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MEMS Fabricated MM-Wave Slow Wave Structure[1]

MARK FIELD, ROBERT BORWICK, Teledyne Scientific & Imaging LLC, 1049 Camino Dos Rios, Thousand Oaks CA 91360, YOUNG-MIN SHIN, Department of Physics, Northern Illinois University, DeKalb, IL 60115 & Fermi National Accelerator Laboratory, Batavia, IL 60510, LARRY BARNETT, NEVILLE LUHMANN, Department of Electrical Engineering, University of California Davis, Davis, CA 95616, TAKUJI KIMURA, JOHN ATKINSON, Communications and Power Industries, 811 Hansen Way, Palo Alto, CA 94304 — We report on the fabrication and test of a MEMS slow wave structure designed for a > 40 GHz bandwidth centered on 220 GHz operation, that slows radiation down to group velocity of 8.16 x 10^7 ms^{-1} where the velocity matches the speed of electrons from a 20 keV source. The slow wave device uses a 40 mm long staggered interdigitated vane structure within a waveguide [1]. Ultimately, such a device will be integrated with an electron beam to become part of a sheet beam travelling wave tube (SBTWT) amplifier. A gold coated deep reactive ion etched (DRIE) silicon test structure was fabricated to test the RF properties of the design. This MEMS structure was coupled to WR-4 waveguide in a metal fixture and the S-parameters measured using a vector network analyzer, allowing extraction of the insertion loss and signal delay as a function of frequency. A further MEMS structure with just 10 cells of the vane structure within a cavity were fabricated which allows points on the dispersion curve to be directly measured as resonances of the structure. Extraction of the dispersion curve verifies the group velocity measurement of the device.

Mark Field
Teledyne Scientific & Imaging LLC,
1049 Camino Dos Rios, Thousand Oaks CA 91360

[1] Y-M. Shin & L.R. Barnett, *Appl Phys. Lett.* 2008, 92, no. 091501

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