

Hazing on display case glass: a review and progress on prevention

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Museum of London

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ClickNetherfield



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Outline

Nature of glass hazing

Overview of occurrence and observations

Analytical work carried out by MOL

Analytical work by others

Nature of glass used in museums: laminated glass, toughened glass, plate glass

Cleaning: initial work

a)



b)



Clean
surface

Hazed
surface

Medieval Gallery case,
Museum of London
Installed 2005





10. Writing block and supports
The figures of birds suggest that these objects were used to hold manuscripts steady.

11. Horn book (1500)
A sheet of horn or wood with a sheet of parchment, this one has a leather protector on which a tablet of parchment on which a syllable, letters of the alphabet and numbers were inscribed. Children carried them to jog their memories.

12. Writing materials
Professional scribes, merchants and clerks who travelled in the course of their work carried their own pens in a leather pen case, and a portable inkhorn which could be slung around the neck or from a girdle. Deep blue-black ink was made by mixing oak gall tannin with iron salts and gum arabic.

13. Writing tablets, styl and leather case
Tablets of wax or wood with wax-filled compartments were used as handy notebooks for the jottings of the day. Notes were scratched into the wax with a bone or metal stylus. The tablets were carried in leather travelling cases.

14. Oxen shell pointers
Illustrations and writing





Horniman Museum and Gardens



Royal Ontario Museum, Toronto



Glass sucker marks



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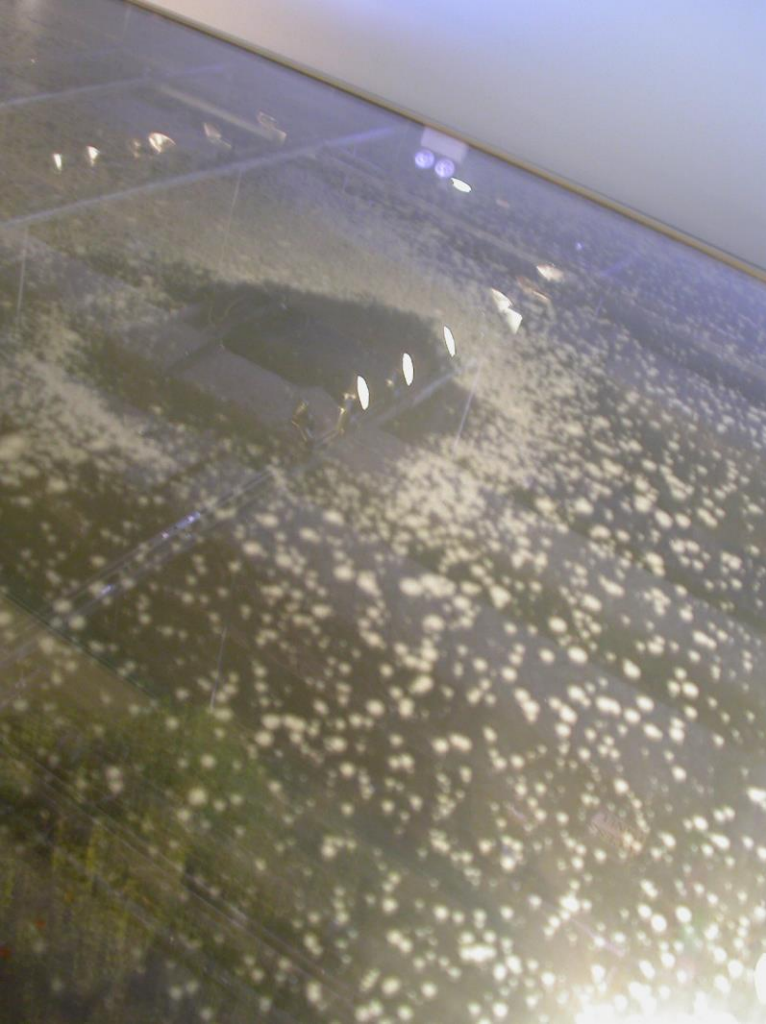
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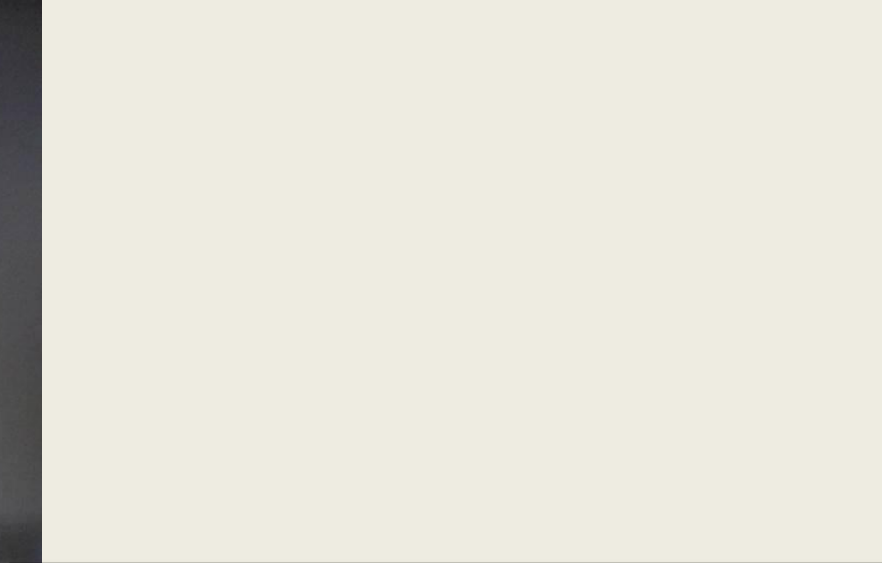
Prehistoric gallery, Museum of London,
Installed 2003



