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Field Emission Model for PIC-DSMC Simulations Based on Nanoscale Surface Characterization

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We are developing a stochastic, micron-scale field emission model for use in Particle-In-Cell Direct Simulation Monte Carlo (PIC-DSMC) simulations of vacuum discharge. PIC-DSMC simulations of mm-sized electrodes cannot resolve atomic-scale (nm) surface features and therefore we generate a micron-scale probability density distribution for an effective "local"work function, field enhancement factor, and emission area. Each micron-scale surface element in the PIC-DSMC simulation draws independent values from the atomic scale measured distributions for work function and other surface characteristics. Some effort has been made to match emission rates for the coarsened model to equivalent current densities from atomic scale measurements over intermediate-scale surface areas. In the present work, we use data from atomic-scale (nm) surface characterization using Scanning Tunneling Microscopy (STM), Atomic Force Microscopy (AFM), and Photoemission Electron Microscopy (PEEM) to generate a representative probability density distribution of the work function and field enhancement factor (beta) for a sputter-deposited Pt surface.

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