

## (51) International Patent Classification:

C03C 3/093 (2006.01) C03C 21/00 (2006.01)

C03C 3/097 (2006.01) C03C 23/00 (2006.01)

## (21) International Application Number:

PCT/US2019/021274

## (22) International Filing Date:

08 March 2019 (08.03.2019)

## (25) Filing Language:

English

## (26) Publication Language:

English

## (30) Priority Data:

62/640,792 09 March 2018 (09.03.2018) US

62/800,629 04 February 2019 (04.02.2019) US

## (71) Applicant: CORNING INCORPORATED [US/US]; 1 Riverfront Plaza, Corning, New York 14831 (US).

(72) Inventors: AMIN, Jaymin; 234 Upper Delevan Avenue, Corning, New York 14830 (US). DEJNEKA, Matthew John; 2385 Ellison Road, Corning, New York 14830 (US). JIN, Yuhui; 57 Katie Lane, Painted Post, New York 14870 (US). MANLEY, Robert George; 29 West Hill Road, Vestal, New York 13850 (US). MIS, Jonathan Michael; 206 Bowers Drive, Horseheads, New York 14845 (US). ORAM, Pascale; 13 Shether Street, Hammondsport, New York 14840 (US). SCHNEIDER, Vitor Marino; 6 Timber Lane, Painted Post, New York 14870 (US). SMITH, Charlene Marie; 222 Watauga Avenue, Corning, New York 14830 (US). SUN, Wei; 121 Fieldview Drive, Painted Post, New York 14870 (US). WALCZAK, Wanda Janina; 2730 County Line Drive, Big Flats, New York 14814

(US). ZHANG, Liying; 7 Tara Place, Painted Post, New York 14870 (US).

(74) Agent: SCHAEBERLE, Timothy M; Corning Incorporated, Intellectual Property Department, SP-TI-3-1, Corning, New York 14831 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

## Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

## (54) Title: METHOD FOR MINIMIZING DENT DEFECTS IN CHEMICALLY STRENGTHENED GLASS

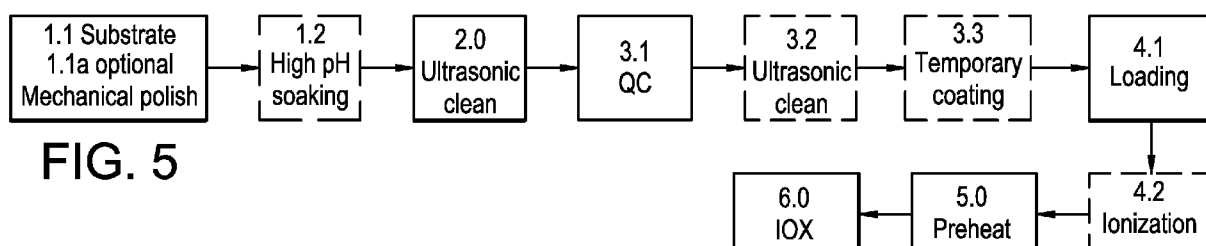


FIG. 5

(57) Abstract: Methods of manufacturing a glass-based article comprise: after mechanical polishing of a glass-based substrate, treating at least one surface of the glass-based substrate for protection of the at least one surface from contamination and/or for removal of contaminants from the at least one surface by a treatment other than ultrasonic cleaning; and exposing the glass-based substrate to an ion exchange treatment after the treating step to form the glass-based article. The treating step includes: exposing the at least one surface to a high pH soaking for removal of contaminants; deionizing the at least one surface for removal of contaminants; and/or applying a temporary coating to the at least one surface for protection of the at least one surface from contamination, and removing the temporary coating prior to the ion exchange treatment step. The ion exchange treatment may comprise a molten salt bath having an increased pH and temperature.

**(88) Date of publication of the international search report:**  
10 October 2019 (10.10.2019)

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2019/021274

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> INV. C03C3/093 C03C3/097 C03C21/00 C03C23/00 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) C03C		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/194974 A1 (WEBER DOUGLAS [US] ET AL) 2 August 2012 (2012-08-02) paragraphs [0004] - [0009], [0097] - [0123]; claims 1-30; figures -----	1,2
X	US 2017/313620 A1 (KASHIMA IZURU [JP] ET AL) 2 November 2017 (2017-11-02) paragraphs [0008] - [0011], [0117] - [0168]; claims 1-6; figures; example 6 -----	1-6
X	JP 2002 237030 A (NIPPON SHEET GLASS CO LTD) 23 August 2002 (2002-08-23) claims 1-9; figure 2; examples -----	1-3,7,8
X	US 2012/135153 A1 (OSAKABE KINOBU [JP] ET AL) 31 May 2012 (2012-05-31) paragraphs [0153], [0154] ----- -/--	1-3,7,8
<div style="display: flex; justify-content: space-between;"> <span><input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C.</span> <span><input checked="" type="checkbox"/> See patent family annex.</span> </div>		
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>* Special categories of cited documents :</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p> </div> </div>		
Date of the actual completion of the international search  <div style="text-align: center; font-size: 1.2em;">11 July 2019</div>		Date of mailing of the international search report  <div style="text-align: center; font-size: 1.2em;">12/09/2019</div>
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer  <div style="text-align: center; font-size: 1.2em;">Wrba, Jürgen</div>

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2019/021274

### Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

### Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-10

#### Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-10

A method of manufacturing a glass-based article comprising: treating at least one surface of a glass-based substrate for protection of the at least one surface from contamination and/or for removal of contaminants from the at least one surface by a treatment other than ultrasonic cleaning; and exposing the glass-based substrate to an ion exchange treatment after the treating step to form the glass-based article.

