

Fingerprinting Picasso, Saving Lincoln: Cultural Heritage Meets Nanoscale

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The Goal: Opening nanoscale x-ray microscopy to cultural heritage research

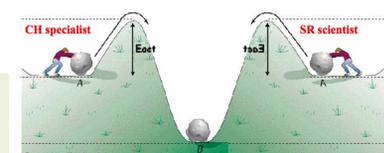
X-ray microscopy with nanoscale spatial resolution and high chemical sensitivity opens new opportunities for cultural heritage research. A view into the nanoscale can help to authenticate artwork, enhance conservation methods, and explore material science problems of unique and precious samples.



The Challenge: Two cultures mix

Synchrotrons are making a big impact on the museum world but there are still cultural barriers to break down.

"The use of synchrotron-based X-ray [...] techniques remains marginal, mostly because CH specialists rarely interact with SR physicists."
M. Cotte et al. Accounts of Chem. Res. 43 (2010) 705.



Overcoming the activation barrier

Did Pablo Picasso use housepaint in some of his artwork?

Abstract

Twentieth century artist Pablo Picasso pioneered a variety of new styles in painting, sculpture and other art forms. As well as innovative styles, he used non-traditional materials. For decades it has been suggested Picasso used ordinary house paint in some of his paintings. But there was no proof. Until now. Using chemical analysis of individual pigments, it has been concluded that Picasso did use house paint from a known French paint company.



Picasso and Ripolin

Pablo Picasso (1881-1973) was one of the early adopters of household enamel paint for artistic uses (since 1912). He was quickly followed by many other avant-garde artists of his time.

- The Ripolin company was established in 1897 outside of Paris
- One of the first to produce high-quality zinc-oxide enamel paints on a large scale
- Ripolin provided quick drying paints that rendered brushless, glossy, enamel-like surfaces in bright colors



Materials

- Analyzed samples of artists' paints (Lefranc), chemical grade zinc oxide (Sigma Aldrich), enamel paints (Ripolin), and samples from paintings by Picasso and Picabia.



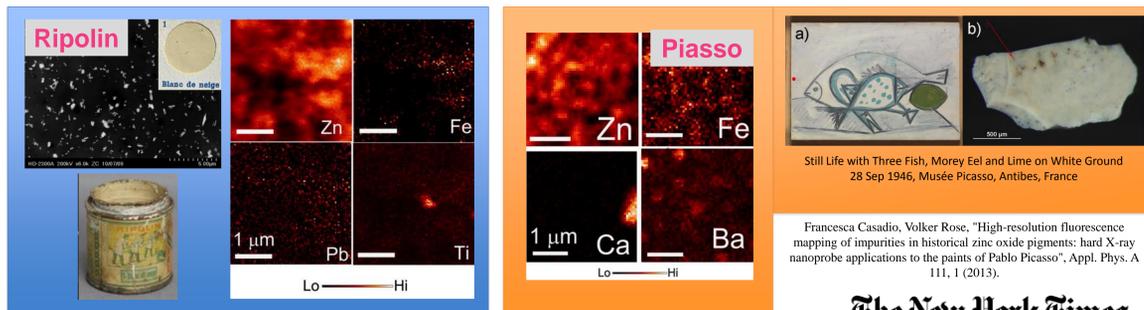
Method

- Hard X-ray Nanoprobe instrument, with two collinear undulators, a Si(111) double-crystal monochromator, and Fresnel zone plate optics. The selected photon energy was 10 keV.



Results

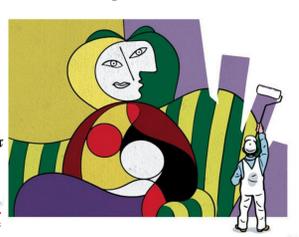
Nanoprobe for the first time enables the acquisition of compositional maps reflecting the distribution of impurities within single pigment particles, and the detection of very small, albeit statistically significant chemical differences.



Francesca Casadio, Volker Rose, "High-resolution fluorescence mapping of impurities in historical zinc oxide pigments: hard X-ray nanoprobe applications to the paints of Pablo Picasso", Appl. Phys. A 111, 1 (2013).

The New York Times

Picasso's Masterpieces Made With House Paint



Can we stop corrosion in Lincoln's daguerreotypes?

