Abstract Submitted
for the GEC17 Meeting of
The American Physical Society

Theoretical study of scaling law for electron kinetics in field emission-driven microplasmas in the pre-breakdown regime[1] XI TAN, DAVID B. GO, Department of Aerospace and Mechanical Engineering, University of Notre Dame, Notre Dame, IN 46556, USA — For microplasmas with a characteristic length less than 10 microns, field emission can be an important process that affects Townsend pre-breakdown regime. In this regime the electron kinetics fail to scale with the reduced electric field E/p (or E/N) due to some population of the electrons behaving ballistically or near-ballistically. This non-collisionality has been considered in a pseudo-analytical expression for the electron energy distribution (EED) that shows that the EED scales with three independent parameters – pd (collisionality), V (voltage drop across gap) and E/p. As a result the reaction rate coefficients also scale with these parameters. The model is validated using 1D particle-in-cell/Monte Carlo collision (PIC/MCC) simulations. The theory provides new scaling in pre-breakdown field emission-driven microplasmas, and a relatively simple model for identifying operating conditions for plasma chemical processes, encouraging new ideas for controlling plasma chemistry at microscales.

[1]National Science Foundation under Award No. FA9550-11-1-0020 and the Air Force Office of Scientific Research under Award No. FA9550-14-1-0041

Xi Tan
Dept., of Aerospace and Mech., Eng. University of Notre Dame

Date submitted: 08 Jun 2017 Electronic form version 1.4