



1 Restored baroque mirror with ornamental etching

2 Sputtered tin mirror in the Jewel Room in the Grünes Gewölbe (Green Vault) in Dresden

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## RESTORATION OF HISTORICAL MIRRORS MERCURY-FREE BY VACUUM COATING VIA MAGNETRON SPUTTERING

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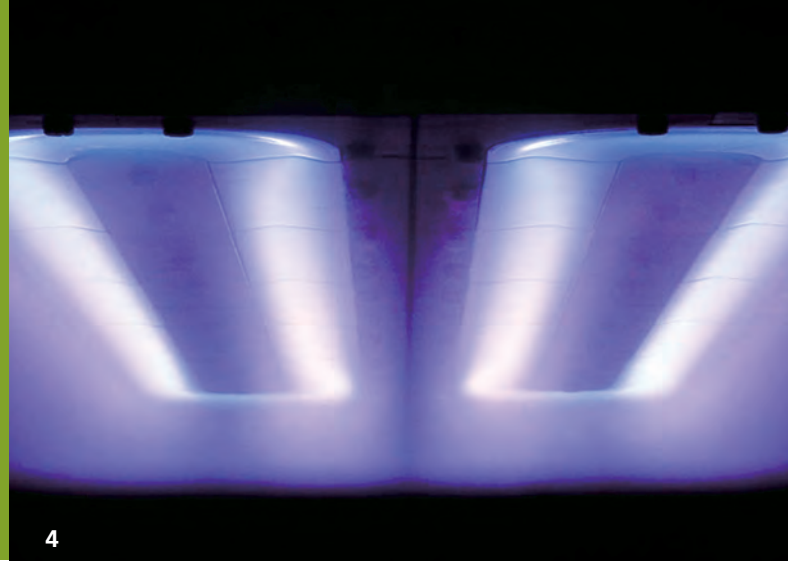
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Depending on their origin, historic mirrors have distinctive color levels and considerably lower degrees of reflection (60%) than modern silver mirrors (96%). When restoring historic mirrors the challenge is to restore the original visual effect using modern scientific technologies, standard commercial glass, and non-toxic materials. Historic tin amalgam mirror coating methods are toxic and are rarely applied today. If they are used extensive health and work safety measures are required.

Using thin film vacuum technology, namely magnetron sputtering, mercury-free tin mirrors can be manufactured at

Fraunhofer FEP. The reflective properties and color levels of the mirrors can be customized for specific historic collections.

Mirrors produced using this method are found in the Jewel Room of the historic Green Vault in the Dresden castle, and can also be seen in the Sybillenkabinett (rare antique cabinet) in the Altenburg castle and as furniture mirrors in the Moritzburg castle.



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### Reconnaissance analyses

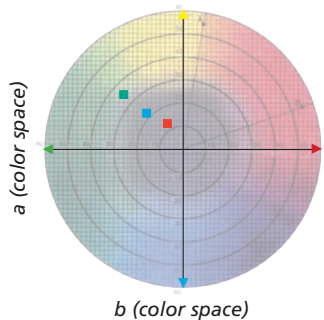
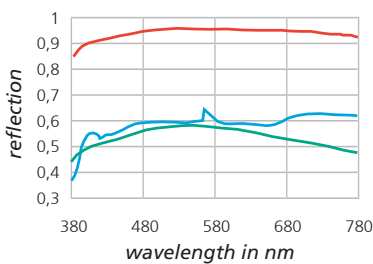
Selection of a suitable mirror glass is vital when restoring historic mirrors. Prior to any coating process, key steps are detailed characterization of modern commercial float glasses and analysis of the historic

mirrors. The chemical composition and distinctive properties of glasses and mirror coatings can be precisely measured at the Fraunhofer FEP.

### Our offer

- characterization of historic collections
  - analysis of the chemical composition of glasses and coatings/layers
  - analysis of the structure and microstructure of metallographic cross-sections
  - determination of the layer thickness
  - roughness measurements
  - determination of the color space in accordance with DIN 5033
  - adhesion strength
  - corrosion tests
- selection of suitable layer systems and adaptation of the coating technology to recreate historic mirror coatings

#### Spectral reflection and color space of different mirrors

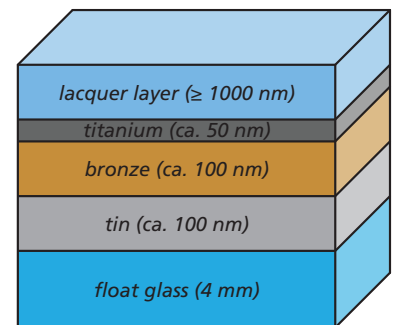


### Coating technology

The mirror manufacture is carried out in a in-line vacuum plant. Machine-cleaned glass is passed via a clean room into the plant and is then coated in successive process chambers. The layer system comprises a reflective tin layer which is stabilized on the back by bronze as a corrosion protection layer and titanium as a hard metal layer promoting

lacquer adhesion. By using suitable masking technology, ornamental mirror coatings can be applied to panes of glass. After removal from the vacuum, all mirrors are coated with protective lacquer to make them ready for use. Non-reflective glass surfaces remain non-lacquered and can be further artistically processed.

#### Sputtered tin mirror



### References

- »Sybillenkabinett« (rare antique cabinet) in the Altenburg castle
- furniture mirrors in the Moritzburg castle
- Jewel Room in the Green Vault in the Dresden castle

3 Sputter plant ILA 900

4 Plasma in a pulse magnetron sputtering process



We focus on quality and the ISO 9001.