4B05

ELECTROMAGNETIC PROPERTIES OF CORRUGATED AND SMOOTH WAVEGUIDES FILLED WITH RADIALLY INHOMOGENEOUS PLASMA

A. Shkvarunets, S. Kobayashi, J. Weaver,
Y. Carmel, J. Rodgers, T.M. Antonsen, Jr.,
V.L. Granatstein, and W.W. Destler
University of Maryland, College Park, MD 20742

The creation and diagnosis of plasma in high power microwave devices remains one of the primary challenges of plasma microwave electronics. In the present work we deal with (a) diagnostics techniques for characterization of radially nonuniform plasma columns suitable for use in high power microwave sources and (b) the effects of such plasmas on the electromagnetic properties of finite length, spatially periodic slow wave structures. Experimental studies were performed both for a strong and weak guiding magnetic field. A single Langmuir probe technique cannot be used alone for precise characterization of magnetized plasma columns, especially for measurements of the electron plasma density. However, using a combination of a novel cylindrical resonant cavity technique supported by accurate numerical calculations of the plasma influence on cavity resonances of a long, thin plasma column we were able to characterize pulsed plasma columns. The peak density (higher than 10^{12} cm^{-3}) and the spatial distributions (transverse and axial) of the plasma was measured as a function of the applied magnetic field (2 to 10 KG) and the plasma gun operating conditions.

By applying a combined probe-microwave resonator (X-band) technique to plasma-filled, open, corrugated cavities we were able to measure *in situ* for the first time the complete dispersion curve of the TM_{01n} modes of a plasma-loaded, finite length, corrugated cavities immersed in guiding magnetic field. The frequency shifts of the TM_{01n} modes in this open slow-wave structure were measured as a function of the background plasma density and the magnetic field intensity. The dispersion diagrams were reconstructed up to peak plasma density of 10^{12} cm^{-3}. Frequency upshifts and "flattening" of the dispersion curves were observed for both strong and weak guiding magnetic fields. A discrepancy between the dispersion calculation and the measured data was identified for background plasma above 10^{12} cm^{-3}.

The authors gratefully acknowledge the support of AFOSR.