Museum of London



Royal Ontario
Museum,
Toronto



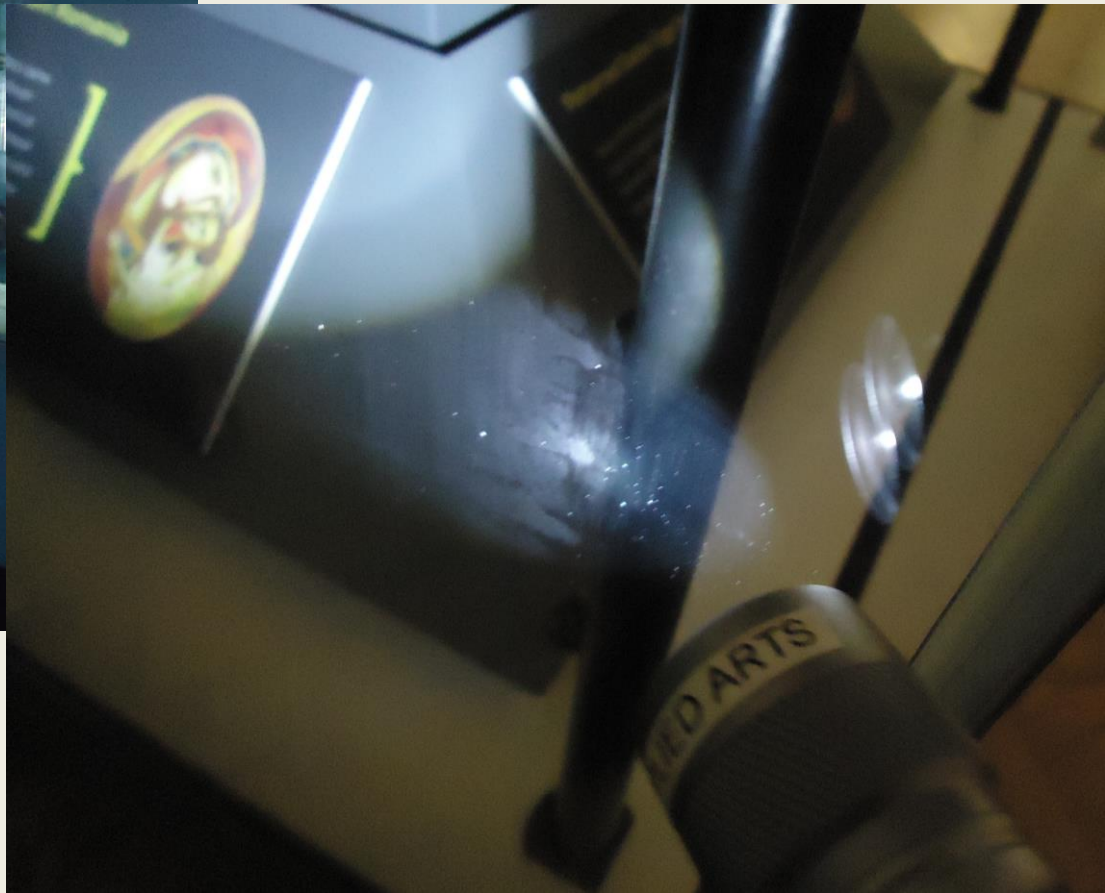
