Contribution ID: **179** Type: **Poster Presentation**

DC Breakdown From Vacuum to Low Pressure in Dielectric-Loaded Systems*

Wednesday 6 July 2016 14:10 (20 minutes)

The purpose of this study is to characterize and order various contributions to breakdown, starting with single-surface multipactor in DC. 2D particle-in-cell (PIC) simulations will be presented for DC breakdown from vacuum through low pressure in dielectric-loaded, high-voltage systems. Simulations follow developments in [1] with a PIC model accounting for discretization errors. Models are included for space charge, dielectric charging, secondary emission, diffusive outgassed species from the dielectric, and various seed-current emission models.

Breakdown will be analyzed and presented in the context of a multiplicative anodic current. Vacuum DC breakdown is characterized by a multipactor front, defined by the saturation of dielectric-surface fields in the wake of the front, leading to a short-lived, high-amplitude anodic current. A similar front develops under low pressure, gaseous breakdown, but coupling between the (charged) dielectric surface and space charge leads to oscillatory effects in otherwise DC discharges. A novel framework for breakdown susceptibility in DC will be shown, characterizing breakdown regimes from vacuum through low pressure via $E_\perp/E_\parallel$ ratios using fields near the surface, grounding results in [2] with relations for secondary emission. Updated results for the effects of diffusive outgassed species from the surface under non-constant diffusivity will be delineated. Finally, effects of the seed current on discharge saturation will be discussed.

1. N.M. Jordan, et al., J. Appl. Phys., Vol. 102, No. 3, pp. (033301-1)-(033301-10), 2007.
2. R. Kishek, et al., Phys. Rev. Lett., Vol. 80, No. 1, pp. 193–196, 1998.

*This work is supported by an AFOSR grant on the Basic Physics of Distributed Plasma Discharges and, in part, by an MSU Strategic Partnership Grant.

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Session Classification: Poster 1-B

Track Classification: Dielectrics, Insulation, and Breakdown