



Study by micro-Raman spectroscopy of wall paints (external parts and cross-sections) from reales alcazares of Seville (Spain)

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The Reales Alcazares of Sevilla was originally builded by the Arabic in the year 913. The Mudejar Palace was built by Christian King Pedro I between 1364 and 1366. At the end of XV century the Catholic Kings, Isabel and Fernando made important transformations especially in the Mudejar Palace. Recently, wall paints from Catholic Kings periods were found during works of conservations in the first floor of the Palace. The study of these paints by non-destructive techniques was considered of great interest in order to determine the technology of manufacture and the originality of the artwork. The main objective of this work was to apply the Raman spectroscopy technique on the surface of the wall and on the different layers of the cross-sections prepared in order to characterize the pigments and the plaster present in these wall paints.

Little information was obtained using a portable Raman spectrometer. In this case the dispersive integrated Horiba Jobin-Yvon LabRaman HR800 system was employed. Small samples of black, red, yellow, white and green colour were taken from the artwork. The surface of the samples were directly studied by the Raman spectroscopy instrument using red (785 nm) and green (522 nm) lasers, similarly to non-invasive experimental technique. This technique showed the presence of gypsum ($\text{SO}_4\text{Ca} \cdot 2\text{H}_2\text{O}$) and calcite (CaCO_3) in all the studied samples. However, the pigments responsible of different colours were not detected. The surface of these wall paints was covered with gypsum and calcite due to contamination. These minerals were also characterized by XRD and SEM-EDX. The presence of these compounds and the heterogeneous surface did not permit the characterization of the pigments responsible of the colour.

In order to better characterization of the pigments and plaster used the study was carried out on cross-sections. The black colour was performed using carbon black. Two different red layers were detected one constituted by cinnabar and lead carbonate and the other one by iron oxides. The green and white colours were constituted by atacamite and calcite, respectively. In addition lead white was detected in green colour.

The white layers (plaster) located under the colour layers were constituted by calcite, quartz and feldspars. These data confirm the use of fresco technique.

The study of the surface (external part) by micro-Raman spectroscopy limited the characterization of the pigments present in these wall paints, due to the presence of a layer of gypsum deposited on the surface. By other hand, the study by Raman spectroscopy of the cross-sections allowed the characterization of different pigments and support used in the manufacture of these wall paints.