Peculiarities of high-pressure plasma diagnostics using high-intensity lasers.

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High pressure non-equilibrium plasmas are usually confined with characteristic dimensions below one millimeter (e.g. capillary microwave discharges) and can exhibit transient behaviors (e.g. nanosecond discharges) with characteristic times below one nanosecond. Laser spectroscopic diagnostics such as absorption or single/multi-photon fluorescence techniques functioning with cw to ultrashort lasers are employed for species density and temperature measurements in these plasmas. Focusing laser beams at micrometer scale for spatial resolved measurements or using femtosecond lasers for temporal resolved measurements, increases tremendously the photon flux and induces several phenomena (e.g. power saturation, photolytic effects, Stark detuning, Rabi oscillations), which need to be considered for a correct evaluation of plasma parameters.

In this lecture, laser induced phenomena, principles and peculiarities of absorption and fluorescence techniques (e.g. undefined absorption length, non-uniform species and temperature distributions, quenching and photon statistics) applied to high-pressure plasmas, will be presented together with measurement examples.