MODELING EMISSION PROCESSES IN THE FINITE-ELEMENT MICHELLE GUN & COLLECTOR SIMULATION CODE*

John Petillo, Dimitrios Panagos, Serguei Ovtchinnikov,
Alexander Burke & Christopher Kostas
Science Applications Int'l Corporation,
700 Technology Park Dr., Billerica, MA 01821

Kevin Jensen & Baruch Levush
Naval Research Laboratory, Washington, DC 20375

Ben Held & John DeFord
Simulation Technology & Applied Research, Inc.,
Mequon, WI 53092

Eric Nelson
Los Alamos National Laboratory, Los Alamos, NM 87545

The MICHELLE code [1], [2] is a Finite-Element Electrostatic Particle in Cell code for application to 2D and 3D particle beam formation, transport, and collection. Although its initial development focus had been for DC electron guns and depressed collectors, other applications such as RF electron guns, ion thrusters, photocathodes, etc. have become a recent focus. The MICHELLE code's ability to manage large mesh sizes and large particle counts in complex geometries requiring the resolution of disparate spatial scales in 2D and 3D on desktop computers has allowed it to be applied to devices that could not have been readily modeled in recent years.

Recent work has included using the time dependent capability for rf guns and photoemission gun applications. For photoemitters, predicting the effect of beam emittance and the complete beamlet phase-space distributions is important to understand in order to design a gun that will produce the desired beamlet characteristics. This presentation gives an overview of recent developments in the area of emission physics models [3], [4] including photoemission, dark current, and thermal beams with applications to time-dependent examples.

1. John Petillo, et al., "The MICHELLE Three-Dimensional Electron and Collector Modeling Tool: Theory and Design", IEEE Trans. Plasma Sci., vol. 30, no. 3, June 2002, pp. 1238-1264.
2. John Petillo, et al., "Recent Developments in the MICHELLE 2D/3D Electron Gun and Collector Modeling Code", IEEE Trans. Electron Devices Sci., vol. 52, no. 5, May 2005, pp. 742-748.
3. K.L. Jensen, et al., "Theory of Photoemission From Cesium Antimonide Using an Alpha-Semiconductor Model." J. Appl. Phys. 104, 044907 (2008).
4. K.L. Jensen, et al., "Emittance of a field emission electron source", J. Appl. Phys. 107,014903 (2010).

* Work supported by ONR, JTO and SAIC IR&D.