Contribution ID: **961** Type: **Oral**

Microscale Gas breakdown voltage dependence on electrode surface

Tuesday 25 June 2019 10:30 (15 minutes)

Surface structure, such as surface roughness and electrode geometry, can modify field enhancement and work function, which subsequently modifies field emission. This can significantly change gas breakdown voltage for microscale gaps at atmospheric pressure [1], where field emission drives breakdown rather than Paschen's law. This presentation uses a tungsten pin anode and a copper plate cathode polished to three different surface roughnesses to characterize the impact of surface roughness and subsequent cathode damage on breakdown voltage for interelectrode gaps of 1, 5, and 10 microns at atmospheric pressure. Changing the surface roughness did not cause a statistically significant change in breakdown voltage; however, it played a critical role in breakdown voltage and cathode conditions for repeated breakdown events. After treatment, the cathode contained small craters from 3 to 50 microns deep. The breakdown voltage for these subsequent breakdown events agrees with theoretical predictions for an effective gap distance equal to the sum of the interelectrode gap distance and the crater depth. These effective gap distances are sufficient to exceed the Meek criterion for streamer discharge, indicating potential breakdown mechanism transition for a single interelectrode gap distance. The implications of the impacts of electrode surface structure on breakdown before and after multiple breakdown events on microdevice operation will be discussed.

[1] S. Dyanko, A. M. Loveless, and A. L. Garner, "Sensitivity of modeled microscale gas breakdown voltage due to parametric variation,"Phys. Plasmas, vol. 25, 2018, Art. no. 103505.

This material is based upon work supported by the Office of Naval Research under Grant No. N00014-17-1-2702. A. M. L. gratefully acknowledges funding from a graduate scholarship from the Directed Energy Professional Society and a fellowship from the Purdue Research Foundation.

Authors: BRAYFIELD, Russell (Purdue University); FAIRBANKS, Andrew (Purdue University); Ms LOVELESS, Amanda (Purdue Univeristy); GAO, Shengjie (Purdue University); Mr DARR, Caleb (Purdue University); MALAYTER, Jacqueline (Purdue University); Dr WU, Wenzhou (Purdue University); GARNER, Allen (Purdue University)

Presenter: BRAYFIELD, Russell (Purdue University)

Session Classification: 1.1 Basic Phenomena I

Track Classification: 1.1 Basic Phenomena;