AN INVESTIGATION OF PULSED HIGH POWER MICROWAVE SURFACE FLASHOVER INITIATION IN ATMOSPHERIC CONDITIONS*

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The production of high power microwaves (HPM) in a vacuum environment for the purpose of radiating into atmosphere requires the use of a dielectric interface to separate the vacuum and atmospheric sides of the radiating structure. For high power to pressure ratios the interface will exhibit surface flashover on the atmospheric side, thus limiting the transmission of microwave power. An experimental setup that utilizes a magnetron operating at 2.85 GHz to produce a 4.5 MW, 3 μs pulse propagating in the TE_{10} mode along with an atmospheric test chamber enables investigating HPM surface flashover phenomena in the presence of various atmospheric conditions. One of the principle parameters measured is the delay time between application of the microwave pulse (50 ns rise time) and the sharp drop in transmitted power due to the flashover plasma formation. Several methods of delay time reduction have been employed to gain a better understanding of the source of breakdown initiatory electrons. For an environment composed of air at, for instance, 155 torr a delay time of 600 ns is observed. Illuminating the dielectric surface with continuous UV radiation reduces the average delay to about 380 ns. An even more distinct reduction in delay time was observed when electric field enhancement was introduced to the window surface via vapor deposition of sub-mm metallic points on the dielectric. These metallic points have proven to reduce the delay time to ~ 150 ns while increasing the global effective electric field by a factor of ~ 1.5. This presentation will include an overview of a variety of methods for investigating flashover initiation, including UV radiation and the application of an external DC electric field, as well as the introduction of field enhancing metallic points on the dielectric surface. An analysis of flashover behavior at atmospheric pressures (60-155 torr) in air, argon, and nitrogen will also be given along with an estimation of field enhancement factors for various geometries.

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