



**CONSTGLASS**



Table of results



## 1- Pilot Object

**Pilot object:**

*The Typological Passion*, CHARTRES  
Bay 37, panel 16

**Picture**



### **Identification of the panel:**

Bay: 37  
Panel: 16  
Internal face, transmitted light  
Internal face, reflected light

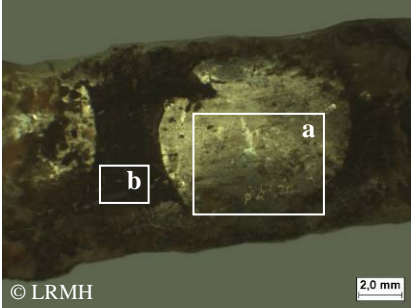

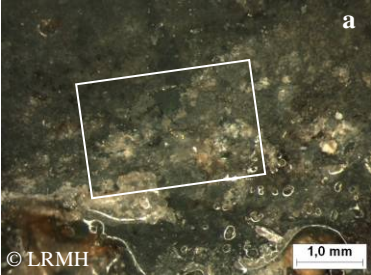
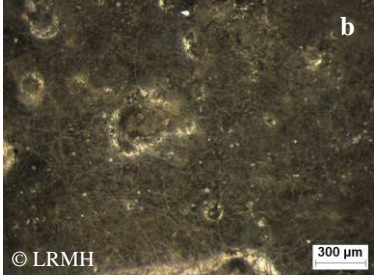
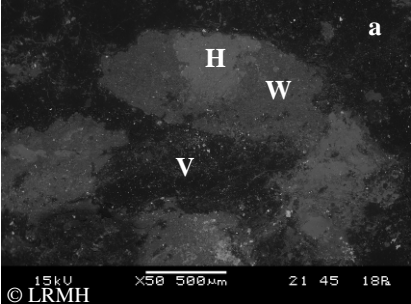
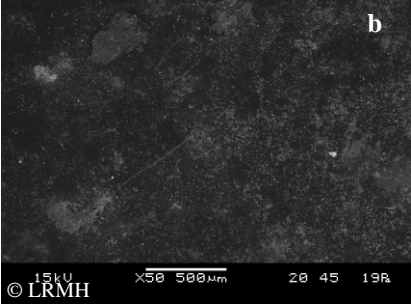
### **Treatment:**

- 1988, by Alliou studio.
- Product: polyurethane resin (80% Viacryl® SM564 + 20% Desmodur® N75).
- Application: with a soft brush after cleaning.

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## 2-Results

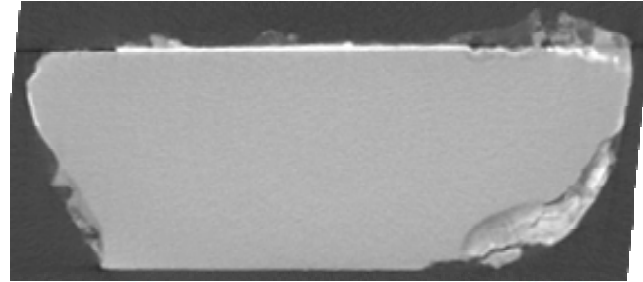
**Sample reference:** *CHA\_b37p16\_I\_v2 : white glass, coated on internal surface (consolidation)*

Questions	Techniques	Answers
<p><b>Morphology</b></p> <ul style="list-style-type: none"> <li>- <i>What is the morphology of the weathered coating?</i></li> <li>- <i>How is the bonding between coating and glass?</i></li> </ul>   <p>© LRMH</p> <p><i>White rectangles locate the optical microscope observations</i></p>	<p><b>Optical Microscope</b></p>	<p>No visible deterioration except scratches (provenance unknown), no macro-cracks, no yellowing or milky aspect.</p> <p>But, with a higher magnification, micro-cracks are visible.</p> <p><i>White rectangle locates the area of SEM observations.</i></p>   <p>© LRMH</p> <p>a - scratch on the Viacryl®, and apparition of glass b - micro-cracks on the coating</p>
	<p><b>SEM</b></p>	<p>The SEM confirms the microscope observations. There is no macro-cracks (b), except the scratch (a).</p>   <p>© LRMH</p> <p>a - detail of the scratch: healthy (H) and weathered (W) glass appearing under damaged Viacryl® (V).</p> <p>b - micro-cracks on the coating, with gypsum inside (and on the surface of Viacryl®).</p>








**Desktop tomography**

Slice of the piece of glass with Viacryl® coating on the grisaille, and remains of putty.



