Optical coherence tomography and reflection FTIR as complementary tools for examination of varnish layers in Vincent van Gogh's Sunflowers– preliminary results

Magdalena Iwanicka[1*], Costanza Miliani[2], Ella Hendriks[3], Marcin Sylwestrzak[4], Patrizia Moretti[2], Letizia Monico[2], Piotr Targowski[4]

[1]*Institute for the Study, Restoration and Conservation of Cultural Heritage, Nicolaus Copernicus University, ul. Sienkiewicza 30/32, 87-100 Toruń, Poland*
[2]*Istituto CNR di Scienze e Tecnologie Molecolari (CNR-ISTM) via Elce do Sotto 8 – 06123 Perugia, Italy*
[3]*Van Gogh Museum, Museumplein 6, Postbus 75366, 1070 AJ Amsterdam, The Netherlands*
[4]*Institute of Physics, Nicolaus Copernicus University, ul. Grudziądzka 5, 87-100, Toruń, Poland*
*magiwani@gmail.com

"Sunflowers" by Vincent van Gogh, the version painted in January 1889 and now in the collection of the Van Gogh Museum in Amsterdam, is one of the icons of the 19th c. European painting. Detailed understanding of the painting's materials, structure, and state of preservation is crucial towards its safekeeping for future generations. In 2016 systematic and multi-technique examination of the Sunflowers was carried out courtesy of the MOLAB Transnational Access (IPERION CH project). Although the results are still under evaluation, some preliminary conclusions can be drawn and will be presented in this contribution.

One aspect involved examination of the varnish layers present. The aim was to reveal their stratigraphy, thickness and chemical composition, to help determine an appropriate conservation strategy for the painting. The varnish layers were investigated with a portable HR OCT system (built at NCU for the CHARISMA project, 870 nm central wavelength, axial resolution in the varnish = 2.2 µm), a portable FTIR system (ALPHA from Bruker, 7500 cm^{-1} – 400 cm^{-1} spectral range, spectral resolution = 4 cm^{-1}) and a HR 3D digital microscope (HIROX KH-7700).

In most places examined, two varnish layers of variable thickness and probably of different composition were found. These layers are separated by a semi-transparent, highly scattering layer. Locally, another semi-transparent deposit was found underneath the bottom varnish layer. Reflection FTIR measurements were able to identify the upper glossy varnish layer as a synthetic resin (showing a rather complicated infrared profile), which was probably applied in the 1960's. In places, the surface of the upper varnish is rendered matt by the local application of a synthetic wax. The bottom varnish present, which must be that applied in 1927 when there is a first record that the painting was comprehensively treated, did not give any visible infrared signals. Using reflection FTIR it was possible to measure the removal of the synthetic varnish during spot cleaning tests made along the edges of the painting, although it was hard to distinguish specific signals that could be ascribed to the uncovered bottom varnish layer, as opposed to the original oil-based paint.

In addition to the overall examination, some fine-scale degradation phenomena disrupting the boundary between paint and varnish (microscopic metal soap protrusions, as well as delamination and/or dissolution of paint) were studied with the HIROX digital microscope and with OCT in order to precisely locate them within the layer build-up of the painting.

The concurrent application of FTIR and OCT techniques was found to provide a valuable tool to support the conservator's evaluation of tests to remove the top layer of synthetic varnish only, leaving the underlying varnish and oil-based paint layers intact.

The complicated structure of the object and its built-up texture made it necessary to develop novel OCT data post-processing techniques in order to provide the conservator-restorer with results in a form convenient for future evaluation and comparison with results obtained with other complimentary techniques.

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