---

2. claims: 11-14

A method of manufacturing a glass-based article comprising: obtaining a glass-based substrate having finished edges; ultrasonic cleaning of the glass-based substrate to form a cleaned substrate; quality control inspecting of the cleaned substrate; loading the cleaned substrate; preheating the cleaned substrate; and ion exchange treating the cleaned substrate, wherein the improvement comprises: before the ultrasonic cleaning, exposing the at least one surface to a high pH soaking for removal of contaminants; after the loading and before the preheating, ionizing the at least one surface for removal of contaminants; and/or after the ultrasonic cleaning and before the loading, applying a temporary coating to the at least one surface for protection of the at least one surface from contamination, and removing the temporary coating by heating prior to the ion exchange treating step.

---

3. claims: 15-19

A method of manufacturing a glass-based article comprising: exposing at least one surface of a glass-based substrate to a high pH soaking for removal of contaminants; exposing the glass-based substrate to at least one additional finishing step; and exposing the glass-based substrate to an ion exchange treatment to form the glass-based article.

---

4. claims: 20-35

A method of manufacturing a glass-based article comprising: applying a temporary coating to at least one surface of a glass-based substrate to protect the at least one surface from contamination; exposing the glass-based substrate to at least one additional finishing step; heating the glass-based substrate to remove the temporary coating; and after the temporary coating is removed, exposing the glass-based substrate to an ion exchange treatment to form the

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

glass-based article.

---

5. claims: 36-49

A method of manufacturing a glass-based article comprising:  
ionizing a glass-based substrate to form an ionized  
glass-based substrate; heating the ionized glass-based  
substrate to form a heated, ionized glass-based substrate;  
and exposing the heated, ionized glass-based substrate to an  
ion exchange treatment to form the glass-based article.

---

6. claims: 50-52

A method of manufacturing a glass-based article comprising:  
heating a glass-based substrate; and exposing the  
glass-based substrate to an ion exchange treatment  
comprising self-cleaning conditions to form the glass-based  
article.

---

7. claims: 53-55

A method of reducing birefringence defects during  
manufacturing a glass-based article comprising: removing  
contaminants on at least one surface of a glass-based  
substrate by: exposing the at least one surface to a high pH  
soaking for removal of contaminants; and/or ionizing the at  
least one surface for removal of contaminants; and exposing  
the glass-based substrate to an ion exchange treatment to  
form the glass-based article.

---

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2019/021274

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011/056244 A1 (WENG CHIEN-MIN [TW] ET AL) 10 March 2011 (2011-03-10) claims 1-15 -----	1-3,9
X	US 2015/175478 A1 (RAVICHANDRAN VASUDHA [US] ET AL) 25 June 2015 (2015-06-25) paragraphs [0063] - [0066]; claims 1-14; examples 1-4 -----	1-3,10

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2019/021274

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2012194974 A1	02-08-2012	AU 2011212982 A1 BR 112012019306 A2 CN 102791646 A EP 2531459 A2 JP 5863674 B2 JP 2013518800 A JP 2016013963 A KR 20120128657 A US 2012194974 A1 WO 2011097314 A2	23-08-2012 08-05-2018 21-11-2012 12-12-2012 17-02-2016 23-05-2013 28-01-2016 27-11-2012 02-08-2012 11-08-2011
US 2017313620 A1	02-11-2017	CN 107207333 A DE 112016000397 T5 JP WO2016117476 A1 TW 201630840 A US 2017313620 A1 WO 2016117476 A1	26-09-2017 26-10-2017 26-10-2017 01-09-2016 02-11-2017 28-07-2016
JP 2002237030 A	23-08-2002	NONE	
US 2012135153 A1	31-05-2012	CN 101689376 A CN 102290056 A MY 167819 A SG 178005 A1 US 2010190038 A1 US 2012135153 A1	31-03-2010 21-12-2011 26-09-2018 28-02-2012 29-07-2010 31-05-2012
US 2011056244 A1	10-03-2011	TW 201109285 A US 2011056244 A1	16-03-2011 10-03-2011
US 2015175478 A1	25-06-2015	CN 104661976 A US 2015175478 A1 WO 2014012003 A2	27-05-2015 25-06-2015 16-01-2014