



EULASNET II:

EUropean LASer Technology and Applications NETwork (Phase II)

Umbrella for Laser Technology and Applications

Monitoring Presentation to NPC Meeting

Portoroz (Slovenia)

April 2008



Centro para el Desarrollo
Tecnológico Industrial



CENTRO LÁSER
UNIVERSIDAD POLITÉCNICA DE MADRID





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Umbrella for Laser Technology and Applications

Leading Objectives (reminder):

- ★ To achieve a truly networked European expertise in laser technology**
- ★ To maintain the leading role Europe plays in the fields of laser technology research and applications**
- ★ To transfer and exploit RTDI results, particularly for the benefit of SME's**



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Envisaged actions and developments:

- ✿ **A European network of competence centres**
- ✿ **Close relations between research institutions and industry**
- ✿ **Market-driven RTD projects involving industry and research institutes**
- ✿ **Partner searches across Europe**
- ✿ **Transfer of technology and expertise**
- ✿ **Access to advanced technologies and world class facilities**
- ✿ **Access to new regions and markets**
- ✿ **Cooperation with other relevant European and international research programmes**



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Technological developments initially envisaged (1/3):

I. LASER ASSOCIATED OPTICAL TECHNOLOGIES

- **Diffractive, refractive, non-linear and adaptive optics for beam shaping, modulation and improving beam quality, extending to higher modulation frequencies, higher spatial resolution and generated wavelength conversion**
- **X-ray and EUV technology: mirrors, coatings, interferometry with nm-resolution**
- **Coupling of diode-lasers: new schemes for higher transfer efficiency and lower costs**

II. LASER SOURCES

- **New, advanced laser media and generating schemes**
- **Laser-plasma X-ray and EUV (extreme UV) sources: higher brilliance, higher efficiency, higher average power**



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Technological developments initially envisaged (2/3):

III. LASER INTERACTION AND PROCESSING

- Hybrid processes based on classical and laser processes
- Laser bending and high intensity laser forming processes
- Advanced high intensity laser processing applications
- Laser microprocessing and structuring with sub-wavelength resolution
- Laser-assisted nanolithography, micro-reactions and structuring of polymers
- Advanced laser surface modification and cleaning processes

IV. PROCESS MODELLING, MONITORING AND CONTROL

- Models development for high intensity laser materials interaction in industrial applications
- Development of advanced monitoring and on line control strategies for laser processing
- Development of laser measurement applications



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Technological developments initially envisaged (3/3):

V. EDUCATION AND TRAINING

- **Compilation and elaboration of educational material in the field of laser Technology**
- **Development of a European academic network in the field of laser Technology**
- **Academic and technical support for the organization of academic schools in the field of laser Technology**
- **Promotion of local/national events and training sessions in the field of laser Technology**

VI. STANDARDIZATION

- **Promote the standardization of laser characteristics according to ISO related documents**
- **Promote the standardization of laser Safety around Europe**



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Major Target Markets:

- The **automotive sector**, where laser technology has been massively introduced in the past 10 years, is now beginning to take full advantage of the maturity of laser technology.
- The **aerospace sector**, where lasers are used for machining difficult materials (e.g. titanium alloys, carbon fibre composites), where welding is beginning to be qualified for use in fabricating lightweight airframes, and where the potential of laser-assisted deposition and laser shock processing are now being considered.
- The **laser job shop sector**, where the SME's are increasingly expanding their range of process capabilities from flatbed cutting and welding to laser surface treatment, laser cleaning, prototyping and micro processing.
- The **IT sector**, which remains a massive application area for lasers and is characterized by a trend to smaller feature sizes, is utilizing short pulse lasers as photolithographic (e UV) sources.
- The **medical equipment sector**, where the need for enduring micro marking is increasing the use of laser matrix coding and where key-hole surgical techniques require smaller and more functional components.
-



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Major Action Lines:

- ✦ **Active generation and promotion of EUREKA Projects in the frame of EULASNET II**
- ✦ **Development of national networks in laser technology and applications**
- ✦ **Mapping of European expertise and needs in laser technology and applications**
- ✦ **Promotion and dissemination of laser technology on the European market**
- ✦ **Coordination of EULASNET II activities to other European RTDI networks**
- ✦ **Evaluation of new and emerging scientific and technological topics in laser technology**
- ✦ **Development of standardization, education and training initiatives in laser technology**



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Participant countries:

- **SPAIN**
- **(AUSTRIA)**
- **BELGIUM**
- **CROATIA**
- **CZECH REPUBLIC**
- **DENMARK (2007)**
- **FRANCE**
- **HUNGARY**
- **ITALY**
- **LITHUANIA**
- **POLAND**
- **ROMANIA**
- **SERBIA-MONTENEGRO**
- **SLOVENIA**
- **(UNITED KINGDOM)**

