Abstract Submitted
for the GEC15 Meeting of
The American Physical Society

A tunable microplasma gradient-index lens for millimeter waves AYYASWAMY VENKATTRAMAN, University of California, Merced — Field-induced electron emission from the cathode and its interaction with microdischarges has gained significant attention in the last few years particularly in the context of microscale gas breakdown. Recent advances in nanofabrication have led to the development of novel cathodes that demonstrate impressive field emission properties with turn-on fields as low as 1 V/μm and field enhancement factors as high as 1000 implying that field emission could play an important role in microplasmas as large as 500 μm. This work presents proof of concept of a novel application of field emission assisted (FEA) microplasmas that exploits the relatively high plasma number densities encountered in these devices. We hypothesize that the number density gradients and the resulting gradient in the microplasma relative permittivity/refractive index can be utilized as a tunable diverging lens with on/off ability to defocus waves in the Terahertz regime. Electron number density profiles obtained from one-dimensional particle-in-cell with Monte Carlo collisions (PIC-MCC) simulations for a typical FEA microplasma are used to determine the relative permittivity and conductivity profiles. Frequency domain wave propagation simulations using these profiles show that sub-mm waves can be controlled using the microplasma lens with the degree of defocusing depending on the wavelength. In spite of the non-zero conductivity, it is shown that the medium is not significantly lossy at the frequencies considered.

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Date submitted: 19 Jun 2015 Electronic form version 1.4