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

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PATENT OWNERS' STATEMENT IN
EX PARTE REEXAMINATION PURSUANT TO 37 C.F.R. 1.530

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SIR:

Patentees respectfully submit the following Patent Owners' Statement pursuant to 37 C.F.R. §1.530 and M.P.E.P. §§ 2249 and 2250, detailing why the subject matter as claimed by U.S. Pat. No. 6,057,221 (hereinafter the "'221 patent") is not anticipated or rendered obvious by the references on which the substantial new questions of patentability (hereinafter "SNQ") are based.

Patent Owners' Statement Regarding the References on which the Substantial New Questions of Patentability are Based (37 C.F.R. § 1.530)

Claims 1-2:

Reexamination of Claims 1-2 is moot, as Claims 1-2 have been canceled (see the Corrected Pre-Amendment filed April 14, 2011 [hereinafter the "Amendment"]).

Claim 3:

Claim 3 has been rewritten in independent form and includes the limitations of Claim 1. Claim 3 recites a method for cutting a link between interconnected circuits, comprising 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 electrically-conductive 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 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 (see the Amendment).

Reexamination of Claim 3 has been requested in view of Koyou, Japan Pat. Appl. Pub. No. 8-213465, published Aug. 20, 1996 (hereinafter "Koyou"). Claim 3 is not anticipated or rendered obvious in view of Koyou because Koyou does not disclose or suggest a cut-link pad that has substantially less thermal resistance per unit length than each of the first and second electrically-conductive lines. Furthermore, Koyou does not affirmatively disclose that 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.

As shown in FIGS. 1(a)-(b) of Koyou, the width of fuse pad 1 is greater than the width of contact holes 2a and 2b and of interconnect lines 3a and 3b. However, the material of the fuse pad 1 is continuous with and formed at the same time as the material in the contact holes 2a-2b, so material in the contact holes 2a-2b is within the laser spot (note the depressions in fuse member 1 in the regions of the contact holes 2a-2b). Therefore, the material in each of the contact holes 2a and 2b ***is part of the fuse***, and these portions of the fuse in the contact holes 2a and 2b are not "first and second electrically-conductive lines." Additionally, the width of the interconnect lines 3a and 3b is greater than the width of contact holes 2a and 2b. Thus, since the material in the narrow contact holes 2a and 2b is part of the fuse, and since at least part of the material in the holes 2a and 2b is irradiated by the laser, the portions of the fuse pad 1 that are in the contact holes 2a and 2b have a thermal resistance that is either ***equal to or greater than*** the thermal resistance of the interconnect lines 3a and 3b.

The material in each of the relatively narrow contact holes 2a and 2b is not an "electrically conductive line" since it is part of the fuse structure 1, it is completely within the laser spot 5, and it is at least partially irradiated by the laser (see e.g., paragraph [0013] and FIGS. 1(a)-(b) of Koyou). Additionally, the portions of the fuse member 1 in the contact holes 2a and 2b effectively ***increase*** the thermal resistance per unit length of the fuse 1 within the laser beam spot 5 (see e.g., FIGS. 1(a)-(b) of Koyou). This situation is demonstrated more clearly in FIG. 2 of Koyou, discussed below.

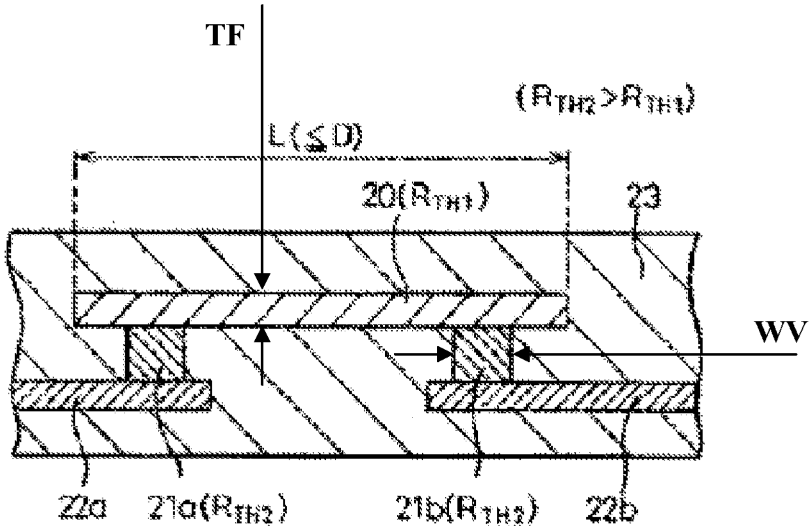
The interconnect lines 3a and 3b in FIGS. 1(a)-(b) of Koyou also are not "electrically conductive lines" as defined in Claim 3 since they are wider than the material in the relatively narrow contact holes 2a and 2b (which is at least partially part of the fuse pad). Based on dimensions alone (Koyou does not suggest that the interconnect lines 3a and 3b are made of a different material from the fuse 1), the wider interconnect lines 3a and 3b presumably have a lower thermal resistance per unit length than the material in the relatively narrow contact holes 2a and 2b, which is part of the fuse structure. Thus, the cut-link pad does not have less thermal resistance per unit length than interconnect lines 3a and 3b.