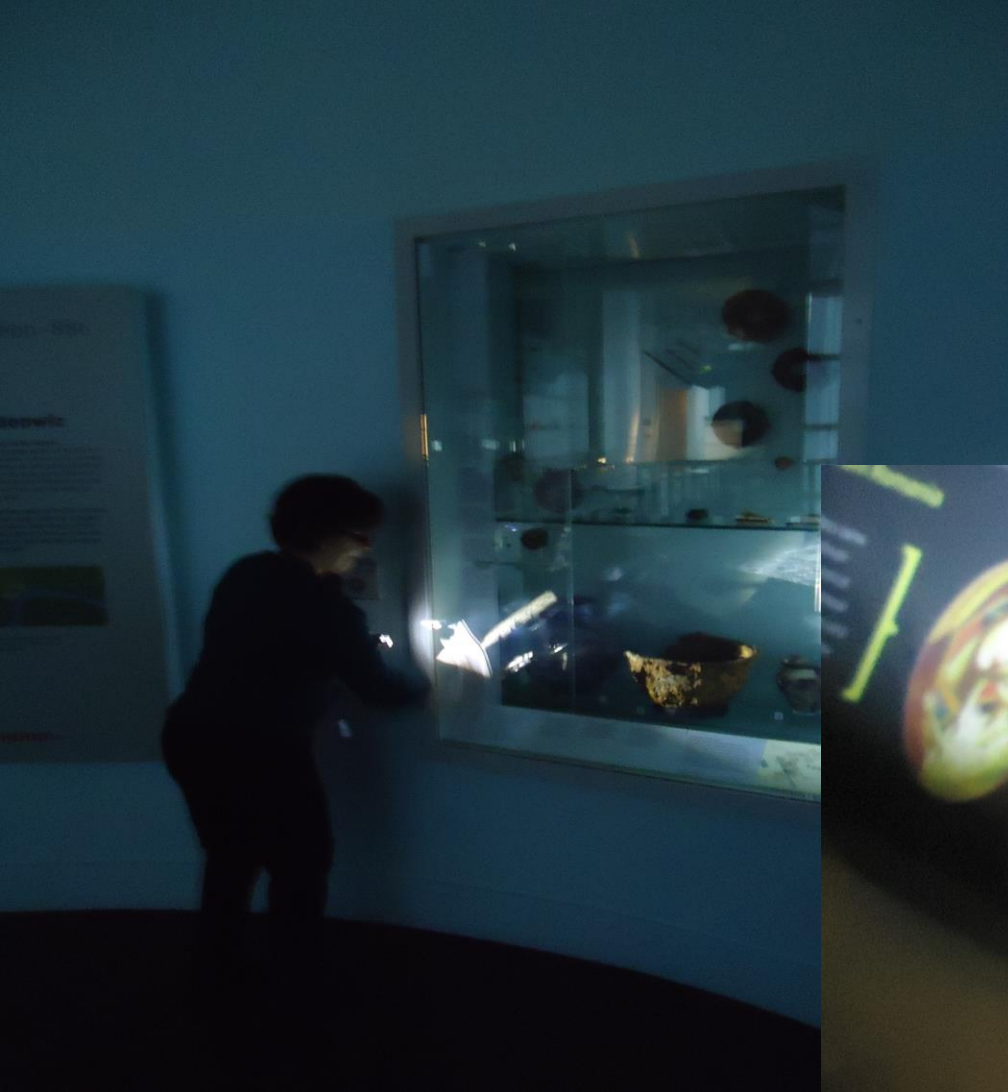
National Gallery of Australia

