Radiation damage of paint samples during µXRD mapping. Follow-up with µFTIR mapping.

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X-ray based techniques are increasingly used for the analysis of artworks, and paintings in particular. In addition to the standard laboratory equipment for X-ray fluorescence and X-ray diffraction analyses, state-of-the-art instruments are developed at large scale facilities (in particular for micro and nano-analyses at synchrotron facilities) but also for in-situ punctual or imaging analyses, with portable equipment.[1]

When studying artworks, risks associated with sample alteration have to be strongly considered. From a scientific point of view, results may be altered if the sample is modified during analyses. From a conservation point of view, analyses carried out on artworks must be completely non-invasive: the artwork must not be modified by analysis, being in the short nor the long term. In this respect, an increasing number of works are dedicated to understanding and assessing sample modulation in the study of artistic materials and have been recently reviewed.[2]

In this talk, we propose to report recent micro-X ray diffraction (µXRD) experiments carried out at the I18 beamline, Diamond Light Source. Paint model samples were prepared to permit a combination of µFTIR and µXRD mapping in the wider context of the study of Rembrandt's impasto technique.[3] This combination turned out to be ideal for assessing radiation damage, and revealed the disappearance and formation of species, specifically in the area exposed to X-rays (Figure 1). Beyond the domain of paintings and artistic materials, we think that this kind of X-ray/infrared mapping combination can be very useful to study X-ray radiation damage in many scientific domains.

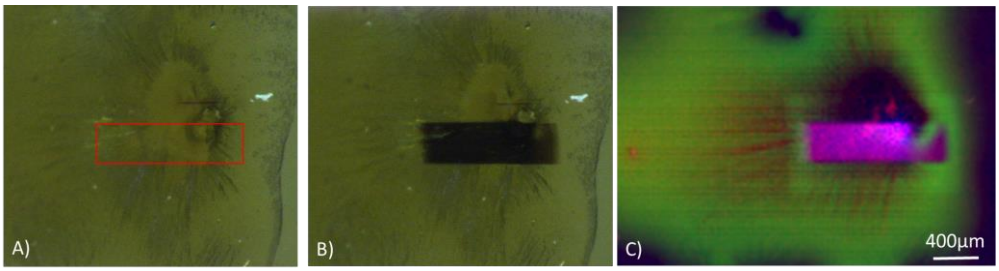

Figure 1: paint model sample before A) and after B) µXRD map. The µFTIR highlights in pink chemical modifications related to X-ray beam damage.

References

[1] - Janssens, K., et al., Topics in Current Chemistry, 374(6), 81 (2016).
[2] - Bertrand, L., et al., TrAC Trends in Analytical Chemistry, 66(0), 128 (2015).
[3] - Gonzalez, V., et al., Angewandte Chemie International Edition, 58(17), 5619 (2019).