Coordination (Chair+Secretariat)

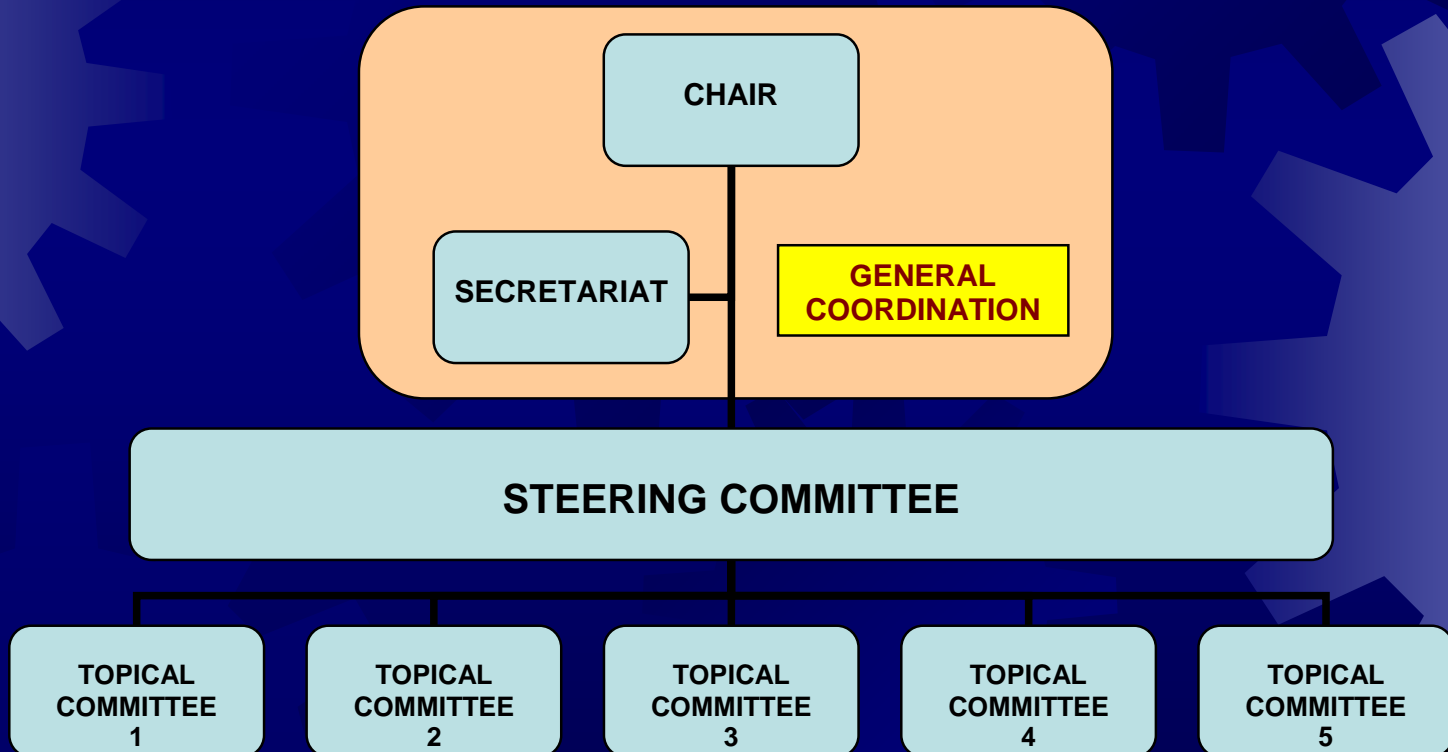


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Organization/work structure:





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Resources presently available in the EULASNET organization

I. General Internet portal: <http://www.eulasnet.org>:

- [Home](#)
- [News](#)
- [Mission](#)
- [Participants](#)
- [Running projects](#)
- [Partner search](#)
- [Submit your idea](#)
- [EULASNET projects](#)
- [EUREKA portfolio](#)
- [Event calendar](#)
- [Links & Downloads](#)
- [CORDIS market](#)
- [FP6](#)
- [COST](#)
- [IRC database](#)
- [Career](#)
- [Member area](#)
- [Contact](#)

II. National EULASNET II connected networks:

- BELASNET: <http://www.belasnet.be>
- POLLASNET: <http://www.pollasnet.org.pl>
- LITHLASNET: <http://www.bit.ac.at/eulasnet/LITHLASNET>
- HULASNET: <http://www.ddkkk.pt.e.hu/hulasnet>
- HISPLASNET: <http://www.hisplasnet.es>



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Developed activities (International Meetings):

