Evaluation of the use of nanoparticles in the protection of non-dyed antiquity textiles from stain effect - experimental study

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Summry

1-Introduction

This study has attempted to solve the archaeological textiles staining problem through the use of modern nanotechnology and its applications to carry out the investigation experimental study on the use of (ZnO, TiO_2) for the protection of archaeological textiles from the effects of deterioration stains and the other deterioration aspects by giving the property of stains self-cleaning for textiles with the future protection from re-staining without cruel changes of the textiles nature of when compared with the traditional methods of cleaning and stains removal, the results of this study was confirmed by using the signs , optical measurements , mechanical tests ,investigation and analysis by Modern equipment for accelerated aging experimental treatment samples with the previous Nano-materials , so This study followed the investigation experimental method for the use of nanotechnology applications, which is the fourth generation of the industrial revolution in the human history to give the materials new properties and Nano sizes up to 1 billionth of a meter, which is smaller than the size of the bacteria, to discover the properties of Nano protection materials for archaeological textiles against the disintegration with different stains , fungi and light and achieved the stains self-cleaning without affecting on the textile fibers, and as an alternative to the dangerous chemical traditional methods for removing and clean some linen textile stains.

Key words:
Staining - Archaeological textiles - Nanotechnology - Experimental study - Self cleaning - Measurements - Analyzes – Investigation

2- Materials and methods

2.1. The study target

This study aimed at the following:

- Obtain simulated of archaeological clean, stain-free textiles samples then applying Nano protection materials and study future preventive conservation
- Efficiency assessment of the Nano protection materials for protective the tensile strength and elongation mechanical properties of the study experimental samples.

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- Study the success of Nano materials to remove the harmful effects of light and using its positive effect to activate its ability to perform self-cleaning of stains with the possibility of stopping the fungal growth damage on experimental textiles samples.

2.2. Experimental Study Steps

Preparing (63) linen textile samples, divided into 21 samples for each of the three experimental stains. Then achieved the first accelerated light ageing process that was done at 100/ h light exposure. Then the Nano protection materials of both ZnO and TiO2 were applied on the clean, stain-free ageing samples. Then the linen samples were staining with the three groups of stains (fruit stains, oil stains, fungus stains) then achieved the second accelerated light ageing was performed at 100 / h light exposure.

3 . Discussion and Results

3.1. The results of SEM examination for samples sating with fungus and after the second light aging, showed that the fungal colonies in the samples treated with both TiO2 and ZnO nanomaterials were dissipated due to the light catalyzing of nanomaterials and their ability to break down the fungus cell walls and destroy them in a strong oxidative reaction process. and that consider strong evidence for multifunctional of nanomaterials and protection degree for experimental textiles samples.

3.2. The results of SEM examination for samples after sating with the fruit juice showed the efficiency of TiO2 to inhibit the penetration of fruit juice and to prevent the formation of the stains film on the fibers textiles surface more efficiently than the protective of Nano ZnO that confirming the ability of TiO2 fruit stains self-clean.

3.3. When SEM was tested for experimental linen samples after the staining with oil that showed the TiO2 efficiency to impede the deposition of the oil stain with higher efficiency than ZnO protective nanomaterial.

3. 4.when investigate the pH values of the(Fruit stains - oil stains - fungus stains) showed that the Fruit juice comes in the first degree with high pH values, followed by linseed oil, whereas fungal stains continues have no effect on pH values.

3.5. The decrease of tensile strength and elongation ratios after the first light ageing showed the extent damaged effect of light on the strength and durability of fibers, which results in a decrease in the polymerization degree of the cellulose and interrupt its chains with decrease in the mechanical properties. .

4. Conclusion

4.1. The results of the visual examination, confirmed by the examination with SEM, explain the effect of accelerated light aging on the color change of the linen samples and their color whitening by their color fading .

4.2. The study showed the role of light stimulation of nanomaterials in protection, and remove the fungal stains, the inhibition and destruction of their colonies through a strong oxidative reaction in self-cleaning processes.

4.3. Protective nanomaterials played an effective role to neutralize the acidity of textiles samples and reduce their values, which were increased by light aging and staining.
4.4. The effect of ZnO, TiO2 nanoparticles to protect the treated samples from the light effect was determined but With the continuous of the light exposure periods and the effect of the falling rays, the degree of protection gradually decreases to the lowest level **.**
4.5. The negatively effect of the nanomaterials self-cleaning property on the experimental samples mechanical properties has been demonstrated by the gradual reduction of tensile strength values and therefore have been considered nanomaterials to be a double-edged sword.
4.6. The study made sure that the use of nanoparticles with a 1% concentration gave more positive results than 0.5% nanoparticles in textile protection. However, the lowest concentration recorded a better degree of absorption on the sample surface.
4.7. It must be sure that there is no absolute protection and sustainability forever, and that in addition to modern research to employ the modern technological technologies in the restoration and conservation of archaeological textiles filed must coincide with the emphasis must be attention to preventive conservation of storage and preservation of archaeological textiles in the standard safety conditions to avoid staining With different stains.
4.8. It should be borne in mind that the results of this pilot study are only on flaxseed tissue samples and can not be applied to other substances without future experimental studies.

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