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Optical emission spectroscopy and shadowgraph imaging of pulsed laser plasmas generated in gaseous, liquid and supercritical CO_2[1]

TORU KATO, YOSHIHIKO TAKIZAWA, SVEN STAUSS, MOTOYOSHI BABA, TOHRU SUEMOTO, KAZUO TERASHIMA, The University of Tokyo — Pulsed laser ablation (PLA) in liquids has attracted a lot of attention due to its potential for the synthesis of a wide range of nanomaterials. Contrary to PLA in vacuum, in liquids the plasma plume is confined due to the high density of the medium. This restricts the diffusion of active species and leads to rapid quenching, which limits particle growth. Compared to liquids, supercritical fluids (SCFs) possess superior transport properties and PLA in SCFs has been used for realizing chemical synthesis of nanomaterials such as diamondoids. We have investigated the dynamics of PLA (laser: Nd-YAG, wavelength 532 nm; pulse width 7 ns; frequency 10 Hz; target: carbon, nickel) in gaseous (0.1-6 MPa), liquid and supercritical CO_2 (T_{crit}: 304.1 K, P_{crit}: 7.38 MPa). From shadowgraphs of PLA taken in gaseous, liquid and supercritical CO_2, images of PLA in SCF showed characteristics similar to that of PLA in liquid. Compared to PLA in the gaseous and liquid states, optical emission spectra in SCF revealed enhanced interactions between plasma and solvent species, especially near the critical point. Owing to the high density fluctuation near the critical point, PLA in SCF is expected to lead to a better control of the synthesis of diamondoids and other nanomaterials.

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