



Abstract

This paper aims to document the conservation processes of a wooden coffin covered with a black resin layer and colored materials in Dahshur Archaeological Area dating back to the late period. The coffin consists of a body and a lid. The lid was broken into more than 16 pieces. The exterior part of the coffin was decorated with a black resin layer and a painted layer. Visual observation, 2D and 3D programs, and Optical Microscopy (OM) were used. Wood identification was carried out. The coffin was previously conserved and was in bad condition. It was covered with a thick layer of dust with lost parts of the painted and gesso layers. Other parts of these layers were lost. Moreover, some parts were missing from the head area of the lid coffin. The conservation processes of the wooden coffin included mechanical and chemical cleaning; reassembling the separated wooden parts, ground layer, and black resin layers; filling the edge of the ground layer; consolidating the wood, black resin, and painted layer. The conservation processes included mechanical cleaning using soft brushes, chemical cleaning using xylene and distilled water for the black resin layer and ethyl alcohol and distilled water for the painted layer, stabilization of the separated ground layer using Paraloid B72, filling the cracks of the ground layers using glass microballoon with Paraloid B72, and consolidating the painted layer with nano-silica with Klucel G (hydroxypropyl cellulose) (0.5% concentration).

Introduction

The studied coffin was found in the Dahshour store room and measured (190) cm long, (51) cm wide, and (55) cm high. The body of the coffin was separated because of the damage to the tenon. In addition, there was a missed part on the left side of the body and the lid, and the face of the lid was missed. The outer surface of the coffin was covered with a textile layer at some parts under the preparation layer, and black resin layer decorated with painted layers (yellow, red, and blue), while the inner surface was covered with a yellow painted layer. The painted layers suffered from many deterioration aspects, including flaking, cracking, and missing parts. It was covered with a thick layer of dust resulting from bad storage inside the storerooms of the Dahshour Archaeological Area. Therefore, this study aims to investigate the pigments, ground layer, and black resin layer, identify the wood species used on the coffin, and provide necessary information for suitable conservation work using 2D and 3D documentation and different techniques.

Materials and Methods

Visual Assessment Light Microscope	Documentation of the Coffin USB Digital Microscope	Photographic Documentation Stereo Microscope	Photogrammetric Documentation Upright microscopes	2D Documentation
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Results and discussion

The coffin was in bad condition. It was previously restored by primal AC33. It was covered with a thick layer of dust. Bad storage plays a major role in deterioration because wooden artifacts undergo complex alteration and degradation during aging. There was a lot of damage to the coffin, e.g., separations, loss of the ground and painted layers, and missing parts from the head area because of the bad condition of the coffin.

