X-rays uncover surprising techniques in the creation of art on ancient Greek pottery

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A chemical map of Greek art revealed that a calcium-based color additive was used for white, which would have added an additional step. It also raised questions about the firing process due to the absence of zinc in the black regions. It had been assumed that a zinc additive was key to achieving the black figures in the heating process. Credit: SLAC National Accelerator Laboratory

Under beams of X-rays, the colors of art become the colors of chemistry. The mysterious blacks, reds and whites of ancient Greek pottery can be read in elements—iron, potassium, calcium and zinc—and art history may be rewritten.

That's the power of a growing collaboration between the Cantor Arts Center's Art + Science Learning Lab, art and science faculty, and the Stanford Synchrotron Radiation Lightsource (SSRL) at SLAC National Accelerator Laboratory.

Having a facility like SSRL just up the hill from the Cantor's conservation lab lends a unique opportunity for students to probe cultural mysteries with advanced scientific tools, says Susan Roberts-Manganelli, director of the Learning Lab. About two years ago, she started a fellowship for science students interested in studying art conservation. She works closely with SSRL scientific staff to mentor students bringing delicate, valuable art objects to SLAC in search of discoveries that benefit art and science.

"We can do a lot of testing here at the Cantor," Roberts-Manganelli says. "But some studies need more robust collaboration and more powerful X-rays to actually get answers to our questions."

One such study, done by Kevin Chow, BS '13, when he was a senior in collaboration with Stanford, SLAC and the Getty Conservation Institute, took a deeper look at the techniques of the ancient Greek potters, which are difficult to reproduce and not entirely understood. Using a technique called synchrotron X-ray fluorescence, the team was able to uncover surprising steps in the production process that challenge the conventional understanding.

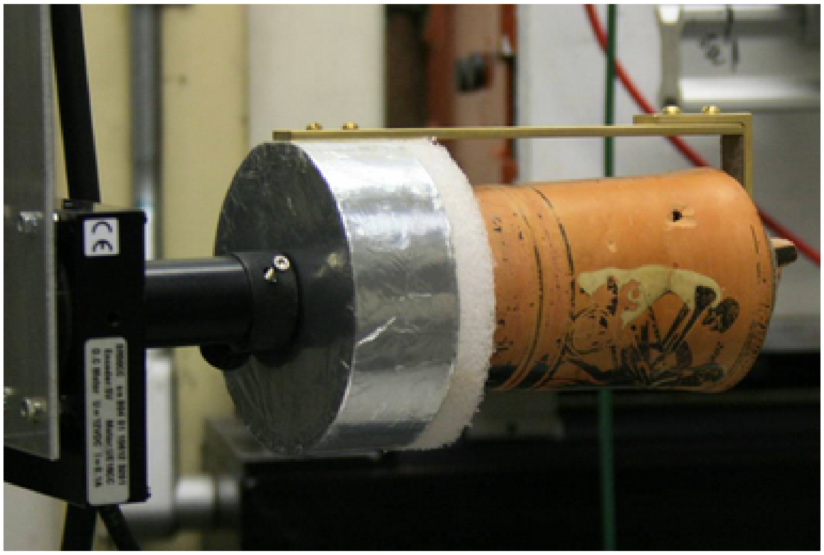
Athenian oil-flask (lekythos) from 500-480 B.C., decorated in the black-figure technique. Credit: Cantor Arts Center

"Under what they thought was a single coat, they found other instances of painting that the naked eye could not see," says Chow's advisor Jody Maxmin, associate professor of art and art history and of classics. "It was thrilling to learn that a very humble vase—hundreds of these were produced for the Festival of Athena every four years—shows certain standards of aesthetic excellence. The artist invested more in his work than we had given him credit for."

Such collaborations spark scientific innovation as well. Well-conserved art objects allow researchers to look at uniquely complex materials of a certain age that generate intriguing chemistry questions and require new techniques, says SLAC staff scientist Apurva Mehta, who is also an affiliated faculty member at the Stanford Archaeology Center. "We had to find a way to see all layers of the Greek pot in detail, which is something we want to do for other materials that might be used in batteries or electronics."

For Maxmin, seeing science students step boldly into art history is inspiring. So is watching her colleagues learn things in fields not their own. "We are complicating the issues, and that's good," she says. "By looking across disciplines we are enabling unconventional friendships and discoveries."

Roberts-Manganelli concurs: "You can't do science, art history or conservation in isolation. We all thought we could at one time, but now we realize we are stronger and better as a group."



A custom-made mount held the delicate pot during a rotational scan at SSRL. Credit: Cantor Arts Center

Provided by Stanford University