POLYDISPERSITY AND FRACTIONATION IN LASER ABLATION STUDIED BY LIBS IN AN OPTICAL TRAP

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LIBS characterization of aerosols produced by laser ablation of bulk samples is strongly influenced by variations of physicohemical properties of the elements integrating the matrix. Among the consequences of these changes are differences on the ablated mass quantities, in the morphology of the aerosolized material or, ultimately, the processes occurring within the plasma such as the so-called fractionation effect[1]. This effect results in spectra that do not represent the bulk composition accurately. Single-particle analysis of these samples constitute a new approach to fundamental studies that are still needed for a better understanding of the involved processes.

Herein, the OC-OT-LIBS technology[2] has been employed to monitor the particle-to-particle size dispersion and fractionation effects observed in aerosols generated during laser ablation of copper-based alloys. Under this methodology, particles generated inside of the ablation cell were stably trapped on-line in air at atmospheric pressure in an optical trap. Particles were dislodged using both, high and low fluence regimes, and then conveniently manipulated for precise positioning before LIBS analysis. Size dispersion of the aerosol was confirmed by SEM images. Dendrite-structured agglomerates of nano-particles and micron-sized spherical particles were observed in every case along single spherical particles. Concerning LIBS analysis, reduced fractionation was observed when the aerosol was generated at high laser fluence due to the production of smaller particles and featuring a narrower particle size distribution. In general, the particle size distribution ranged from nanometers to ca. 2 micrometers even under high fluence conditions. In this sense, the possibility offered by OC-OT-LIBS to study the single-particle compositional variation in aerosols with detection power in the sub-femtogram regime opens the door to a new way of understanding the fundamental processes that occur during laser ablation.

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References

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