Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Optimization of a carbon nanotube field emission electron gun for applications in mass spectrometry[1] ADRIAN SOUTHARD, University Space Research Association, STEPHANIE GETTY, DANIEL GLAVIN, GREGORY HIDROBO, STEVEN FENG, NASA Goddard Space Flight Center, NICHOLAS COSTEN, MUNIZ, CARL KOTECKI, NASA Goddard Space Flight Center — Field emission electron guns composed of carbon nanotube (CNT) pillar arrays make a low power, robust field emission source with turn-on fields as low as 1.8 Volts/μm. Fowler-Nordheim fits to the current-voltage data exhibit field enhancement factors of greater than 1000. Scaling of a carbon nanotube field emission electron gun to an aspect ratio of 2 mm x 40 mm using MEMS fabrication techniques has increased emitted current by two orders of magnitude beyond previous designs up to a current of 0.7 mA. Enhanced sensitivity from a time-of-flight mass spectrometer compatible with such a source was also obtained. Finite difference simulations (SIMION) of emission from CNT pillar arrays indicate that the field enhancement factors measured in the experiments can't be explained by emission from smooth pillars and must be due to emission from CNTs that protrude from the top of the pillar. SIMION simulations also explain why much of the emitted current is absorbed by the extraction grid using the current geometry and provide methods for improving electron beam transmission through the addition of a second grid. Simulations of electron beam focusing also demonstrate how the addition of a second grid could enable better focusing of the electron beam.

[1]Astrobiology Science and Technology Instrument Development grant

Adrian Southard
University Space Research Association

Date submitted: 20 Nov 2012 Electronic form version 1.4