Hyperspectral LIBS imaging of single-optically trapped particles

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The interaction between discrete particles with laser-induced plasma presents some complexities that directly affects the analysis of bulk aerosols by LIBS. Single-particle analysis is not exempt of this kind of phenomena and fundamental studies are still needed for a better understanding of the involved processes [1].

In this work, the OC-OT-LIBS technology [1-4] has been employed to study the distribution of emitting species in the plasma using hyperspectral LIBS imaging. The combination of a typical LIBS imaging system within a bandpass spectral filter offers the possibility for the acquisition of hyperspectral images (Fig. 1). Graphite and copper nanoparticles were studied under this methodology. The bandpass spectral filter selected for graphite and copper were centered at 390 nm and 324.7 nm, respectively. Time-resolved spectroscopy in combination with the acquisition of hyperspectral images allow the separated observation of different species along the plasma lifetime. Hyperspectral photography also provides information concerning on the size and shape of the plasma. In addition, the dual role of air as the atomization and excitation source during the laser-particle interaction is discussed on the basis of spectral evidences.

One of the main challenges of the proposed research is to improve the absolute limits of detection of copper previously calculated in ~60 attograms. Emission sensitivity of the hyperspectral images will be compared with those reported in [3] by the same authors, whose calculated the number of absolute photons emitted by the single trapped copper particle by measuring the photon budget of the whole instrument. In this sense, the possibility offered by OC-OT-LIBS to study the single-particle – laser interaction in aerosols in the regime of sub-femtograms opens the door to a new way of knowing the fundamental processes that occur in laser ablation.

Fig.1 Hyperspectral LIBS imaging of single-optically t

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