Photographic Documentation



Documentation using Illustrator

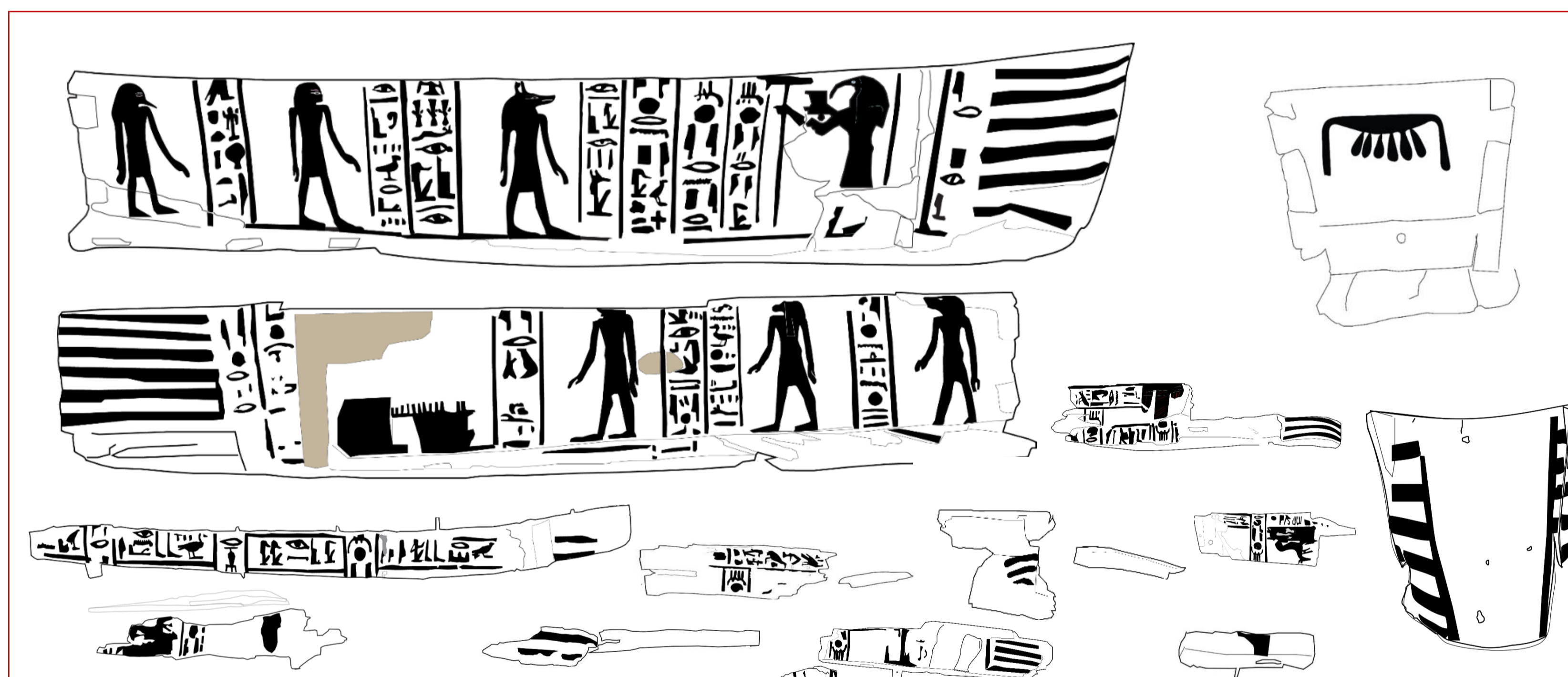


Fig.1. the deterioration of the coffin and missing parts and previous restoration

Fig.2. 2 D documentation of the lid of the wooden coffin

Photogrammetric documentation

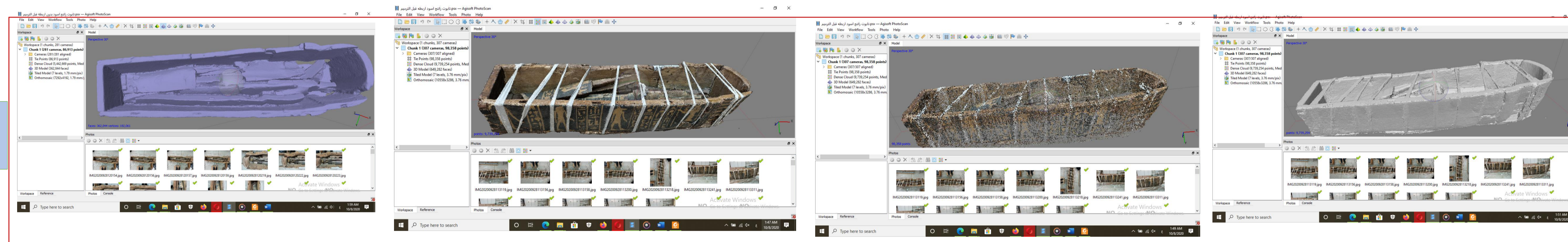


Fig.3. Stages of producing a 3D model of the coffin

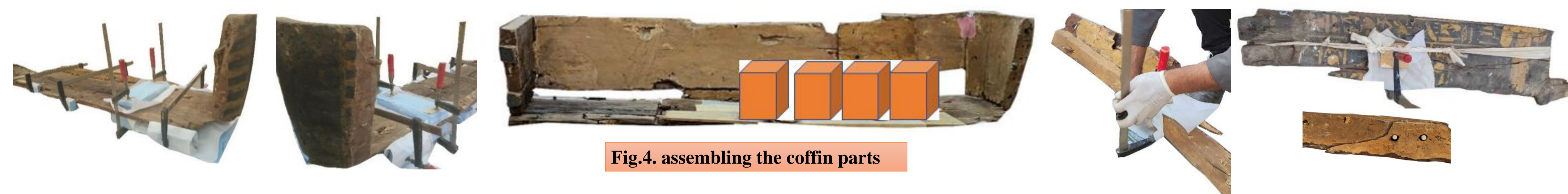


Fig.4. assembling the coffin parts

During assembling the parts of the wooden coffin, the uneven surface of the coffin base was observed; Therefore, an adjustment was made to the base of the coffin; by using Klucel G (1%). Three times, some blocks of different weights were placed on the base of the coffin to return it to its original shape to complete the reassembly of the coffin.

Reassembly

These parts were separated, and the condition of the tenon and mortise deteriorated, and sometimes, there was a break in the wooden coffin. Therefore, the broken dowels were removed and replaced with new dowels, and the separated and broken parts were reassembled again using paraloid B72 (50%). While reassembling the wooden pieces, beech wood dowels were used because of their great hardness and suitability for the size of the coffin. They were used in different lengths. We removed the dowels used from balsa wood in the previous restoration because they were very weak, and some were broken.

