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Detection and Identification of Asbestos in Aerosols by LIBS in a Low Temperature Plasma

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Introduction

Forbidden in french constructions since 1997, asbestos remains present in most of the buildings constructed before this date. Thus, during work or in case of degradation, asbestos fibres can be emitted in air. The smaller the asbestos particles, the longer they stay in suspension in air, increasing the hazard of inhaling them.

The current determination of airborne asbestos presence in France follows a long and cumbersome normative protocole (AFNOR NF X 43-050), with an analysis carried out by Transmission Electron Microscope at laboratory after air filtration on-site. Such a protocole induces wasting time between the sampling and the results delayed by not less than 48 hours, and therefore prevents for the intervention on-site-on-time. Thus, the demand of a real-time measurement increases, even if it is only an alert technique.

Methods

The PLASMIANTE project aims to develop an apparatus able, on-site and in near-real-time, to analyse the particles present in an air sample and to identify the presence of asbestos. The device will sample air and send the particles in a reactor in which they will be trapped in a low-temperature argon plasma. Then, the particles will be analysed directly in suspension. From the scattering diffusion, known as Mie diffusion, the mean particle morphology can be obtained. Laser Induced Breakdown Spectroscopy (LIBS) is used to determine the composition of the particle cloud. LIBS consists on focusing a high-energy laser on the particles, which vaporizes and ionizes the surface. A micro-plasma is then generated and the atoms, ions and electrons, excited in this micro-plasma, emits photons during their de-excitation with a wavelength characteristic of the chemical elements (Figure 1). The emission spectrum thus generated is dependent on the material studied and makes it possible to identify the phase in presence.

After collecting the spectrum, the latter is compared to an asbestos database elaborated from our experiments on a software we developed. By comparing the position and the intensity of the peaks, the software is able to determine the presence of asbestos in the sample and to identify which kind of asbestos is present.

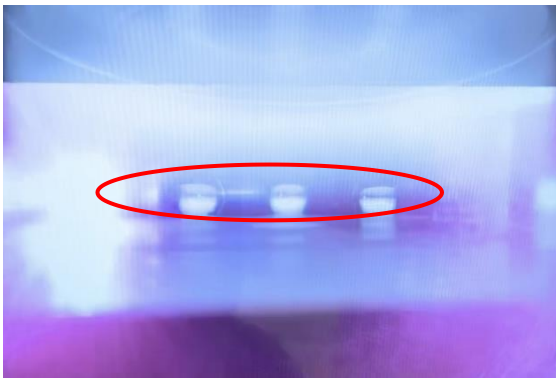


Figure 1. LIBS signal emitted by chrysotile (asbestos) particles.

Conclusions

This study presents the first results obtained by LIBS on pure asbestos (chrysotile, amosite, tremolite, antigorite, crocidolite), building materials and mixtures directly in suspension in a low temperature argon plasma. It evidences the ability of the device to detect and identify asbestos. A lot of work remains since we have to:

- enhance the signal/noise ratio;
- determine the detection limits of our device;
- study samples which could be confused with asbestos, such as lizardite, antigorite, riebeckite…

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