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X-ray Microscale Spectroscopic Characterization in Cultural Heritage –Implications for the Monitoring and Mitigation of Radiation Effects

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Synchrotron based techniques are widely used for the analysis of complex materials, in part due to the high brilliance of the x-ray source and the ability to tune the x-ray energy. While these characteristics often provide superior performance over traditional lab-based sources, it may also create problems with respect to the high photon flux and potential modification of the sample, which presents unique challenges to the stakeholders of cultural heritage experiments.

Paintings and paint pigments have been well studied by synchrotron-based techniques. While a wealth of information can be obtained through x-ray analysis, one must also be aware of radiation damage. Of particular interest in this work is the chemistry of S moieties in lapis based ultramarine pigments, and As in emerald green pigments. Both of these pigments have been used extensively throughout history and the elements at the center of their color have shown the ability to undergo beam-induced reactions in many samples of biological and environmental origin.

Results from this work show that the x-ray beam can alter these compounds under some experimental conditions. Calculation of the doses applied and absorbed allows a kinetic analysis of the reactions, allowing an assessment on the acceptable amount of radiation exposure. Further work continues to characterize the reactivity of increasingly complex matrices found in real-life Cultural Heritage materials in order to define optimal acquisition parameters for safer analyses.

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