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SECONDARY ION MASS SPECTROMETRY AND LOW-ENERGY ION SCATTERING OF III-V SEMICONDUCTOR HETERO-STRUCTURES.

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Secondary ion mass spectrometry (SIMS) has been widely applied to the analysis of the surface and interface chemistry in semiconductors, providing outstanding depth resolution and sensitivity. Nevertheless, ion-induced effects during sputtering modify the surface composition due to atomic mixing and ion implantation. These effects are especially relevant when using chemically-active primary species as Cs+, which leads to modifications of ionization and sputter yields due to the Cs implantation into the surface and near-surface regions and the concomitant work function reduction. In order to understand the Cs retention on the surface, low-energy ion scattering (LEIS) was used to probe the outermost surface during ToF-SIMS analysis of III-V semiconductor hetero-structures.

DIM-33

FEMTOSECOND LASER ANALYSIS OF SOLIDS

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Our current studies are facing fundamental and applied studies with the aim of better understanding laser-matter interaction processes in condensed phase using femtosecond lasers in an attempt to improve the analytical performance of laser-based optical emission spectroscopy and mass spectrometry for inspection of solid samples. Phase-change time-resolved microscopy is also used.

Ablation using femtosecond lasers exhibits significant differences with that at the nanosecond timescale, where the concurrence of photochemical and photothermal processes taking place during the photon absorption govern the process. In the ultrashort regime, the several phenomena involved in the laser-matter interaction are markedly different. Thus, a prior comprehension of the processes is required in order to extend the range of current applications and improve the analytical results.

The most important aspects that will be deeply commented are related to:
1. Experimental determination of the energy threshold, temporal regime and macroscopic effects occurring in a variety of materials as a consecuence of the interaction with a laser pulse.
2. Designing of experimental strategies that will allow an improvement in the analytical signal for the mesoscopic and nanoscopic characterization of materials of interest.

The core of the experiment is a 80 Mhz, 100 nJ, 400 fs Ti-Saphire oscillator that is additionally subjected to chirped pulse amplification to produce an output of 3,5 mJ at 35 fs and a maximum repletion rate of 1 KHz. Different wavelengths (800, 400 and 266 nm) are achievable. An intensified CCD and a dual-state reflectron equipped with a cassegrain reflective optics are used for the analysis of the photons and ion generated after laser irradiation. Additionally, a pump-probe microscope has been designed to allow time-resolved studies of phase-change in the ablated samples.