KHZ RANGE PULSED FIELDS IN PARTIAL VACUUM

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Insulating materials play a significant role in the performance of high voltage power systems, because, the high performance electrical insulation materials and structures must be free from unwanted and unpredictable dielectric breakdown through the insulator as well as over the surface, and along the interface between the insulator/electrode/ambient.

Surface flashover and the following electrical breakdown events across solid insulators in vacuum has been a topic of interest in the area of space power systems[1]. It is believed to be due to the field emission of electrons at the cathode 'triple-junction' when the applied field exceeds a certain threshold value[2]. The atmospheric pressure surface flashover is an interest to most high-voltage utility power transmission, because they results in power loss and insulation failure; and is believed to be due to the surface contamination[3].

The studies of surface flashover at partial pressure are important, because, most aerospace systems and vehicles operate in this regime (i.e. the pressure between the vacuum and atmospheres pressures). In an earlier work it is shown that surface flashover voltage of nano/micro dielectric materials is about 10% higher compared to the same polyimides with no fillers added under dc and 20kHz sinusoidal fields in partial vacuum[4]. In this work, surface flash over characteristics of the nano-dielectric material prepared using electrically insulating single component epoxy filled with 99.7% pure Al_2O_3 fused insulating powder under 20 kHz pulsed, unipolar applied field in partial pressure nitrogen. The plasma characteristics, such as voltage, current, and spectroscopic analysis of the breakdown allows us to predict the breakdown voltage for a given electrode gap distance and pressure range. Also, these data is valuable in studying the surface breakdown initiation mechanism, which is expected to be similar to the vacuum surface with an influence of avalanche process.

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