Investigation of ancient Egyptian polychrome wooden artifacts by the combined use of imaging and handheld XRF spectroscopy

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The scientific analytical techniques of artifacts, belonging to museum collections in particularly unique objects such as King Tutankhamun collection (18^{th} dynasty 1347-1337BC, in ancient Egypt) which emphasize the necessity of working with noninvasive techniques, have gained much interest in the last years.

In this study, we demonstrate the ability of combining imaging techniques and hand held XRF as a very efficient and non-destructive method for analyzing the polychrome layers and previous applied materials for a number of wooden objects belong to King Tutankhamun.
In the first step, Multispectral techniques [visible-reflected (VIS), ultraviolet-induced visible luminescence (UVL), Visible-induced visible luminescence (VIVL), ultraviolet-reflected (UVR), infrared-reflected (IRR) and infrared-reflected false colour (IRRFC)] and optical microscopy were applied to gather information and to provide evidences on the distribution of original and previous applied materials on the polychrome surfaces. In the second step of our work, we analyzed the selected areas with hand held X-ray fluorescence spectroscopy (XRF). The materials of the previous restoration interventions were studied by Fourier Transform Infrared Spectroscopy (FTIR).

The results showed that the application of a protocol based on imaging techniques combined with data obtained from single-spot techniques such as X-ray fluorescence spectroscopy (XRF) allowed the characterization of a remarkable number of pigments and some previous restoration materials and mapping of their distribution on original and retouching areas of the surface without sampling. However, complete characterization of some polychrome layers required the use of other techniques such as XRD and FTIR spectroscopy.

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