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Field-emitting Townsend regime of surface dielectric barrier discharges generated in CO_2 emerging at high pressure[1] DAVID PAI, Institut PPRIME, SVEN STAUSS, KAZUO TERASHIMA, University of Tokyo — Surface dielectric barrier discharges (DBDs) in CO_2 from atmospheric pressure up to supercritical conditions (T_c = 304.13 K, p_c =7.4 MPa) generated using 10-kHz ac excitation are studied experimentally. Two discharge regimes are obtained: the standard and field-emitting Townsend regimes. The former resembles typical surface DBDs that have streamer-like characteristics, but the latter has not been reported previously. Here we present an analysis of the electrical and optical diagnostics of the field-emitting Townsend discharge regime using current-voltage and charge-voltage measurements, imaging, optical emission spectroscopy, and spontaneous Raman spectroscopy. Using an electrical model, it is possible to calculate the discharge-induced capacitances of the plasma and the dielectric, as well as the space-averaged values of the surface potential and the potential drop across the discharge. The model also accounts for the space-averaged Laplacian field by including the capacitance due to the fringe electric field from the electrode edge. The electrical characteristics are similar to those of atmospheric-pressure Townsend DBDs, i.e. self-sustained DBDs with minimal space-charge effects. The purely continuum emission spectrum is due to electron-neutral bremsstrahlung, with a corresponding average electron temperature of 2600 K. Raman spectra of CO_2 near the critical point demonstrate that the discharge increases the average gas temperature by less than 1 K.

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