PPPS-2013: CHARACTERIZING ELECTRICAL AND THERMAL BREAKDOWN OF METAMATERIAL STRUCTURES FOR HPM APPLICATIONS*

T. Wynkoop, M. Gilmore, A.G. Lynn, S. Prasad, and E. Schmiloglu
University of New Mexico,
MSC01 1100, 1 University of New Mexico
Albuquerque, NM 87131 USA

The use of metamaterials (MTM's) in high power microwave (HPM) devices has been proposed as a way to improve efficiency and overall performance. However, by nature, MTM's are composed of subwavelength structures, often with sharp features, where high electric field concentrations may occur. Thus these structures may be prone to electrical breakdown. Additionally, some materials – especially dielectrics – proposed for MTM composite structures may have difficulty withstanding the levels heat loading found in typical HPM devices. In order to investigate the survivability of potential MTM structures in an HPM environment, two test stands are being constructed to characterize MTM material response to electric field stress, thermal stress, and charging. This is part of an overall, multi-university effort to develop MTM-based HPM devices with improved performance. The first of these test stands will utilize an existing HPM accelerator (Sinus-6 accelerator at UNM) that operates at ≤ 600 kV, kA current levels, and a 15 ns pulse. MTM's will be placed in close proximity to the beam, and breakdown will be characterized via fast imaging, and survey and high resolution spectroscopy. Additionally, a low current electron gun with $V_{beam} \leq 50$ kV, that can operate from ns pulsed to steady state, will be used to investigate effects of thermal loading and charging. Ultimately, results of this characterization will be used to develop robust MTM resonant/slow wave structures for HPM applications.

* Work supported by US AFOSR MURI Grant FA9550-12-1-0489