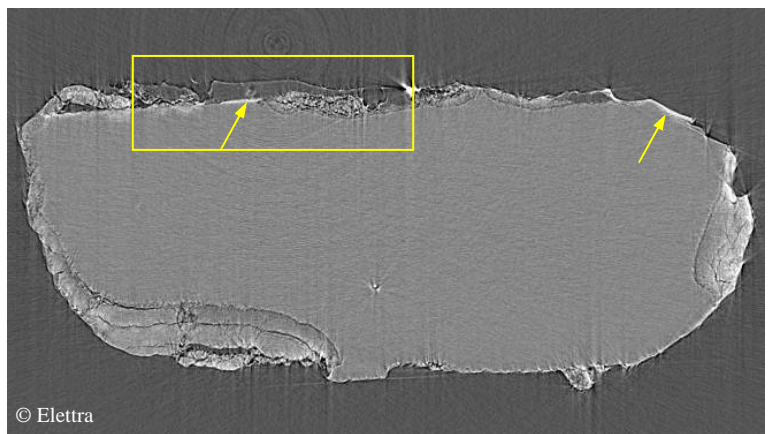
© UGhent

-  Homogeneous glass (healthy)
-  Glass with porous structure (silica gel layer)
-  Grisaille
-  Putty
-  Viacryl coating

Application of Viacryl® is not smooth, its thickness is varying.

**Phase-contrast tomography on Synchrotron**

Other slice of the piece of glass (dense grey) with some grisaille (arrows), the rectangle locates the detailed view below.



© Elettra



# CONSTGLASS






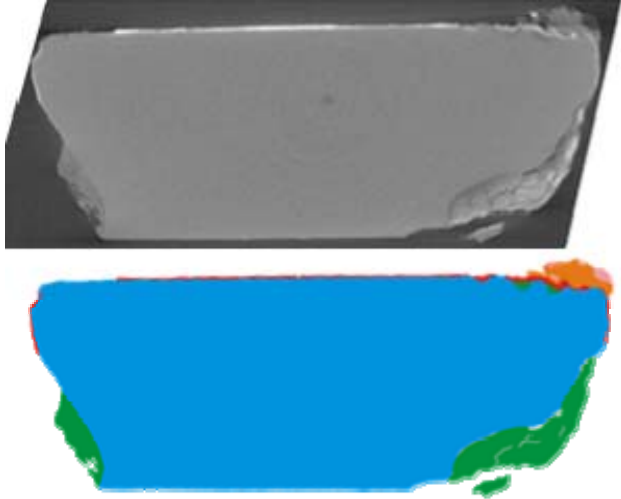
## Table of results



		<p>Detail of the slice with artificial colouring:</p> <p>© Elettra</p> <ul style="list-style-type: none"> <li><span style="color: blue;">■</span> Homogeneous glass (healthy)</li> <li><span style="color: darkblue;">■</span> Glass with porous structure (silica gel layer)</li> <li><span style="color: yellow;">■</span> Viacryl® coating</li> </ul> <p>The Viacryl® takes the shape of the glass surface, whether it is altered or not. The thickness of the film varies. A gap is observed, may be due to one of the scratches. When it is well preserved, the adhesion is conserved.</p>
<p><b>Chemical Composition</b> - What is the chemical composition of the alteration products?</p>	<p><b>SEM/EDX</b></p>	<p>Calcium sulphate neo-crystallisations (gypsum)</p>
<p><b>Organic component composition</b></p>	<p><b>FTIR</b> <b>RAMAN</b></p>	<p>See sample v9</p>
<p><b>Microbiology</b></p>	<p><b>Molecular biology</b> <b>ATP measurements</b></p>	<p>Not foreseen in this case, see sample "microbiology tests" at the end of this data sheet.</p>
<p><b>Reversibility</b></p>	<p><b>Test studies</b> <b>Elimination</b></p>	<p>A first application of 2 hours was made with a poultice of Methyleneketone (MEK), but nothing changed. The cleaning was finally made with ethanol poultices, with several applications during 6hours.</p>
<p><b>Re-treatability</b></p>	<p><b>Test studies</b> <b>Re-treatability</b></p>	<p>Then, the piece has been coated with ORMOCER® (ORM-G : EE / ET (2:1) 1 : 4): with a brush, 4 times in a week, drying in climabox 67%RH.</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Before cleaning</p> </div> <div style="text-align: center;"> <p>After re-treatment</p> </div> </div>

