EXPERIMENTAL STUDY OF HIGHLY PERIODIC PLASMA FILAMENT ARRAYS IN 110 GHZ MICROWAVE BREAKDOWN

Alan Cook, Michael Shapiro, and Richard Temkin
MIT Plasma Science & Fusion Center, 167 Albany St.
Cambridge, MA 02139 USA

Recent studies of gas discharges at high pressure (~1 atm) initiated by a focused mm-wave beam show the formation of periodic arrays of plasma filaments elongated along the electric field polarization[1]. The highly repeatable pattern, characterized by a triangular lattice arrangement with roughly quarter-wavelength spacing between filaments, progresses antiparallel to the incident microwave beam direction as the filaments appear and extinguish in succession. Further understanding of this phenomenon, which is distinct from the well-known filamentation in laser-induced breakdown, may have application in manipulating mm-wave beams and shielding sensitive electronics from high-power microwave pulses.

We present experiments studying breakdown in gases induced by a focused Gaussian beam of pulsed 110 GHz radiation at 100 kW - 1.3 MW. Observed aspects of the formation and dynamics of filament arrays are compared with published numerical models[2,3]. The effect of gas pressure on filament pattern formation, propagation speed, and power threshold for breakdown is studied. Reflection of microwave power by the filament array is observed and quantified. Methods of reducing the breakdown threshold by field enhancement are explored.

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