Platinum Photographic Prints Examined Using Variable Pressure Scanning Electron Microscopy (VP SEM)

Patrick Rавines, Art Conservation Department, SUNY Buffalo State, Buffalo, New York, USA, ravinepc@buffalostate.edu
Natasha Erdman, Applications Scientist JEOL USA Inc., Peabody, MA, USA 01960
Rob McElroy, Photographer & daguerreotypist, Archive Studio, 347 Franklin St., Buffalo, NY 14202 USA

This study provides a first look at the nature of the image particles found on 19th century and modern platinum (Pt) photographic prints as a means to characterize and understand these historically important images. The Pt prints have been studied using new variable pressure scanning electron microscopes (VP SEM). The modern advances in electron microscopy instruments with variable and environmental pressures allow for the study of organic substances such as cellulose and proteinaceous materials without the need for sample preparation using carbon, gold or other metal coatings. This advantage allows for the direct observation of organic surfaces without interference from sample preparation protocols. Pt print cross-sections were prepared using an argon ion plasma polishing system and were also examined with VP SEM.

Electron microscopic study of an historic 1910 Pt photographic print:

The electron microscopic images and the energy dispersive X-ray spectroscopy of the surface of the 1910 print of an elderly woman wearing a black dress show that the Pt image particles follow the shape of the surface paper fibers.

1910 Pt print: surface of the black dress area

Pt M series

1910 Pt print: Cross sections of the black dress area at different magnifications

Pt image particles closely follow the shape of the paper fibers.

Modern platinum/palladium print

A modern Pt/Pd print (not shown) shows the image particles to be evenly distributed nano-sized image particles in the cellulose fibers. The SE and BSE images of the Pt/Pd print below shows some image particles to be clumped, like grape bunches, ‘resting’ on the cellulose fibers.

Summary

The Pt image particles in the historic and modern samples show the following features:

- Size ranges from 10 – 40 nm with a narrower range of 15 – 25 nm.
- The distribution of the particles in the 1910 print are on the surface as well as in the paper’s cellulose fibers; the location of the particles inside the cellulose fibers are mostly on the top surface and, as the cross sections show, the particles go deep into the paper.
- Particle morphology appears to be oval/oblate but are likely to be face centered cubic (FCC) nano-grains; the overall shape of these is smaller than the imaging capacity of the SEM, and at high magnifications there is electron beam–induced radiation damage to the cellulose fibers.

Instruments

JEOL JSM–7100FT/LV Analytical Low Vacuum FE–SEM
JEOL Cross Section Polisher (CP) for SEM sample preparation