Using Some Examination and Analysis Devices for Authenticity of Manuscript

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Abstract: The technological advancement process of falsifying old documents and manuscripts of doubtful authenticity that constituting a major problem in the field of forgery, and this study aims to reduce forgery and forgery in a scientific and safe manner, so it is necessary to understand and study the compounds that involved in forming the differentiation between old paper and modern paper by (FTIR & SEM), firstly, when using (SEM) to identify the sample surface and then compare between the old sample and forgery sample, to notice the difference between them and is there a time fingerprint applied to the sample? Second: When using (FTIR), in which the internal compounds are studied with a follow-up of the time factor and its mark on the functional groups, and the result was a clear difference between the fake sample and the original sample, this difference clearly appeared in the analyzes and examinations used, where it appeared using (SEM) found dust what firm penetrator is not visible to the eye in the applied sample due to the accumulation of dust over time and its penetration, and the most important thing that the analysis (FTIR) showed is the emergence of the group of alkanes responsible for energy storage, which explains the speed of burning old paper, and the group responsible for the presence of gelatin in the applied sample only appeared due to the technique Industry in the past, and finally, the group responsible for carbonyl appeared in the old paper due to its complete drying after losing the hydrogen atom unlike the modern forgery paper, so we came out of this study with the possibility of establishing the idea of detecting forgery with easy-to-apply scientific evidence.

Keywords: Manuscripts, Fake, Forgery, Authenticity, FTIR, SEM

1. Introduction

Using the scanning electron microscope by generating a current of high energy electronics from (0.5: 40) kV, the current will clash with the sample which studied, The sample image will reflect clearly and accurately up to a distance of (10) nm, thus The electronic microscope features that the samples do not need many of the processing except in the case of the powder sample, so the soft material is in a state of agglomeration to reduce its chemical energy, as this problem can solve by adding some acetone to the sample to reduce its energy without aggregation, as the scanning microscope use to picturing the structure of the sample with a clear and high magnification [1, 2], however the analysis by (SEM) helps to distinguish between the original and fake manuscript by studying the dating the manuscript and the technology of the pulp industry with linking the image of the used compounds historically with the image of the elements Samples to be

examined, FTIR is a non-destructive method to illustrate the chemical properties of manuscript and document surfaces, It analyzes a sample of 1-4 cm, either FTIR is used to identify functional groups of cellulose in each sample and to detect the vibration and dysfunction of functional groups, these differences help to definition of natural or industrial and fabricated aging, as well as to determine the chemical composition of the additives during the preparation of the pulp for each sample paper, It also distinguishes between the paper by identifying the raw materials used and the additives in the industry paper, Which determines the method of making the pulp if it is from the chemical or quasi-chemical pulp [3, 4].

2. Materials and Methods

2.1. Historical Samples

Manuscript of the Islamic era named (Al-Hawi LiLmsayil

Al-Nfayis), written by (Refaa Al-Tahtawi) and (Mostafa Al-Zrabi), it from a Special library in upper Egypt, manuscript dimensions (24x 19 cm) 288 pages, the binder is made of textile, dyed in green color, the manuscript is connected together with three-piece sutures, It has no tongue, it is printed with black ink by (Dar- Al-Tebaa) with dating (1865 AD).

Figure 1. Applied Manuscript of the Islamic era.

2.2. Experimental Samples

2.2.1. Analysis (SEM + ED-X) of the Applied Sample

The analysis and examination was done to can do the corresponding experimental samples in the laboratory of the Egyptian General Authority for Mineral Resources in the Ministry of Petroleum and the characterization of the scanner electron microscopy used as follows:

(Model Quanta 250 FEG + ED X Unit with accelerating Voltage 30 K.V. magnification 14x up to 100000 & resolution for Gun.in)

Figure 2. A place of a sample of an applied manuscript by circle red color.

Examine and analyze the manuscript paper using (SEM + ED-X):

Figure 3. Paper under 100.

The fibers used are cotton fibers.

Figure 4. The analysis of the manuscript paper using (ED-X) The components of cellulose are shown next to the elements of the additives (S, Al, Si) with the presence of (Na, Fe).

2.2.2. Paper Samples

It Based on the examine and analysis of the applied manuscript, it was found that the paper pulp was made of cotton beside the additive materials used in the pulp (Rosin, kaolin, gypsum and gelatin) [3], The samples were prepared by hand mill to soften the ingredients and remove the undesirable materials, (90% cotton, 10% additives) [5, 6].

Figure 5. The experimental samples were prepared based on The analyzes and tests of the applied manuscript by 'Rakta' Company in Alexandria.

2.2.3. The Aging of Paper

Thermal ageing of the experimental samples under 90 ° C for 500 hours in the presence of a source of moisture, based on the scientific specifications of the measurements (TAPPI T 453) [5] with a 90 ° pattern for 72 hours equal to 25 years old, Using a Thermal oven (Nabertherm – Model L N31 P) In the laboratory of the Department of Conservation - Faculty of Fine Arts - Minya University, to be a sample after every 100 hours are analyzed by FTIR & SEM components to choose the appropriate sample to compare with the original [7, 8].

