US006648503B2

(12) **United States Patent**
**Tanaka et al.**

(10) **Patent No.: US 6,648,503 B2**
(45) **Date of Patent: Nov. 18, 2003**

(54) **CALORIMETER AND MANUFACTURING METHOD THEREOF**

(75) Inventors: **Keiichi Tanaka**, Chiba (JP); **Toshimitsu Morooka**, Chiba (JP)

(73) Assignee: **Seiko Instruments Inc.**, Chiba (JP)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/760,030**

(22) Filed: **Jan. 12, 2001**

(65) **Prior Publication Data**

US 2002/0003830 A1 Jan. 10, 2002

(30) **Foreign Application Priority Data**

Jan. 14, 2000 (JP) ..... 2000-006509
Dec. 25, 2000 (JP) ..... 2000-393134

(51) **Int. Cl.**[7] ..... **G01K 17/02**; G01N 7/02; G01N 25/00; G01J 5/20

(52) **U.S. Cl.** ..... **374/31**; 374/10; 250/338.1; 422/51

(58) **Field of Search** ..... 374/31, 41, 42, 374/121, 10, 32; 422/51; 250/338.1, 338.4, 332; 29/592

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,575,631 A * 3/1986 Satchell ..... 250/332
5,100,479 A * 3/1992 Wise et al. ..... 136/225
5,120,505 A * 6/1992 Lowell, Jr. et al. ..... 422/58
5,162,658 A * 11/1992 Turner et al. ..... 250/554
5,298,748 A * 3/1994 Kenny et al. ..... 250/338.1

(List continued on next page.)

FOREIGN PATENT DOCUMENTS

EP 000534768 A * 3/1993 ..... 374/121

OTHER PUBLICATIONS

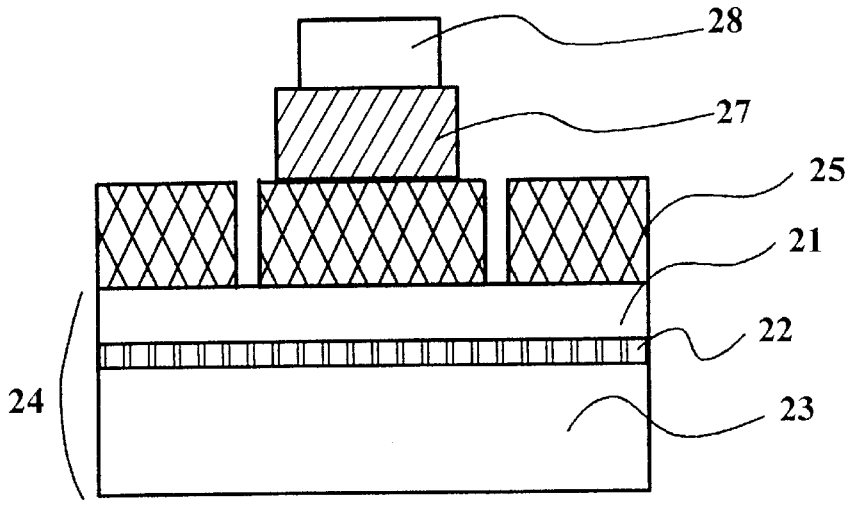
Mechin L et al; "Microbolometres SupraconductteursSuspendus Operant A La Temperaturede L' Azote Liquide; Conception Et Fabrication Par Micro–Usinage De Substrats De Silicium" Le Vide: Science, Technique Et Applications, FR, SFV, vol. 53, No. 283, 1997, pp. 124–139, XP000681492 ISSN: 1266–0167.

Mechin L et al; "Sensitive Ir Bolometers Using Superconducting Ybacuo Air Bridges Onmicromachined Silicon Substrates" Sensors and Actuators A, CH, Elsevier Sequoia S. A., Lausanne, vol. A55, No. 1, Jul. 15, 1996, pp. 19–23, XP000641562 ISSN: 0924–4247.

(List continued on next page.)

*Primary Examiner*—Diego Gutierrez
*Assistant Examiner*—Gail Verbitsky
(74) *Attorney, Agent, or Firm*—Adams & Wilks

(57) **ABSTRACT**

A colorimeter has an absorber for absorbing radiation energy and converting the radiation energy into thermal energy. A resistor is connected to the absorber for converting thermal energy into an electrical signal. A membrane is connected to the resistor for controlling a thermal discharge from the resistor. A substrate is connected to the membrane and has a tri-layer structure comprised of an etching layer having a preselected thickness, an etching stop layer and a support substrate. The membrane is spaced-apart from a main surface of the etching stop layer by the preselected thickness of the etching layer.

**9 Claims, 11 Drawing Sheets**