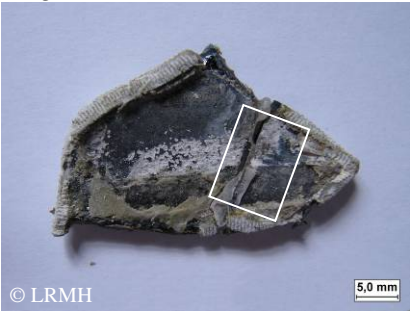
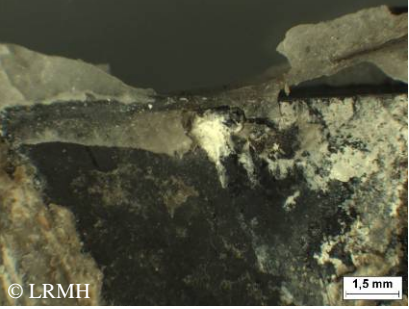
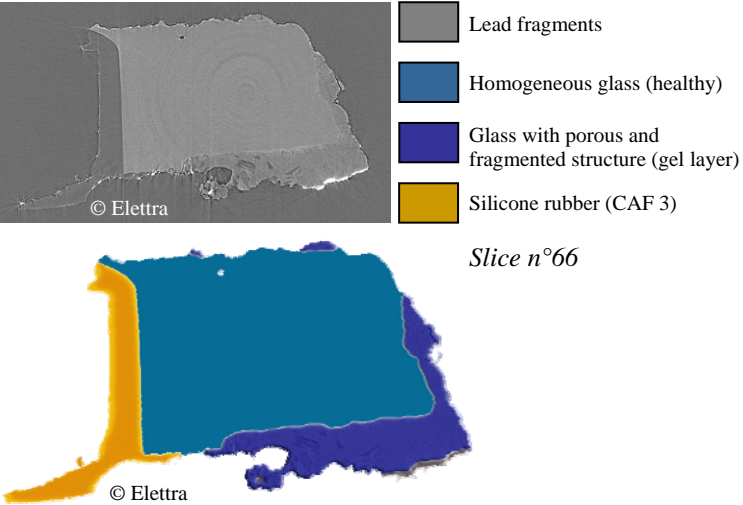


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<h3>Re-treatability</h3>	<p>The tomography was performed on the re-treated piece, in the same area as much as possible, in order to compare before and after the manipulations, to see possible damages and to indicate the effectiveness of the re-treatment.</p> <p>Before cleaning: <i>see Desktop tomography above</i></p> <p>After cleaning and re-treatment:</p>
<p>Caption:</p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: blue; border: 1px solid black; margin-right: 5px;"></span> Homogeneous glass (healthy)</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: green; border: 1px solid black; margin-right: 5px;"></span> Glass with porous structure (silica gel layer)</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: red; border: 1px solid black; margin-right: 5px;"></span> Grisaille</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: orange; border: 1px solid black; margin-right: 5px;"></span> Putty</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: pink; border: 1px solid black; margin-right: 5px;"></span> Viacryl® coating</li> </ul>	 <p style="text-align: center;">© UGhent</p>
<p>Observation with tomography allows to see the efficiency of the cleaning: no Viacryl® polymer remains (except on the putty) and the grisaille seems not to be damaged. But this technique did not give information about the re-treatment: the layers of ORMOCER® are very thin, because of the dilution of the polymer for the application.</p>	

