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Spectroscopic diagnostics of high density plasmas

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Recently, plasmas generated in high density media of gases and liquids are used for variety of applications such as material processing, environmental and biomedical technologies. Diagnostics of plasma parameters in such plasmas, however, are not simple due to their inherent non-uniform and transient natures, where higher spatial and temporal resolutions are required. In the first half of this talk, I will explain a combined method of mm-wave transmission and CO₂-laser heterodyne interferometry, including their respective validities checked in diagnosing microplasma jet and microplasma-integrated discharge devices. As a practical application of this combined method, I will show our measurement of dynamic behaviors of n_e in a dielectric barrier discharge (DBV) at atmospheric pressure. In the latter half, I will introduce our recent optical emission spectroscopy (OES) measurement for the line profile analyses in an underwater discharge containing bubbles of various sizes. In some cases, very large contribution of Van der Waals broadening was noticed, suggesting the effective density of the surrounding media in between the atmospheric gas density and the liquid water density. The possible reason and the reproducibility of realizing such a heterogeneous high density medium will be argued based on the results of a simultaneous high speed camera observation correlated with the spectral data.