

ILS is the first operative, scanning, remote instrument that integrates four spectroscopic techniques:

- **Laser Scattering (LS) 650 nm**: detection of surface state (roughness. Presence of particles or liquids)
- **LIF 355nm**: detection of organic and some inorganic materials
- **Raman 355 nm**: molecular identification
- **LIBS 1064 nm**: elemental analysis in top sample layers (depth profiling)

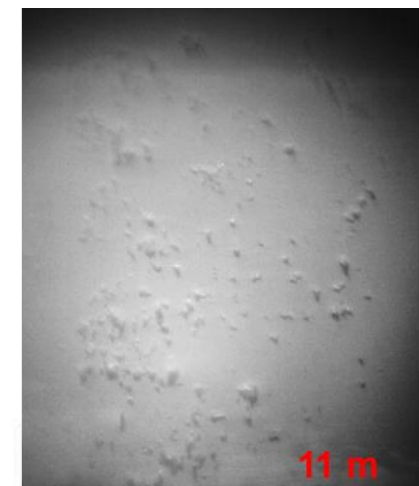
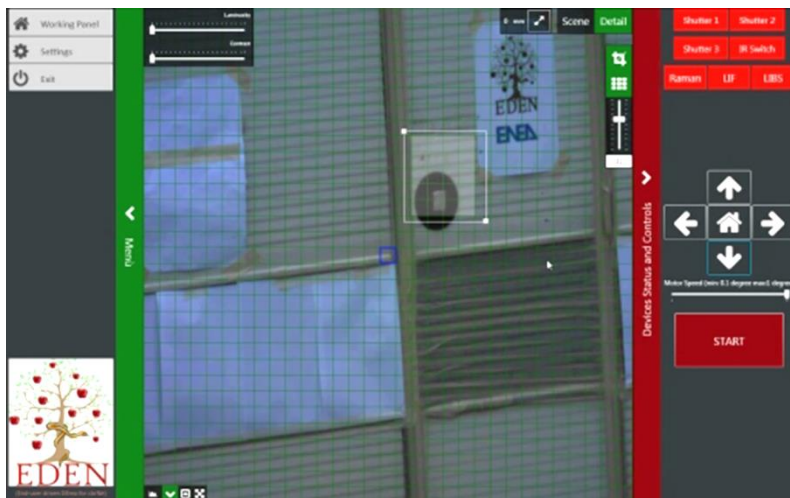


Fully developed and patented by ENEA

ILS working distance: tested 9-30m, projected for ≈ 100 m

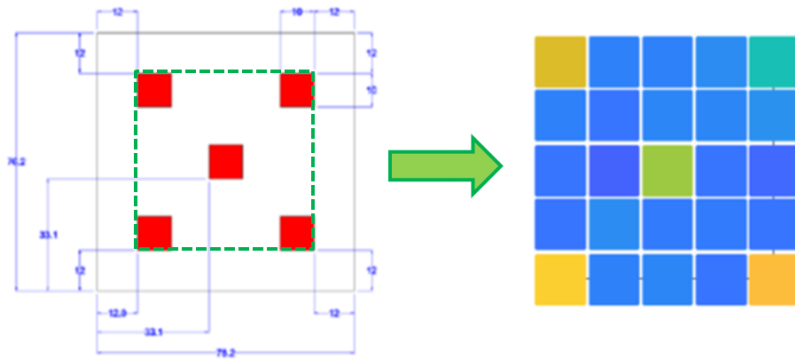
Other features:

- Interactive choice of scanning area and grid density through the external camera
- Interactive visualization of the results on 2D map
- Switch to the high magnification camera for details and precise pointing
- Fast switch (<10 s) between different measuring techniques
- Autofocus, remote (WiFi) operation