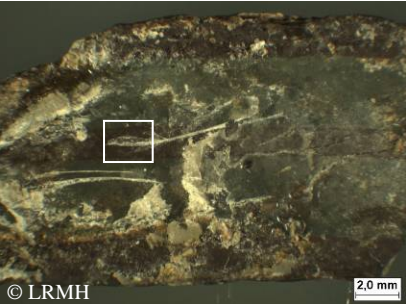


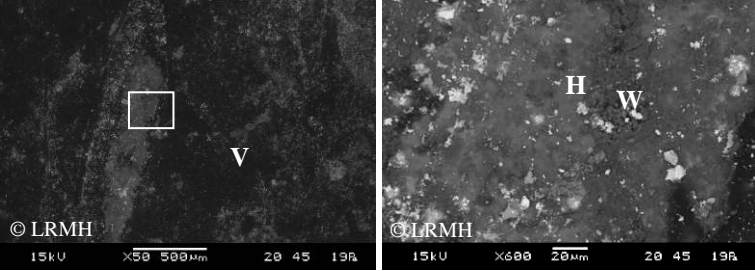
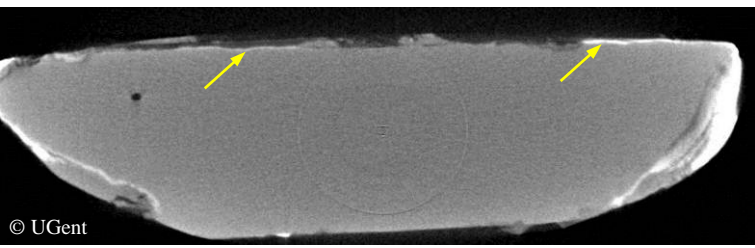
	<h1>CONSTGLASS</h1>	
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**Sample reference:** *CHA\_b37p16\_I\_v4 : blue glass, with silicone bonding*



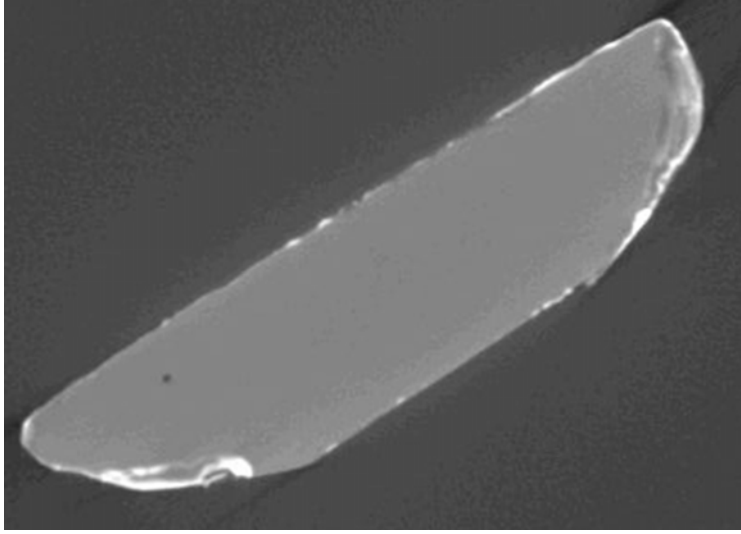
Questions	Techniques	Answers
<p><b>Morphology</b></p> <ul style="list-style-type: none"> <li>- What is the morphology of the weathered coating?</li> <li>- How is the bonding between coating and glass?</li> </ul>  <p>© LRMH</p>	<p><b>Optical Microscope</b></p>  <p>© LRMH</p>	<p>No visible deterioration, no macro-cracks, no yellowing or milky aspect, still smooth.</p> <p>There is a rest of bonding between silicone and the edge of the glass piece.</p> <p><i>White rectangle locates the area of tomography slices.</i></p>
	<p><b>SEM</b></p>	<p>This technique doesn't give answers about morphology or bonding.</p>
	<p><b>Desktop tomography</b></p>	<p><i>Not foreseen</i></p>
	<p><b>Phase-contrast tomography on Synchrotron</b></p>	 <p>© Elettra</p> <p><i>Slice n°66</i></p> <p>© Elettra</p> <p>The Silicone takes the shape of the glass surface. The adherence is good with the edges of the glass.</p>
<p><b>Chemical Composition</b></p>	<p><b>SEM/EDX</b></p>	<p><i>Not possible between silicone and glass</i></p>
<p><b>Organic component composition</b></p> <ul style="list-style-type: none"> <li>- What is its chemical evolution?</li> </ul>	<p><b>FTIR</b></p>	<p><i>Not foreseen</i></p>
	<p><b>RAMAN</b></p>	<p><i>Not foreseen</i></p>
<p><b>Microbiology</b></p>	<p><b>Molecular biology ATP measurements</b></p>	<p><i>Not foreseen in this case, see sample "microbiology tests" at the end of this data sheet.</i></p>
<p><b>Reversibility</b></p>	<p><b>Test studies Elimination</b></p>	<p>Mechanical removal is possible without any tool. A scouring on the edges of the glass is necessary to remove little leftovers.</p>
<p><b>Re-treatability</b></p>	<p><b>Test studies Re-treatability</b></p>	<p>Made with silicone without acetic acid (Silirub N05 neutral, Soudal)</p>

