a jigsaw puzzle, by the plastic layer helping to maintain the structural integrity of the glass. A vehicle with a broken windshield can still be operated. The plastic layer 4 also helps to prevent penetration by objects striking the laminate from the exterior and in the event of a crash occupant retention is improved.

10

The glass layers are formed using gravity bending, press bending, cold bending or any other conventional means known in the art. Gravity and press bending methods for forming glass are well known in the art and will not be discussed in the present disclosure.

15 Cold bending is a relatively new technology. As the name suggest, the glass is bent, while cold to its final shape, without the use of heat. On parts with minimal curvature a flat sheet of glass can be bent cold to the contour of the part. This is possible because as the thickness of glass decreases, the sheets become increasingly more flexible and can be bent without inducing stress levels high enough to significantly increase the long-term
20 probability of breakage. Thin sheets of annealed glass, in thicknesses of about 1 mm, can be bent to large radius cylindrical shapes (greater than 6 m). When the glass is chemically, or heat strengthened the glass can endure much higher levels of stress and can be bent along both major axis. The process is primarily used to bend chemically tempered thin glass sheets (≤ 1 mm) to shape.

25

Cylindrical shapes can be formed with a radius in one direction of less than 4 meters. Shapes with compound bend, that is curvature in the direction of both principle axis can be formed with a radius of curvature in each direction of as small as approximately 8 meters. Of course, much depends upon the surface area of the parts and the types and
30 thicknesses of the substrates.

The cold bent glass will remain in tension and tend to distort the shape of the bent layer that it is bonded to. Therefore, the bent layer must be compensated to offset the tension. For more complex shapes with a high level of curvature, the flat glass may need to be partially thermally bent prior to cold bending.

5

The glass to be cold bent is placed with a bent to shape layer and with a bonding layer placed between the glass to be cold bent and the bent glass layer. The assembly is placed in what is known as a vacuum bag or also on a ring that has a suction hose. The vacuum bag is an airtight set of plastic sheets, enclosing the assembly and bonded together at the edges, which allows for the air to be evacuated from the assembly and which also applies pressure on the assembly forcing the layers into contact. The assembly, in the evacuated vacuum bag, is then heated to seal the assembly. The assembly is next placed into an autoclave which heats the assembly and applies high pressure. This completes the cold bending process as the flat glass at this point has conformed to the shape of the bent layer and is permanently affixed. The cold bending process is very similar to a standard vacuum bag/autoclave process, well known in the art, except for having an unbent glass layer added to the stack of glass.

Heat strengthened, full temper soda lime float glass, with a compressive strength in the range of at least 70 MPa, can be used in all vehicle positions other than the windshield. Heat strengthened (tempered) glass has a layer of high compression on the outside surfaces of the glass, balanced by tension on the inside of the glass which is produced by the rapid cooling of the hot softened glass. When tempered glass breaks, the tension and compression are no longer in balance and the glass breaks into small beads with dull edges. Tempered glass is much stronger than annealed laminated glass. The lower thickness limits of the typical automotive heat strengthening process is about 3 mm. This is due to the rapid heat transfer that is required. It is not possible to achieve the high surface compression needed with thinner glass using the typical blower type low pressure air quenching systems.

30

Examples

The tests performed were carried out taking into account the following criteria to select the materials of the inorganic paint: i) that the paint has a CTE lower or equal than the CTE of the glass where the paint is going to be used; and ii) that the paint frits has a lower melting point than the glass substrate. It should be noted that the state of the art provides paintings with low melting point but this at the expense of having a frit with high CTE. The present invention discloses an inorganic paint that does not raises the CTE of the glass frit.

1. Example 1. Referring to the composition shown in Figure 1, a first example was carried out on a laminate windshield comprising a standard Borosilicate glass, 1.1 mm thick exterior glass layer 201 and a 0.7 mm thick Aluminosilicate interior glass layer 202. A sheet of 0,76 mm PVB interlayer 4 is placed between the exterior and interior glass layers. A black frit is printed on the number four surface 104 of the interior glass layer 202, comprising the following composition: 14% silicon dioxide, 10% boron oxide, 40% bismuth (III) oxide, 5% zinc (I) oxide, 14% chrome (III) oxide, 8% copper (II) oxide, 2% iron (III) oxide, 1% molybdenum (VI) oxide, 1% aluminum oxide, 4% tin oxide and 1% sodium oxide.

