3D Visualization of the Effect of Light Aging on Orpiment Pigment Particles

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Photo degradation of pigments used in (oil) paintings is unfortunately rather common. One of the classes of pigments that is known to photodegrade are arsenic sulphide pigments. The photo degradation of orpiment (As_2S_3) and realgar (As_4S_4) leads to the formation of arsenolite (As_2O_3) and other degradation products [1][2]. The exact degradation pathway is not yet clear and also the migration of arsenic degradation products throughout the multiple layers of a painting is not yet understood [3]. To understand the complete degradation pathway, in this study we focus on the effect of artificial light ageing on pigments particles on a nanometric scale.

The alteration of orpiment pigment particles due to light is visualized using Transmission X-ray Microscopy (TXM). The measurements were performed at beamline 6-2c at the Stanford Synchrotron Radiation Lightsource. It was clearly observed that the structure of the pigment particle had changed. These results are supported by Scanning Electron Microscopy (SEM) images in which a clear difference is seen between the area that was exposed to light and the area that was not exposed. For the TXM experiment, multiple field of views had to be recorded using mosaic imaging. The multiple field of views were afterwards stitched using the Mosaic Image Stitcher in TXM-Wizard software [4]. After aligning and reconstruction of the tomographic data in TXM-Wizard, the data was visualized in 3D using the AVIZO software package. As TXM was performed at different energies around the As K-edge, information on the 3D distribution of arsenic degradation species was obtained.

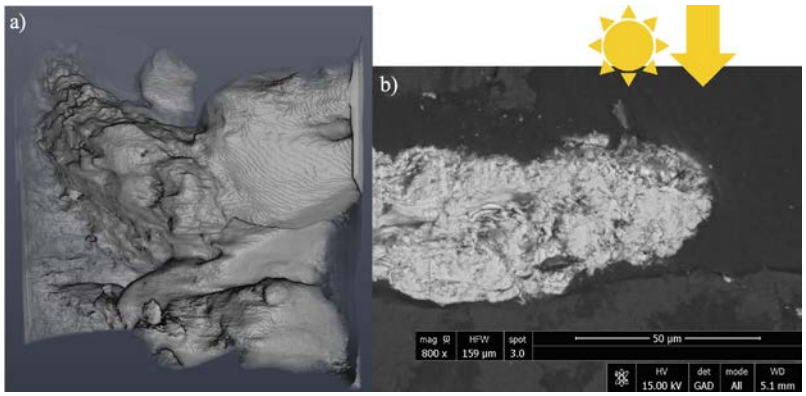

Figure 1: a) 3D visualization of light aged As_2S_3 pigment particles obtained by TXM shows an alteration in the morphology of the pigment particles b) SEM image of light aged As_2S_3 pigment particles in Paraloid B-72 resin. Left side of the pigment particles were covered by PTFE tape, blocking direct illumination.

References

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