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Surface dielectric barrier discharges generated in CO_2 exhibiting field emission at high pressure[1] DAVID PAI, Institut PPRIME, SVEN STAUSS, KAZUO TERASHIMA, University of Tokyo — For dielectric barrier discharges (DBDs) generated at atmospheric pressure or less, field emission has generally not been considered as a possible mechanism of electron emission. At higher pressures, however, gas-phase ionization may only become significant at electric fields that are comparable to the threshold field for field emission. Surface DBDs are studied experimentally in CO_2 from atmospheric pressure up to supercritical conditions (T_c =304.13 K, p_c =7.4 MPa). Two discharge regimes are generated using 10-kHz AC excitation. The "standard" regime is similar to previously studied surface DBDs in terms of onset voltage as a function of pressure, as well as electrical and optical emission characteristics. However, a "field-emitting" regime emerges starting from 0.7 MPa that exhibits constant onset voltage up to 7.9 MPa, purely continuum emission spectra in the visible/near-infrared range, and current waveforms similar to an atmospheric-pressure Townsend discharge. The maximum amount of negative charge deposited as a function of the applied voltage amplitude is consistent with the Fowler-Nordheim equation, demonstrating the presence of field emission. This behavior cannot be attributed to the Townsend or streamer ionization mechanisms, secondary electron emission, or non-discharge processes. No field-emitting structures are specially added to the electrodes. The onset voltage of the field-emitting regime does not follow the modified Paschen's law for field emission-assisted breakdown.

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