Synchrotron radiation in application to 19th century daguerreotypes

M.S. Kozachuk[1]; T.K. Sham[1]; R.R. Martin[1]; A.J. Nelson[1,2]; I. Coulthard[3]; A.R. Woll[4]; L. Smieska[4]; J.P. McElhone[5]

[1]The University of Western Ontario, The Department of Chemistry, 1151 Richmond Street, London, Ontario, N6A 5B7, Canada
[2]The University of Western Ontario, The Department of Anthropology, 1151 Richmond Street, London, Ontario, N6A 5B7, Canada
[3]Canadian Light Source Inc., 44 Innovation Boulevard, Saskatoon, Saskatchewan, S79, 2V3
[4]Cournell High Energy Synchrotron Source, Cornell University, 200L Wilson Laboratory, Route 366 & Judd Falls Road, Ithaca, New York, 14853, The United States of America
[5]National Gallery of Canada, Musée des beaux-arts du Canada, 380 Sussex Drive, P.O. Box 427, Station A, Ottawa, Ontario, K1N 9N4, Canada

Background

The development of the first commercially viable photographic image, the daguerreotype, captured images for a span of approximately 25 years between 1839 and 1860. Daguerreotypes provide a significant historical record of 19th century individuals and events; image deterioration now disfigures many of these valuable images. One restoration method used on these images is an electrocleaning process, which has proven to be one of the safest conservation techniques to date. However, the effects of this preservation treatment, and the extent of the physical and chemical implications to the daguerreian image, have not yet been analyzed in depth. The research undertaken here used synchrotron radiation analysis, particularly micro X-ray fluorescence (μ-XRF) imaging capabilities, to map the elemental distribution on the daguerreotype surface. By imaging the L emission from Hg, which plays an integral role in the production process and whose distribution mirrors that of the image particles that make up the photograph, full portraits that are obscured entirely by extensive corrosion can be retrieved in a non-invasive, non-contact, and non-destructive manner.

Methods

The National Gallery of Canada Canadian Photography Institute (NGC-CPI) provided the daguerreotypes examined in this study. The synchrotron experiments were conducted on the G3 and A1 line at the Cornell High Energy Synchrotron Source (CHESS), Cornell University, Ithaca, NY, U.S.A. The elements of interest were Ag, Au, Hg, Fe, and Cu.

Results

Micro-XRF Hg distribution images from daguerreotypes show that the distribution of Hg follows that of the light exposure, and image particles, on the surface, and therefore accurately reproduces the original image. Although the daguerreotype optical image has

been lost, the collection of the Hg L fluorescence allows the original image to be reconstructed. This level of imaging was achieved on both the pre-and post-electrocleaned daguerreotypes, suggesting that a complete removal of Hg during the cleaning process does not occur.

Conclusion

XRF mapping using the Hg L emission lines was successfully used to analyze entire daguerreotype plates, even when degradation and tarnish masked the original image from optical view, in a non-destructive, non-invasive, and non-contact manner. Post-cleaning analysis showed that electrocleaning did not fully remove the elements integral to the image particle morphology. Further investigation of the electrocleaning methodology needs to be undertaken to ensure treatments do not negatively impact the daguerreian surface.