

**A Multi-instrument Investigation of Pigments, Binders and Varnishes  
from Egyptian Paintings (AD 1300-1900): Molecular and Elemental  
Analysis Using Raman, GC-MS and SEM-EDX Techniques**

Mona Hussien **Abdel-Ghani**  
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**Key words:** Raman spectroscopy, gas chromatography-mass spectrometry, SEM-EDX, paint layers (pigments, media, varnishes), Egyptian Coptic icons, Islamic wooden ceilings, degradation, conservation sciences

## **Abstract**

The focus of this study was analytical investigations of Egyptian paintings, mainly Coptic icons and Islamic wooden ceilings, dating from 1300-1900 using multi-instrumental techniques. Twenty three Coptic icons and three wooden ceilings dated from different periods and painted by different painters in case of icons were examined. The materials used including pigments, media, varnishes, ground layers and gold layers. The surface stratigraphy of paint samples, their layered structured and the composition of materials used in each layer were analysed. Variations in painting techniques, pigments palettes, paint media and varnishes applied in Egyptian paintings according to painters, time and type of paintings were revealed.

A total of twenty-eight organic and inorganic pigments were identified in this study, of which nine have never been previously included as a part of the Egyptian pigment palettes, namely; smalt, lapis lazuli, indigo, pararealgar, Prussian blue, chrome yellow, barium yellow, barium white and hydromagnesite. The identification of hydromagnesite, which has never been to date considered as a pigment either in Egypt or elsewhere and the identification of smalt from the mid-14<sup>th</sup> century, whose reported earliest large scale use was in the 16<sup>th</sup> century. Two types of resins were identified as a constituent of the oil/resin varnish applied on Coptic icons of which Venice turpentine has been identified for the first time as an ingredient of Egyptian varnishes. The identification of mosaic gold in an 18<sup>th</sup> C. icon, a novel usage of dammar resin and the multilayered structure of the white ground layers were revealed.

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