

Detection of Manufactured Nanoparticles in Air using LIBS (Laser Induced Breakdown Spectroscopy)

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New achievement

Today, nanoparticle-based materials is a fast growing market. The development of robust and reliable technologies for detection and measurement of airborne nanoparticles is a key point for the protection of the individual health and the environment.

INERIS and CILAS present the first AIRBORNE NANOPARTICLES CHEMICAL SELECTIVE DETECTOR that will help the community to face the future environmental challenges

Commercially available instruments provide global measurements of the particles concentration in the air. Selective monitoring will strongly improve the security level by giving the concentration of each element present in the air. To achieve this goal, the LIBS (Laser-Induced Breakdown Spectroscopy) technique was deemed as a potential candidate.



AIR SECURE gives a new solution for the airborne workplace monitoring

Principle

LIBS measurements consist in focusing a laser pulse on a material which elemental composition is to be determined. At the focus spot, plasma is generated and analysed by optical emission spectroscopy (figure 1).

This method provides the **CONCENTRATION** of **EACH ELEMENT** in the aerosol, is **REAL TIME**, and **DOES NOT REQUIRE SAMPLE PREPARATION**.

The LIBS technique is:

- Fully optical remote measurements
- Does not require any sample preparation
- Fast
- Multielemental

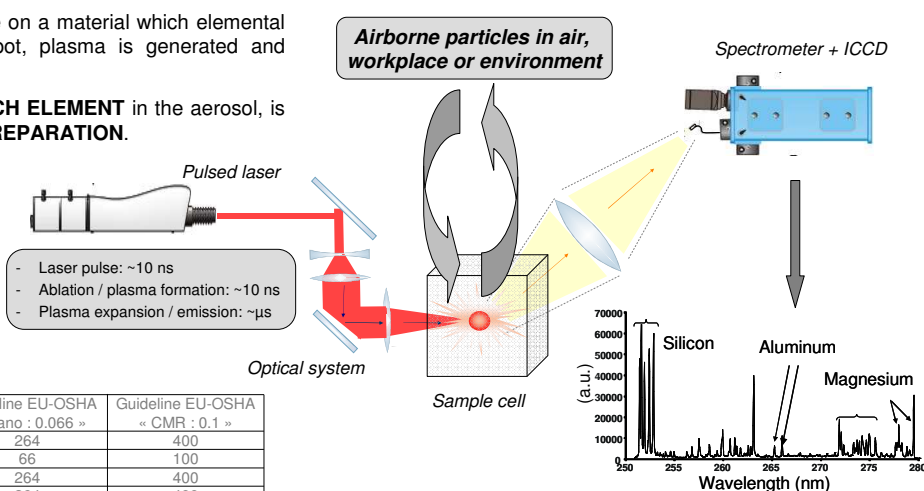


Figure 1: General principle of the airborne particle composition determination

Spectrum analysis:

- Each element has its own unique fingerprint
 - ↳ Line position element identification
- Each element absorbs with a specific intensity
 - ↳ Line intensity element quantification

Materials	LIBS Detection limits (µg/m ³)	Occupational Exposure Limit Values (µg/m ³) PM10	Guideline EU-OSHA « Nano : 0.066 »	Guideline EU-OSHA « CMR : 0.1 »
Al	560 (250)	4000	264	400
Cu	80 (50)	1000	66	100
Ti	430 (280)	4000	264	400
Ca	10	4000	264	400
Mg	10	4000	264	400
Cd	500 (<300)	30	1.98	3
Cr	45	500	33	50
Fe	310 (~200)	5000	330	500
Ni	250	100	6,6	10
Si	100	4000	264	400

Extrapolation / Surface area

Table 1: Occupational Exposure and LIBS detection limits comparison

LIBS Detection Limits are in agreement with Occupational Exposure Limit for micro and nano particles for most of materials (table 1)

Impact for green technology

This instrument makes possible continuous monitoring of targeted engineered nano and ultra-fine particles suspended in the air.

The sensitivity and detection limits are below the actual recommended level in the micro range and could be compatible with future « nano » legislation.

This is a first and very important step towards legislation and effective control of airborne particles concentrations in air, workplaces and environment.

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Conclusion

CILAS & INERIS decided to make this innovative technology available for nano-community with exposure risk. Thanks to a collaborative program, we are working on a commercially available instrument able to perform on line and in situ detection of engineered nanoparticles in agreement with legislation. This detection could allow protecting workers from accidental release or chronic exposition to engineered nanoparticles.

AIR SECURE is the first **AIRBORNE NANOPARTICLES CHEMICAL SELECTIVE DETECTOR**

Is Your Workplace Safe ? → nano@cilas.com