- 1. Joint International HULASNET-POLLASNET meeting
(Budapest, Oct. 2006)**
- 2. International POLLASNET meeting
(Warsaw, Nov. 2006)**
- 3. 1st EULASNET II WG Meeting and Technical Workshop
(Madrid, May. 2007)**
- 4. 2nd EULASNET II WG Meeting and Technical Workshop
(Brussels, Nov. 2007)**
- 5. 3rd EULASNET II WG Meeting and Technical Workshop
(Vilnius, Scheduled Jun. 2008)**



EULASNET II:

EUropean LASer Technology and Applications NETwork (Phase II)

Umbrella for Laser Technology and Applications

Main Strengths of EULASNET II:

1. High S&T Competence of WG members
2. High experience in the conduction and participation in European scope projects
3. Broad coverage of different laser fields of application
4. Conceptual proximity to advanced fields where technological developments can have a significant mobilizing effect

Main Weaknesses and Difficulties experienced by EULASNET II:

1. Generally long times from S&T innovation to reach market applications
2. Difficult penetration of WG members organizations into companies innovation strategies
3. Difficult competition of EUREKA with other European funding Programs (namely FP7)
4. Lack of uniformity in EUREKA funding schemes in different member countries + Innovation Subjects prioritization by some of them



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Umbrella for Laser Technology and Applications

Main Opportunities for EULASNET II:

1. Immensely broad field for laser applications
2. Highly specific character of laser technology applications able to solve problems beyond other technologies possibilities
3. Generally high added value and mobilizing effect of laser applications
4. High S&T Competence and experience of WG members institutions (**again**)

Main Threats and Uncertainties for EULASNET II:

1. Minimization of EUREKA innovative impact by other European funding programs
2. Present ralentization phase of world economy (very dangerous when implying a practical shortcoming of resources at the R&D level)
3. Continuation of the lack of penetration of of WG members organizations into companies innovation strategies. **The help of NPCs is strongly required.**
4. Possible reduction of high level innovation programs in companies



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Most significant Projects coming from EULASNET Portfolio (1/2):

EI 3483

EULASNET
LASCAN

Advanced laser renovation of old paintings, paper, parchment and metal objects

EI 3444

EULASNET
ULCOP

Laser Cladding as a modern WCCo (Wolfram-Carbide-Cobalt) melting process

EI 3376

EULASNET
LASERTECH

Development of innovative technological processes and equipment for precision cutting of materials for microelectronics using the Laser Controlled Thermocracking Technique (LCTCT).

EI 3258

EULASNET
MAFALDA

Fibre lasers: (1) the development of a low cost solution for specific micro-surgery applications and (2) showing the technology's reliability and capacity for powerful modern medical and non-medical applications.

EI 3209

EULASNET
HICARLAW

Development of a new prototype of high cadence laser welding system for short stitches substituting resistance spots for 3D automotive components.



EULASNET II:

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Most significant Projects coming from EULASNET Portfolio (2/2):

EI 3109

EULASNET
EXPLOSIVES
ANALYSER

Creation of an extremely sensitive and reliable portable system to detect and analyse explosives agents for areas in danger of terrorist attack (e.g. air transport, nuclear power plants), based on laser technologies.

EI 3095

EULASNET
LEO
SATELLITE

Design of a small-sized mobile satellite laser ranging system (SLR) with a high capability to track fast-moving low earth orbiting satellites including the zenith zone. The main innovation is the pilot project of the semi-automated SLR.

EI 2841

EULASNET
ADVANCED
PLD

Pulsed Laser Deposition (PLD) is a well-established laboratory coating technology. up to now PLD has not become a standard industrial coating technique. the aim of this project is to optimise the suitability of PLD for industrial applications.

EI 2767

EULASNET
LASHYFORM

Develop a new process of hydroforming, where selective laser heating facilitates deformations of hybrid parts made of workpieces of different strengths.

EI 2732

EULASNET
LARLASC

The aim is to develop a new paint stripping process capable of cleaning several dozen square metres per hour.



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Main Successes achieved by EULASNET/EULASNET II (1/4):



EI3483 *EULASNET LASCAN*

*Advanced laser renovation of
old paintings, paper,
parchment and metal objects.*



UNIVERSITIES, ACADEMIES	5
RESEARCH CENTRES, INSTITUTES	2
SMEs	2
END USERS	2



EI3483 *EULASNET LASCAN*

DPSS Nd:YAG LASER



Pulse energy: 3.0 mJ @ 1064 nm;
1.3 mJ @ 532 nm
0.9 mJ @ 355 nm
0.6 mJ @ 266 nm

Pulse energy stability: 1.0 % @ 1064 nm (St.Dev);
4.0 % @ 266 nm (St.Dev)

Pulse duration stability: < 1 % @ 1064 nm (St.Dev).

