

Non-invasive X-ray powder diffraction and fluorescence measurements on medieval artworks by using an in-house-built mobile instrument

General Scope:

This research topic is proposed within the framework of the UGA Cross Disciplinary Program PATRIMALP (<https://patrimalp.univ-grenoble-alpes.fr/patrimalp/>), which brings together research laboratories studying ancient artworks. The main objective of this project is to use ancient materials as records of artistic habits and gestures and to track significant traces of the origin of the raw materials, manufacturing processes or degradation over time. Here, we focus on the analysis of relief decorations found on artworks of the late Middle Ages. This form of sophisticated decoration, called "applied brocade", proved to be a very convincing illusionistic polychromy technique to imitate fabrics enriched with gold and silver, created by textile craftsmen in Italy in the 15th and 16th centuries: it is based on a sheet of tin foil pressed into a mould previously incised with the decorative pattern, eventually gilded and painted. Our aim is to perform *non-invasive* X-ray powder diffraction (XRPD) and fluorescence (XRF) measurements of artworks *on site*, by using a mobile instrument developed at Néel Institute. Thanks to such an instrument it becomes possible to reach a chemical and structural characterization of cultural heritage artefacts, paintings, sculptures, etc. without the need to displace them or to take samples.

Research topic and facilities available:

A mobile instrument, designed by the technological group X'Press, in collaboration with the MRS team, has been recently built and used to perform XRF measurements on flat surfaces (mural paintings, figure 1). The M2 student will be in charge of optimizing the XRPD measurements (including on "3D objects" such as sculptures) and to improve the overall data collection strategy. He/She will be also in charge of data processing: analysis of XRF spectra and XRPD patterns in order to identify/quantify chemical elements and crystalline phases. Measurements will be conducted (i) on standard samples at Néel Institute, (ii) on site (in museums and/or churches) according to the progress of the project and the accessibility to artworks.



Figure 1. Mobile instrument in front of mural painting (Saint-Jean de Maurienne cathedral, France, 15th century).

Possible collaboration and networking:

This research topic is proposed within the framework of the ongoing PATRIMALP collaboration, labelled Cross Disciplinary Program by IDEX UGA in 2017, regrouping 7 laboratories and large research facilities in materials sciences, art history, restoration/conservation and informatics.

Possible extension as a PhD:

Yes if a funding source for a PhD thesis is obtained (research project grant or PhD contract awarded by the Physics Graduate School of Grenoble).

Required skills:

- Master 2 de Recherche in physics, materials science, chemistry, or closely related science
- A background in physicochemical analysis techniques (X-ray based technics in particular) is desirable

Starting date: February 2021

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