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A Novel Temperature Measurement Approach for a High Pressure Dielectric Barrier Discharge Using Diode Laser Absorption Spectroscopy ROBERT LEIWEKE, BISWA GANGULY, Air Force Research Laboratory — Tunable Diode-Laser Absorption Spectroscopy (TDLAS) technique based upon peak frequency shifts, β, and collision-broadened full widths at half maximum, w_c, of argon metastable $1s_3 \rightarrow 2p_2$ and $1s_5 \rightarrow 2p_7$ transitions, separated by 22.5 GHz, was used to measure both the gas temperature and the gas density in a short-pulse excited ($\approx$10 ns applied voltage rise time having $\approx$200 ns duration) argon DBD operating between 50-500 Torr, 1-4 kV total applied voltage, and 5 kHz repetition rate. TDLAS technique is well suited for high pressure environments having a small gas temperature rise ($\Delta T<100$ K) where the Doppler width component $w_D << w_c$. If there is no resonance between the absorber and the perturber and the absorbing transition terminates on a metastable state then, according to Lindholm-Foley theory, β and w_c scale as $nT^{0.3}$ where n is number density. Using the perfect gas law, the proportionality parameters β_o (frequency shift/Torr) and Γ_o (collisional broadening width/Torr) permits self-consistent measurements of both gas temperature and density. Reproducibility and accuracy of the temperature measurements were determined through the simultaneous independent measurements of these four parameters. The effects of applied voltage rise time on the power deposition and also metastable production efficiency will be reported.

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