SURVEY: James Crawford, University of Warwick

‘The recent experiences and future needs of users of exhibit enclosures for local environmental control of indoor cultural heritage collections’

International survey of people using display cases and glazed frames - 14% reported fogging ‘frequently’, 20% ‘sometimes’

SEAHA *Science and Engineering in Arts, Heritage and Archaeology*
Conference, 14-15 July 2015 *University College London*





Coupons placed in display case, 2 weeks
Medieval Gallery, 2011

Imperial College London: results of first project

- 3 coupons: silicon, gold coated silicon and glass
- In three positions, in one case for 2 weeks
- Case materials: metal, glass, Perspex, silicone seals; no MDF, paint or fabric
- Organic and inorganic excavated materials displayed
- Ion ToF SIMS used for analysis
- Results: range of sodium salts, hydrocarbons and silicon-carbon species

Sarah Fearn, unpublished report, 2011

Imperial College London: results of second project

- Sampling: razor blade – deposits held between 2 glass slides
- Samples from 14 different cases from 4 museums
- Analytical methods and results:
 - SEM – EDX: Na, Mg, Si, S, Cl, Ca
 - XRD: sodium chloride, sodium formate, sodium sulphate, sodium nitrate

Hakimah Aziz, unpublished report, 2014

Label	Elements detected by EDX	XRD results			
		Compound	Chemical Formula	Score	Reference ID
LBL5.1	O, C, Na, Cl, Ca	Halite, syn	NaCl	77	00-005-0628
LBL5.3	O, C, Na, Cl, Ca	Halite, syn	NaCl	77	00-005-0628
DLSS	O, C, Na, Cl, Si, Al	Sodium formate	CHNaO ₂	77	00-013-0812
LBL7.16	C, Na, S, Cl, K, Ca	Halite, syn	NaCl	61	00-005-0628
		Sodium sulphate	Na ₂ SO ₄	29	01-078-1883
VCP1	C, Na, Cl, Ca	Halite, syn	NaCl	74	00-005-0628
		Sodium nitrate	NaNO ₃	45	01-072-1213
NHH42	C, Na, S, Cl, Ca	Halite, syn	NaCl	77	00-005-0628
		Sodium nitrate	NaNO ₃	35	01-071-2010

Other analytical work

- Metropolitan Museum of Art NY, Luxford, 2005: mainly sodium salts
- Royal Ontario Museum and CCI, Coxon and Poulin, 2015: sodium salts of organic material and inorganic ions
- National Gallery of Australia, Addison and Hinton, 2015: mainly sodium salts and silicone compounds

Emerging from the fog

Investigating the problem of
'fogging' display case glass

Lisa Addison & Donna Hinton
National Gallery of Australia

30 09 2015



Draeger tube testing,
National Gallery of Australia,

Key messages

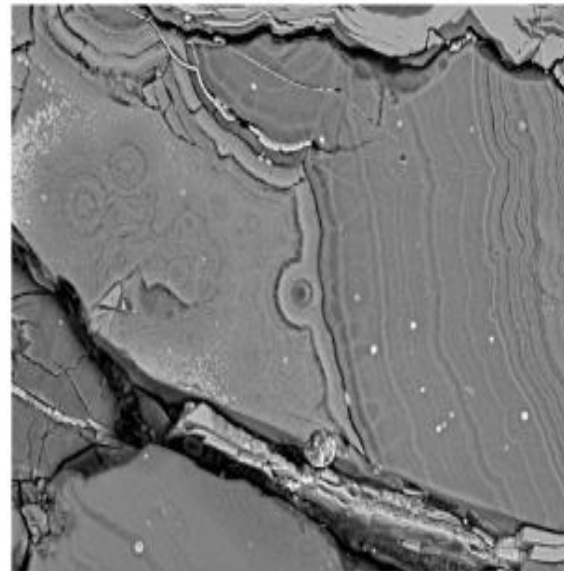
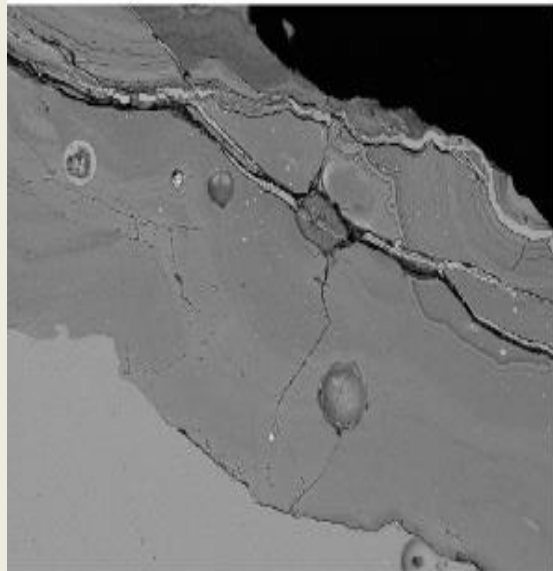
- Similar substances found by several institutions
- Generally seems to be related to pollutants, display case materials, sometimes the objects
- Glass is not inert; type and treatment of glass may have an effect
- Analytical work needed: what is happening at the glass interface?



Fig. 1: Initial stages of alteration on an Islamic glass bowl from the 10th century.

