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A Universal Theory for Microscale Gas Breakdown for a Pin to Plate Geometry[1] AMANDA LOVELESS, LORIN BREEN, RUSSELL BRAYFIELD, ALLEN GARNER, Purdue University — Decreasing electronics size necessitates better characterization of electron emission at micro- and nanoscales for applications including microplasmas, micro- and nanoelectromechanical systems, and directed energy. While Paschen's Law has historically predicted breakdown voltage based on the Townsend avalanche criterion, field emission, must be incorporated for gap sizes below 15 micrometers. Extensive work has modified Paschen's law to include additional emission and breakdown phenomena for planar geometries [1]; however, practical experiments use pin-to-plate geometries (PPG). This work modifies a previously derived theory coupling Paschen's law and field emission to account for PPG by replacing the field enhancement, which has been used primarily as a fitting parameter, with the vacuum electric field for the PPG. The theory is applied to experimental data, and limiting cases relating gap distance to tip radius will be presented with applications to other geometries discussed. [1] A. L. Garner, A. M. Loveless, J. N. Dahal, and A. Venkattraman, IEEE Trans. Plasma Sci. 48, 808-824 (2020).

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