Repetition rate: 1000 Hz.

Pulse duration: < 70 ps (30 ps)

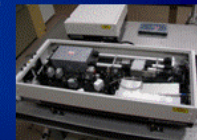
Spatial mode: TEM00

Beam diameter: ~ 3 mm.

Beam divergence (full angle at 1/e²): < 1.6 mrad.

Polarization purity (vertical): > 100:1.

Contrast ratio (to residual pulse): > 200:1.





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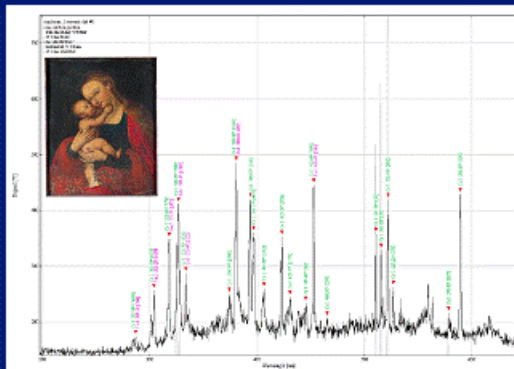
Umbrella for Laser Technology and Applications

Main Successes achieved by EULASNET/EULASNET II (2/4):



E!3483 EULASNET LASCAN

PAINTINGS – LIBS RESULTS

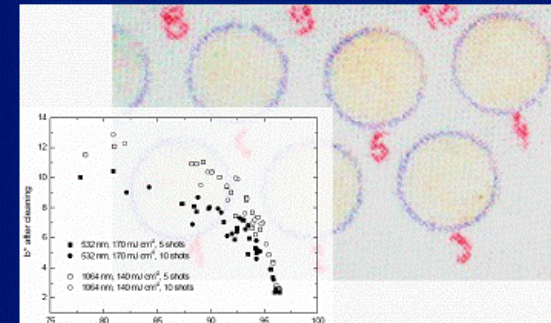


PANNONLASER



E!3483 EULASNET LASCAN

LASER CLEANING – ARTIFICIAL DUST FROM PAPER



SLOVENIA

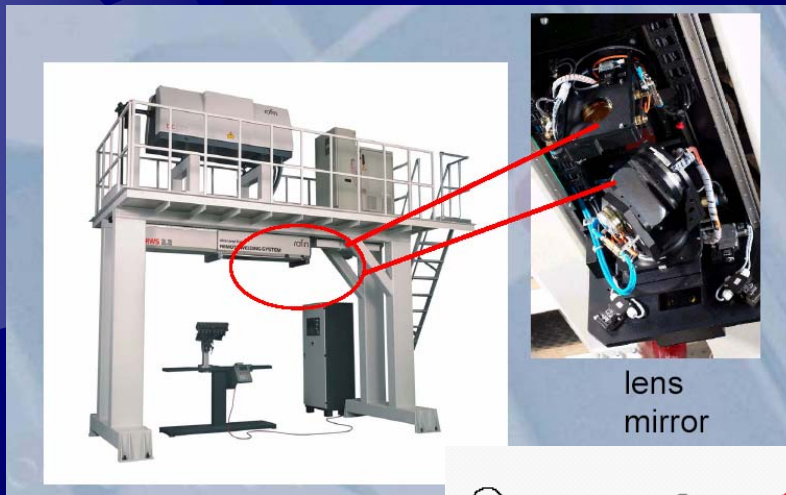


EULASNET II:

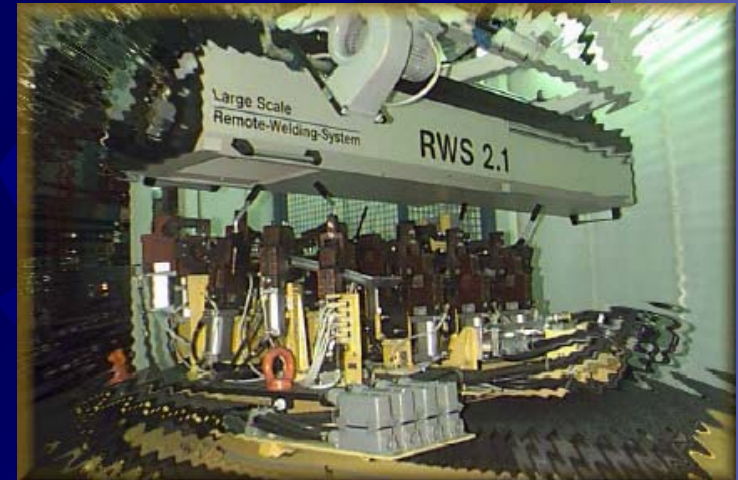
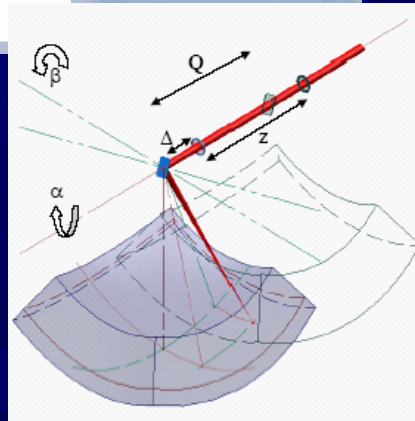
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Main Successes achieved by EULASNET/EULASNET II (3/4):



