EUREKA PROJECT E!1681 - EUROCARE LACLEPA

1. General description

Project	E! 1681 - EUROCARE LACLEPA	**Status**	Finished - 24-OCT-2003
Title	**Laser Cleaning Of Paper And Parchment**		
Class	Sub-Umbrella	**Technological area**	Lasers
Start date	01-JAN-1997	**End date**	01-JAN-2002
Duration	60 months	**Total cost**	0.58 Meuro
Partner sought	No		

Summary

Prototype Laser Cleaning System Development For Historical Paper And Parchment Including A Catalogue Of Working Parameters To Define The Optimum Conditions For Application By Parchment And Paper Restorers.

Budget and duration

Phase	Budget(Meuro)	Duration (Months)
Definition phase	0.08	8
Feasibility phase	0.04	4
Full Exploitation	0.12	34
Implementation phase	0.34	14
Total	**0.58**	**60**

Member contribution

Member	Contribution	Position	Since
Austria	**9.80%**	**Notified Finished**	**24-OCT-2003**
Germany	43.30%	Notified Finished	24-OCT-2003
Greece	6.90%	Notified Finished	24-OCT-2003
Slovenia	38.00%	Notified Finished	24-OCT-2003
Vatican City	2.00%	Notified Finished	24-OCT-2003

Participants

Company	Country	Type	Role
Institut Fuer Papierrestaurierung	**Austria**	**SME**	**Main**
F.O.R.T.H. / Institute Of Electronic Structures And Lasers(Iesl)	Greece	Research Institute	Partner
Ljubljana University/Chemistry & Chemical Technology Faculty Deptartment Of Analytical Chemistry	Slovenia	University	Partner
Freie Universitaet Berlin/Institute Of History Of Arts	Germany	University	Partner
Bam - Laboratory For Thin Film Technology Bundesanstalt Fuer Materialforschung Und Preufung	Germany	Research Institute	Partner

Participants

Company	Country	Type	Role
Oesterreichisches Staatsarchiv	Austria	Governm./Nat. Admin.	Partner
Oesterreichische Staatsbibliothek/Papyrussammlung	Austria	Governm./Nat. Admin.	Partner
Staatsbibliothek Zu Berlin - Preussischer Kulturbesitz	Germany	Governm./Nat. Admin.	Partner
Oesterreichisches Museum Fuer Angewandte Kunst	Austria	Governm./Nat. Admin.	Partner
Biblioteca Apostolica Vaticana	Vatican City	Governm./Nat. Admin.	Partner
Nat. & Univ.Library Of Slovenia/Preservation Department	Slovenia	Governm./Nat. Admin.	Partner
Bayerische Staatsbibliothek/Institut Fuer Buchrestaurierung	Germany	Governm./Nat. Admin.	Partner

2. Project outline

Project description

Objective:
The objective of the project is to develop a prototype laser cleaning system particularly fit for flexible paper and parchment cleaning. The design of this system has to be compact, easy to use and economical to allow operation by trained paper restorators at public and private institutions, e.g. archives, museums, collections, etc.
The method will be based on the use of ultraviolet pulse lasers, ensuring the preservation of the delicate artefacts by minimising the absorption volume, the heat affected zone and the mechanical shock.
Complementing the laser system, a catalogue of working parameters for typical artefact types, including for example optimum laser fluence ranges and damage threshold data, will be defined to allow the restorators to determine the optimum conditions for cleaning the objects in a minimum of time and with the utmost security of substrate preservation.
On the basis of this research, the specifications for the laser cleaning system will be put in a call for tenders with the purpose of contracting the company with the best offer to build and market the instrument.
Background:
Cleaning of paper and parchment artefacts is necessary not only for aesthetic but also conservation reasons; any foreign material such as dirt can either serve as a culture medium for micro-organisms or can penetrate deeper into the material under increased humidity in the environment. Conventional mechanical and wet cleaning methods have proved insufficient in numerous cases as there are, for instance, brittle papers, fissures and sensitive inscripts. The main problem lies in the fibre structure of paper and parchment. Dirt and fluid cleaning media may irreversibly penetrate into the bulk structure where removal is either impossible or leads to mechanical or chemical destruction. Contactless cleaning, on the other hand, can be performed by applying short laser pulses in the nanosecond pulse duration regime. Fast removal of stains and dirt will be achieved by evaporation while inscripts are preserved and the composite structures consisting of protein or cellulose fibres remain chemically and structurally intact. This result will be achieved by ultimate confinement of the optical and thermal energy to a minimum volume in the foreign dirt phases. The use of ultraviolet laser light allows extremely small absorption depths, and choosing pulse durations of the order of 10 nanoseconds will reduce the heat affected zone to less than 10 um.
The restoration and art history expert partners will define and select artefacts for which conventional techniques appear difficult or impossible. The laser technology partner will demonstrate the advantageous features of contactless laser cleaning, e.g. at fissures and bents, in the removal of foreign ink penetrated into white vellum areas, or removal of strongly adherent stain films on parchments. The evaluation of the test cleaning of selected artefacts will be done by microscopic and surface analytical inspection (scanning electron microscopy,

scanning force microscopy, Fourier-transform-infrared microscopy, etc.).
Keywords: laser cleaning, paper, conservation.