The tension stress was measured in fourteen different points along the surface of a curved laminated glaze where the frit was printed and vitrified. The results are shown in the table below, and were below the standard (≤ 8 MPa) for windshields:

Measured point	Tension stress measure [MPa]
1	1.6
2	0.9
3	1.6
4	3.7
5	5.2
6	0.0
7	0.0
8	0.9
9	3.5

10	1.8
11	1.1
12	4.4
13	0.3
14	1.3

The color properties of the frit (lightness value L) were also measured using the CLI Lab color measurement standard. The measured lightness of the glass frit was below 14 L .

5

2. Example 2. A second example consisted in a laminate windshield comprising a standard Borosilicate glass, 1.1 mm thick exterior glass layer 201 and a 0.5 mm thick Aluminosilicate interior glass layer 202. A sheet of 0,76 mm PVB interlayer 4 is placed between the exterior and interior glass layers. A black frit is printed on the number four surface 104 of the interior glass layer 202, comprising the following composition: 8% silicon dioxide, 10% boron oxide, 17% zinc (I) oxide, 34% chrome (III) oxide, 20% copper (II) oxide, 1% molybdenum (VI) oxide, 1% aluminum oxide, 3% zirconium (II) oxide, and 6% sodium oxide.

10

15

The tension stress was measured in fourteen different points along the surface of a curved laminated glaze where the frit was printed and vitrified. The results are shown in the table below, and were below the standard (≤ 8 MPa) for windshields:

Point	Stress measure [MPa]
1	1.6
2	4.1
3	1.1
4	1.9
5	3.4
6	6.7
7	1.7
8	1.9
9	4.3
10	1.6
11	1.3

12	4.4
13	5.3
14	1.2

The measured lightness of the glass frit of this example was also measured and was below 14 *L*.

- 5 3. Example 3. A third example consisted in a laminate windshield comprising a standard Borosilicate glass, 1.1 mm thick exterior glass layer 201 and a 0.5 mm thick Aluminosilicate interior glass layer 202. A sheet of 0,76 mm PVB interlayer 4 is placed between the exterior and interior glass layers. A black frit is printed on the number four surface 104 of the interior glass layer 202, comprising the
- 10 following composition: 36% silicon dioxide, 10% boron oxide, 7% bismuth (III) oxide, 28% chrome (III) oxide, 16% copper (II) oxide, and 3% aluminum oxide.

The tension stress was measured in fourteen different points along the surface of a curved laminated glaze where the frit was printed and vitrified. The results are

15 shown in the table below, and were below the standard (≤ 8 MPa) for windshields:

Point	Stress measure [MPa]
1	0.7
2	0.5
3	1.5
4	1.4
5	0.4
6	0.4
7	1.4
8	1.6
9	1.6
10	1.9
11	0.9
12	0.8
13	0.7
14	1.8

The measured lightness of the glass frit of this example was also measured and was below 14 *L*.

5 It must be understood that this invention is not limited to the embodiments described and illustrated above. A person skilled in the art will understand that numerous variations and/or modifications can be carried out that do not depart from the spirit of the invention, which is only defined by the following claims.

CLAIMS

1. An inorganic paint for glass substrates, comprising a Coefficient of Thermal Expansion (CTE) lower or equal than that of the glass substrate.
- 5 2. The inorganic paint according to Claim 1, further comprising boron, silicon, bismuth, zinc, chrome, copper, iron, molybdenum, aluminum, tin, zirconium, and sodium oxides.
- 10 3. The inorganic paint according to Claim 1, comprising 8-50% silicon oxides, 5-15% boron oxides, 0-45% bismuth oxides, 0-20% zinc oxides, 10-40% chrome oxides, 0-25% copper oxides, 0-5% iron oxides, 0-1% molybdenum oxides, 0-5% aluminum oxides, 0-5% tin oxides, 0-3% zirconium oxides, and 0-10% sodium oxides.
- 15 4. The inorganic paint of Claim 1, wherein the paint has a CTE between $30-70 \times 10^{-7}/^{\circ}\text{K}$.
5. The inorganic paint of Claim 1, wherein the paint has a CTE between $30-55 \times 10^{-7}/^{\circ}\text{K}$.
- 20 6. The inorganic paint of Claim 1, wherein the paint has a CTE between $30-45 \times 10^{-7}/^{\circ}\text{K}$.
7. The inorganic paint of Claim 1, wherein the paint has a viscosity less or equal to 10^4 Poise at temperatures between 500 °C to 750 °C.
- 25 8. A laminate glazing comprising:
 - a- an outer glass layer;
 - b- an inner glass layer;
 - 30 c- an intermediate plastic layer;
 - d- the inorganic paint of Claim 1;

wherein at least one of the outer or inner glass layers have a CTE between 30 to $70 \times 10^{-7}/^{\circ}\text{K}$.