In the embodiment shown in FIG. 2 of Koyou, the combined length L of fuse member 10 and conductive portions 10a and 10b are completely within the illumination spot diameter D of the laser beam. Conductive portions 10a and 10b are selected to be smaller in cross-sectional area than fuse member 10, thereby increasing the thermal resistance of the contact portion relative to the fuse member 10. The electrically conductive portions 10a and 10b may also be formed from materials other than the material of fuse member 10, but the materials for portions 10a and 10b should be selected to have thermal resistances ***as great as possible*** (see paras. [0016]-[0017] and FIG. 2 of Koyou; emphasis added). Consequently, since portions 10a and 10b of fuse 10 are completely within the laser spot, portions 10a and 10b ***increase*** the thermal resistance per unit length of fuse 10, especially relative to the conductive lines connected thereto.

Koyou discloses a third embodiment in FIG. 3, including a fuse member 20 and contact holes 21a and 21b. Koyou is also silent with regard to the relative widths of the fuse member 20 and the material filling each of the contact holes 21a and 21b. Thus, this embodiment of Koyou is also deficient with regard to the most important dimension of the invention claimed in the '221 patent (i.e., that 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).

For example, at the time of Koyou's publication, line widths of 1.1-1.3 μm in the uppermost layer of metal were not uncommon (see, e.g., p. 10 and p. 11, respectively, of the Construction Analyses of the Lattice ispLSI2032-180L CPLD [hereinafter the "Lattice Analysis"] and the Samsung KM44C4000J-7 16 Megabit DRAM [hereinafter the "Samsung Analysis"], published by Integrated Circuit Engineering, Scottsdale AZ, Report Nos. SCA 9712-573 and SCA 9311-300I, respectively; submitted herewith as Exhibits A and B). The vias between the uppermost layer of metal and the next layer of metal therebelow in these devices had a width of 1.0 μm and 1.2 μm, respectively. Thus, while the uppermost layer of metal in the Lattice ispLSI2032-180L CPLD was arguably 10% wider than the vias connected thereto (1.1 μm vs. 1.0 μm), the uppermost layer of metal in the Samsung KM44C4000J-7 16 Megabit DRAM was not (i.e., [1.3 - 1.2] / 1.2 = 8.3%). Accordingly, it is not inherent that the width of the fuse member 20 disclosed in FIG. 3 of Koyou is at least ten percent greater than the width of the material filling each of the contact holes 21a and 21b.

Furthermore, Koyou does not affirmatively disclose a cut-link pad having substantially less thermal resistance ***per unit length*** than each of the first and second electrically-conductive lines. It is clear from FIG. 3 of Koyou that the width of the contact holes (vias) 21a and 21b (designated as WV below) is much greater than the thickness of the fuse member 20 (designated as TF below). Based on measurement of the relative dimensions of WV (e.g., about 6.3 mm in the diagram below) and TF (e.g., about 4.0 mm in the diagram below) in FIG. 3 of Koyou, the thickness TF of the fuse member 20 is approximately 60% of the width (WV) of the material in the contact holes 21a and 21b (i.e., TF/WV ≈ 0.6).



Although Koyou does not disclose the width of the fuse member 20 or the width of the contact holes 21a and 21b, based on (i) dimensions for these parameters that were arguably considered "state of the art" at the time of Koyou's publication (see, e.g., the Lattice Analysis and the Samsung Analysis), (ii) the approximate ratio of the thickness of the fuse member 20 to the width of the contact holes 21a and 21b as calculated from FIG. 3 of Koyou, and (iii) the thermal conductivity of the most likely or most commonly used metals for the fuse member 20

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