

Cleaning Daguerreotypes with a Femtosecond Laser

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An ultrafast laser irradiation method for the removal of corrosion from Daguerreotypes without detrimentally affecting image quality has been developed. Chemical cleaning of corrosion products such as silver oxide and silver sulfide often damages the underlying silver and image particles, ruining the image. The 150 fs 780 nm Ti:Sapphire laser pulses used in this study are focused to a beam diameter of 60 μm and are normally incident to the Daguerreotype. It was found that the corrosion layer has a lower material removal threshold than silver allowing for removal of corrosion with minimal removal of vital information contained in the Daguerreotype image. The cleaning process was characterized using a combination of optical microscopy, SEM, and AFM.

The daguerreotype is composed of a silver/gold amalgam with silver image particles on the surface with a silver sulfide/silver oxide film on the surface. Preliminary studies on 50 nm silver sulfide/silver oxide corrosion films grown on silver substrates suggested that it was possible to remove the film with minimal damage to the substrate. The two films were shown to have similar composition in EDS. To test the process on the more complex system, two 19th century daguerreotypes were irradiated with 10 pulses at $0.12 \pm 0.01 \text{ J/cm}^2$.

Characterization in optical microscopy and SEM does not show signs of damage in the silver. Figure 1 contains an optical micrograph of a 19th century daguerreotype in which half of the sample has been irradiated. The areas of dark contrast in Figure 1 have the same contrast as the corrosion films grown in the preliminary studies. The areas of dark contrast are no longer visible on the daguerreotype where the laser struck the sample. Figure 2 contains two SEM images of a specific location on a 19th century daguerreotype. The image particles do not appear to be removed by the cleaning process. However, a more thorough characterization must be conducted to ensure that no information in the daguerreotype is lost during cleaning.

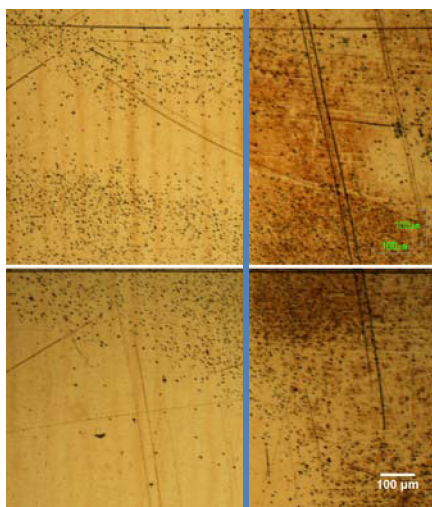


FIG 1. Optical Image of 1st 19th century daguerreotype. The left portion of the image has been irradiated in lines with 10 pulses at $0.12 \pm 0.01 \text{ J/cm}^2$.

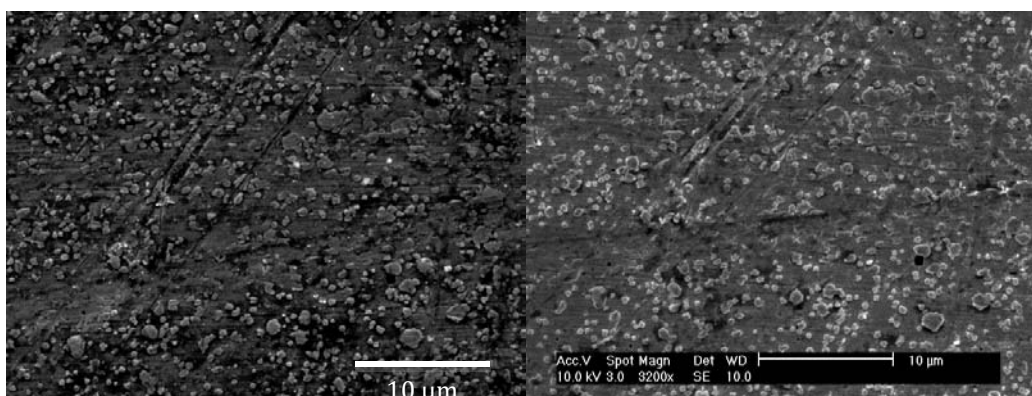


FIG 2. SEM images of the same region of a 2nd 19th century daguerreotype both before (left) and after (right) irradiation with 10 pulses at $0.12 \pm 0.01 \text{ J/cm}^2$. The particles in the image are image particles and have not been removed during irradiation.

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