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Datasheet for the decision of 16 May 2007

Case Number: T 0758/04 - 3.4.03

Application Number: 97306584.0

Publication Number: 0827196

IPC: H01L 21/768

Language of the proceedings: EN

Title of invention:
Laser ablation improvement for energy coupling to a film stack

Applicant:
International Business Machines Corporation

Opponent:
-

Headword:
Laser ablation/INTERNATIONAL BUSINESS MACHINES CORPORATION

Relevant legal provisions:
EPC Art. 56, 83, 113(1), 123(2)
EPC R. 67, 68(2)

Keyword:
"Inventive step (yes)"
"Decision on the state of the file"
"Substantial procedural violation (yes)"
"Reimbursement of the appeal fee (yes)"

Decisions cited:
T 1360/05, T 1356/05

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0758/04 - 3.4.03

D E C I S I O N
of the Technical Board of Appeal 3.4.03
of 16 May 2007

Appellant: International Business Machines Corporation
Armonk, NY 10504 (US)

Representative: Waldner, Philip
IBM United Kingdom Limited
Intellectual Property Department
Hursley Park
Winchester,
Hampshire SO21 2JN (GB)

Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 5 February 2004 refusing European application No. 97306584.0 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: R. G. O'Connell
Members: E. Wolff
U. Tronser

Summary of Facts and Submissions

I. This is an appeal from the refusal of European patent application 97 306 584.0 for lack of inventive step having regard to the following prior art documents:

D1: US 5 538 924 A
D2: US 4 908 493 A

of which D1 was regarded as closest prior art.

II. The grounds for the decision of the examining division posted 5 February 2004 read in full: "In the communication(s) dated 11.04.2002, 22.07.2003 the applicant was informed that the application does (sic) not meet the requirements of the European Patent Convention. The applicant was also informed of the reasons therein. The applicant filed no comments or amendments in reply to the latest communication but requested a decision according to the state of the file by a letter received in due time on 22.01.2004. The European application is therefore refused on the basis of Art. 97(1) EPC."

III. On appeal the applicant maintained his main claim request as refused and filed three new auxiliary requests. In response to a telephone inquiry from the board the appellant filed an amended main claim request. The documents underlying the main request are:

Main request

Description: pages 1,3 to 6, and 9 as originally filed
page 2 faxed 11 May 2007

Claims: 1 to 7(part) faxed 11 May 2007
7(part) to 14 filed 28 April 2007

Drawings: sheets 1 to 7 as originally filed

IV. Independent claims 1 and 7 of the main request read:

"1. A method of laser ablation of a fuse (13) under a multilayer dielectric stack (11, 12) on a wafer (16) having an integrated circuit device characterised by the steps of:
matching an incidence angle (theta) of a laser beam (21) to an index of refraction of said multilayer dielectric stack (11, 12); and
transmitting said laser beam (21) from a laser at said angle (theta) through said mutilayer dielectric stack (11, 12) onto said fuse to improve coupling of laser energy to the stack and reduce overall fuse ablation sensitivity to stack thickness variation."

"7. An apparatus for laser ablation of a fuse (13) under a multilayer dielectric stack (11, 12) on a wafer (16) having an integrated circuit device characterised by:
a laser (51) sending a beam (52) to said wafer (54);
a stage for said wafer (54); and
a means (55) for matching an incidence angle of the laser beam to an index of refraction of said multilayer

dielectric stack and transmitting said laser beam from said laser at said angle through said multilayer dielectric stack onto said fuse to improve coupling of laser energy to the multilayer dielectric stack and reduce overall fuse ablation sensitivity to stack thickness variation."

V. The appellant applicant requests that the decision under appeal be set aside and that a patent be granted on the basis of the main or one of the auxiliary requests.

VI. The appellant also draws attention to the apparent failure on the part of the examining division to acknowledge his response of 24 December 2003 ("The applicant filed no comments or amendments in reply to the latest communication ...").

VII. The examining division argued essentially as follows:

The preamble of claim 1 was known from D1 and the person skilled in the art of blowing fuses by laser would necessarily be also familiar with documents concerning material processing by laser such as D2, whose title was *"Method and apparatus for optimising the efficiency and quality of laser material processing."* and which taught (column 8, lines 5 to 58) that the most efficient energy transfer to the workpiece from the laser beam was achieved when the angle of incidence was maintained at or near the Brewster or polarising angle. The skilled person would also know that the transmission angle depended on the angle of incidence and the refractive index. The teaching of D2 was not restricted to laser shape

cutting or welding since the principle involved was applicable to any material having a refractive index. The last feature of the claim - reduced overall process sensitivity of stack variation was a bonus effect as was confirmed by the passage at column 4, lines 12 to 14, of the published application.

