OQA-OC04

TIME-RESOLVED LASER-INDUCED PHASE CHANGE MICROSCOPY: UNDERSTANDING LASER-MATTER EFFECTS AT THE FEMTOSECOND SCALE

I.M. Carrasco, J.M. Vadillo, J.J. Laserna
Departamento de Química Analítica, Universidad de Málaga, Málaga, Spain
e-mail: jmvadillo@uma.es

The particular coupling of energy and high peak power enabled by ultrashort laser pulses facilitates energy coupling inside materials by multi-photon or tunneling ionization mechanisms. Thus, ultrashort laser pulses have proven to be a powerful tool for the solids spectroscopy, surface micro- and nano-structuring as well as for the production of subsurface photonic and micro-fluidic devices. From the analytical point of view, ultrashort laser ablation opens new possibilities due to the significantly different properties when compared with their nanosecond counterpart. The most relevant is due to the lack of interaction between the incoming laser beam and the expanding plasma what allows the visualization of the different phenomena occurring until mass transfer occurs.

The present communication details the design, construction and evaluation of a microscope with time-resolved imaging capabilities. With such instrument, femtosecond-resolved micrographies of the surface of samples exposed to ultrashort laser pulses are obtained, allowing the dynamic observation of the phase-change during the laser-matter interaction. The results obtained are in the basis of the physics governing the ablation process and are in close contact with analytical techniques as LIBS, LIMS, MALDI or LA-ICP.

The results presented demonstrates the appearance of dynamic Newton rings at the surface of the sample that corresponds to the formation of a thin laser-induced surface layer resulting in constructive and destructive interference of the light reflected from the surface with the light reflected from the layer interface. The phenomenon is highly dependent of the material used as will be shown in the comparison of the micrographies obtained with the same sample (Si) in different crystalline forms. The effect of the laser energy per pulse and the time-scale of the different dynamic events occurring will be discussed.