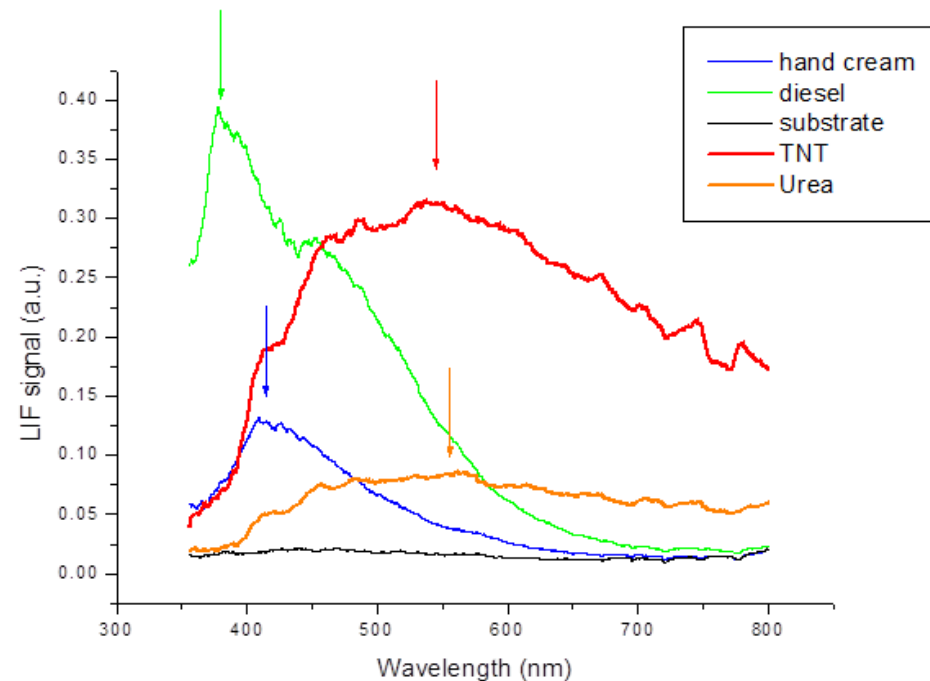


Red - RDX 50 $\mu\text{g}/\text{cm}^2$

Scanned by LS



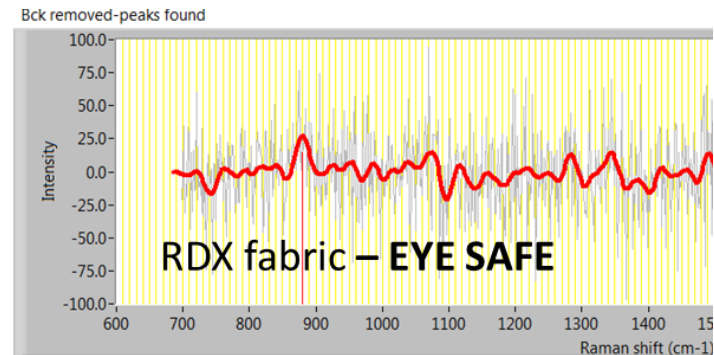
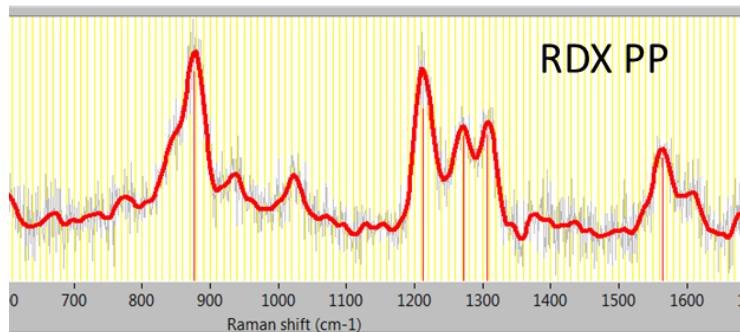
Mapping of particles by Laser Scattering (distance ≈ 10 m)



Fluorescence (LIF) might directly differentiate some residues

Fluorescing nitro-compounds on a not fluorescing substrate: **LoD ~ 10 ng** on spot of 3.3 mm diameter

Raman: molecular identification = **high selectivity** but also a high detection threshold, dependent on the substrate



On a weakly fluorescing and not interfering substrate:

LoD for RDX at distance of 10 m: ~150 ng on spot diameter of 9.3 mm

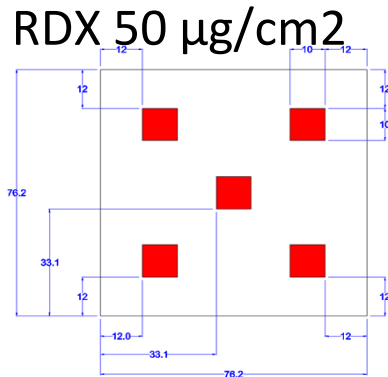
LIBS: multi-elemental detection 200-830 nm, high resolution spectra

Recognition of surface residues implemented in ILS:

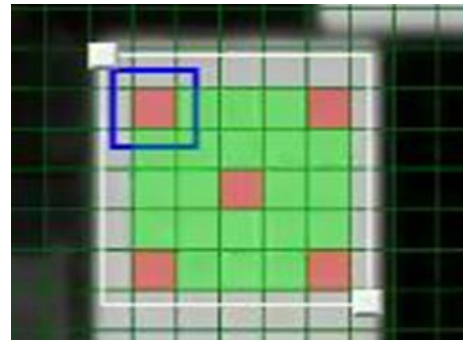
- 1) First laser shot - on residue
- 2) Second laser shot - on the substrate cleaned by the ablation and shockwaves
- 3) differences in spectra after 1st and 2nd laser shot at the same position.

LoD for RDX at distance of 10 m ~1 ng (spot of 1.3 mm)

LIBS: scanning at 10 m distance, RDX on white car varnish



Scanning LIBS,



Article [Sensors 2019, 19, 4269; doi:10.3390/s19194269](https://doi.org/10.3390/s19194269)
**Integrated Laser Sensor (ILS) for Remote Surface
Analysis: Application for Detecting Explosives
in Fingerprints**

ILS is a highly performing scientific instrument, intended:

- ❑ For scientific and feasibility studies, and for measuring campaigns
- ❑ As a starting point for building up new, simplified instruments for specific applications (eye-safe Raman, LIBS + vision system, etc).

Some other applications of ILS:

- Detection of toxic materials in soils and wastes.
- Characterization of building materials and their deterioration.
- Analysis for Cultural Heritage.
- Forensic – mapping and analysis of a crime scene (H2020 RISEN)
- Classification of materials for recycling.
- Quality monitoring of industrial processes and products

ENEA's interests:

- Feasibility or scientific studies, projecting and realization of laser spectroscopy instruments (portable, table-top or remote)
- Measuring campaigns by our laboratory or in field instruments
- Networking, scientific collaboration and new funding opportunities
- Hosting post-graduate students

Other applications

ILS instrument could be:

- Simplified and adapted for only eye-safe measurements (no LIBS)
 - Simplified and adapted for a specific application or working distance
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- Detection of toxic materials in soils and wastes.
 - Identification of leakages on solid or liquid surfaces.
 - Characterization of building materials and their deterioration.
 - Analysis for Cultural Heritage.
 - Forensic – mapping of a crime scene
 - Classification of materials for recycling.
 - Quality monitoring of industrial processes and products

