Ultrafast laser excitation in atmospheric pressure optical traps for studying attogram mass nanoparticles

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Owing to the exceedingly small mass involved, complete elemental characterization of single nanoparticles demands a highly precise control of signal background and noise sources. LIBS has demonstrated remarkable merits for this task, providing a unique tool for multielemental analysis of particles in the attogram-picogram mass scale [1-3]. Despite this outstanding sensitivity, the air plasma acting as heat source for particle dissociation and excitation is a meddling agent, often limiting the acquisition of an accurate sample signature [4]. Although thermal effects associated with ultrashort laser pulses are known to be reduced when compared to the widely used nanosecond pulse duration regime, attempts to improve nanoinspection performance using ultrafast excitation have remained largely unexplored. Herein, picosecond (*ps*-) laser pulses are used for the first time as a plasma excitation source for the elemental characterization of single nanoparticles isolated within optical traps in air at atmospheric pressure (Figure 1). Results for *ps*- excitation of copper particles lead to a mass detection limit of 27 attogram, equivalent to single particles of 18 nm in diameter. Temporal and wavelength-resolved plasma imaging reveals unique traits in the mechanism of atomic excitation in the picosecond regime, leading to a deeper understanding of interaction in single nanoparticle spectroscopy [5].

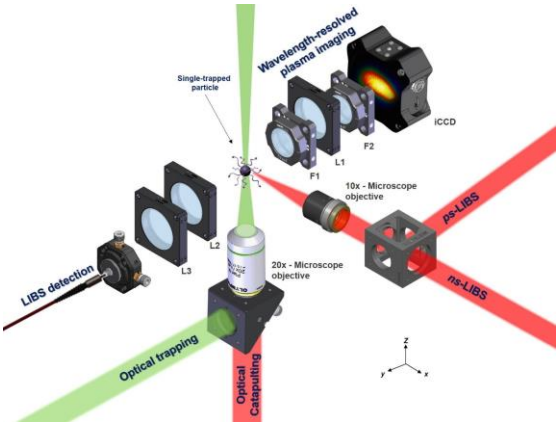

Fig. 1. Experimental setup illustrating the different excitation and detection lines comprising the λP-OC-OT-LIBS instrument.

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