

PHYSICO-CHEMICAL CHARACTERIZATION AND CONSERVATION STATUS OF DAGUERRETYPE SURFACES



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Daguerreotype of 19th Century



The surface has a mirror-like aspect

The daguerreotype process was the first method widely used for obtaining photographic images, from 1840's through the early 1860's, before the albumen prints time. Nowadays many of the daguerreotypes present a highly detailed but fragile image, which was obtained on a silvered copper plate. Some of them show signs of corrosion as well as other degradation processes.

In order to study the morphology and the degradation status of some daguerreotypes, Scanning Electron Microscopy (SEM-EDS) technique was used. Local chemical composition and degradation products were also evaluated by in-situ nondestructive spectroscopic techniques such as Energy Dispersive X-Ray Spectrometry (EDS).

The microscopic examination and the use of non-invasive techniques (SEM-EDS) revealed morphological details and allowed elemental analysis to be performed in-situ providing relevant information concerning the methodology used for the production of the daguerreotypes.

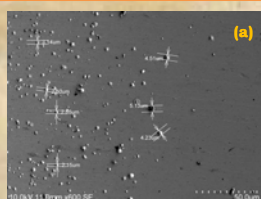
The elemental distribution maps obtained with the SEM-EDS technique revealing itself as a technique of particular interest for the study of daguerreotypes once it allows a fine identification of the degradation zones. This type of study is essential for the characterization and conservation of these images that are unique testimonies of the 19th century.



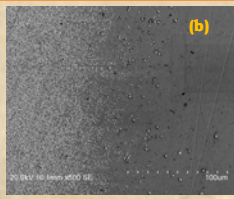
SCANNING ELECTRON MICROSCOPY COUPLED WITH X-RAY ENERGY DISPERSIVE SPECTROMETRY (SEM-EDS): HITACHI S-3700N variable pressure Scanning Electron Microscope coupled with a Bruker X-Ray Energy Dispersive Spectrometer

- Acceleration voltage of 20.0 kV and high vacuum conditions.
- Secondary and backscattered electrons imaging mode were used.
- A 20 cm width chamber allows the analysis of the entire Daguerreotype.

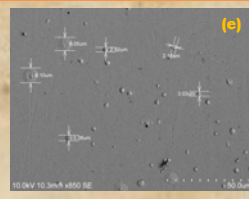
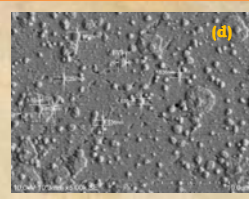
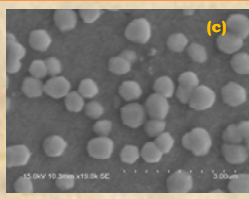
Image Structure



J1: SEM examination
(a) Particle size vary in the interface area

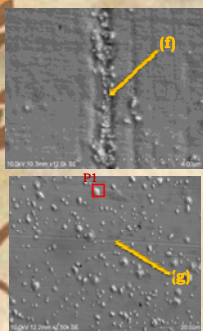


J2: SEM examination
(b) Particle size vary in the highlight area
(c) In highlight areas, particles are smaller and numerous, with hexagonal shape.

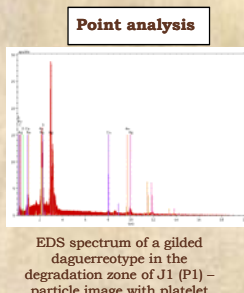


J3: SEM examination
Particle size vary in the highlight area (d) and in the shadow areas (e).
In highlight area a large quantity of platelets were observed.

Image Deterioration

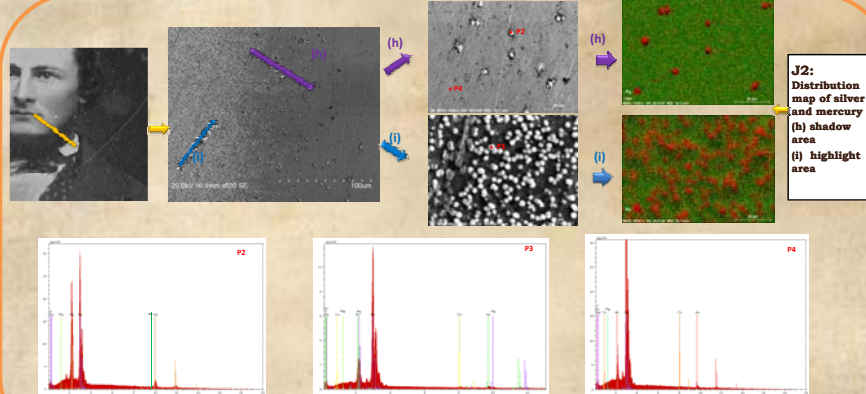


Different type of scratches:
(f) - J3 and (g) - J1



EDS spectrum of a gilded daguerreotype in the degradation zone of J1 (P1) - particle image with platelet

Image Composition



EDS spectra of a gilded daguerreotype: particles (P2 - shadow area, P3 - highlight area) and base area (P4)

J2: Distribution map of silver and mercury
(h) shadow area
(i) highlight area

Final Notes

- The use of SEM-EDS techniques on the study of daguerreotypes allowed information on morphological details and elemental analysis, relevant data concerning the production methodology and the evaluation of degradation products.
- Gilded daguerreotypes on silver-plated copper sheet were identified. In the degradation area of J1 daguerreotype were detected corrosion copper-containing products and sulfur on silver plates.
- Particle size vary with numerous hexagonal shape and smaller particles (diameter: 0.1 - 1.0 μm) in the highlight areas and with fewer and irregular shaped particles (diameter: 2.0 - 9.0 μm) in the shadow areas. In mid-tone regions both type of particles are found (see J1 - a). The hexagonal shape from images particles (see J2 - c) suggest an epsilon-phase amalgam Ag₁₁Hg₉ (Barger & White, 2000). In daguerreotypes J1 and J3, with more degradation signals, it is possible to find some platelets, with chemical composition similar to the other agglomerates (Ag-Hg).
- Mercury was found only within image particles and the Hg content increasing from highlight to shadow particles while for gold, Au, it happens just the opposite; this suggests that in the gilding process, Au is unevenly distributed over the daguerreotype surface and mercury from the image particles is replaced by gold.
- Physical damage in the form of scratches was observed; some scratches can serve as nucleation zones, changing the image information.

References

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