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Using Electron Back Scattered Diffraction (EBSD) & Energy Dispersive Spectrometry (EDS) to Characterize the Surface of 19th Century and Modern Daguerreotypes

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The daguerreotype is unlike any other of the many silver-based black and white photographic processes. The daguerreotype is an image that rests on the surface of a highly polished silvered copper plate. The final stage of the daguerreotype process is to affix the silver-mercury amalgam image particles to the plate by passive electrochemical coating with a thin gold film. Even though gold is a noble metal, tarnishing readily occurs on all of the components of the daguerreotype, namely the image particles and the background surface. Previous studies have suggested a correlation between the chemistry and morphology of the corrosion product or tarnish (Daffner et al. 1996; Gregory et al. 2007, Centeno et al. 2008).

This work presents a study of 19th century and modern contemporary daguerreotypes as seen in figure 1 using the two microanalysis techniques of energy dispersive X-ray spectroscopy (EDS) and, for the first time, electron backscatter diffraction (EBSD). While EDS provides the chemical composition, EBSD provides the microstructural and crystallographic information of a material.

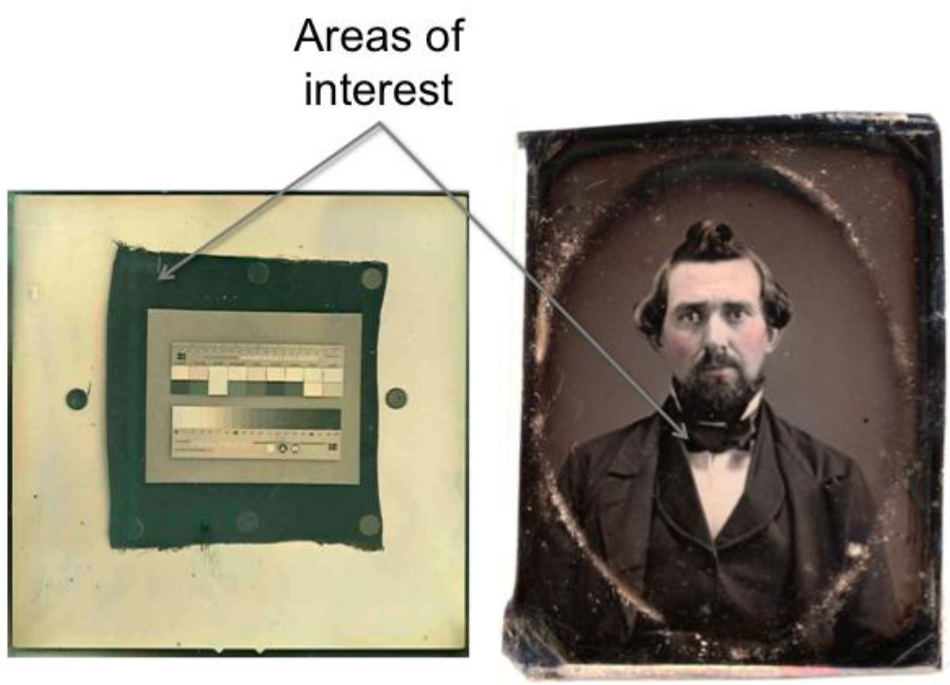

Fig. 1. Modern and 19th century daguerreotypes used in this study and the dark shadow areas of interest in both.

Even though the 19th century daguerreotype contains organic contamination, no cleaning procedure can be performed, as such cleaning actions could permanently remove image particles residing on the surface of the silvered copper plate. For this analysis, the daguerreotypes were not polished or cleaned prior to being tilted to 70 degrees in a Phillips XL-30 field-emission scanning electron microscope. An EDAX Hikari Camera and Apollo X silicon drift detector were used to collect EBSD and EDS information.

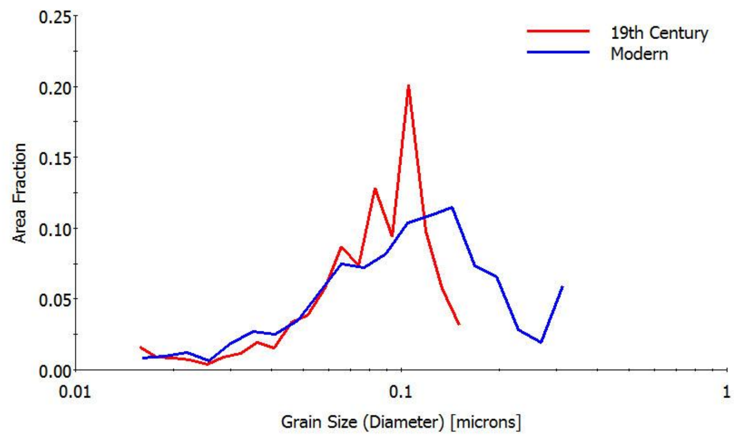

Fig. 2. Grain size distribution of the 19th century (red) and the modern daguerreotypes (blue). The average grain sizes were 86 nm for the 19th c daguerreotype and 121 nm for the modern one.

The grain size distribution of the 19th century daguerreotype is very different from that of the modern daguerreotype, as seen in figure 2, with the average grain size being 86 nm and 121 nm. The orientation data from each of the daguerreotypes can be seen in figure 3. Even though no preferential orientation distribution was observed, the orientation distributions are very similar between the 19th century and modern daguerreotypes. The ability to correlate chemical and crystallographic information with microstructural features provides the potential to explain the occurrence of tarnish as corrosion in the intergranular boundaries of gold grains on gilded daguerreotype surfaces. The similarities between modem and historic daguerreotypes also indicate that the modern daguerreotype making process is a good approximation of historic plates and, therefore, can serve as surrogates for further study.

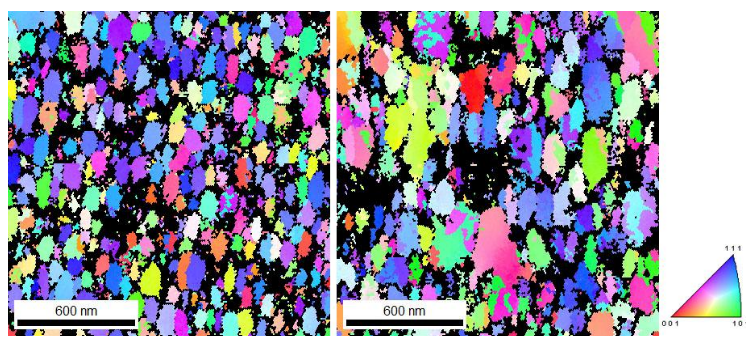

Fig. 3. EBSD inverse pole figure (IPF) maps of the 19th century (left) and the modern (right) daguerreotypes. The IPF maps color each measurement point according to the stereographic triangle showing the crystal directions that are parallel with the sample normal direction.

References

Centeno, S., T. Meller, N. Kennedy, and M. Wypyski. 2008. The daguerreotype surface as a SERS substrate: Characterization of image deterioration in plates from the 19th century studio of Southworth & Hawes. Journal of Raman Spectroscopy 39(7), p914-921.

Daffner, L.E., D. Kushel, and J.M. Messinger. 1996. Journal of the American Institute for Conservation **35**, p9-21.

Gregory, E.A., C.S. DeRoo, and J.F. Mansfield. 2007. Microscopy and Microanalysis **13 S02**, p1422-1423.

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