lens
mirror



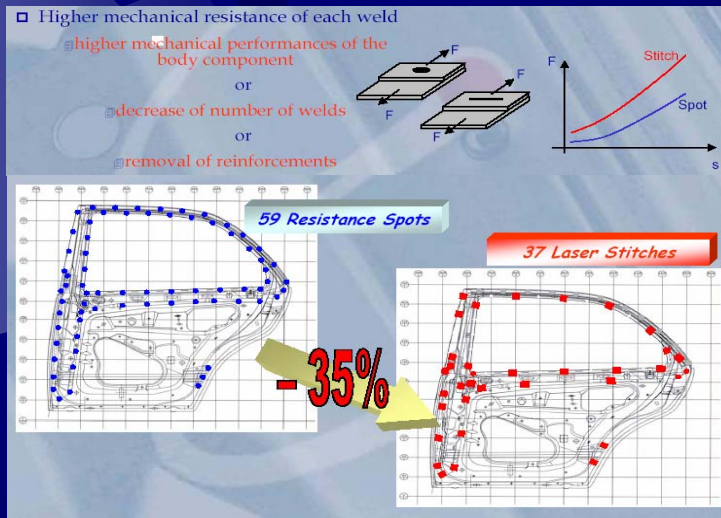


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Main Successes achieved by EULASNET/EULASNET II (4/4):



MINISTERIO DE CIENCIA Y TECNOLOGIA

PROFIT 2004

EUREKA

PROYECTO DE INVESTIGACIÓN INDUSTRIAL:

DESARROLLO E INSTRUMENTACIÓN INDUSTRIAL DE PROCESOS DE SOLDADURA LÁSER REMOTA A ELEVADA VELOCIDAD DE COMPONENTES DE AUTOMOCIÓN

DEVELOPMENT AND INDUSTRIAL IMPLEMENTATION OF HIGH CADENCE REMOTE LASER WELDING OF AUTOMOTIVE COMPONENTS (HICARLAW)

EUREKA E! 3209

MEMORIA

rofin

AUTOTECH ENGINEERING

abrerab

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Present EULASNET Projects and ideas looking for partners:

E! 3483 EULASNET LASCAN

Advanced laser renovation of old paintings, paper, parchment and metal objects

EULASNET HOLOPATT

Laser-assisted Micropatterning

E! 8341 EULASNET LIEM

Following further in-depth research on the interaction of laser radiation with energetic materials, a laser-based system will be developed.

EULASNET FIBOPTSENS

Optical security sensor using two fiber-optic interferometric probes with the ability to detect a place of disturbance: securing of large areas.

EULASNET LAMAWAM

Application of a water micro-stream, guiding the laser energy as optical fibre, for micro-machining of materials.

EULASNET USPL

YB-doped potassium tungstates are of great interest for diode-pumped solid-state lasers. Novel technology for production of new stoichiometric crystals oriented of thin disk active material for disk laser design.

EULASNET LASFOR

Controllable heat distortions created by a high power laser beam to bend metal component under numerical control.

E! 8294 EULASNET DAMDELAS

Damage detection using laser technologies

E! 8292 EULASNET LATRAC

Laser Training Action



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New EUREKA Projects in the frame of EULASNET II:

**E! 3892 EULASNET II
MODPOLEUV**

Modification of Polymer Foils With EUV (Extreme-Ultra-Violet) Radiation for Applications in Biomedical Technology

**E! 4088 EULASNET II
E-FOLKART**

Electronic Services for the Sustainability of Traditional Folk Art

**E! 3483- EULASNET
LASCAN (Cont.)**

Advanced Laser Renovation of Old Paintings, Paper, Parchment and Metal Objects

E! 3507- BRASOLD

Advanced Brazing and Soldering for the Jewellery Industry

E! 3622- ACCLAM

Aeronautic Cast Components by Laser Manufacturing

E! 3645- DIM-LAST

Die And Mould Laser Surface Texturing

E! 3720- NUGGET

Numerical Modelling for Mastering Welded Joints

E! 3727- WOLACE

Wood Laser Cutting and Engraving for the Furniture Industry



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New Ideas for Projects in the frame of EULASNET II (Coming from WG meetings and workshops and in phase of implementation as E! Proposals following confirmation at next WG meeting in Vilnius):