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<h2>Table of results</h2>		

**Sample reference:** *CHA\_b37p16\_I\_v6 : white glass, coated on internal surface (consolidation)*

Questions	Techniques	Answers
<p><b>Morphology</b></p> <ul style="list-style-type: none"> <li>- What is the morphology of the weathered coating?</li> <li>- How is the bonding between coating and glass?</li> </ul>   <p>© LRMH 2,0 mm</p> <p>© LRMH 2,0 mm</p> <p><i>White rectangle locates the area of microscope observations.</i></p>	<p><b>Optical Microscope</b></p> <p><b>SEM</b></p> <p><b>Desktop tomography</b></p> <p><b>Phase-contrast tomography on Synchrotron</b></p>	<p>No visible deterioration except scratches (provenance unknown), no macro-cracks, no yellowing or milky aspect.</p> <p>The scratches on the Viacryl® expose the glass paint to environment. Did the scratches damage the grisaille?</p> <p><i>White rectangle locates the area of SEM observations.</i></p>   <p>© LRMH 1,0 mm</p> <p>© LRMH 15kV x50 500µm 20 45 19R</p> <p>© LRMH 15kV x600 20µm 20 45 19R</p> <p>Details of a scratch: healthy (H) and weathered (W) glass paint appear under damaged Viacryl® (V).</p> <p>Slice of the piece of glass (dense grey) with Viacryl® film (darker layer) coated on the grisaille (arrows):</p>  <p>© UGent</p> <p>The adherence of the film seems to be still good, either on glass, or on grisaille, or on putty.</p> <p><i>Not foreseen in this case</i></p>
<p><b>Chemical Composition</b></p> <ul style="list-style-type: none"> <li>- What is the chemical composition of the alteration products?</li> </ul>	<p><b>SEM/EDX</b></p>	<p>Altered glass (gel layer)</p> <p>Calcium sulphate neo-crystallisations (gypsum)</p>
<p><b>Organic component composition</b></p> <ul style="list-style-type: none"> <li>- What is its chemical evolution?</li> </ul>	<p><b>FTIR</b></p> <p><b>RAMAN</b></p>	<p><i>See sample v9</i></p>


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<b>Microbiology</b>	<b>Molecular biology ATP measurements</b>	<i>Not foreseen in this case, see sample "microbiology tests" at the end of this data sheet.</i>
<b>Reversibility</b>	<b>Test studies Elimination</b>	<p>A first application of 2 hours was made with a poultice of Methylketone (MEK), but nothing changed. The cleaning was finally made with ethanol poultices, with several applications during 6hours.</p> <p>Then, the piece has been coated with Paraloid® B72 (doping : B72 5% : EE/Toluol 95%, 20% Sartomer 349).</p>  <p style="text-align: right;">Before cleaning</p>
<b>Re-treatability</b>	<b>Test studies Re-treatability</b>	 <p style="text-align: right;">After re-treatment</p> <p>As on the sample v2, desktop tomography did not provide information on the re-treatment. A doping of Paraloid® was tried in order to see it on the sample, but then it is hard to distinguish the polymer from the grisaille.</p> 



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	<h2>Table of results</h2>	

<b>Sample reference</b>	<i>Microbiology tests</i>
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Questions	Techniques	Answers
<p><b>Microbiology</b></p> <p><i>-Is there a biological contamination?</i>  <i>-Is there an active infestation?</i></p> <div style="text-align: center;">  </div>	<p><b>Molecular biology ATP measurements</b>  (Microscopical analysis, metabolic activity and taxonomical description of microorganism)</p>	<p>Treatment with VIACRYL® (coarse application, in storage):</p> <ul style="list-style-type: none"> <li>- slight accumulation of dust and dirt, no visible fungal infestation</li> <li>- low metabolic activity (ATP 159 RLU/25 cm<sup>2</sup>)</li> <li>- isolated microorganisms: none</li> </ul> <p>Conclusion: No problem, no contamination</p>

**Conclusion:** Regarding Viacryl®, the consolidation was systematic and most of the pieces are coated on internal surface (rather than a punctual consolidation). The polymer is well preserved: no yellowing, no milky aspect, no macro-cracks (micro-cracks on some pieces), no flaking, good adherence with the support. The only weak glass paints are those found under some scratches: the weathered and the healthy paint are bore.

The re-treatability of Viacryl® is hard because of the glass paint under it and the good state of preservation of the film. Nevertheless, ethanol gel (or poultice) is the best products to remove the polymer. The re-treatments with ORMOCER® or PARALOID® are both satisfactory.

Regarding Silicone rubber, the bonding is still effective until the unstopping of the piece. Removing the polymer is easy, and the re-treatments with neutral silicone or epoxy rubbers are possible.