PRISM Seminar Series – Spring 2012

PRISM
NNSA Center for Prediction of Reliability, Integrity and Survivability of Microsystems

" Particle Simulations of Ion Generation and Transport in Microelectromechanical Systems and Micropropulsion "

PURDUE UNIVERSITY Discovery Park

Wednesday, March 21, 2012
3:30 pm, LWSN 3102

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Abstract:

Field emission/ionization is the process of electron/ion generation due to intense electric fields. This work presents a particle-based computational approach using the particle-in-cell (PIC) and the direct simulation Monte Carlo (DSMC) methods to study ion generation and transport in microelectromechanical systems (MEMS) and micropropulsion. In particular, the effects of field emission and field ionization due to intense electric fields are studied in detail. Electrostatically actuated MEMS devices such as switches, filters, resonators use significant voltage bias across micron-sized gaps resulting in electric fields > 107 V/m. The resulting electron emission from the cathode has important implications on reliability and performance of such devices. The first part of the talk deals with use of the PIC method with Monte Carlo collisions (MCC) between electrons and the ambient neutral gas to develop models to predict charge accumulation, breakdown voltage, etc. for various ambient gases, gap sizes, cathode material, and frequency of applied voltage. The second part deals with the modeling of field emission ion thrusters which are low thrust/high specific impulse devices used for in-space propulsion. The thrust is generated by extracting ions from a metallic liquid surface and accelerating them through a few kV potential difference. Particle simulations used to predict performance parameters of these thrusters are validated using experimental data for the current distribution.

Bio:

Venkattraman received his BS in Aerospace Engineering in 2007 from the Indian Institute of Technology Madras, India. He got his MS in Aeronautics & Astronautics, with a specialization in computational engineering from Purdue in 2009. His main research interests are in theoretical and computational nonequilibrium flows including plasma physics. During his graduate school he has worked, with his advisor Prof. Alina Alexeenko, on several problems in diverse applications such as MEMS, vacuum technology, and hypersonic flows. Venkattraman was also a summer student in 2010 at the Lawrence Livermore National Laboratory (LLNL) working on 3D plasma simulations for the National Ignition Facility (NIF).

Refreshments will be served. For further information please contact Prof. Alina Alexeenko, alexeenk@purdue.edu
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