

Laser cleaning systems

A series of laser cleaning systems are available at IESL-FORTH laboratories, fulfilling the cleaning requirements of a variety of Cultural Heritage objects and surfaces. These involve **transportable cleaning systems** of compact size dedicated for field interventions, as well as, **sophisticated cleaning set-ups** for demanding studies and objects. **Monitoring and/ or evaluation modules** based on laser analytical and diagnostic techniques are also available in order to follow the cleaning process and safeguard the treated objects.

Features:

- ✓ **Transportable** laser cleaning systems for **field applications**
- ✓ **Sophisticated laboratory set-ups** for demanding studies and objects
- ✓ Emitted **wavelengths** span in the range of **193 - 2940 nm**
 - ✓ **Pulse durations** vary from several **microseconds** (150 μ s) down to a few **femtoseconds** (500 fs)
 - ✓ Laser **analytical** and **diagnostic** modules can be synchronized to **monitor** and/or **evaluate** cleaning

Applications:

- ✓ **Cleaning of inorganic encrustations** (soiling, pollution accumulations, burial crusts) **from stonework**
- ✓ **Elimination of polymeric layers** (aged varnish, unsuccessful consolidation treatments, over-paintings) **from painted surfaces** (icons, easel and wall paintings)
 - ✓ **Removal of corrosion layers from metals**
 - ✓ **Cleaning of various crusts from proteinaceous substrates** (wood, leather, skin, parchment, feather, bone, ivory, textiles)



Laser cleaning workstation for the removal of polymeric coatings and/or over-layers from painted surfaces;

The workstation was developed at IESL-FORTH and employs UV laser radiation to remove unwanted polymeric layers. The laser beam is guided through a galvanometric system to the object, where it removes selectively a part of the over-layer of predetermined thickness.

Removal of **aged** and **polymerised varnish layers**, **unsuccessful conservation** and **consolidation treatments** and **over-layers** from painted surfaces such as **icons, easel and wall paintings** are among the conservation problems that can be dealt with this cleaning workstation.

The development of the system was financed from IESL-FORTH

Laser cleaning systems and applications

Removal of pollution crusts from stone using a combination of laser beams; The Athens Acropolis Sculptures

The selective and controlled removal of soot deposits and black encrustations from the surface of the Athens Acropolis sculptures is realised, by means of a novel laser cleaning methodology specially designed for the specific needs of these sculptures.

The prototype laser cleaning systems were designed by IESL-FORTH, in collaboration with the Acropolis Restoration Service and the A' Ephorate of Prehistoric and Classical Antiquities in order to ensure a safe and controlled cleaning without any disfiguring side-effects (yellowing). The success of this innovative cleaning methodology lies in the combination of infrared (1064 nm) and ultraviolet (355 nm) radiation.



Laser cleaning of hard burial crust from stonework



This is a straightforward laser cleaning application which employs the fundamental frequency of a QS Nd:YAG laser at 1064nm at relatively high laser Fluences.

A series of relative laser cleaning projects have been successfully carried out in collaboration with the local Ephories and conservation companies. In all cases the laser systems have been transferred on site and, following a necessary brief optimisation study and a training session, the objects have been treated by the conservators in charge.



Successful examples: «Hermes» of Ancient Messene in Peloponnese in collaboration with «Lithou Sintirsis», Conservation Associates and the stone objects exhibited in the Archaeological Museum of Aiani, in Kozani in collaboration with the L' EPKA

Removal of over-layers from Ad Reinhardt's "Black Painting"

Elimination of unwanted over-layers from icons, easel and wall paintings can be achieved using ultraviolet laser pulses. This laser cleaning methodology ensures a layer-by-layer removal which can be fully controlled to a resolution of several micro-meters. The parallel use of laser based analytical (LIF, LIBS, Raman) and diagnosis (interferometric) techniques can guarantee that the original surface is safeguarded from any excessive action.

The laser cleaning of acrylic over-layers from the oil *Black Painting* by Ad Reinhardt using LIBS as a monitoring tool is a well known successful example of this type of intervention.

The presented work is a collaborative effort between IESL-FORTH, the Solomon R. Guggenheim Museum (New York US), the Museum of Modern Art (New York US) and "Art Innovation" (Netherlands) funded by AXA Art Insurance.



Laser cleaning of corrosion layers from metals



Given the **multitude of corrosion problems and substrates**, this is a rather complicated laser cleaning application still under investigation. The removal of corrosion layers from historic low carbon steel engraved knives from the Criminology Museum, Medical School, Univ. of Athens is a successful example of this type of cleaning problems.

Contact: Paraskevi Pouli, IESL – FORTH, PO Box 1385 – 71110 Heraklion Greece, e-mail: ppouli@iesl.forth.gr, tel.: +30 2810 391870, Website: www.iesl.forth.gr