Atty. Docket No. MIT-7581L-RX1

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE PATENT OF:	:	
Joseph BERNSTEIN et al.	:	PATENT NO.: 6,057,221
SERIAL NO.: 08/825,808	:	ISSUE DATE: May 2, 2000
FILING DATE: April 3, 1997	:	CONTROL NO.: 90/011,607
ASSIGNEES:	:	

MASSACHUSETTS INSTITUTE OF TECHNOLOGY;
THE UNIVERSITY OF MARYLAND

FOR: LASER-INDUCED CUTTING OF METAL INTERCONNECT

I hereby certify that this document is being transmitted to the USPTO or deposited with the United States Postal Service as first class mail in an envelope addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on March 26, 2012.

By: /Judy Ryan/
Judy Ryan

DECLARATION

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SIR:

Now comes Joseph B. Bernstein, who declares and states that:

1. I am an inventor in U.S. Pat. No. 6,057,221 (hereinafter the "'221 Patent"), which is the subject of this Ex Parte Reexamination.

2. I am familiar with the subject matter disclosed and claimed in the above-identified patent, including the claims in the Preliminary Amendment filed on April 14, 2011 (hereinafter

the "Preliminary Amendment") in this Reexamination. I am also familiar with the subject matter of the cited references (i.e., Koyou, Japan Pat. Appl. Pub. No. 8-213465, published Aug. 20, 1996 [hereinafter "Koyou"], Wada, et al., Japan Pat. Appl. Pub. No. 6-244285, published Sep. 2, 1994 [hereinafter "Wada"] and Lou et al., U.S. Patent No. 5,729,042 [hereinafter "Lou"]), and the evidence attached hereto as Exhibits A-N.

3. I am currently a Professor in the School of Engineering, Bar Ilan University, Ramat Gan, Israel. I was awarded a Ph.D. in Electrical Engineering and Computer Science in 1990 from the Massachusetts Institute of Technology, Cambridge, Massachusetts. My curriculum vitae is attached hereto as Exhibit A.

I. The Rejection of Claim 3 Under 35 U.S.C. § 103(a)

4. I understand that Claim 3 in the Preliminary Amendment is directed to a method for cutting a link between interconnected circuits, comprising the steps of (i) directing a laser upon an electrically-conductive cut-link pad conductively bonded between a first electrically-conductive line and a second electrically-conductive line on a substrate, ***the cut-link pad having substantially less thermal resistance per unit length than each of the first and second lines, wherein the width of the cut-link pad is at least ten percent greater than the width of each of the first and second electrically-conductive lines***, and (ii) maintaining the laser upon the cut-link pad until the laser infuses sufficient energy into the cut-link pad to break the conductive link across the cut-link pad between the pair of electrically-conductive lines, wherein the electrically-conductive cut-link pad has an inner surface facing the substrate and an opposing outer surface facing away from the substrate, the first and second electrically-conductive lines extending from the inner surface into the substrate (emphasis added).

5. I understand that Claim 3 has been rejected under 35 U.S.C. 103(a) for obviousness over Koyou in view of Wada.

6. As further explained below, Claim 3 is patentable over the combination of Koyou and Wada because (1) the combination of Koyou and Wada does not lead to the method of Claim

3, (2) the method of Claim 3 runs contrary to conventional wisdom in the art, and (3) the method of Claim 3 provides unexpected results.

1. The Combination of Koyou and Wada Does Not Lead to the Present Invention

7. Two of the most significant features of Claim 3 of the '221 Patent are (i) "the cut-link pad having ***substantially less thermal resistance per unit length*** than each of the first and second lines," and (ii) "the width of the cut-link pad is ***at least ten percent greater*** than the width of each of the first and second electrically-conductive lines." Having both of these features in a cut-link pad ***in a vertical fuse*** is particularly advantageous.

8. The combination of Koyou and Wada does not lead to the present invention because (1) Koyou discloses a vertical fuse, but does not affirmatively disclose a cut-link pad having a width that is at least ten percent greater than the width of each of the first and second electrically-conductive lines, (2) Koyou does not disclose or suggest a cut-link pad having substantially less thermal resistance per unit length than each of the first and second lines, (3) Wada discloses a horizontal fuse, and therefore, does not cure the deficiencies of Koyou with regard to a cut-link pad having a width at least ten percent greater than the width of the electrically-conductive lines and a cut-link pad having substantially less thermal resistance per unit length ***in a vertical fuse***, and (4) one of ordinary skill in the art would not combine features from the horizontal fuse of Wada with the vertical fuse of Koyou.

