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Impulsive Dielectric Performance of HFO-gas Mixtures

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There is a strong demand in the power and pulsed power industries for environmentally friendly insulating gases and liquids with advanced dielectric properties as a replacement for SF6 due to environmental concerns. Recently several novel dielectric fluids have been proposed for potential use as insulating materials. 3M has developed the fluoroketone Novec™ 5110 dielectric fluid as a possible alternative to sulphur hexafluoride, [1]. Based on the Novec™ 5110 molecule, General Electric has developed a novel gas mixture, g3 (Green Gas for Grid described in [2]), with a low, 98% less compared to SF6, green house potential for switch-gear and grid applications. Other potential alternatives to SF6 include gases such as CF3I [3, 4] and hydrofluoroolefin, [5] mixed with buffer gases, typically with carbon dioxide or nitrogen. However, the breakdown properties of these fluids are not well understood and required further investigation in order to establish potential practical applications of these gases and gas mixtures.
The present work is aimed at investigation of the impulsive dielectric breakdown properties of the hydrofluoroolefin HFO1234ze in combination with other buffer gas(es) such as CO2. The triggered switching topology developed for this research project was used to characterise the switching performance, i.e. jitter and breakdown voltage spread of the gas mixtures stressed with high voltage impulses with rates of voltage rise in ns and /⊠s ranges. In pulse power applications in order to minimise the switch inductance and electrode's erosion rate, it is desirable to achieve multi-channelling operation of the plasma closing switch. Investigations into potential multi-channeling operation of the switching topology filled with different proportions of hydrofluoroolefin and buffer gas(es) has therefore been conducted. Based on the obtained results, the paper provides recommendations for potential applications of the hydrofluoroolefin HFO1234ze gas mixtures for plasma closing switching operations.

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