MEASUREMENTS OF UV-VUV RADIATION PRODUCED FROM DIELECTRIC SURFACE FLASHOVER

A. Fierro, G. Laity, A. Neuber, L. Hatfield
Center for Pulsed Power and Power Electronics
Texas Tech University
Box 43102, Lubbock, TX 79409-3102, USA

High energy photons released during the early stages of pulsed surface flashover are believed to be a contributing factor to the overall plasma formation. It is clear that only radiation with wavelength in the Ultraviolet (UV) and Vacuum Ultraviolet (VUV) regimes is capable of ionization and excitation processes of atmospheric gases, thus potentially providing seed electrons for secondary electron avalanches. To investigate the role of VUV photons in the breakdown process, an experiment was designed enabling detection of photons with energies greater than 7 eV with high temporal and spatial resolution. A transient low temperature plasma is generated on an MgF2 surface between two point-to-point stainless steel electrodes using a 200 ns rise-time high voltage pulser. Light emitted during the plasma formation is transmitted through the VUV transmissive MgF2 window into vacuum avoiding the strong absorption of VUV radiation in the atmosphere. High resolution measurements of the flashover event are acquired using a VUV-sensitive ICCD camera and photomultiplier tube (PMT) mounted to the exit ports of the VUV spectrograph. Detailed analysis of the two electrode regions clearly shows the presence of VUV emission lines prior to voltage collapse in atmospheric gases. Although a symmetric field geometry was chosen, it was seen in all cases that initial VUV emission originates from the anode. Furthermore, measurements of the 120 nm nitrogen ground transition taken at locations away from the anode demonstrated peak emission that coincided with streamer head locations. The observed behavior is consistent with a build-up of positive ion space charge in the gap attracting electrons from the surrounding medium causing excitations and ionizations in this high field region. Further time-resolved spectroscopy of the developing plasma in a high purity nitrogen environment captured the presence of the second positive system from molecular nitrogen as well as atomic emission lines. It was seen that the lifetime of the second positive system is much shorter (nanoseconds) than that of the atomic nitrogen emission lines (microseconds). The experimentally observed behavior will be discussed is it relates to the transient formation of a low temperature plasma along a dielectric surface.

* Work supported by the Air Force Office of Scientific Research with additional student fellowship support provided by the National Physical Science Consortium in collaboration with Sandia National Laboratories.