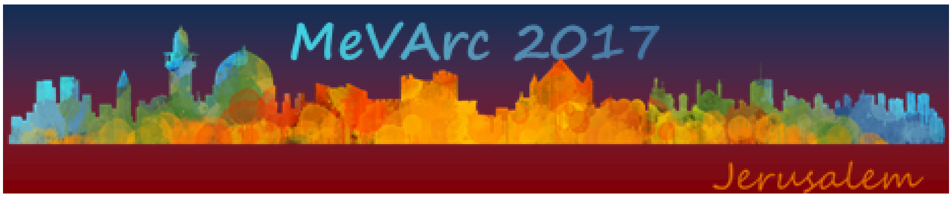

Contribution ID: **37**

Type: **oral**

Vacuum Field Emission Models, Measurements, and Simulations

Monday, 20 March 2017 14:00 (30 minutes)

In this talk we will introduce a new effort at Sandia to better understand the mechanisms involved in vacuum field emission from real, contaminated surfaces. We concentrate on the vacuum field emission of electrons from a surface based strongly on the role of initial emission as a necessary precursor to vacuum discharge. Although other ongoing work at Sandia is concerned with the evolution of the discharge process, including surface-gas interactions, plasma creation and growth, plasma chemistry, etc., we are solely concerned with vacuum field emission in this work.

To better understand field emission physics we are developing experimental and modeling capabilities to investigate the processes governing subsurface electron transport resulting in surface emission. The goal of the work is to develop models (captured in computational simulation capabilities) that predict correct electron transport and emission through conductors and heterogeneous surfaces (e.g., applied dielectric films). Progress is measured through improved comparisons between our experimental measurements and simulation results.

In the experimental regime, we are employing scanning tunneling microscopy (STM), atomic force microscopy (AFM), tunneling electron microscopy (TEM), and x-ray photoelectron spectroscopy (XPS) capabilities in novel experiments to bridge the tunneling-to-field-emission regime on specially prepared surfaces. Initially using single crystal Pt as a well characterized and well behaved emission surface, we add controlled specific layers of selected dielectrics (e.g., TiO_2, Al_2O_3) through atomic layer deposition (ALD) techniques, and make similar local I vs. V measurements under differing field strengths and tip-to-sample distances to understand the role of surface dielectric barriers (of varying thickness), grain boundaries, dislocations, and other micro- and nanoscale features on emission.

In the modeling regime we will couple density functional theory (DFT) models to describe a potential field, and apply electron Ensemble Monte Carlo transport methods developed at Sandia to account for the transport of electrons in the material leading to eventual surface emission. These detailed models will eventually be incorporated into coarser level modeling capabilities (e.g., PIC-DSMC) for use in simulating behavior of real devices.

Type of contribution

Oral

session

Field Emission

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