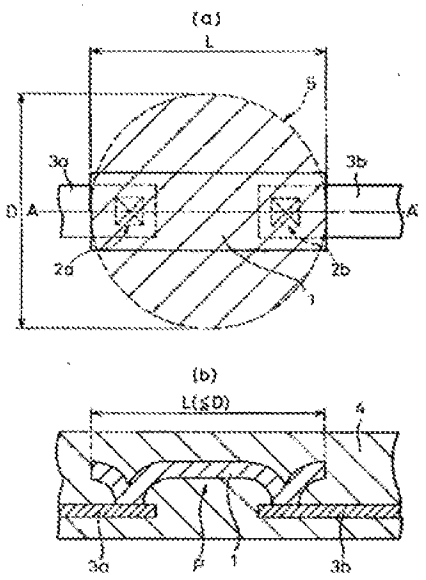
A. Koyou Does Not Affirmatively Disclose or Suggest a Cut-link Pad Having a Width That is at Least Ten Percent Greater Than the Width of the Conductive Lines

9. Koyou discloses three embodiments of vertical fuses as shown in FIGS. 1-3. The three embodiments are discussed below. Claim 3 of the '221 Patent is distinguished over each of these three embodiments.

10. Koyou discloses a fuse member (of length L) that can be disconnected by a laser beam, and interconnection layers 3a and 3b that are connected to the fuse member through contact holes 2a and 2b (see para. [0009], and FIG. 1(a) and 1(b) of Koyou; shown below).

Koyou also discloses that the length L of fuse member 1 is less than or equal to the illumination spot diameter D of the laser beam 5 (see para. 0010 of Koyou), and that the fuse member 1 is structured to be, at the largest, about the same size as the illumination spot diameter of laser beam 5 so as to minimize the thermal capacity by minimizing the volume of fuse member 1 (see para. 0012 of Koyou).

PRINCIPAL BLOCK DIAGRAM OF A SEMICONDUCTOR DEVICE ACCORDING TO THE PRESENT INVENTION



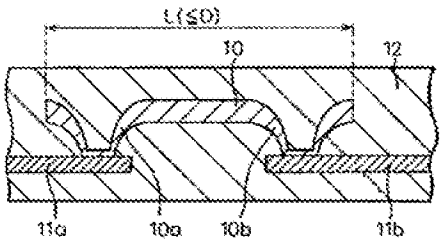
11. FIG. 1(a) demonstrates that the width of the interconnection layers 3a and 3b is greater than the width of the material in the contact holes 2a and 2b. However, FIG. 1 also clearly shows that the material in the contact holes 2a and 2b ***is part of the fuse member 1*** because the length L of the fuse member 1 includes the material in contact holes 2a and 2b, the material in the contact holes 2a and 2b is the same material as the material of the fuse (see the hatching in FIG. 1(b)), the material in the fuse member 1 has a uniform thickness throughout its structure, and the laser directly irradiates material in the contact holes 2a and 2b (note the v-shaped depression in the uppermost surface of fuse member 1 in the regions of contact holes 2a and 2b). These facts clearly indicate that the same process (or series of process steps) forms fuse pad 1 and the material in the contact holes 2a-2b at the same time. Therefore, since the material

in contact holes 2a and 2b is part of the fuse, this material cannot be the "electrically-conductive lines" conductively bonded to the fuse, as recited in Claim 3.

12. Consequently, in the embodiment of FIG. 1, the only structure that can be the "electrically-conductive lines" are interconnection layers 3a and 3b. Koyou does not affirmatively disclose that the width of the fuse member 1 is at least ten percent greater than the width of interconnection layers 3a and 3b. In fact, the width of interconnection layers 3a and 3b is greater than the width of the contact holes 2a and 2b. Therefore, the interconnection layers 3a and 3b do not necessarily constrain the flow of heat/thermal energy from the fuse member 1.

13. Similarly, as shown in the embodiment of FIG. 2 (see below), Koyou discloses a fuse member 10 having portions 10a and 10b, and underlying interconnection layers 11a and 11b below the fuse member 10 (see para. [0015] and FIG. 2 of Koyou). Koyou discloses that "the laser beam for disconnecting the fuse is selected to be approximately 5 μm, where the length L of the fuse member 10 must be formed to be at most 5 μm" (see para. [0016] and FIG. 2 of Koyou). Koyou further discloses that "as illustrated in FIG. 2, the cross-sectional areas of the individual portions 10a and 10b are selected to be smaller than the disconnection cross-sectional area of the fuse member 10," and that "by reducing the coverage rate of each of the conductive member portions 10a and 10b it is possible to achieve a relative increase in the thermal resistance of the contact portion relative to that of the fuse member 10" (see para. [0016] and FIG. 2 of Koyou).

(FIG. 2)
CROSS-SECTIONAL DIAGRAM ILLUSTRATING SCHEMATICALLY THE STRUCTURE OF THE CRITICAL COMPONENT (THE LASER FUSE) IN A SEMICONDUCTOR DEVICE AS SET FORTH IN A FIRST EXAMPLE OF EMBODIMENT ACCORDING TO THE PRESENT INVENTION



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