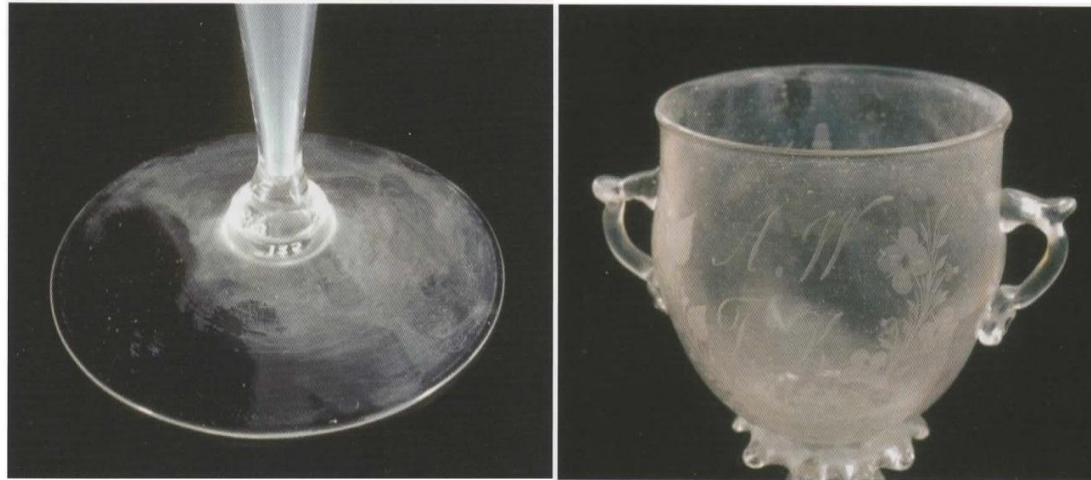


Fig. 2: Extensive corrosion on glass beads from Mesopotamia, c. 1350 BCE.



from Katherine Eremin, Harvard: overview of glass deterioration for Stuttgart Historic Glass deterioration colloquium 2015

Historic glass



From Steve
Koob,
Conservation
and Care of
Glass Objects,
2006



Abstract

A study was undertaken to understand the formation and composition of so-called "ghost images," which are hazy films that may appear on the inside surface of protective glasses over framed oil paintings.

Thermogravimetric analysis demonstrated that evaporation of free fatty acids is one mechanism responsible for ghost image formation. Evaporation rates, expressed on the basis of half-time, were calculated from the thermogravimetry data. It was discovered that palmitic acid evaporates approximately twice as rapidly as

Gas chromatographic determination of the fatty acid and glycerol content of lipids. IV. Evaporation of fatty acids and the formation of ghost images by framed oil paintings

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VOC EMISSIONS FROM CANVAS AND ACETIC ACID DEPOSITION TO CANVAS AND GLASS

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Anne Sommer Larsen⁴



Toughened glass shelf,
Museum of London



Toughened glass shelf,
Museum of London



Laminated glass shelves,
Metropolitan Museum of Art,
New York



Plate glass shelf
Used by courtesy of The
British Museum

Types of glass

- Plate or float glass
- Toughened/tempered glass
- Laminated glass

Glass types for showcases

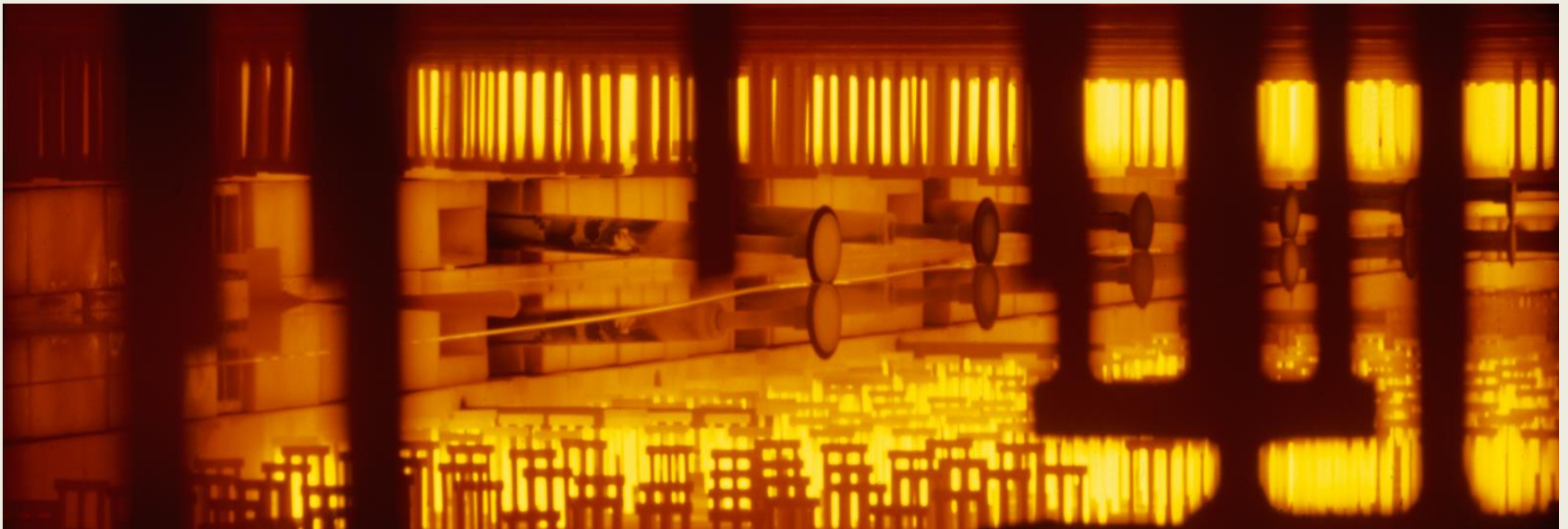
Showcase sides: laminated glass used since late 1990s

