

## Technology Offer

# Optoelectronic device/mounting and process for the stratigraphical analysis of chemical composition of art object surface layer material using LIBS (Laser induced Breakdown Spectroscopy) techniques

## Summary

*A research team from Romania has created a method and a device for stratigraphic analysis of the superficial material layers of artworks, using LIBS (Laser induced Breakdown Spectroscopy) techniques. The sought partners are universities, research institutes or SMEs from the same activity field in order to cooperate in preparing the device for market or for a joint venture.*

Creation Date	18 May 2015
Last Update	04 November 2015
Expiration Date	03 November 2016
Reference	TORO20150518001

## Details

### Description

A Romanian research team has developed a method and a device for stratigraphic analysis of the superficial material layers of artworks. The laser interaction with various materials always involves an energy exchange. The interaction of a pulsed laser beam with the surface may lead to a partial evaporation, originating a process known as laser induced ablation, one of the main mechanisms involved in laser cleaning of artworks.

For high irradiances (e.g.  $> 1\text{MW}/\text{cm}^2$ , depending on the target composition) the evaporation occurs with a plasma formation, involving several successive processes such as: surface melting with hydrodynamic flow, vaporization, vapor ionization, surrounding and evaporating gas breakdown, free electron acceleration within the evaporated cloud, plasma heating. The plasma growth and decay implies: expansion, shock waves formation and propagation, deceleration of free electrons with inverse Bremsstrahlung emission, collisions in the gas cloud with excitation and relaxation of atoms/ions, chemical recombination, radiative recombination. Occasionally conditions associated to a Local Thermal Equilibrium (LTE) can occur, whenever electrons, atoms and ions in the plasma are associated to the same temperature. The (LTE) is a dynamic status reached for plasma parameters slowly varying in a suitable temporal range, during the plasma relaxation. Initially, the plasma temperature is very high (typically  $T > 30000\text{K}$ ), while auto-ionization accompanied by a continuum emission spectrum is dominant. Upon (LTE) conditions, characteristic line emission spectra are detected mostly from the atomic and first ionic excited species produced. Further plasma cooling and recombination cause plasma departure from (LTE). In its final stages the process is characterized by cluster and nanoparticles ejection in the dark slow expanding tail of the plume.

During the laser ablation at high energy densities, accompanied by the plasma formation which

gives rise to line emissions recorded in LIBS, the bright plume is observed in combination with the formation of a crater at the surface. One of the main objectives of the research work has related to LIBS crater assessment and determination of the ablation rate for different Cultural Heritage materials, mainly metal, as well as the monitoring of its evolution in relation to the laser beam fluency.

The Romanian research team is looking for universities, research institutes or SMEs from the same activity field in order to cooperate in preparing the device for market or for a joint venture.

## Advantages and Innovations

- micron level damages of the investigated surface, allowing the conservation stage preservation of the investigated artworks;
- method and device suitable for qualitative and quantitative multi-elemental analyses on a large variety of samples surfaces;
- high speed in delivering results;
- compact and transportable device.

## Stage of Development

Available for demonstration

## IPR Status

Granted patent or patent application essential

## Comment Regarding IPR status

Patent applied for at the State Office for Inventions and Trademarks. IP rights on national level – Romania.

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## Keywords

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### Technology

05001001	Analytical Chemistry
09001003	Chemical material testing

### Market

08005	Other Industrial Products (not elsewhere classified)
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### NACE

M.72.1.9	Other research and experimental development on natural sciences and engineering
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## Network Contact

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### Issuing Partner

NATIONAL INSTITUTE OF RESEARCH AND DEVELOPMENT FOR OPTOELECTRONICS

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**Open for EOI :**   **Yes**

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**Dissemination**

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**Send to Sector Group**

Nano- and Microtechnologies

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**Client**

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**Type and Size of Organisation Behind the Profile**

R&D Institution

**Year Established**

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**Already Engaged in Trans-National Cooperation**

No.

**Languages Spoken**

Romanian  
English

**Client Country**

Romania

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**Partner Sought**

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**Type and Role of Partner Sought**

The targeted partners are universities, research institutes or SMEs from the same activity field in order to cooperate in preparing the device for market or for a joint venture.

**Type and Size of Partner Sought**

SME 11-50, University, R&D Institution, SME <10, SME 51-250

**Type of Partnership Considered**

Joint venture agreement