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1P02 - Implications of surface roughness on microscale gas breakdown theory

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Predicting gas breakdown for micro- and nanoscale dimensions increases in importance as devices continue to shrink. A recent study derived a single universal theory to predict breakdown voltage for any gas and pressure for breakdown characterized by Townsend avalanche or field emission at microscale [1]. At microscale, the gas breakdown model more strongly depends on the electrode conditions, such as work function and field enhancement, than geometric or gas parameters [2]. Thus, more accurately predicting breakdown voltage requires further elucidating how physical electrode parameters, such as surface roughness, may alter the work function. This presentation theoretically examines the impact of sinusoidal surface roughness, specifically its amplitude and period, on work function [3] and breakdown voltage. Comparison to microscale gas breakdown experiments assessing cathode surface roughness and implications for nanoscale devices will be discussed.
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[1] A.M. Loveless and A.L. Garner, "A Universal Theory for Gas Breakdown from Microscale to the Classical Paschen Law,"Phys. Plasmas, vol. 24, 2017, art. no. 113522.
[2] S.D. Dynako, 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.
[3] W. Li and D. Y. Li, "On the correlation between surface roughness and work function in copper,"J. Chem. Phys., vol. 122, 2005, art. no. 064708.

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