Shelving:

- Toughened glass – disadvantage, will break into small cubes
- Laminated glass: will deflect
- Plate glass: is used for large expanses; if knocked will chip and form shards

Plate or float glass

The mixture of sand, cullet and other material, is fed into the tank furnace at 1500°C and dragged over a pool of molten tin cooling to 600°C.



Toughened or tempered glass

Glass is annealed to remove strain in the glass, cut to size and processed. Toughened or tempering makes 'safety glass'. It is toughened by re-heating to around 620°C and passed back on forth on rollers. It is rapidly cooled with blast of cold air that puts around 15,000 psi of compressive force on the glass.



Laminated glass

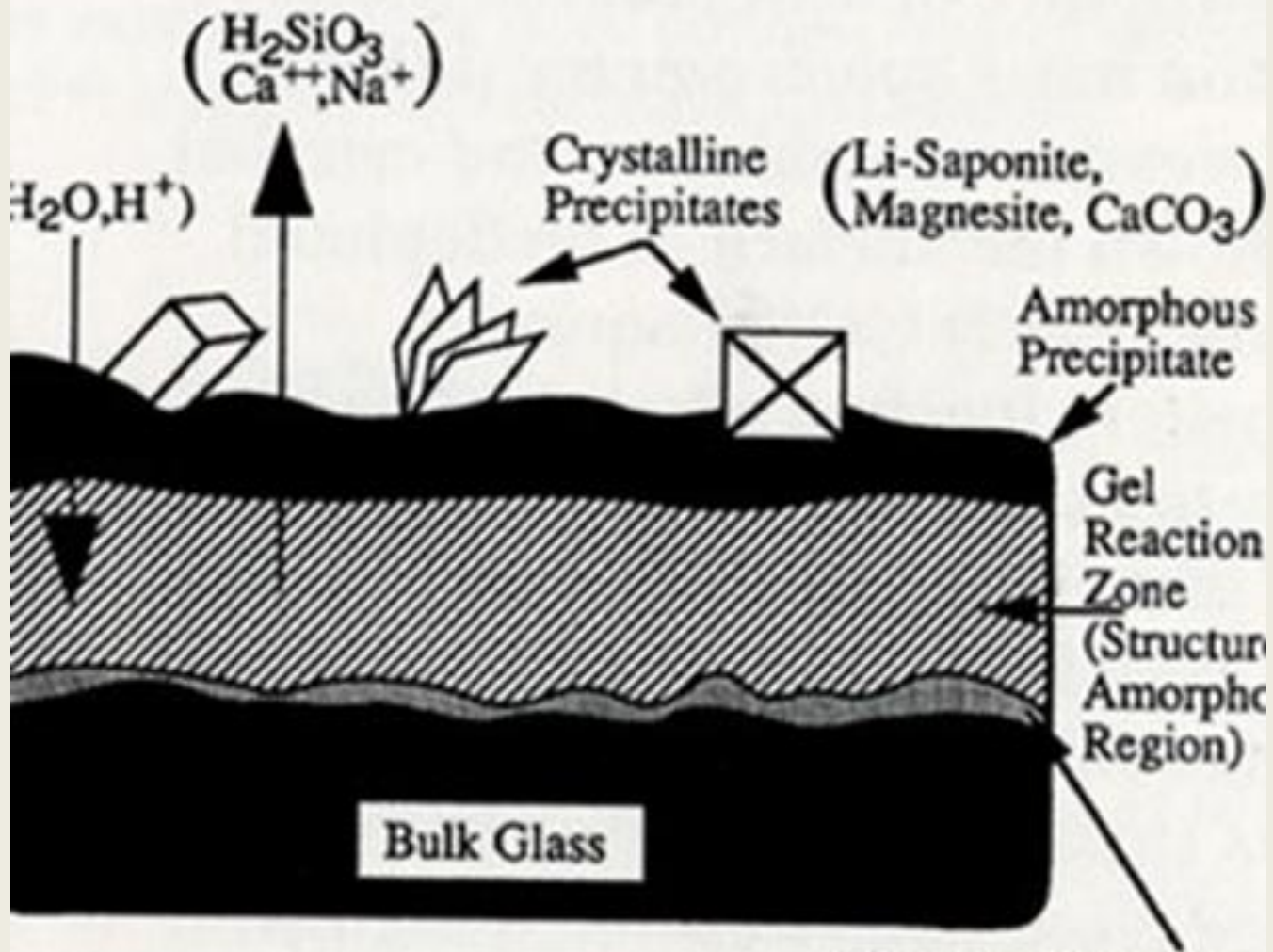
- Laminated glass, usually layers of PVB or EVA in between layers of glass
- Can use polycarbonate or other substrates
- Heated in a low pressure autoclave



