Cairo University

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Optimization of Laser and Ultrasonic Cleaning Parameters for the Conservation of Metal Embroidery with Application on a Selected Object

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Abstract

This study aimed at testing innovated approaches as laser and ultrasound scaler for cleaning corrosion off the metal decoration.Case studies were investigated and analysed with means of microscopy and ESEM equipped with EDAX that helped identify the fibre types, metal composition, corrosion, and contamination.EDAX Line-Scan helped detect the plating on the surface(surfacings).Laser cleaning is a particular crirtical case of the ablation process. Nano-second Q-switched Nd:YAG laser at 1064 nm and 532 nm was used.Pilot tests depended on varying energy, spot size, and time of ablation(repetition rate) for both wavlengths.Varying spot size was performed through the unfocused or/ focused/defocused beam via changing the lens types(concave or convex or rectangular).Changing the laser condition from dry "normal ablation" to steam laser cleaning (SLS) using wetting agent(ethyl alcohol 3:deionised water1) was a significant parameter to be tested.Fluence value was decreased via either decreasing power or increasing spot size.The latter showed to be most effective than decreasing power.In addition, defocusing was an effective when fix the target far/near from the focusing point to enlarge the spot size.At wavelength 1064nm, best results were achieved in case of repetition rate of 10 Hz, pulse width 7ns as constant, for case study "1"copper thraeds, at power180 mW, time10 shots, fluence 0.09 J/cm^2), while silvered brass alloy given at power 380mW, 5 shots, 0.13 J/cm^2), for gilded copper-gold alloy, power 380mW, 5 shots, 0.13 J/cm^2), silvered copper, power 140mW, 10, 0.001 J/cm^2), another silvered copper alloy, power 140mW, 10, 0.001 J/cm^2), silver alloy(eutectic alloy) power 180mW.

Concerning the scaler/cavitron, it achieved pronounced results for removing the corroded layers.A piezo-electric scaler was preferred than magneto-scaler.Testing the different power settings and parameters was accomplished, which related to the instrument and the probe itself, tips, motion of action,..etc.A scaling pattern of zigzag, coiled, concentric, dabbing,…etc are stroke patterns could be simply performed by the tip itself when working, but each pattern should be used carefully with working angles"incidences" that affected the scaling effect. Beside to the tips types, each tip has a definite curvature. Optimum results for copper threads were achieved at insert p, zigazag pattern,incidence B, and power 7.2 – 9 .3 Watt, while silvered brass spangles, insert p, incidence B, zigzag pattern, and power 7.2-9.3W, for gilded tumbaga alloy, insert P, incidence C, repeated dabbing strokes, and power 3-5.12W, while silvered copper, insert G, incidence C, coiled stroke, and power 7.2-9.3W.While another silvered copper, insert G, incidence C, coiled stroke with power 3-5.12 W.For eutectic silver alloy, insert G, incidence C, coiled stroke, at power 7.2 W.It was found that zigzag pattern was commonly involved while wide area was worked on.While in case of encrustations in the form of spots, repeated dabbig was traced, whereasthe in case of thin wires or strips, coiled pattern was traced.Incidence B was commonly involved, while in case of thin plating,..e.g. gilding or silvering, incidence B found to be aggressive, so, Incidence C on the back of the insert was preferred.In addition to insert type G was less aggressive than P isert.

Coupling of microscopy means and quantative EDAX analysis aided assess the ablation process.Light microscopy, Polarized microscopy, and USB digital imaging assisted in-situ inspection during the laser cleaning to observe the surface colours.Electron micrographs showed the alterations occurred on the surface structure and morphology. It was dedueced that when evaluate the cleaning process using the both approaches, morphology inspection on the macro-and micro-scale should be consistent with each other and with the quantitative estimation.

Keywords

Textile Embellishment/Embroidery/Decoration

Scaling process

UDS Scaler

Morphology

Stroke

Incidence

Steam Laser

Fluence /Laser Intensity

Optimisation

ESEM-EDAX

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Dedication

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To all those who help to create, not to blind imitate……!

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THIS WORK WAS GRANTED ….

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