Ancient Egyptian pigment provides modern forensics with new coat of paint

May 30 2016, by Ivy Shih

Latent fingermarks dusted with micronised Egyptian blue on a $20 note, viewed in the Near Infrared. Credit: Simon Lewis, Author provided

It was during a trip to Indianapolis that Professor Simon Lewis, a forensic and analytical chemist, was approached by Gregory Smith from the Indianapolis Museum of Art (IMA) with an idea.

Smith, senior conservation scientist at the IMA, had read and known of Lewis' search for new luminescent compounds that could be used in fingerprint detection.

It was common practise in Smith's work to use white light to sweep ancient painted artefacts to find traces of an ancient pigment, which was revealed by viewing in the near infrared part of the spectrum.

Egyptian Blue is considered to be the earliest known artificial pigment with origins dating back to 3200 BCE. Even on artefacts dating back several thousands of years, Egyptian Blue still glowed brightly in the near infrared.

Smith asked if Lewis had considered using artistic pigments in his fingerprint research?

The rest as they say, was history.

Egyptian Blue pigment was found to be a promising candidate as luminescent fingerprint dusting powder. Under visible light it lit up the fingerprints in the near infrared against non-porous or patterned surfaces, such as polymer notes or soft drink cans, outperforming commercially available fingerprint dusting powders.

The findings could bring new colour not only to the field of modern forensics but also challenges in artefact conservation, demonstrating how the past could provide solutions for the future.

Out of the blue

Ancient Egyptian mask image showing Egyptian blue pigment. Credit: Indianapolis Museum of Art, Author provided

Egyptian Blue is a pigment with a remarkable lineage that showcased the ancient Egyptians' highly advanced grasp on chemistry.

The colour is a synthetic product, prepared with a mixture of copper-containing material, sand and a strong alkali. The compound is then roasted to around 800℃ to 900℃ under very tightly controlled conditions.

In ancient Egypt, this vivid blue product was highly favoured and widely used as a pigment in paintings such as tombs and mummies' coffins.

The faience technique used a blue ceramic glaze that contained Egyptian Blue on art objects such as amulets and figurines.

Beyond its brilliant blue colour, the pigment also glowed in near infrared, a characteristic that researchers had their eye on.

"You can use that to detect latent fingermarks on non-porous surfaces," Professor Simon Lewis, from the Nanochemistry Research Institute at Curtin University, told The Conversation.

Fingerprint detection is still a critically important part of forensic investigation. To detect a fingermark, a dusting powder is used that that would provide the highest possible contrast to the surface, in order to show the ridge and contour details of the fingerprint.

But in the case of highly patterned, dark or reflective surfaces, this can prove troublesome.

The advantage of Egyptian Blue is that when you shine white light on the pigment, it is able to absorb the energy from the light and then emit it in the near infrared part of the spectrum, which our eyes are unable to see.

Egyptian blue was widely used by ancient Egyptians as a ceramic glaze known as faience, shown in this hippopotamus figurine. Credit: Carole Raddato/Wikimedia Commons, CC BY-SA

Lewis said a similar example could be seen in a gin and tonic, but in the ultraviolet light spectrum.

"Have you ever held up a glass of gin and tonic and seen a blue haze in it?" he said.

"What you are seeing there is the quinine in the tonic water, which is a fluorescent compound. It absorbs the ultraviolet light and then emits it as visible light."

Researchers from Curtin University and conservation scientists from the Indianapolis Museum of Art showed that using Egyptian Blue as a dusting powder consistently provided good contrast compared to commercial powders, with it glowing brightly even on difficult surfaces.

The method of using white light to illuminate the fingerprints was safe, simple and inexpensive. A slightly modified digital camera was used to photograph them, by removing a filter that usually prevents near infrared light from getting to the camera sensor.

The hard grind

Fortunately for Lewis's team, Egyptian Blue is still being manufactured. Its main users are art restorers and conservation scientists, who still favour using the traditional pigments.

"There are a lot of artists and of course conservation scientists who like to use the older pigments. It's readily available and can be purchased relatively straightforwardly," Lewis said.

But they couldn't just use the powder as it manufactured. Lewis said the original pigment particles were far too large and not up to fingerprinting standards.

Latent fingermarks dusted with micronised Egyptian blue. Credit: Ben Errington, Author provided

"We actually had to reduce the particle size so that it was small enough to stick to the fingerprint," he said.

So they employed an instrument more commonly used to prepare rock samples for chemical analysis. This microniser was able to break down the particle size of the pigment through centrifugal force.

"There have been a few examples of people looking for near infrared emitters for fingerprint research over the last few years, but the beauty of this one is that it is the lovely intersection between art and science."

A starting point

Lewis said the study is only a starting point and researchers need to go further to see whether Egyptian Blue can be improved for forensic use.

"We are looking at both heavy and light impressions and wider variety of surfaces," he said.

"We are also looking into seeing if we can look at the properties or modify them, coatings that allow them to stick better. There are still bags of work to be done."

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