**E! XXXX EULASNET II
EUV-XR MICROSCOPE**

Development of EUV/X-Ray Microscope (in cooperation with COST)
for biomedical applications (PL, DE)

**E! YYYY EULASNET II
LASMICROSTAND**

Benchmarking and Standardization of Laser Pulse Properties for
Microprocessing Applications (ES, LT, PL)

**E! ZZZZ EULASNET II
DLDCCLAD**

Development of Advanced Cladding and Direct Laser Deposition Techniques
(DK, BE)

**E! UUUU EULASNET II
LSPSURF**

Development of Laser Shock Processing for Surface Mechanical Properties
Improvement (ES, PL, CZ)

**E! VVVV EULASNET II
SCLASCHAR**

Development of Laser Semiconductor Characterization Techniques (LT, PL)

**E! WWWW EULASNET II
HIBLASWELD**

Development of High Brightness Laser Welding Techniques (DK, ES, BE)

**E! QQQQ EULASNET II
STDMETROLAS**

Development of Laser Based Metrological and Characterization Standards (ES,
PL, LT)

**E! RRRR EULASNET II
ENVIROLAS**

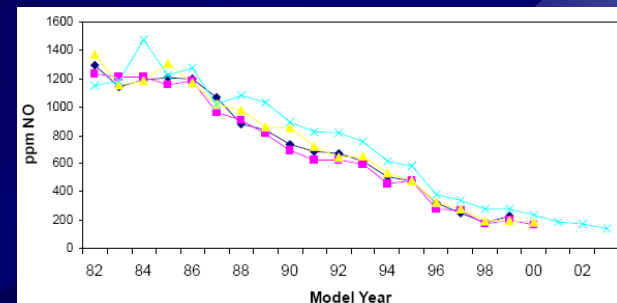
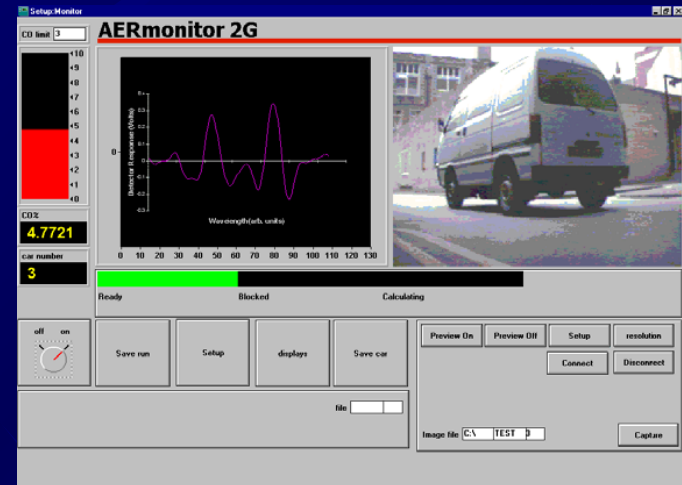
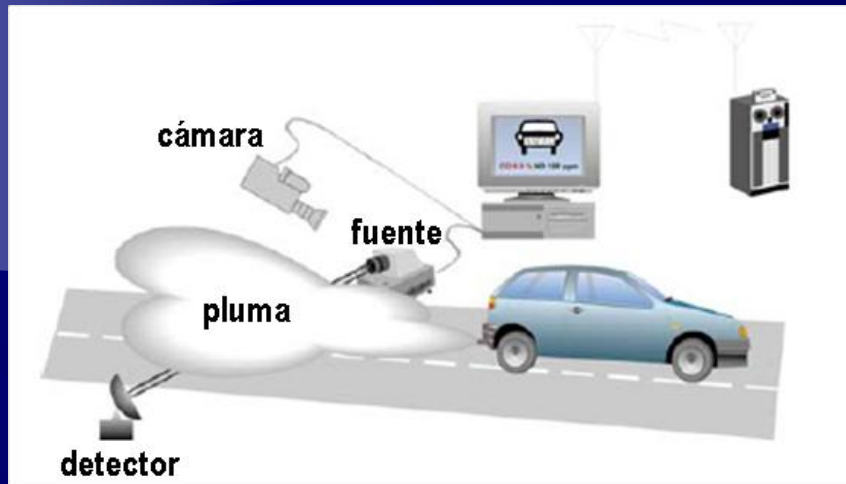
Laser Based Monitoring of Contaminant Gases (ES, PL)