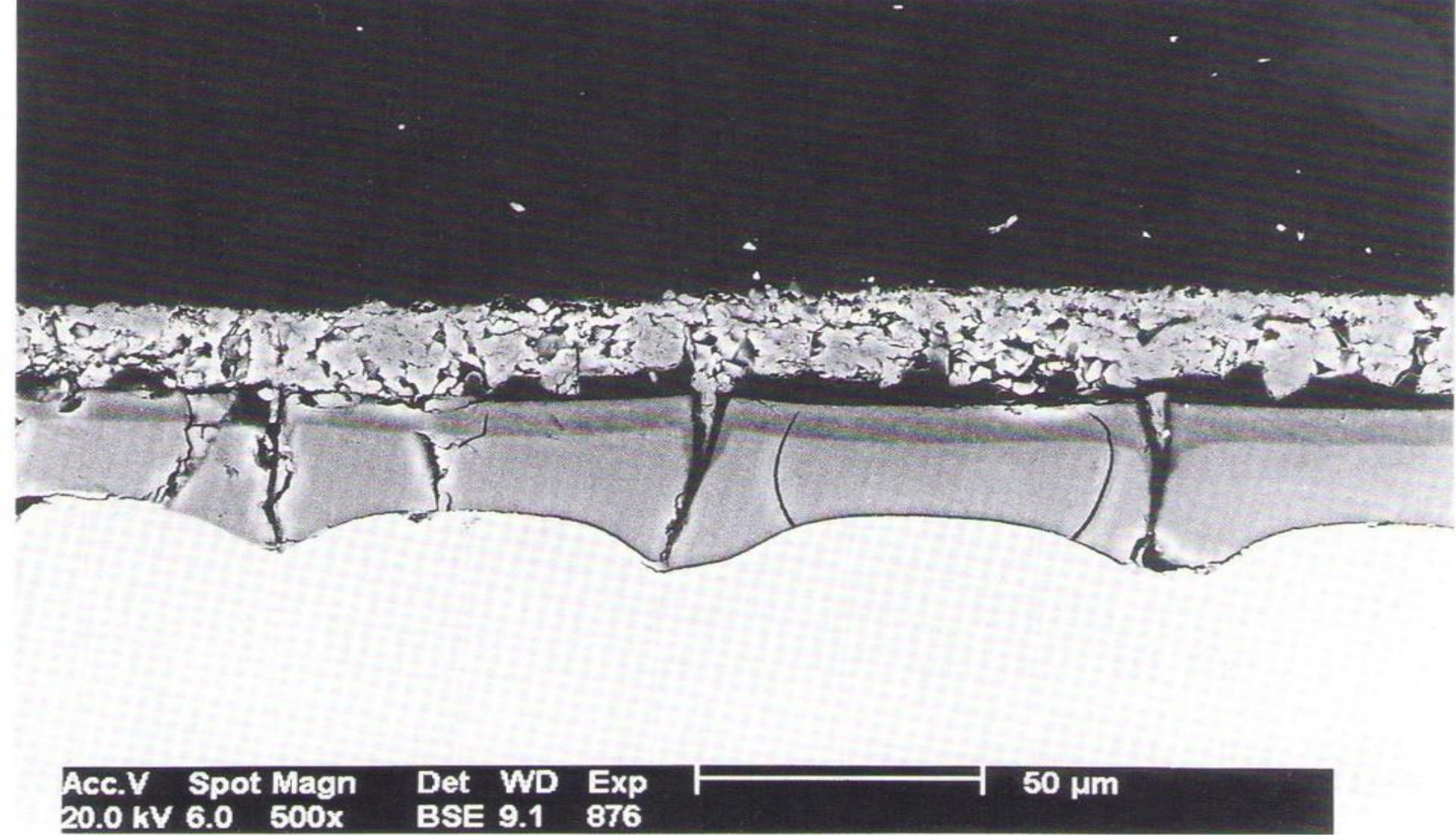
Coatings

The application of various coatings can expose the surface of the glass to:

