



US005634718A

# United States Patent [19]

[11] Patent Number: **5,634,718**

Martinis et al.

[45] Date of Patent: **Jun. 3, 1997**

## [54] PARTICLE CALORIMETER WITH NORMAL METAL BASE LAYER

[75] Inventors: **John Martinis**, Boulder, Colo.;  
**Michael Nahum**, Sudburg, Mass.;  
**Steve Castles**, Lusby, Md.

[73] Assignee: **The United States of America** as  
represented by the Secretary of  
Commerce, Washington, D.C.

[21] Appl. No.: **281,360**

[22] Filed: **Jul. 27, 1994**

[51] Int. Cl.<sup>6</sup> ..... **G01K 17/00; G01K 13/00**

[52] U.S. Cl. .... **374/32; 374/142; 374/45**

[58] Field of Search ..... **374/32, 45, 141,**  
**374/142; 505/847, 849**

## [56] References Cited

### U.S. PATENT DOCUMENTS

3,906,231	9/1975	Fletcher et al. .	
3,939,706	2/1976	Pinson .....	374/32
4,687,342	8/1987	Betzler et al. ....	374/32
4,739,382	4/1988	Blouke et al. .	
4,765,749	8/1988	Bourgade et al. ....	374/32
4,869,598	9/1989	McDonald .....	374/176
4,904,869	2/1990	Schneider .	
4,935,626	6/1990	Schneider .	
4,943,559	7/1990	Severin .....	374/176
4,964,735	10/1990	Sasnett et al. ....	374/32
5,090,819	2/1992	Kapitulnik .....	374/176
5,171,733	12/1992	Hu .....	374/121
5,179,072	1/1993	Bluzer .	
5,316,380	5/1994	Secemski .....	374/32
5,321,276	6/1994	Kurakado et al. .	

## FOREIGN PATENT DOCUMENTS

1413432 11/1975 United Kingdom ..... 374/32

## OTHER PUBLICATIONS

Boulanger P. et al., "An absolute calorimeter for high power CO<sub>2</sub> laser", J. Phy. E: Scient. Instrum., vol. 6, pp. 559-560 (Great Britain, 1973).

Thermal Detectors As X-Ray Spectrometers, Moseley, Mather, & McCannon Phys. 56(5), Sep. 1, 1984.

Design Analysis Of A Novel Hot-Electron Microbolometr, Nahum and Richards, IEEE Transactions On Applied Superconductivity, 3, 2124(1993).

Primary Examiner—Diego F. F. Gutierrez

Attorney, Agent, or Firm—Patent Law Offices of Rick Martin, P.C.

## [57] ABSTRACT

A detector of X-ray and the like in which very good resolution of energy can be obtained. The device is based on two basic components. The first is the x-ray absorber in which an x-ray interacts with a film and converts its energy into heat. Because the absorber is operated at cryogenic temperatures, approximately the range of 0.01 Kelvin to 1 Kelvin, its heat capacity is small and causes a measurable temperature rise. The second component of the invention is a base layer of normal metal which absorbs the heat generated by the x-ray. The third component of the invention is the method to detect the temperature rise. This thermometer is based on a normal metal-insulator-superconductor tunnel junction, where part of the base layer is the normal metal. When the tunnel junction is electrically biased at a voltage slightly below the gap voltage of the superconductor, the electrical current that flows through the junction is sensitively dependent on the temperature of the normal metal.

18 Claims, 5 Drawing Sheets