Figure 6. The experimental samples after aging.

2.2.4. Experiment for Authenticity

By Devices for authenticity (Scan Electron Microscope, SEM) in the laboratory of the Egyptian General Authority for Mineral Resources in the Ministry of Petroleum, the - (FTIR) Device laboratory analysis of precision in the sector of Archaeological projects in Cairo.

3. Results

3.1. Analysis Using FTIR

3.1.1. Analysis of Aging Experimental Samples Using FTIR

An ageing experimental sample analyzed by FTIR after every (100 hours) to select the nearest to applied manuscript as follows:

Compare the five experimental samples (sample every 100 hours) and monitor the differences between them, then a comparison between the experimental sample before the ageing and the experimental sample after the ageing.

First, Comparison of the five experimental samples (sample every 100 hours): A comparison of five ageing samples at (100/200/300/400/500 hours) was conducted to monitor the differences between the five samples and select the best ones to compare them with the experimental and applied samples using FTIR.

Figure 7. The analysis pattern is illustrated using FTIR Transmittance and comparison of the five samples.

Figure 8. The pattern of analysis is illustrated using FTIR Absorbance and comparison of the five samples.

Note, there is no significant difference between the five samples so indicating that the heat does not affect experimental paper compounds, the fifth sample is the most aging sample, and therefore used in the following comparisons.

Second, Comparison between the experimental sample

before the aging and the experimental sample after the aging:

Figure 9. Pattern analysis is illustrated using FTIR Absorbance, Comparison of the experimental sample prior to aging and the experimental sample after aging.

Figure 10. The applied sample, the experimental sample after the aging (500 h) and the experimental before the aging using FTIR.

Figure 11. Applied Sample and Experimental Sample After aging (500 h) Using FTIR.

After comparing the experimental sample before the aging and the experimental sample after the aging within 500 hours it became clear that the difference between them is nonexistent and negligible, the comparison between the experimental samples before, after the aging (500 h) and applied sample explain the functional groups there is no significant difference between the experimental sample

before the aging and the experimental sample after the aging (500 h) but the difference was between applied sample and sample before & after aging.

Figure 12. The applied sample and the experimental sample after the aging (500 h) using FTIR.

3.1.2. The Comparison

Showed the following differences in the applied sample:

a- Appear:

- The group of (C-CH₃) at (2916 Cm⁻¹)

This group represents the group of hydrocarbons (alkanes), especially (methyl), which is responsible for storing energy in the old paper and this explains the speed of ignition of old paper.

b- Appear:

(C-C) group at (1620 Cm⁻¹).

(C-N-H) group at (1575 Cm⁻¹).

(C-H) group at (1539 Cm⁻¹), (2889 Cm⁻¹) [9, 10].

These gelatin groups, which appeared more densely in the applied sample than the experimental sample, were due to the less developed industrial method as well as the treatments for the gelatin ore in the applied sample, which made it retain its density.

c- Appear:

The carbonyl group (C=O) at (1645 Cm⁻¹)

It is a component of cellulose, and it is noted that there is a double bond of the carbonyl group, which appeared only in the applied sample [11, 12].

3.2. Examine Using SEM

The comparison showed that the applied fibers of the manuscript are spread by the dust grains that are diffused and cause the white spots along the fibers, this is not found in the experimental sample [13, 14].

Figure 13. Applied sample under (SEM) 1000 x.

Figure 14. Experimental sample under (SEM) 1000 x.

4. Discussion

4.1. Comparison of Surface Appearance Using (SEM) of the Applied Sample and the Experimental Sample

It is noticed from the comparison between the modern experimental sample and the original old sample that there are clear differences that were accurately recorded by the devices used, and the differences were in clear physical phenomena such as the reason for the appearance of dust in the old sample, as well as the reason for the appearance of a group of alkanes in the old sample and not appearing in the modern sample.[15] These differences have been monitored and the phenomena explained in the following tables for ease and clarification.

Table 1. Comparison of surface appearance using (SEM) of the applied sample and the experimental sample.

	Applied Sample	Experimental Sample	Interpretation
SEM	The applied fiber is permeated by the dust particles that are permeable and cause white spots scattered all over the surface of the applied manuscript.	There is no dust and granules.	The manuscript was exposed for a long time to dust, which enabled it to penetrate

4.2. Comparison of Functional Groups Using FTIR for the Applied Sample and the Experimental Sample

Table 2. Comparison of surface appearance using (FTIR) of the applied sample Paper and the experimental sample Paper.