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New Projects and Ideas in the frame of EULASNET II (1/4):

Laser based monitoring of
contaminant gases

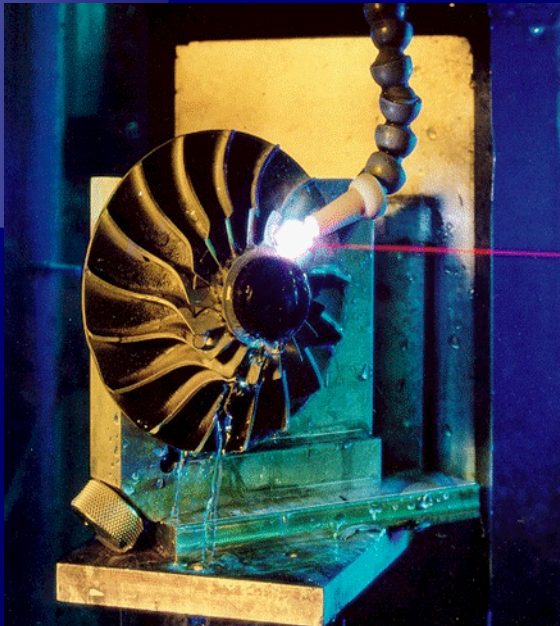




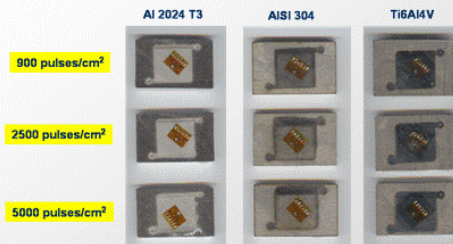
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New Projects and Ideas in the frame of EULASNET II (2/4):

Laser shock processing for the surface mechanical properties improvement of metallic components

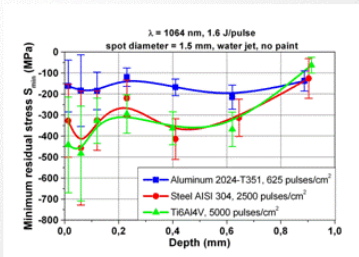


Experimental results



CENTRO LÁSER UNIVERSIDAD POLITÉCNICA DE MADRID
XVI International Symposium on Lasers and Chemical Lasers + High Power Lasers Conference (SCL 2006)
Eindhoven (Netherlands), September 4-6, 2006

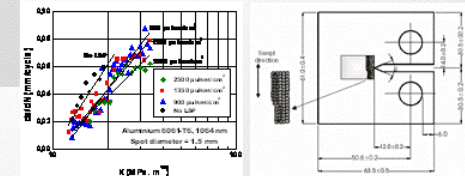
Experimental results



Ocaña, J.L. et al.: GCL/HPL 2006 Conf. Proc. (Gmunden, Austria; 4-8 Sept. 2006)

CENTRO LÁSER UNIVERSIDAD POLITÉCNICA DE MADRID
Workshop on Surface Treatments and Coatings for Mechanical and Aeronautical Applications
Petershof, March 28-30, 2007

Experimental results



$$\frac{da}{dN} = C \cdot K^m$$

Pulse density (cm ⁻²)	C (mm/cycle)	M (dimensionless)
0 (No LSP treatment)	4x10 ⁻¹³	7.664
900	8x10 ⁻¹⁷	6.818
1350	2x10 ⁻¹⁷	5.733
2500	3x10 ⁻¹⁸	4.723

Rubio-González, C. et al.: Mat. Sci. Eng. A., 386 (2004) 291-295

CENTRO LÁSER UNIVERSIDAD POLITÉCNICA DE MADRID
XV International Biotechnology and Technical Conference on Beam Technology and Laser Applications (BTLA 2006)
St. Petersburg (Russia), September 23-26, 2006



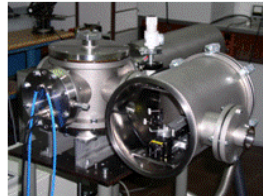
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New Projects and Ideas in the frame of EULASNET II (3/4):

LASER-PLASMA EUV SOURCE

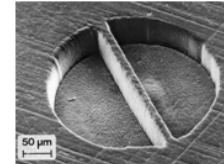
MEDEA+ project Institute of Optoelectronics, Warsaw

• laser-plasma EUV source based on a gas puff target irradiated with 5ns/0.5J/10 Hz laser pulses from a commercial Nd:YAG laser was developed for metrology applications

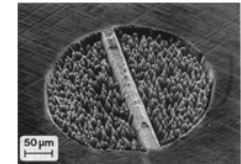


LASER ABLATION WITH UV LASER RADIATION

Cone Formation Si₃N₄ Ceramics - Institute of Applied Physics, University Linz, Austria



