

Remarks

Patentees and their representatives wish to thank Examiner Heyman for the thorough reexamination of U.S. Pat. No. 6,057,221 (hereinafter, the “‘221 Patent”) and the detailed explanations in the Office Action dated January 26, 2012. The Examiner’s concerns have been given serious consideration. However, in view of the accompanying amendments and the following remarks, the present claims are allowable over the cited references.

Claim 3 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.

Claim 14 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 cut-link pad is covered with ***a passive layer that is harder than the substrate***; 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.

The references cited in the Office Action dated January 26, 2012 (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”]) neither disclose nor suggest a method for cutting a link between interconnected circuits, comprising directing a laser upon an electrically-conductive cut-link pad having substantially less thermal resistance per unit length than each of the first and second electrically-conductive lines conductively bonded thereto, and:

- the cut-link pad has (i) an inner surface facing the substrate and an opposing outer surface facing away from the substrate, and the first and second electrically-conductive lines extend from the inner surface into the substrate (see, e.g., Claims 3, 17 and 26) and (ii) a width that is at least ten percent greater than the width of each of first and second electrically-conductive lines (see, e.g., Claims 3 and 17);
or
- the cut-link pad is covered with a passivative layer that is harder than the substrate (see, e.g., Claim 14).

Consequently, the present claims are patentable over the cited references.

The Rejection of Claim 23 under 35 U.S.C. § 112, Second Paragraph

The rejection of Claim 23 under 35 U.S.C. § 112, second paragraph, is respectfully traversed.

A via is a common structure in semiconductor devices, and the term has a clear meaning to those skilled in the art. It is also understood in the art that a via can have a cross-sectional area. The cross-sectional *area* of the via has two dimensions, and is thus definable by one or two dimensional components, depending on the cross-section and the shape of the via. For example, in a side view, the cross-sectional area of the via may be defined by the width of the via and the height or depth of the via. In a top-down view, when the via is substantially square or substantially circular, the cross-sectional area of the via may be defined by the width of the via alone (a square having an area that is the square of the width, and a circle having an area that is

proportional to the square of the radius, a dimension that is equal to half of the diameter or width). Thus, the cross-sectional area of a via can be defined at least in part by the width of the via.

Although Claim 23 does not require that the cross-sectional area of the via be defined by two specific dimensional components (which is not necessary in at least two possible embodiments of the invention), Claim 23 also does not exclude the possibility of a second dimensional component contributing to the definition of the cross-section of the via. As a result, the rejection of Claim 23 under 35 U.S.C. § 112, second paragraph, is improper and should be withdrawn.

The Rejection of Claim 11 under 35 U.S.C. § 102(b)

The rejection of Claim 11 under 35 U.S.C. § 102(b) as being anticipated by Nishimura has been obviated by appropriate amendment.

The Rejection of Claims 3, 4, 6-8, 23, 25, 26 and 28 under 35 U.S.C. § 103(a)

The rejection of Claims 3, 4, 6-8, 23, 25, 26 and 28 under 35 U.S.C. § 103(a) as being unpatentable over Koyou in view of Wada is respectfully traversed.

As 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 (see paragraph 6 of the Declaration of Joseph B. Bernstein, dated March 8, 2012 and submitted herewith [hereinafter, the “Bernstein Declaration”]).

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

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 being ***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 (see the Bernstein Declaration, paragraph 7). In vertical fuse structures, the electrically-conductive lines are in a metal layer under and/or below the fuse pad (see the Bernstein Declaration, paragraph 35). In a vertical fuse, the fuse pad has an inner surface facing the substrate and an opposing outer surface facing away from the substrate, and the electrically-conductive lines extend from the inner surface into the substrate (see Claims 3, 17 and 26), and the fuse pad, the first and second electrically-conductive lines, and the underlying interconnection layers may be formed at different times and with different materials (see the Bernstein Declaration, paragraph 35). Vertical fuses have the advantage of being manufacturable using structures having the smallest possible dimensions (see the Bernstein Declaration, paragraph 33).

The combination of Koyou and Wada does not lead to the present Claims 3 and 26 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 (Claim 3 only),
- (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 (Claim 3 only) and/or 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 (see the Bernstein Declaration, paragraph 8).

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