Loss Compensation

Cotton was used in paraloid B72 (15%) in acetone to fill the voids in the wooden coffin. After complete drying, a glass microballoon was used in paraloid B72 (15%) to level the surface and prepare for the coloring process of the completed parts.



Fig.5. the coffin before the assembly process; a) the left side of the coffin; b) the right side, of the coffin; c) the lid of the coffin

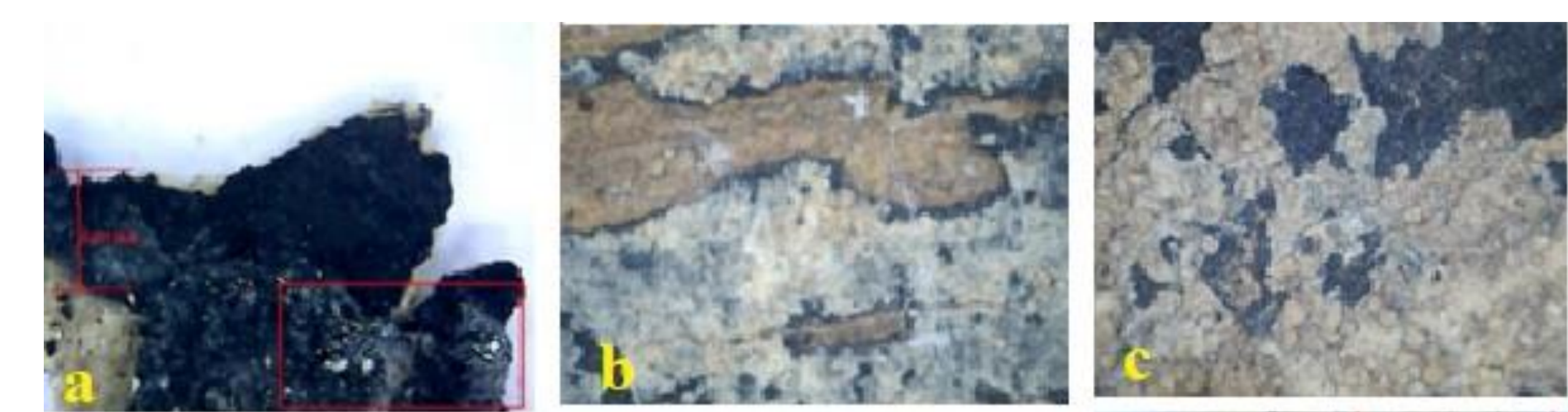


Fig.6. Optical photomicrographs showing the course morphology of the black resin layer and painted layers surface used in the coffin



Fig.7. during the application of Klucel G; In preparation for complete assembly of the base of the coffin



Fig.8. the the coffin,during and after assembling



Fig.9. the coffin after reassembly and completing the missing parts the left side and the right side, of the coffin.



Fig.10. the places of the modern dowel; that was installed during the assembly process

Consolidation

From the experimental study of the different consolidation materials and after making the appropriate evaluations, the lowest color change rate of nanocellulose and nano-silica was 1% in water to consolidate wood samples. Therefore, nano cellulose was used with 1% Klucel G to consolidate the coffin from the inside using the brush. The consolidation process was done for the black resin layer and the colored materials with 0.5% nano-silica in alcohol



Fig.10. the coffin after restoration

A wooden support was used inside the coffin after restoration to support the lid from the inside. It was made without the use of chemical materials. To make it removable or modified in the future, silicone paper was used to isolate the new wooden stand used for the reinforcement from the wood of the coffin.

Conclusion

The paper presents the investigation and documentation of the coffin and documents the conservation process. The coffin suffered from several deterioration phenomena, including damage to the coffin, separations, loss of the ground and painted layers, and missing parts because of bad storage and previous conservation. Therefore, a 2D program was utilized to illustrate the decoration of the black resin layer, and a 3D program was used to make a 3D model of the coffin. Optical microscopy was applied to investigate the surface of the black resin and painted layers. In addition, wood was identified as sycamore (*Ficus sycomorus*), and tenon was *Quercus cerris L.* (Cupressaceae).

The phases of restoration were documentation, mechanical and chemical cleaning, consolidation, reattaching of the ground layer to the support, and filling the ground layer edges. Paraloid B72 (50%) was used for the reassembly of the ground layer, while a mixture of microballoon, Paraloid B72 (15%) and earth pigments was used to maintain the edge of the ground layer. Nano cellulose was used with 1% Klucel G to consolidate the coffin from the inside using the brush. The consolidation process was done for the black resin layer and the colored materials with 0.5% nano-silica in alcohol.