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Generalizing Microdischarge Breakdown Scaling Laws for Pressure and Gas[1] AMANDA LOVELESS, ALLEN GARNER, Purdue Univ — Shrinking device dimensions for micro- and nanoelectromechanical systems necessitates accurate breakdown voltage predictions for reliable operation. Additionally, one must accurately predict breakdown voltage to optimize system geometry for applications in microplasmas and micropropulsion. Traditional approaches use Paschen's law (PL) to predict breakdown, but PL fails at small gap distances (˜15 μm) where field emission dominates (A. Venkattraman and A. A. Alexeenko, Phys. Plasmas **19**, 123515 (2012).). Subsequent work (A. M. Loveless and A. L. Garner, Appl. Phys. Lett. **108**, 234103 (2016).) derived scaling laws and analytic expressions for breakdown voltage in argon at atmospheric pressure. Applications at high (e.g. combustion) and low (e.g. vacuum nanoelectronics) pressures for various gases motivate the generalization of these models for pressure and gas. This work addresses these concerns by deriving scaling laws generalized for gap distance, pressure, and gas, while also specifically incorporating and exploring the impact of field enhancement and work function. We compare these analytic scaling laws to experimental data and particle-in-cell simulations.

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