Technological development envisaged

Recently there has been a significant increase in the use of advanced laser technologies for the preservation of cultural heritage objects, most notably for the restoration of stone monuments. The technological innovation of this project stems from adapting laser technology to the specific requirements for the cleaning of historical paper and parchment artefacts.
The environmental issue is also being considered because laser cleaning avoids the employment of chemical cleaning media.
Conventional restoration methods rely on mechanical and/or chemical means exhibiting only limited control. Mechanical cleaning may lead to the destruction of inscriptions, paintings and substrates. The application of chemicals may affect the pigment and medium or cause aging due to irreversible infiltration.
Laser cleaning, however, is a contactless technique avoiding any chemical contamination and mechanical destruction of the artefact.

Markets application and exploitation

The restoration market in Europe and North America is valued at several hundred MECU.
Artefacts are cleaned conventionally by mechanical and chemical treatments, which not only means risk of mechanical and chemical damage but also environmental hazards. Dry laser cleaning technology offers, therefore, economic potential in the global market of conservation; for museums, archives, laboratories, collectors, restorers and conservation studios.
The market will include paper and parchment artefacts. The number of specimens of interest may be appreciated at least in tens of millions. The major advantage of laser cleaning, however, lies in the ultimate cleaning quality and preservation security.
Results of the LACLEPA project will be disseminated by future publications, international workshops and seminars.
FEDERAL INSTITUTE FOR MATERIALS RESEARCH AND TESTING (BAM) will develop the laser cleaning technology and apply it to various artefacts provided by the other participants. A laser system prototype will be set up at BAM.

Project codes

BSI

AIQ	contamination
AUY	conservation
KXV	lasers
PJB.L	dry cleaning
WFJ/WFP	paper
ZW	arts

NACE

7310	Research and experimental development on natural sciences and engineering
9251	Library and archives activities
9252	Museum activities and preservation of historical sites and buildings

3. Main participant

Company	**Institut Fuer Papierrestaurierung** Finsterer Gang, 71 1030 Wien Austria Tel +43 1 817 8664 Fax +43 1 817 86649
Contact	**Mag. Karin K. Troschke** Head Tel Fax
Organisation type	SME
Participant role	Main

Contribution to project

Expertise in paper restoration. IPR will define and select paper artefacts (e.g. engravings, prints) for laser cleaning and will judge the results.

Expertise

The largest paper restoration studio in AUSTRIA, expert in the restoration of a broad variety of paper artefacts including historical and ethical aspects. INSTITUT FUR PAPIERRESTAURIERUNG works for both public and private collections.

4. Partner

Company	**F.O.R.T.H. / Institute Of Electronic Structures And Lasers(Iesl)** Vasilika Vouton, 711 10 Heraklion Greece Tel +30 2810 391 300 Fax +30 2810 391 305 www.iesl.forth.gr
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Organisation type Research Institute
Participant role Partner

Contribution to project

Experimental and theoretical studies on the effect of yellowing of the paper samples after laser-assisted cleaning and studies on Laser-Induced Fluorescence (LIF) on the surface of various paper substrates.

Expertise

Expertise: * know-how on Laser Ablation and (a) basic research (b) applications * Know-how on Laser-Matter Interactions including polymers, marble/stone, paper/parchment, glass, wood, ceramics, etc. * Diagnostic techniques for structural Analysis and Non-Destructive Testing (NDT) (holographic techniques) * Spectroscopic techniques for in-situ analysis (LIF, LIBS) * Multispectral Imaging Techniques * Fundamental Research on Laser-Matter Interactions. Contribution: Experimental studies on Laser-Induced Breakdown Spectroscopy (LIBS) for discriminating between different pollution layers.

4. Partner

Company

Ljubljana University/Chemistry & Chemical Technology
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Organisation type University
Participant role Partner

Contribution to project

Evaluation of possible damage done to cellulose during laser cleaning treatments by artificial ageing and size exclusion chromatography (SEC) of treated samples.

Expertise

Expertise in the analysis of environmental, medicinal and food samples, lately also paper/cellulose objects. Bulk analysis by mass spectrometry, UV-VIS and FT-IR spectrometry and coupled techniques, electroanalytical methods, various high pressure chromatography systems, including SEC, particularly useful

in the analysis of cellulose samples.

