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doi:10.1017/S1431927613009124
Microsc. Microanal. 19 (Suppl 2), 2013

Using EBSD & EDS to Characterize the Surface of 19th Century and Modern Daguerreotypes

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The daguerreotype is the first viable imaging process that gave birth to photography and the imaging revolution. Unlike other 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 [1-2].

This work presents a study of 19th century and modern contemporary daguerreotypes 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.

Even though the 19th century daguerreotype contains organic contamination, no cleaning procedure can be performed as that will permanently remove the image particles that reside on the surface of the silvered copper plate. Hence 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 respectively.

The grain size distribution of the 19th century daguerreotype is very different from that of the modern daguerreotype, as seen in *Fig. 1*, with the average grain size being 86 nm and 121 nm respectively. The orientation data from each of the daguerreotypes can be seen in *Fig. 2*. 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 explaining the occurrence of tarnish as corrosion in the intergranular boundaries of gold grains on gilded daguerreotype surfaces.

References:

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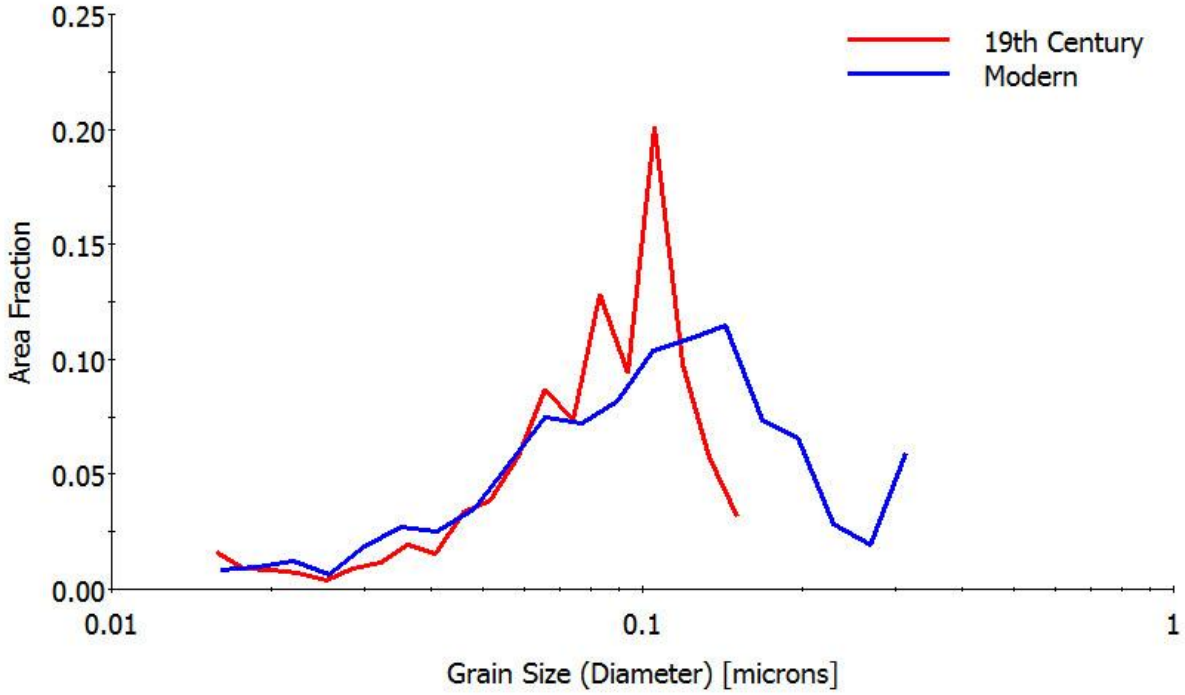

Figure 1. Grain size distribution of the 19th century and the modern daguerreotypes. The average grain sizes were 86 nm and 121 nm respectively.

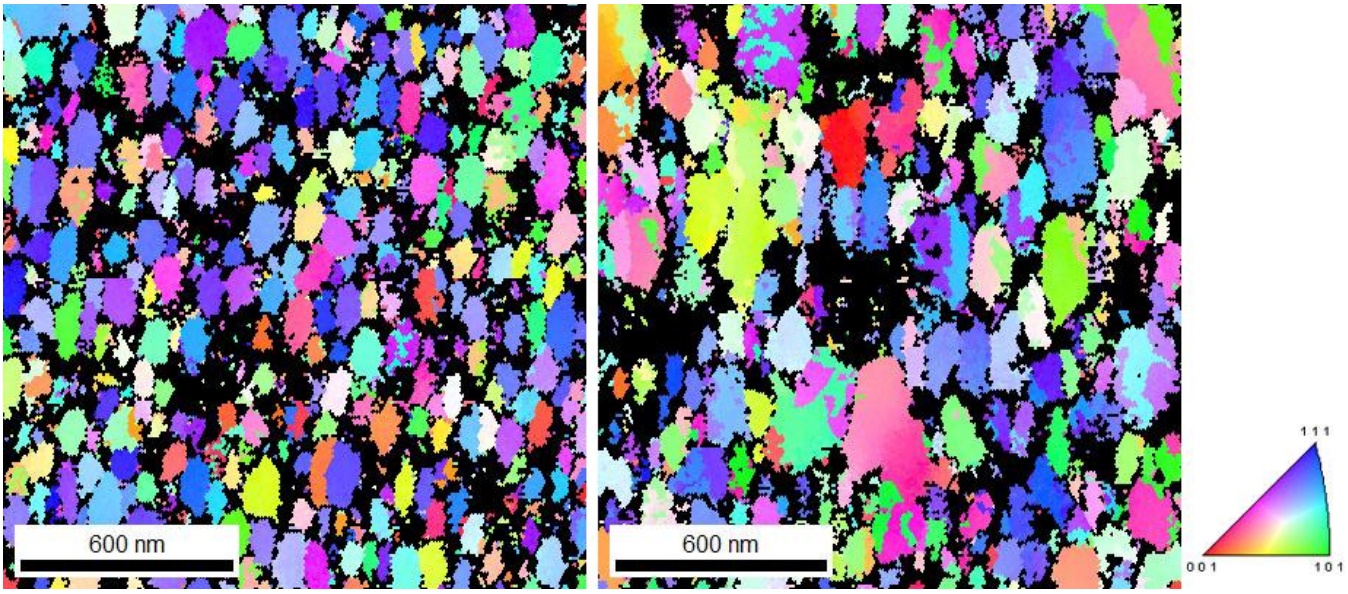

Figure 2. EBSD inverse pole figure (IPF) maps of the 19th century (left) and the modern (right) daguerreotypes. The IPF maps color each measurement point according to the stereographic triangle showing the crystal directions that are parallel with the sample normal direction.

https://doi.org/10.1017/S1431927613009124 Published online by Cambridge University Press