Contribution ID: **1140** Type: **Oral**

Characterizing breakdown voltage in micro-gaps with multiple field emitters at atmospheric pressure*

Friday 28 June 2019 15:30 (15 minutes)

Insulation between high voltage electrodes is often in the form of micro-gaps which leverage the high breakdown voltage that occurs on the near-side of Paschen's curve. Structures on the electrodes are a concern due to electric field enhancement that can occur. The breakdown voltage in atmospheric pressure micro-gaps having multiple cathode field emitters was computationally investigated using a hybrid plasma hydrodynamics model in which electron transport following cathode emission is addressed using a Monte Carlo simulation [1]. Three mechanisms for electron emission from the cathode were included - ion-impact secondary emission, photo-electron emission, and thermionically enhanced electric field emission. The cathode had three post electron emitters with a work function of 4.0 eV, diameter of 5 μm and with a cathode-tip to anode distance of 30 μm. A linearly ramping voltage was applied to the anode and the cathode was grounded. The electric field at the top of the cathode posts was enhanced by a factor of 100 to account for surface roughness. The rate of applying voltage was varied from 1 to 100 V/ns. It was found that in the thermionic emission regime the electron emission induced by ions and photons have a minor impact on the breakdown, which is much different from the processes in Townsend mode regimes [2, 3]. The consequences of cathode work function, field enhancement factor, surface temperature and surface morphology on breakdown voltage will also be discussed.

[1] M. J. Kushner, *J. Phys. D: Appl. Phys.* 38, 1633, 2005.
[2] Y. Fu, P. Zhang, and J. P. Verboncoeur, *Appl. Phys. Lett.* 112, 254102, 2018.
[3] Y. Fu, J. Krek, P. Zhang, and J. P. Verboncoeur, *Plasma Sources Sci. Technol.* 27, 095014, 2018.

*This work was supported by the Air Force Office of Scientific Research (FA9550-18-1-0062, FA9550-18-1-0061) and the Department of Energy Office (DE-SC0001939).

Authors: Dr FU, Yangyang (Michigan State University); KREK, Janez (Michigan State University, CMSE); Prof. ZHANG, Peng (Michigan State University); Prof. VERBONCOEUR, John (Michigan State University); Dr PARSEY, Guy (University of Michigan); Prof. KUSHNER, Mark (University of Michigan)

Presenter: Dr FU, Yangyang (Michigan State University)

Session Classification: 5.5 Insulation and Dielectric Breakdown III

Track Classification: 5.5 Insulation and Dielectric Breakdown