SEM
ArF*-laser, $\lambda = 193 \text{ nm}$
 $\Phi \approx 5.3 \text{ J/cm}^2$
N = 500
mask projection



SEM
ArF*-laser, $\lambda = 193 \text{ nm}$
 $\Phi \approx 1.2 \text{ J/cm}^2$
N = 500
inhomogeneities \Rightarrow shadowing
 \Rightarrow **Cones**

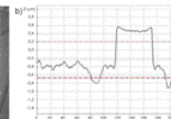
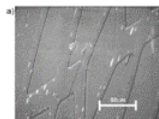
Excimer-Laser Ablation and Micro-patterning of Ceramic Si₃N₄, J. Hettl, J. D. Pedarnig, D. Biserle, G. Petzow, Appl. Phys. A 65, 259 (1997)

EUV PHOTO-ETCHING POLYMERS

Single shot radiation fluence at material surface: 2 - 3 mJ/cm²
for a distance of 2 cm from the plasma

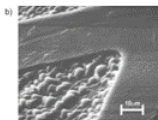
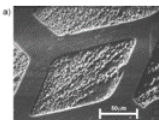
1000 pulses

SEM microphotograph of microstructures in PMMA



~1 μ m

SEM microphotographs of microstructures in PTFE



~2 μ m

Barbik et al. Microelectronic Engineering (2005)

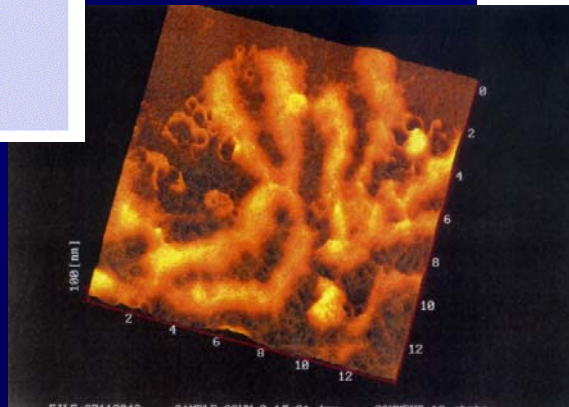
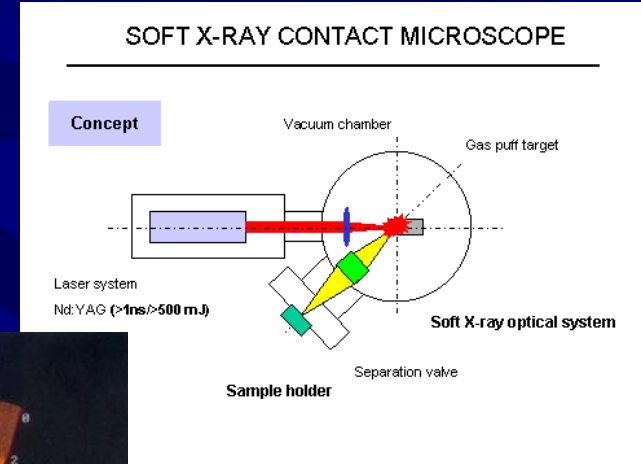
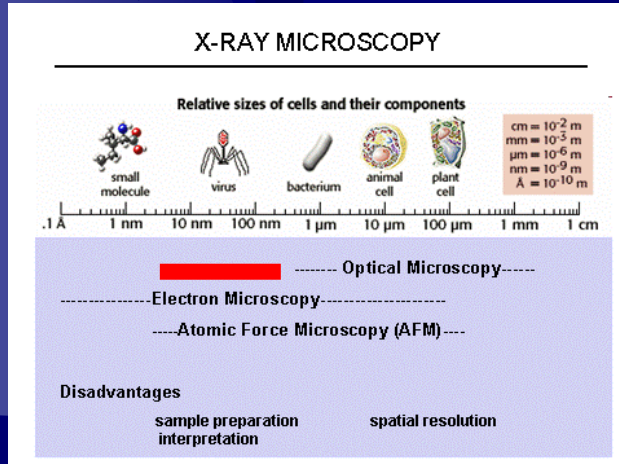


EULASNET II:

EUropean LASer Technology and Applications NETwork (Phase II)

Umbrella for Laser Technology and Applications

New Projects and Ideas in the frame of EULASNET II (4/4):



Y.Kinjo, M.Watanabe, H.Fiedorowicz, H.Daido, E.Yanase, S.Fujii, E.Sato, K.Sinohara
 Fine structure of human chromosomes observed by x-ray contact microscopy coupled with atomic force microscopy
 Journal de Physique IV 104 (2003) 313



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Thank you!



Let's cooperate for innovation!