9. The laminate of Claim 8, wherein the glass is from the family of Aluminosilicate,
5 Alkali aluminosilicate, Borosilicate, Boroaluminosilicate, Alkali
Boroaluminosilicate.
10. The laminate of Claim 8, wherein said laminate has a maximum tension of 8 MPa
and a minimum compression of -5 MPa.
- 10
11. The laminate of Claim 8, wherein the black band color is below 14 L.

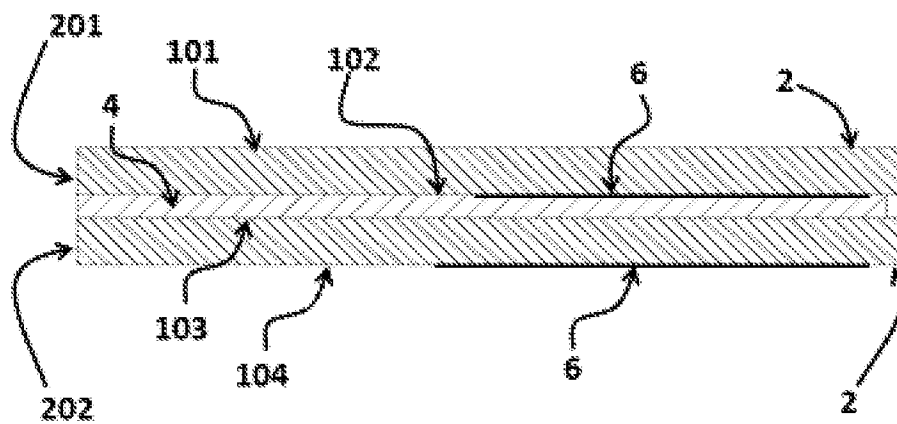


Fig. 1A

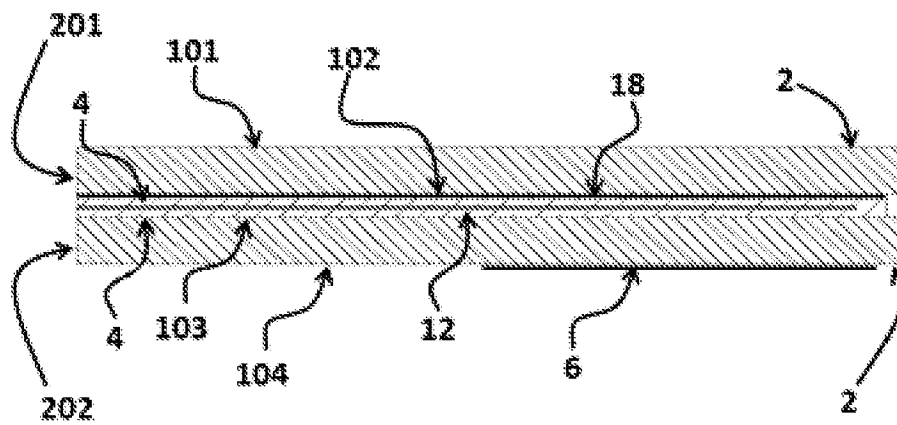


Fig. 1B

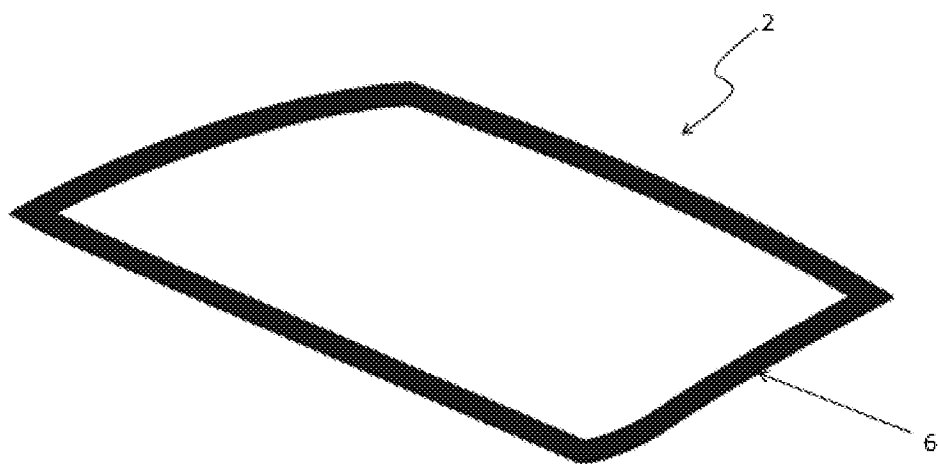


Figure 2

Electronic Acknowledgement Receipt

EFS ID:	32437280
Application Number:	62662262
International Application Number:	
Confirmation Number:	5468
Title of Invention:	Inorganic Paint for Low CTE Glass Substrates
First Named Inventor/Applicant Name:	Mario Arturo Mannheim Astete
Customer Number:	130961
Filer:	Joseph L. Morales
Filer Authorized By:	
Attorney Docket Number:	1511.26500
Receipt Date:	25-APR-2018
Filing Date:	
Time Stamp:	11:07:02
Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	\$280
RAM confirmation Number	042518INTEFSW11080000
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Provisional Cover Sheet (SB16)	15414.PDF	1477232	no	3
			4550c9d9f56869c02972aee94315237b93a dda34		
Warnings:					
Information:					
2	Application Data Sheet	15415.PDF	1819253	no	7
			8f6c355d87d041121d0c2ea1a33068c3185 84953		
Warnings:					
Information:					
3	Specification	15413.PDF	250141	no	18
			ba1350b254218ef055ca2d1ad9b6d46bca2 3a5ab		
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	29906	no	2
			39edc333e0cd047d10d9000a0790ce84b1c c0aaa		
Warnings:					
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Total Files Size (in bytes):			3576532		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

ASSIGNMENT

CESION

**MARIO ARTURO MANNHEIM ASTETE
IVAN ARTURO CORNEJO
MAURICIO FERNANDO CORNEJO POL**

by means of this document assign(s) worldwide,
to

por medio de la presente cedo(cedemos) a
nivel mundial, a

AGP AMERICA S.A.

A company
organized under the laws of

una compañía
organizada bajo las leyes de

REPUBLICA DE PANAMA

Domiciled in

domiciliada en

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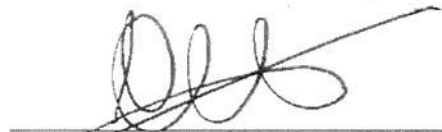
(hereinafter referred to as the "ASSIGNEE").

(de ahora en adelante el
"CESIONARIO").

all my (our) rights, including those of priority,
title and interest in and to my (our) invention for
