Design, Fabrication and Characterization of Waveguide to Substrate Transition Based on Unilateral Substrateless Finline Structures

C. Lopez[1], V. Desmaris[1], D. Meledin[1], A. Pavolotsky[1] and V. Belitsky[1]

Waveguide-to-substrate transitions play a fundamental role in any THz system since active components are realized using thin film technology. The main requirements of such transitions are good impedance match and ease of fabrication.

Due to its large fractional bandwidths, waveguide E-probes have been widely adopted in the field [1,2]. Nevertheless, its performance is widely affected by its position inside the waveguide. Unilateral finline structures have been proposed [3] as an alternative solution. However, this approach results in problems related to impedance matching, which affects its performance over large operational bandwidths.

We present a novel waveguide to substrate transition, for prospective use in broadband mixer. The high impedance of the full-height waveguide is matched to the slotline using a unilateral substrateless finline structure and a 2-section slotline Chebyshev transformer.

The transition is designed of a silicon substrate covered by a superconducting niobium thin layer. In order to reduce the overall insertion loss and achieve the correct matching, the substrate encompass by the fins is fully removed. A gold layer located on top of the superconducting film provides grounding for the fins and aids the mounting process in the slit-block waveguide mount. Furthermore, the waveguide width is reduced in steps to reach a subcritical square cavity.

For the sake of comparison between simulations and measurements, a back-to-back arrangement was designed for the 211-373 GHz frequency band. Simulation results for this structure showed a fractional bandwidth of 55% with a return loss better than 15 dB. Moreover, a second design was developed for room temperature operation, where the superconducting film has been replace by gold.

The fabricated cryogenic transitions were characterized at 4K using a cryostat. The test setup also included a Rohde & Schwarz ZNA43 VNA with frequency extension modules operating at room temperature.

At the Conference, simulations and measured results for both, cryogenic and room temperature transitions, will be presented.

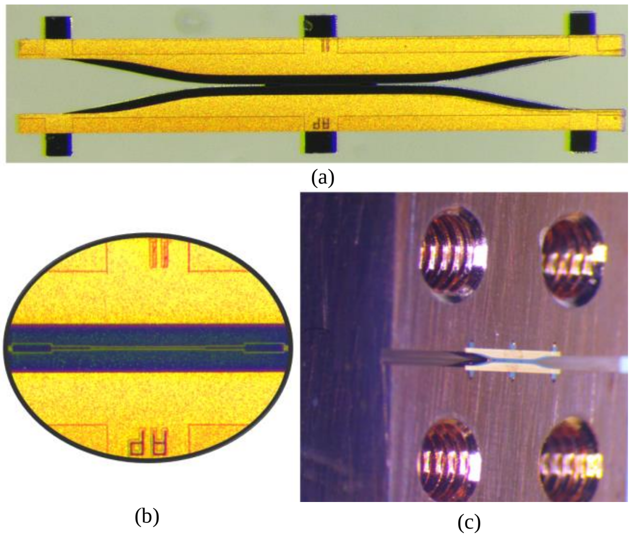

Fig. 1. (a) Photograph of the fabricated back-to-back transition. (b) Detail of the central slotline Chebyshev transformer. (c) Device mounted in the split-block waveguide. Silicon tips facilitate the mounting process and aids the handling of devices.

References

[1] Risacher, C., Vassilev, V., Pavolotsky, A., & Belitsky, V. “Waveguide-to-microstrip transition with integrated bias-T.”, IEEE Microwave and Wireless Components Letters, vol 13, pp. 262-264, 2003.

[2] J. W. Kooi, G. Chattopadhyay, S. Withington, F. Rice, J. Zmuidzinas, C. Walker, & G. Yassin, “A full-height waveguide to thin-film microstrip transition with exceptional RF bandwidth and coupling efficiency,” International Journal of Infrared and Millimeter Waves, pp.261-284, 2003.

[3] Tan, Boon Kok, and Ghassan Yassin, “Unilateral finline transition at THz frequencies,” Twentieth International Symposium on Space Terahertz Technology”, 2009

[1] Group for Advanced Receiver Development, Chalmers University of Technology, SE412 96, Gothenburg, Sweden.

NOTES: