Abstracts

Simultaneous measurements of electric and thermal fields utilizing an electrooptic semiconductor probe

R.M. Reano, Kyoung Yang, L.P.B. Katehi and J.F. Whitaker. "Simultaneous measurements of electric and thermal fields utilizing an electrooptic semiconductor probe." 2001 Transactions on Microwave Theory and Techniques 49.12 (Dec. 2001 [T-MTT] (Special Issue on 2001 International Microwave Symposium)): 2523-2531.

A method to simultaneously measure electric and thermal fields with a single probe is presented in this paper. The Pockels effect is employed within a gallium-arsenide probe to measure electric fields, and the effect of photon absorption due to bandtail states in the semiconductor is used to determine temperature. The measured optical power is found to be inversely related to temperature, in agreement with theory, and experimental results demonstrate a temperature sensitivity of 0.31 /spl mu/W//spl deg/C at 25/spl deg/C and an accuracy of /spl plusmn/0.5/spl deg/C between 20/spl deg/C-60/spl deg/C. The minimum detectable electric field is 1.24/spl plusmn/0.06 V/m using a 300-ms electrical bandwidth. Temporal phase stability of /spl plusmn/3/spl deg//h is achieved through the implementation of a system phase reference channel. The invasiveness of the probe is quantified by examining the change in the characteristic impedance and capacitance per unit length of a planar transmission line. Measured and simulated data show that the effect is equivalent to a lumped shunt capacitance on the order of a few femtofarads. The examination of a monolithic microwave integrated circuit in an X-band quasi-optical power-combining array and the calibration of electric-field data that was corrupted by temperature-dependent effects inherent to the electrooptic probe demonstrate the capability of this combined electrothermal measurement technique.

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