

**FAR-INFRARED AND SUB-MILLIMETER
MICROBOLOMETER DETECTORS**

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MICROBOLOMETER DETECTORS**

by

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DISSERTATION

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Electromagnetic signals near the sub-millimeter wave (SMMW) and far-infrared (FIR) region are very difficult to process, and present many challenges to researchers who work in this field. Antenna-coupled microbolometers are broad-band detectors which operate well throughout this spectral range. Understanding the issues which affect microbolometer performance are important for designing and optimizing these detector systems. Since the dynamics of microbolometer performance involve components of current flow as well as heat flow, both circuit analysis and thermal modeling must be integrated in order to model actual microbolometer performance. By developing such models, the electrical and thermal responses can be related to material properties and device geometry. An understanding of these relationships is essential in evaluating material and geometric choices for these devices.

Analytical and numerical techniques were developed and used to explore and expand the theory behind microbolometer performance. A three dimensional finite difference numerical method was used to quantitatively model the thermal properties of various microbolometer devices. Both steady state and transient analysis techniques are discussed. Numerical simulations were used to develop a new empirical relation for accurately estimating the thermal impedance of the detector into the substrate while accounting for arbitrary length-to-width ratios of the detector. A new numerical algorithm for transient analyses developed for this study is discussed. A composite microbolometer which uses a Y-Ba-Cu-Oxide superconducting detector element was modeled, fabricated, and tested.

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