

Towards a Safe Ion Beam Analysis of Historical Paint Materials

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Analytical techniques using energetic ion beams produced by small particle accelerators such as PIXE, RBS, or NRA have been long applied in Heritage Science because they feature outstanding analytical capabilities and avoid sampling. Still, they might not be fully ‘non-destructive’ since under bombardment visible or non-visible modifications might develop on the most sensitive materials, notably in paintworks. While radiation effects have been long investigated in many fields like life sciences, semiconductors or core materials, the potential radiation effects in heritage materials have been rarely addressed [1].

The contribution reports the outcomes of the pilot program implemented in the frame of the IAEA Technical Meeting ‘Developing Strategies for Safe Analysis of Paintings and Paint Materials’ [2]. Its objective was to investigate the effects induced during the analysis by MeV ions on paint materials: mock-up paint layers containing lead white pigments with organic binders and in an oil painting of the 18th century. The complementary ion beams provided by five facilities worldwide were applied in routine conditions, i.e. protons from and He beams from 2 to 5 MeV with doses ranging from 0.1 to 40 $\mu\text{C}/\text{cm}^2$. The induced modifications were investigated using various methods: optical (Vis-NIR reflectance and UV photoluminescence), chemical (ESR, FTIR) and physical (microtopography, nanoindentation). The exploration of the damage thresholds constitutes a first step towards the development of monitoring methods and the establishment of safer and improved ion beam analysis procedures that will insure the preservation of the studied heritage artifacts.

References

[1] Loïc Bertrand et al.: Mitigation strategies for radiation damage in the analysis of ancient materials, *Trends in Analytical Chemistry*, 66 (2015) 128-145.

[2] <https://www.iaea.org/newscenter/news/nuclear-science-for-art-workshop-focuses-on-safe-practices>