DETECTION OF MANUFACTURED NANOPARTICLES IN AIR USING LIBS

INERIS: Tanguy Amodeo, Christophe Dutouquet, Olivier Le Bihan, Emeric Fréjafon
CILAS: Jean Paul Dufour, Christophe Goepfert

INTRODUCTION

Today, nanotechnology is a growing field of research and nanoparticle-based material production is expected to soar in years to come.
The development of robust and reliable technologies for detection and measurement of airborne nanoparticles is a key point for the protection of workers health in the research and industry.

OBJECTIVES OF THE WORK

Today, 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.

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. This method provides the concentration of each element in the aerosol, in real time, and does not require sample preparation. These qualities are advantages over the other techniques.

WHAT ARE THE SIGNIFICANT NEW ACCOMPLISHMENTS?

Research studies up to technical optimisations were realized on laser / plasma / particle interactions in order to further achieve LIBS measurements with optimum efficiency. Polydisperse and monodisperse flows of sodium chloride and metallic particles with sizes ranging from 40 nm up to 1 µm produced by two different particle generators were introduced inside a cell for where they were vaporized by the laser induced plasma for LIBS analysis purposes. Time-resolved emission spectroscopy measurements were carried out and the influence on the LIBS signal of parameters such as chemical nature of particles, their concentration, laser wavelength, laser energy, kind of background gas was investigated. Then, calibration curves and limit of detection have been investigated for a wide range of metallic particles (Ti, Al, Cu) [1]. These results allowed making a first assessment of LIBS potentialities for manufactured nanoparticle detection in workplace.

IMPACTS FOR THE NANOTECHNOLOGY FIELD

The results obtained by INERIS show a strong improvement of the continuous monitoring of aerosol containing engineered nano and ultra-fine particles. The sensitivity and detection limits are below the actual recommended level in the micro range and could be compatible with the future “nano” legislation. **This is a first and very important step towards legislation and effective control of airborne particles concentrations at work places.**

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.

References:

[1] T. Amodeo, C. Dutouquet, O. Le Bihan, M. Attoui and E. Frejafon, On-line determination of nanometric and submicrometric particle physicochemical characteristics using spectral imaging-aided Laser-Induced Breakdown Spectroscopy coupled with a Scanning Mobility Particle Sizer, Spectrochimica Acta, Part B (2009)

INERIS, DRC/CARA/NOVA INERIS is the French Agency for Industrial Environment and Risks.
Parc Technologique Alata, 60550 Verneuil En Halatte, France

CILAS, 8 Avenue Buffon – BP 6319 – ZI La Source - 45063 Orléans cedex, France
Jean-Paul DUFOUR – Project Manager
Phone : +33(0) 2 38 64 59 35 - Fax : +33(0) 2 38 64 59 22 – dufour@cilas.com