Non-destructive Analysis and Conservation of Greek Papyrus in Egyptian Museum Cairo, Egypt

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ABSTRACT

Using modern analysis methods is very important for identifying archaeological materials to understand the deterioration mechanism and select appropriate treatments ,so this research shows several analysis of Greek papyrus document No.SR.1772, (CG) 31194 at Egyptian Museum , Cairo ,Egypt . The analysis is done by using Raman microscopy, Scanning electron microscope (SEM) with energy dispersive x-ray analysis (EDX) and Fourier transform infrared spectroscopy (FTIR) for identifying the writing materials and also the adhesive that was used in adhere ancient papyrus with secondary support ,as well as its conservation processes involving cleaning, consolidation, removing unsuitable secondary support, and finally storing.

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INTRODUCTION

Papyrus plants were one of the most important sources of writing material in ancient cultures and are first used over 5000 years ago in the Nile Valley Kingdoms.

Papyrus number SR.1772, CG.31194 housed in Egyptian Museum ,Cairo was selected for this study ,measure 7.5 *5.5 cm, it was found in Gebelein ,Luxor. it is part from document with Demotic line dates back to Ptolemaic era.(Fig.1)

For many years different kinds of secondary supports have been used such as (gelatin, celluloid film, paper ,cardboard, gold beaters skin, Plexiglas and glass) with different kinds of adhesives like(starch, animal glue and waxes) which cause many deterioration aspects to archaeological papyrus.

In this paper, the goal is to use non-destructive analytical techniques in order to provide a deeper understanding of the materials . Moreover, apply appropriate conservation techniques to the papyrus, Different techniques have been applied for investigation and analysis of selected papyrus.

METHODS AND MATERIALS

The object were studied using SEM-EDX, Micro Raman and Micro FTIR .

1) SEM-EDX: Philips Environmental Scanning Electron Microscope (ESEM) model: XL30 was used to observe the surface morphology. also we analysis sample ink and surface of papyrus to know the components of it.

2) Fourier transform infrared spectroscopy (FTIR) : Infrared reflectance spectra was recorded using a Vertex 70V (Bruker Optics) spectrometer, The recording time varied according to the quality of spectra obtained and ranged between 600-4000 scans and spectral resolution was 4 cm^{-1} .

3) Raman spectroscopy: The micro-Raman spectra were obtained using a Renishaw spectrometer equipped with a CCD The blue beam of an Ar+(488.0 nm) laser was used for sample investigation. The phonon peaks, appeared in the spectra, were fitted with Lorentzian distributions, for the best possible determination of their frequencies. The instrument was calibrated using the spectrum of a silicon wafer as a reference.

RESULTS and Discussion

The results of the analysis proved that starch adhesive was used to fix archeological papyrus on old paper backing ,**The IR spectrum** of starch sample was described by many absorbance peaks as follow ,The peaks at 3334 cm−1 and 2918 cm−1 could be attributed to O–H and C–H bond stretching, respectively, while the peaks at 1423 cm−1 and 1,368 cm−1 were attributable to the bending modes of H–C–H, C–H and O–H. The peaks at 1300-1000 cm−1 were attributed to C–O–H stretching. The peaks at 1155 cm−1 , 1202 cm−1 and 1027 cm−1 were assigned as the C–O bond stretching. (Michele,R et al 1999) Additionally, The comparison between the spectra from the old adhesive and the starch standard yields a good fit as (Fig.4) This finding is agreement with (walker,A.1988) .

Carbon ink was determined as the writing material by using **Raman Spectroscopy** which revealed through the characteristic strong and broad bands at ~1320 and 1567 cm−1 (Alessia C. et al 2012) (Fig.2) which confimed with SEM-EDX. In (Fig .3).

Arabic gum is identified as a binder for the ink in this papyrus by FTIR anlalysis , The restoration process reveal that hydroxylpropyl cellulose (HPC) and Gampi paper achieved great success for lining surface of papyrus during the removal of old paper backing.

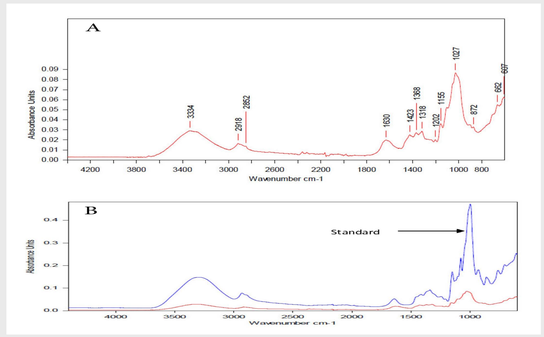

Fig.4A FTIR spectra of the old adhesive used in attaching papyrus on paper support,4B FTIR spectra of old adhesive compared with starch standard.

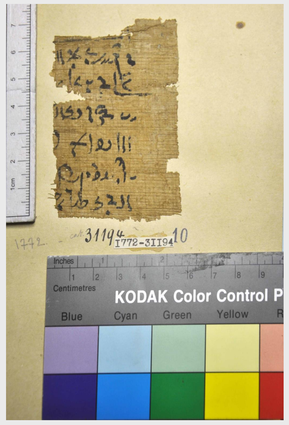

Fig.1. papyrus fragment before conservation with many types of deterioration..

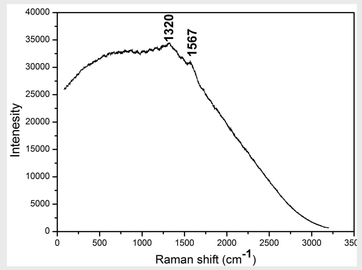

Figure 2. Raman spectrum of black ink .

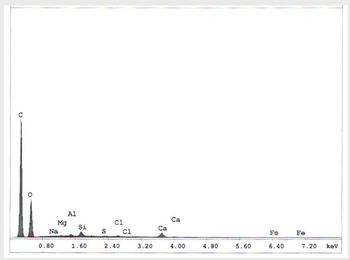

Figure.3 .SEM- EDX spectrum of black ink

Conservation Treatment

Papyrus conservation processes included surface cleaning, removing unsuitable secondary paper support by applying surface lining using hydroxylpropyl cellulose (HPC) 4%and Gampi paper (Fig.5a) . damping the backing with (ethanol+distilled water) and peel it off , then we dampened the facing lining with a brush impregnated with acetone and remove it (5d,5e), the treated Papyrus was mounted between two sheets of three-millimeters glass.

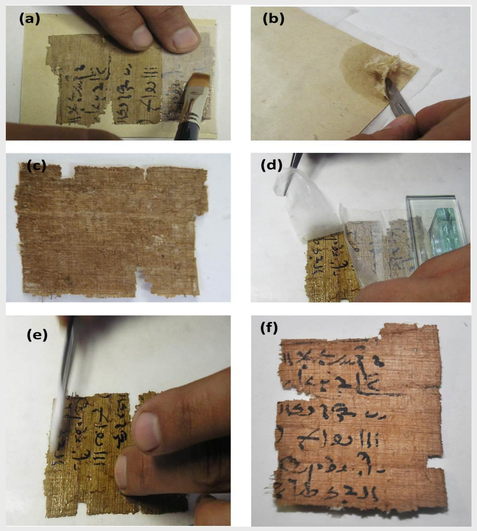

Fig.5.shows the conservation treatment of the selected papyrus.

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