

# Materials science reveals clues about pigment degrading on painting

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UD Prof. Robert L. Opila and materials scientists are working to uncover the mystery behind color changes in Matisse's "Le Bonheur de vivre." Credit: Ambre Alexander

(PhysOrg.com) -- The painting *Le Bonheur de vivre*, by Henri Matisse, is revered as one of two masterpieces that changed the course of painting in the early 20th century.

Unlike anything that came before it, with its shocking colors and radical spatial distortion, the painting caused an uproar among French audiences when it was first shown in 1906, according to Martha Lucy, associate curator at the Barnes Foundation.

Matisse used a lot of vibrant yellows in the work, also known as *The Joy of Life*, particularly a warm yellow made from [cadmium sulfide](#).

Unfortunately, portions of the painting containing cadmium sulfide are turning, alternately, white or brown, degrading the work, which is part of the Barnes Foundation collection.

University of Delaware Prof. Robert L. Opila is collaborating with Barbara Buckley, head of conservation at the Barnes, and Jennifer Mass, a senior scientist and head of the Scientific Research and Analysis Laboratory at Winterthur, to study the paint's material microstructure and attempt to determine why the cadmium sulfide is changing color.

“It is a very disheartening phenomenon, considering the painting's position in history,” says Opila, professor of materials science at UD.

“The work is known to have invigorated fellow artists, especially Pablo Picasso, who, in an effort to outdo Matisse in terms of shock value, immediately began work on his watershed *Les Femmes d'Alger (O. J. R. M.)*,” Lucy says.

Opila's team is using X-ray Absorption Near Edge spectroscopy (XANES), sharply focused high energy light similar to that used in hard X-rays, to deeply penetrate the microscopic paint chip's layers and map the material's chemical composition. The paint chips are tiny, measuring only about a micron, or a millionth of a meter in diameter.

Near edge means “you get wiggles near the absorption edge – where the light is first absorbed,” explains Opila, which tells scientists about the chemical state of the cadmium material and the materials to which it is chemically bound.

Preliminary test results conducted by UD doctoral student Jonathan Church at the European Synchrotron Radiation Facility (ESRF) in Grenoble, France, reveal that the cadmium sulfide is deteriorating to cadmium carbonate, which is white. There is also a consistent presence

of chloride in the painting, which, Church suspects, is acting as a catalyst. Additionally, carbon dioxide is reacting with the cadmium and forming cadmium carbonate.

“It looks like the presence of chloride is important,” says Church.

While Opila and his research team are not yet sure where the sulfide is going; they theorize that the binder, a drying oil like linseed oil, may be turning brown.

The challenge now involves analyzing the data and developing methods to prevent further degradation of the painting. The Barnes will use this information to determine what kind of light exposure and humidity is advisable, and whether other measures, such as dimming shields, are needed to protect the work.

“The scientific studies being undertaken will contribute significantly to the preservation of the painting and to our understanding of the change that has taken place to the visual appearance of the [painting](#),” says Buckley.

Another question is whether science can convert the white and brown materials back to their original yellow form as cadmium sulfide. Opila believes it’s unlikely, and says it may even be unadvisable to attempt.

“There is huge philosophy at play here because if you have a work of art that degrades over time – is the work of art the original piece or the time-integrated work of art,” Opila remarks, then continues, “We may want to slow the rate of change, but I’m not sure we’d want to change it back, even if we could.”

Discoveries made in this project may someday impact other post-impressionist and early modern works.

“Van Gogh’s paintings also feature a large amount of cadmium sulfide-based yellow,” Opila says.

Provided by University of Delaware

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