Abstract

In 1839 the first practical form of photography, termed the Daguerreotype process, was first presented to the scientific community in France. The technology spread rapidly and was widely used around the globe until the late 1850s. New measurements enabled visualizing incipient corrosion of these valuable objects where silver sulfide has formed. Understanding the corrosion process will lead to better ways of conservation of these unique objects.



The daguerreotype process

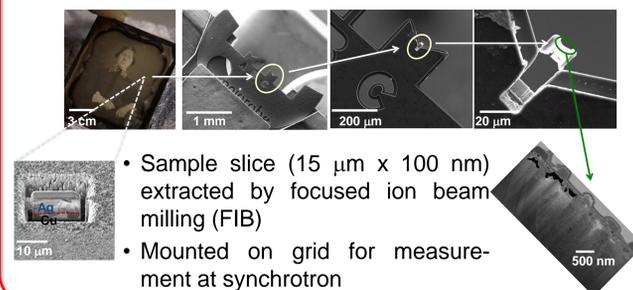
The daguerreotype process

- A plate of silver-coated copper is cleaned and polished with a soft cloth until the silvered surface has a mirror-like quality.
- The plate is sensitized by exposing it first to chloride of iodine until the surface turns yellow and then suspended over bromine fumes. The two chemicals combine with the silver coating of the plate to form a light sensitive surface.
- The sensitized plate is inserted into a light-proof holder with a protective slide and placed inside the camera.
- The subject is placed in front of the camera. If needed for a long exposure, clamps, head rests and posing stands are used to hold the subject still. The protective slide is removed, and once the subject is ready, the lens cap is removed for a period of time until the image is captured.
- The plate is taken out of the camera and the image is "brought out" by suspending the plate over a dish of mercury inside a fuming box. A lamp heats the chemical, and the mercury fumes combine with the silver to produce a clear image on the plate.
- The plate is washed in distilled water and dried and presented behind a plate of glass. Some daguerreotypes are colored by hand to add more detail.

SOURCE: Sussex PhotoHistory

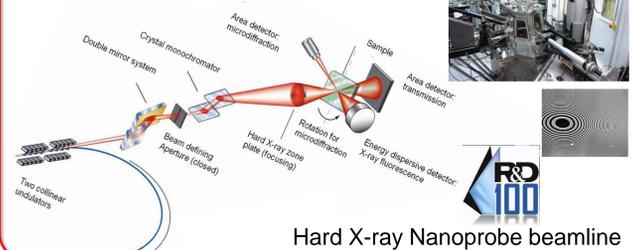
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Sample preparation



- Sample slice (15 μm x 100 nm) extracted by focused ion beam milling (FIB)
- Mounted on grid for measurement at synchrotron

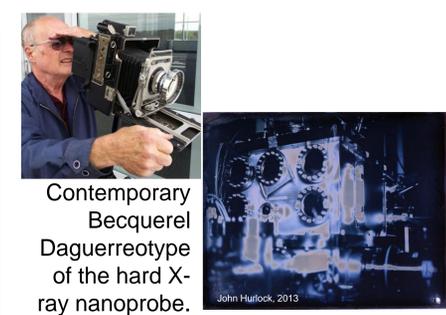
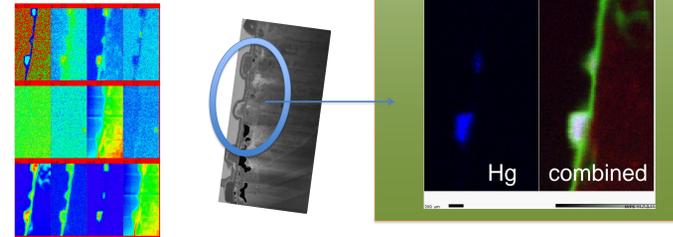
Method



Hard X-ray Nanoprobe beamline

Results

Sulfide corrosion in daguerreotypes has been visualized at the nanoscale. The quantitative composition of HgAg nanoparticles and the AuAg protective nanofilm coating was determined. Measurements enable visualizing incipient corrosion of these valuable objects where silver sulfide has formed.



Contemporary Becquerel Daguerreotype of the hard X-ray nanoprobe.



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