4. Partner

Company

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Contact

Prof. Eberhard Koenig
Professor

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Organisation type University
Participant role Partner

Contribution to project

Expertise in historical and ethical context of antique parchments and paper artefacts. FUB will define and select antique artefacts, like parchment and vellum documents, for laser cleaning.

Expertise

An expert in the historical and ethical context of antique parchment and paper artefacts, particularly book paintings.

4. Partner

Company

Bam - Laboratory For Thin Film Technology Bundesanstalt Fuer Materialforschung Und Preufung
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12205 Berlin
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Organisation type Research Institute
Participant role Partner

Contribution to project

Dry laser cleaning of parchments and papers by means of ultraviolet pulse lasers; preservation of sensitive inscriptions/substrates by minimisation of radiation absorption volume, heat affected zone and shock.

Expertise

Expertise in ablation and microstructuring of metals, ceramics, semi-conductors, dielectrics, biological tissues, technical composites, parchments and papers by nanosecond and femtosecond pulse lasers. Laser ablation plasma emission spectroscopy. Pulsed laser deposition (PLD) of metallic and ceramic thin films. Surface characterisation by FT-IR spectroscopy, grazing incidence X-ray diffractometry (GIXD), scanning probe microscopy (SPM), scanning electrode microscopy (SEM), energy dispersive X-ray spectroscopy (EDX).

4. Partner

Company **Oesterreichisches Staatsarchiv**
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Contact **Dr. Lorenz Mikoletzky**
Generaldirektor

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Organisation type Governm./Nat. Admin.
Participant role Partner

Contribution to project

Expertise in paper restoration.

Expertise

Expertise in the restoration of a broad variety of paper and parchment artefacts, including historical and ethical aspects.

4. Partner

Company	**Oesterreichische Staatsbibliothek/Papyrussammlung** Josefsplatz, 1 1015 Wien Austria Tel +43 1 53410 429 Fax +43 1 53410 323
Contact	**Mag. Andrea Donau** Head Of Preservation Department Tel Fax
Organisation type	Governm./Nat. Admin.
Participant role	Partner

Contribution to project

Expertise in paper restoration and will define and select particularly precious artefacts for laser cleaning.

Expertise

Expertise in the restoration of a broad variety of paper and parchment artefacts, including historical and ethical aspects.

4. Partner

Company	**Staatsbibliothek Zu Berlin - Preussischer Kulturbesitz** Tiergarten, Potsdamer Strasse, 33 10785 Berlin Germany Tel +49 30 266 2841 Fax +49 30 266 2814
Contact	**Dr. Ernst Bartelt** Research Group Leader Tel +49 30 266 2455 Fax +49 30 266 3009
Organisation type	Governm./Nat. Admin.
Participant role	Partner

Contribution to project

Expertise in paper restoration and will define and select paper and parchment artefacts for laser cleaning.

Expertise

Expertise in the restoration of a broad variety of paper artefacts, including historical and ethical aspects.

4. Partner

Company	**Oesterreichisches Museum Fuer Angewandte Kunst** Stubenring, 5 1010 Wien Austria Tel +43 1 711 36 Fax +43 1 713 1026
Contact	**Mag. Manfred Trummer** Chefrestaurator Tel Fax
Organisation type	Governm./Nat. Admin.
Participant role	Partner

Contribution to project

Expertise in paper restoration.

Expertise

Expertise in the restoration of a broad variety of paper artefacts, including historical and ethical aspects.

4. Partner

Company	**Biblioteca Apostolica Vaticana** Vaticano, 99 120 Citta Del Vaticano Vatican City Tel +39 6 698 83301 Fax +39 6 698 85327
Contact	**Don. Raffaele Farina**

Head

Tel
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Organisation type Governm./Nat. Admin.
Participant role Partner

Contribution to project

Expertise in paper restoration and will define and select particularly precious artefacts for laser cleaning.

Expertise

Exactly a century of experience of parchment restoration.

4. Partner

Company **Nat. & Univ.Library Of Slovenia/Preservation Department**
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Organisation type Governm./Nat. Admin.
Participant role Partner

Contribution to project

NUK will by means of artificial ageing and testing of physical properties of treated and aged samples provide an objective evaluation of possible damage done to the treated paper samples.

Expertise

NUK has experience in the conservation and restoration of a broad variety of paper and parchment artifacts and regularly performs teting of new conservation treatments using artificial ageing and different tests of physical and optical properties of treated artifacts.

4. Partner

Company	**Bayerische Staatsbibliothek/Institut Fuer Buchrestaurierung** Ludwigstrasse, 16 80539 Muenchen Germany Tel +49 89 28638 238 Fax +49 89 285 773
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Organisation type	Governm./Nat. Admin.
Participant role	Partner

Contribution to project

Expertise