UNIVERSIDAD DE MÁLAGA

SOLIDS ANALYSIS BY LIMS (LASER IONIZATION MASS SPECTROMETRY)

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WHAT IS LIMS?

Laser-ionization mass spectrometry (LIMS) is a direct analytical technique based on the local ionization of the surface of a solid sample due to the incidence of a gently-focused pulsed laser. The generated ions are sorted and detected in a time-of-flight mass spectrometer (ToF-MS). Being a mass spectrometry technique, the sample must be analyzed under high vacuum conditions.

The main advantages of LIMS are:

- Excellent surface sensitivity
- Outstanding microanalyital capabilities (spot size < 20 microns)
- Atomic, molecular and isotopic information.
- High sensitivity and selectivity
- Quantitative capabilities
- Multiple analysis modes: point analysis, line analysis (X, Y or Z), chemical mapping, 3D

RANGE OF APPLICATIONS

The versatility and analytical capabilities of the technique have allowed the successfully application of LIMS in a number of applications. Relevant topics include microelectronics, geochemistry, surface studies, forensics or cultural heritage.

TECHNICAL HIGHLIGHTS

Two different time-of-flight mass spectrometers are available in the Laser Laboratory. Both are open-architecture systems with many instrumental configurations available including linear or two-stage reflectron, delayed extraction and bipolar pulsing for positive and negative ions recording. Both are equipped with vacuum-compatible X-Y stages for precise positioning of the sample. Different configurations based on excitation with nanosecond (at 1064 nm, 532 nm, 355 nm, 266 nm or 213 nm) or femtosecond (at 800 nm, 400 nm or 266 nm) beams are possible. An electron-ionization gas gun (O_2, He, Ar …) with acceleration voltages up to 5 keV and spot size down to 50 mm is also available to be fitted in any of the mass spectrometers. For laser focusing, an all-metal Cassegrain objective (50x) with low aberrations is used in one of the instruments to achieve spot sizes down to 5 μm. Energies per pulse as low as a few microjoules are just needed to record surface ions, turning the technique virtually non-destructive.

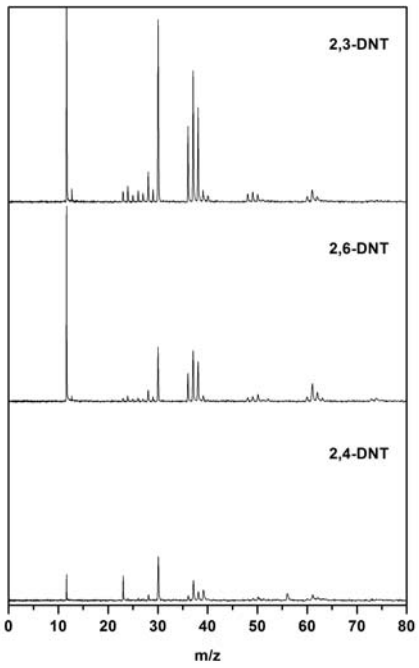

Figure 1. Solid-phase mass spectra of three dinitrotoluene isomers. The three plots are shown at the same y-axis scale for proper comparison of the relative intensities.

LIMS IN FORENSIC SCIENCE

Mass spectrometry and laser excitation are advantageous for forensic analysis due to the low sample consumption, high sensitivity and complete chemical information attainable. The example shown in Figure 1, where three isomers of dinitrotoluene are unequivocally identified using 266 nm laser pulses of 1.5 mJ/pulse, is self-explicit about the potential of the technique.