

Comparison between Two Molecular Spectroscopy Techniques as Analytical Tools in the Characterization of Pigments in Southern Spain Cultural Heritage: Micro Raman and Micro-FTIR Spectroscopy

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A general overview about the complementary use of two techniques of molecular spectroscopy in the study of Cultural Heritage is described in this work: micro FT-IR and micro FT-Raman spectroscopy.

Both of them share a series of advantages such as the sensitiveness or spatial refinement (by the incorporation of the microscope); nevertheless, the greater specificity or the possibility of non-destructive (by means of an optical fiber) and on site analysis (by means of a portable equipment) make the Raman spectroscopy a very suitable and powerful technique in Cultural Heritage studies.

On the other hand, Raman spectra are more easily obtained, however difficulties may arise through the scattered signal being obliterated through filters.

A variety of pigments in samples belonging to the Cultural Heritage of Southern Spain are characterized by micro Raman spectroscopy using visible excitation sources and micro FT-IR spectroscopy. Some of the pigments studied comprise blue (azurite, ultramarine blue, Prussian blue), red (vermilion, haematite, red ochre, red lakes), green (copper resinate, verdigris, chromium (III) oxide), orange (realgar), yellow (lead-tin yellow) and white pigments (calcite, gypsum, white lead, titanium white, zinc white, barite, lithopone) among others. A protocol is established for their appropriate characterization.

Some samples have been prepared using the cross-section technique, what involves obviously a destructive study but the total number of samples taken diminishes noticeably due to the combined on site study of the artwork. This technique of preparation provides a wide variety of information: it discloses the stratigraphic succession of the layers in the painting and permits an exact localization of the identified pigment grains. It allows the examination of a quite large portion of a single paint layer in its original condition avoiding any further manipulation. Additionally, the same cross-section sample can be characterized by other techniques of analysis such as energy dispersive X-rays microanalysis coupled to the scanning electron microscopy (SEM-EDX).

Of course, the possibilities of Raman and FT-IR spectroscopies are greatly enhanced if they are used in conjunction with an elementary microanalysis by SEM-EDX. Characterization by micro FT-IR and micro Raman presents difficulties with some pigments. In these cases, analysis by EDX solves most of these arising doubts.

We can conclude that the combined use of both spectroscopic techniques, micro FT-IR and micro Raman together with the SEM-EDX microanalysis, provides a useful method in the characterization (and possible dating) of materials used in Cultural Heritage.