Functional Groups	Applied manuscript	Experimental Sample	Interpretation
C-CH ₃	Appear	Do not appear	This group represents hydrocarbons that appear over time (alkanes), especially methyl, which is responsible for storing energy in the old paper and this explains the speed of ignition of old paper.
C-C	Appear	Do not appear	These gelatin groups, which appeared more densely in the applied sample than the experimental sample, were due to the less developed industrial method as well as the treatments for the gelatin ore in the applied sample, which made it retain its density.
C-N-H			It is considered a component of cellulose, It is noted that there is a double bond of the carbonyl group, which appears only in the applied sample, whose hydroxyl content (OH) has been dehydrated. The hydrogen (H) is moving and the oxygen atom (O) is bound to the bond with the naturally occurring carbonyl (CO) In cellulose, the bond became a binary (C=O).
C-H			
C=O	Appear	Do not appear	

5. Conclusion

The SEM examination showed that the applied sample paper and experimental sample paper have a clear difference in the penetration of dust in the fibers of the manuscript paper. The FTIR analysis showed differences in the appearance of functional groups, such as alkenes, and functional groups representing gelatin. As well as the emergence of the carbonyl group in the old sample, due to complete dehydration, which did not occur in the modern sample, finally both of FTIR & SEM were important tools to detect of forgery and fake the archaeological.

References

- [1] Gambaro. A., Ganzela. R., Fantin. M., Cappelletto. E., Piazza. R., and Cairns. W., (2009) Study of 19th Century Inks from Archives in the Palazzo Ducale (Venice, Italy) Using Various Analytical Techniques Micro, chemical Journal 91., P. 203.
- [2] Doumenq. P., Mille. G., and Carvalho. M., (2015) Conservation of Moroccan Manuscript Papers Aged 150-200 and 800 YEARS, Analysis by Infrared Spectroscopy (ATR-FTIR), X-Ray Diffraction (XRD), and Scanning Electron Microscopy Energy Dispersive Spectrometry (SEM-EDS), Spectrochimica Acta Part A., PP. 1040-1041.
- [3] Derrick. M., Stulik. D. and Landry. J., (1999) Infrared Spectroscopy in Conservation Science, The Getty Conservation Institute., PP. 179: 198.
- [4] Wahba. W. and Rushdy. A., (2017) Influence of Bleaching Materials on Mechanical and Morphological Properties for Conservation, Egypt. J. Chem. Vol. 60. No. 5, P. 897.
- [5] Zervos. S., (2010) Natural and Accelerated Ageing of Cellulose and Paper, Nova Science Publishers, P. 30.
- [6] Borrego. S. and Gomez. S., (2016) Biocidal Activity of two Essential Oils on Fungi that Cause Degradation of Paper Documents, International Journal of Conservation Science, Vol. 7., P. 372.
- [7] Thompson. J. M., (2012) A Guide to Museum Practice, Routledge Taylor & Francis Group, P. 249.
- [8] Hajji. L. and Boukir. A., (2015) Conservation of Moroccan Manuscript Papers aged 150.200 and 800 Years, Analysis by (ATR+FTIR), (XRD) AND (SEM –EDS), Spectrochimica
- [9] Liang C. Y. and Mechessault R. H., (2009) Infrared spectra of crystalline polysaccharides. I. Hydrogen bonds in native celluloses, Journal of Polymer Science, vol. 37, no. 132, P. 385.
- [10] Alexopoulou. I., Zervos. S., (2015) Paper conservation methods: a literature review, Cellulose, Vol. 5, pp. 1087: 1108.
- [11] Othman, E., Zidan, Y. & Kamal, N. (2014) Using the microscopic and spectroscopic techniques to identify and characterize of archaeological artifacts, International journal of conservation science, Vol. 5, Issue 4, pp. 459-468.
- [12] Beier, G., Niehoff, S., Ziems, T., & Xue, B. (2017). Sustainability aspects of a digitalized industry—A comparative study from China and Germany. International Journal of Precision Engineering and Manufacturing-Green Technology, 4 (2), 227–234.
- [13] Puică, N. M., & Florescu, A. M. (2006), FTIR Spectroscopy for the analysis of vegetable tanned ancient leather. European Journal of Science and Theology, 2 (4), 49–53.
- [14] Samadi, P. Y. (2011). Moist heating-induced changes in protein molecular structure, protein sub fraction, and nutrient profiles in soybeans. Journal of Dairy Science, 94 (12), 6092–60102.
- [15] Noshay W., Nazel. T., Hassan R. R. A., and Hosni. A., (2020), The Use of Digital Technology (2.5D) in the Authenticity of a Manuscript from the Islamic Era, Egyptian Journal of Archaeological and Restoration Studies, vol. Vol. 10, issue (1), pp. 1-7.

CTA, p. 1043.

Biography

Ahmed Hosni, my Work in cultural studies field especially conservation of archaeology and detection of fake of archaeology, As you will see from my article, my skills and experience are fit of the idea what I offer, Particular reverence is matched my 10 years' experience working in conservation archaeological, and my university certificates in the field, I had a PhD in conservation and restoration of archaeology field.