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Surface flashover behaviour of insulating materials under impulsive electric fields in environmentally friendly gases

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The insulating level of a pulsed-power system is usually limited by the voltage that initiates flashover over the surface of its solid insulators, rather than by the bulk solid breakdown strength. Due to environmental concerns, the use of SF6 is being reduced and it is therefore imperative to investigate the surface flashover performance of various commonly used solid insulating materials, in conjunction with the use of more environmentally friendly gases for compact pulsed power systems. Gases like nitrogen and carbon dioxide, that are proven to have desirable dielectric strength under pulsed conditions, are being considered as potential insulating gases for pulsed power systems and applications. Such gases can potentially be mixed with 4th generation refrigerants that exhibit high dielectric strength while having low global warming potential, approximately 5 orders of magnitude lower than that of SF6.

In this work, the flashover characteristics of solid dielectrics in a gaseous CO2 environment were studied. Disc shaped solid dielectric samples (20 mm diameter and 2 mm thickness) were subjected to high voltage impulses in the gas pressure range of 1-5 atm (absolute). HV impulses with positive and negative polarities and with rise times in both ns and μs regimes were applied. PVC, Tufnol, Nylon 66, glass reinforced Nylon and Perspex were used as insulating materials. The HV electrode was a 1.6 mm radius tungsten rod, located at the centre of the samples.

It was observed that flashover strength increases with increasing gas pressure. It was also found that some insulating materials consistently show higher flashover voltage, especially at elevated pressures. Based on the obtained results, recommendations for the use of different solid dielectrics in conjunction with environmentally friendly gases are provided, contributing to insulation coordination for pulsed power systems.

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