a new and useful improvement entitled and as
fully set forth and described in:

todos mis (nuestros) derechos, incluyendo
los de prioridad, título e interés sobre mi
(nuestra) invención tal como describe en:

PINTURAS INORGÁNICAS PARA SUSTRATOS DE VIDRIOS CON BAJO CTE



Place, date and signature
Mario Arturo MANNHEIM ASTETE

17. 01. 2018

Lugar, fecha y firma

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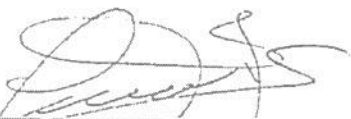
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Abogados - Attorneys



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Place, date and signature

Mauricio Fernando CORNEJO POL

Lima, Perú 12/01/2018

Lugar, fecha y firma

Lima, Perú 17/01/2018

Lugar, fecha y firma

Señores

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

DIRECCIÓN DE NUEVAS CREACIONES

E. _____ S. _____ D. _____

Re: Expediente No. NC2018/0006372

**Solicitud de Patente de Invención Titulada: “PINTURAS INORGÁNICAS
PARA SUSTRATOS DE VIDRIOS CON BAJO CTE”**

Solicitante: AGP AMERICA S.A.

Nuestra Ref.: P2018/000114

RESPUESTA AL OFICIO No. 7795, NOTIFICADO EL DÍA 25 DE JUNIO DE 2018
(EXAMEN DE FORMA)

CARLOS R. OLARTE, mayor de edad y vecino de Bogotá, identificado tal como aparece al pie de mi firma, en mi carácter de apoderado de la sociedad solicitante, me permito manifestar lo siguiente ante el auto emanado por ese Despacho, dentro del plazo legal previsto en el artículo 39 de la Decisión 486 en los siguientes términos:

1. a- El Examinador solicita allegar el documento de cesión de derechos de los inventores al solicitante.
- b- Me permito adjuntar al presente memorial la respectiva copia del documento de cesión.

2. a- El Examinador señala que se debe presentar dentro de los nueve meses siguientes contados a partir de la fecha de presentación de la solicitud, la copia certificada de la prioridad.

b- Considero superada la anterior objeción en tanto que se adjunta al presente escrito la copia de prioridad.

3. Por lo anterior, considero que la objeción presentada por la Examinadora en su examen de forma ha sido resuelta y por consiguiente solicito respetuosamente que el Despacho tenga por cumplidos los requisitos de forma y proceda con la publicación de la solicitud de acuerdo con el artículo 40 de la Decisión 486.

Atentamente,



CARLOS R. OLARTE

C.C. No. 79.782.747 de Bogotá

T.P. 74.295

Anexos:

- Copia documento de cesión;
- Copia del documento de prioridad.