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High Field RF Breakdown of Pressurized SF_6

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Pure N2 and SF_6 as well as their mixtures are evaluated for high electric field breakdown tested at pressures ranging from 756 torr up to 1655 torr at 2.85GHz. Previous research concerning the breakdown characteristics of pressurized SF_6 and SF_6 mixtures at S-Band frequencies is limited, likely due to the high electric fields required to breakdown pressurized SF_6. A stepped impedance transformer is used in conjunction with a traveling wave resonator to obtain the electric field amplitudes necessary to break down the gases. Starting with the output from a 3.5 MW coaxial magnetron the electric field amplitude in the test piece at the center of the stepped impedance transformer yielded a maximum of about 150 kV/cm RMS.
Using Pure SF_6 as a baseline, the electric field breakdown threshold in the low pressure range (750 torr to 1450 torr) is distinctly lower, ˜ 80%, for a 20/80 SF_6 to N2 mixture and closer, ˜ 88%, at the higher pressures (1,450 torr to 1,650 torr). As a general observation, the measured breakdown field shows a mostly linear dependence upon pressure in a range from 750 torr to 1350 torr, while some levelling out tendency is observed at pressures greater than 1350 torr. Since pure N_2 exhibits a much lower breakdown threshold, ˜ 60%, compared to pure SF_6, mixing the two gases also results in a lower effective breakdown threshold; however, the reduction in the electric field breakdown threshold is not strictly proportional. For example, a 60/40 SF_6 to N2 mixture resulted in a 90% breakdown field while a 20/80 mixture still yielded about 80% in the high pressure regime.

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