- hydrofluoric acid
- aggressive cleaning and stripping chemicals
- microwave radiation
- high vacuum
- metal plasma



Glass Reaction Zone
 $<1\mu\text{m}$ deep; Depleted
 in Soluble Elements,
 (B, Na, Li)





Before

After





1. Degrease 2. Wash 3. Renew 4. Rinse 5. Protect 6. Activate

Trials at
Click
Netherfield
plant





English Republic, 1649–1660

Execution of Charles I in 1649, England
the 'Commonwealth'. Power was entrusted
of State and in 1653 Oliver Cromwell,
Chief of the Parliamentary army, was
Lord Protector.

entire zeal for the Parliamentary cause
the city prospered under the Commonwealth
the networks expanded and Cromwell's
city helped to make Britain one of the
commercial nations of Europe.

of Cromwell's death in 1658 he had
the sole source of state power, virtually a
dictator. This alienated many Republicans who
demanded the abolition of the monarchy and
renewed debate among the populace at large.

...d he, 'as much for a government
...nt as any man; but where shall we
...nsent?'



1. **Parliamentary army, 1642–1645**
The Parliamentary army was created in 1642 to fight the First English Civil War. It was a volunteer force, and its members were known as 'the Ironsides'. The army was led by Oliver Cromwell and was instrumental in the victory at the Battle of Marston in 1649.

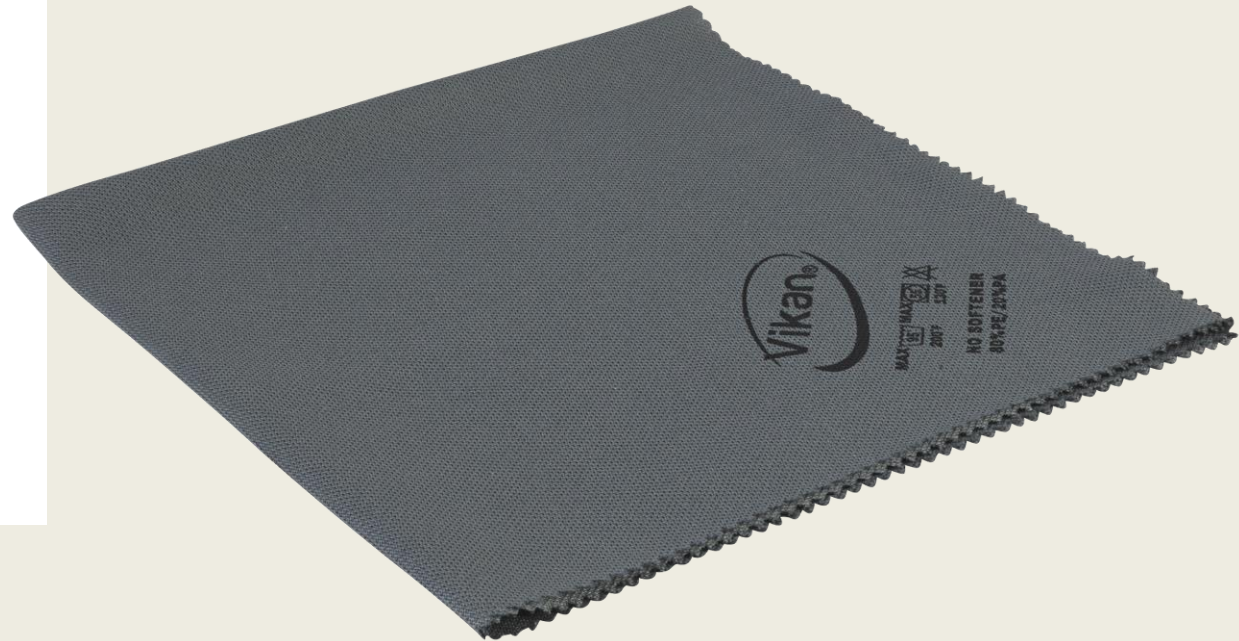
2. **Execution of Charles I, 1649**
Charles I was executed by beheading on 30 January 1649. This was a significant event in the history of the English Republic, as it marked the first time a monarch had been executed in England.

3. **Commonwealth, 1649–1653**
The English Republic was established in 1649, following the execution of Charles I. It was a period of political and social change, with power being shared between the people and the government.

4. **Lord Protector, 1653–1658**
Oliver Cromwell was appointed Lord Protector in 1653. He was a military leader and a statesman, and he played a key role in the history of the English Republic.

5. **Restoration, 1660**
The English Republic ended in 1660, when the monarchy was restored. Charles II was crowned king, and the country returned to royal rule.

Damp microfibre cloths



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