Non-Destructive XRD Analysis of Paints for Art Historical Research

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We have tested the application of a novel, non-destructive XRD technique to the crystallographic analysis of the pigments in artistic paint samples as a forerunner to the investigation of paintings. Back-reflection energy-dispersive XRD is a powder technique that is not sensitive to the shape of the sample and can therefore be applied without sample preparation[1,2]. A panel of oil-based paints commonly used by 20th century artists, previously prepared to test hyperspectral imaging capabilities[3], was used as a test-bed (Fig. 1). This panel was taken to the Diamond Light Source synchrotron in the UK and the diffraction patterns of individual paints were recorded.

An example pattern of 'Flake White' (Michael Harding paints) is shown in Fig. 2. The analysis shows clearly the presence of zincite (ZnO), cerussite ($PbCO_3$) and hydrocerussite ($2PbCO_3.Pb(OH)_2$). In addition to simple phase identification, the technique also furnishes precise unit cell dimensions and information about particle size and morphology via the analysis of peak widths. These additional parameters have the potential to distinguish pigment production methods and dates, crucial information for art historical research and authentication purposes. In this presentation, we will review the data derived using the test panel and discuss the implications for the scientific analysis of paintings and other painted objects.

Fig. 1. Image of the test panel of oil-based paints. Flake White is 2nd from the left on the white row.

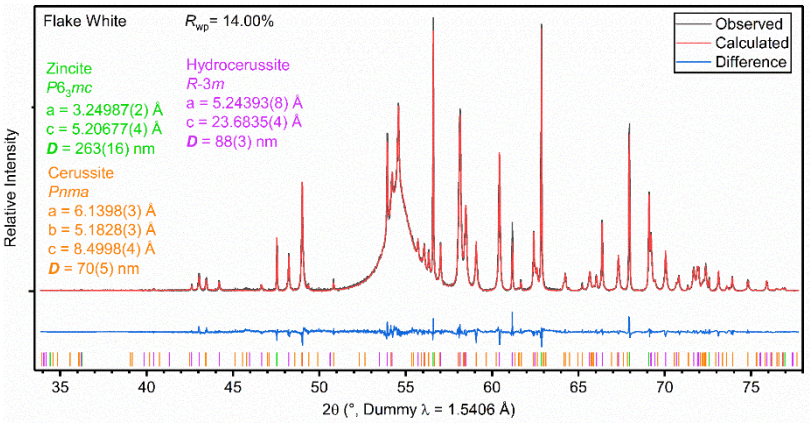

Fig. 2. LeBail whole-pattern fit of the Flake White paint diffraction pattern. The energy scale has been converted to the equivalent 2θ scale (Cu-Kα). The broad feature centred at 54.5° is a reflection due to a graphitic carbon window between the source and the sample which is mounted in free space.

References

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