FAR-INFRARED MICROBOLOMETER DETECTORS

APPROVED BY SUPERVISORY COMMITTEE:

Dean Neikirk (Chairman)

Alejandro de Lozanne

Tatsuo Itoh

Christine Maziar

Ben Streetman

Dedicated to D.J., for helping to launch it; and to Julie, for helping to keep it on course.

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STUART MARTIN WENTWORTH, B.S., M.S.

DISSERTATION

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Finally, with one hand over my heart and the other raised in a 'hookem', I proudly recite the club MED motto: "if it's broke, don't fix it!"

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Receivers and imaging systems for the far-infrared (FIR) spectral region (wavelengths between 100 μ m and 3 mm) are desired for applications in astronomy, radar, and fusion research. Microbolometer detectors integrated with planar antennas are broad-band devices which work well in the FIR and which can be assembled into arrays for imaging. Radiation captured by the antenna heats the microbolometer detector, causing its temperature to change. With a good microbolometer material, this temperature change will result in a significant change in resistance, which can be measured. Also, a microbolometer has a small thermal mass, which means it can respond rapidly to a modulated FIR signal.

This study addresses the theory and operation of microbolometer detectors, and demonstrates the performance of conventional microbolometers using the elements bismuth and tellurium. The application of a bismuth microbolometer as the detector for a twin slot antenna structure is presented. The conventional microbolometer structure is constrained in that the resistance of the detector must match reasonably well with the impedance of the antenna. A composite microbolometer structure is demonstrated which removes this constraint. Finally, the sharp change in resistance at the transition temperature of a superconductor could be utilized to make a very responsive microbolometer. Preliminary results of such a transition edge microbolometer (TREMBOL) are presented using a conventional superconductor (lead) chilled to 7 K.

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