VIII. The appellant's arguments on inventive step can be summarised as follows:

The invention related to the reduction of the absorption variation due to the improved coupling of the laser with the dielectric stack. To conclude from the statement in the application that "an added process benefit is an improved process window" that the inventive step was merely a bonus effect was to read the statement out of context and ignore its unexpected effect. The specification described the problem of thickness variation prominently at the end of the background discussion. In the summary of the invention, the specification described two general objectives and one specific objective. The general objectives were to improve overall laser energy coupling and fuse blow yield and the specific improvement was to reduce the overall process sensitivity. Figs 2 and 7 were provided so that the reduction in process sensitivity could be seen directly. Improving laser coupling on its own might improve the general efficiency but one might as well simply increase the power of the laser.

D1 taught only normal laser incidence for laser cutting of fuses under material such as a dielectric stack.

The primary teaching of D2 was that laser material processing was optimised by rotating the plane of polarisation of a linearly polarised beam in relation to a workpiece such that rotation was performed simultaneously and in synchronisation with steering the laser beam over the workpiece so as to keep the plane of polarisation parallel to either the plane of incidence or the direction of travel of the beam in relation to the workpiece (abstract first sentence). In D2 'fusing' related to 'fusing together' (column 7 line 37) and not to 'fuses' (fusible links) in the sense of D1 or the present application. The Brewster angle was mentioned only in respect of a secondary teaching in relation to welding or fusing (together) where the angle of incidence was kept at or near the Brewster angle.
D2 was directed towards welding, fusing, cutting, machining, marking (col. 1 line 20 to 21) of work pieces which were not under a dielectric stack and therefore the skilled person would not be motivated to use such a technique on a fuse under a dielectric stack. Whereas the skilled person might check D2 because it had a broad title on reading the abstract of D2 they would realise that D2 had nothing to do with the field of blowing fuses that are under a dielectric stack and it was the abstract that the skilled person would consider.

It might be general knowledge that no radiation was reflected at the Brewster angle but this general knowledge said nothing about a fuse under a dielectric stack and moreover said nothing about how energy varied as the stack thickness varied.

It was not possible to combine the teachings of D1 and D2. This is because D2 teaching applied to the fuse of Dl would use the Brewster angle of the fuse rather than the dielectric stack because the fuse was the subject of the cutting not the dielectric stack.
The D2 teaching of aligning the incidence angle of the laser with the Brewster angle was with respect to welding and fusing only and not cutting.

The examining division appeared to believe that the appellant considered D2 as restricted to laser shape cutting or welding and argued that D2 was not limited just to cutting and welding because the formula '1' in column 8 of D2 did not contain any parameter related to cutting or welding. This was a misunderstanding of the appellant's argument. D2 mentioned using Brewster angle in relation to particular processing such as welding and fusing only as described in the abstract at line 2; cutting was not mentioned there. In contrast, cutting was mentioned at line 1 and line 3 with respect to the plane of polarization of the laser beam. The same is true in the description in relation to Figure 3 at column 7 line 31 to column 8 line 58 where welding was discussed but laser cutting in relation to the Brewster angle was not mentioned. Therefore it seemed speculative to suggest that the skilled person would understand from D2 that efficient laser cutting was associated with the Brewster angle and that it could be used with Dl. Furthermore it was not understood how a formula which did not consider cutting could suggest that cutting was relevant, this was tantamount to saying that silence was specification.

A skilled person would not look to D2 for a fuse cutting solution because such a solution was not disclosed in D2. The skilled person would not look to D2 for a solution to improve fuse blow yield as such a solution was not disclosed in D2. The skilled person would not look to D2 for a solution to reduce overall process sensitivity of cutting a dielectric stack as such a solution was not disclosed. The skilled person would not look to D2 for a solution to improve energy coupling due to the geometrical effect of distributing laser energy over the side of the fuse as well as the top as this was not disclosed in D2. The skilled person would not look to D2 for a solution to improve laser energy coupling in a fuse cutting process due to optical effects of changing angle of incidence as such a solution was not disclosed in D2. D2 was concerned with maintaining the plane of polarisation parallel to a plane of incidence for general laser material processing (not including fuse blowing) and disclosed a Brewster angle of incidence only in relation to welding. D2 did not extend to a laser traversing a dielectric stack to cut a fuse in the dielectric stack.

Reasons for the Decision

1. The appeal is admissible.

2. The decision under appeal is a so-called "decision on the state of the file". This board (in differing compositions) in decisions T 1360/05 and T 1356/05, both of 16 February 2006, has dealt at some length with the appropriateness of decisions in this form ie *decisions by reference* (to previous communications) and

their compatibility with the requirements of Rule 68(2) EPC. In both these appeals the board, without proceeding to examine the substantive merits of the case, remitted it to the department of first instance for further examination. The board reasoned that the examining division had, in each case, failed to take into account amendments and arguments timely submitted by the appellant and in one of the cases even the fact that oral proceedings had taken place.

2.1 In the present case the two communications referred to in the decision under appeal (EPO Form 2061) form a coherent and convergent argument on inventive step which is not affected by the intervening clarifying amendment of the claims. The board has not had to do any mosaicing ie choose which parts of each of the communications were relevant and which should be disregarded, although it is noted in passing that it would assist the board if a refusal decision - even a *decision by reference* - could indicate the application documents on which the refusal is based. Nonetheless, in the present case also, the examining division has failed to take into account arguments timely submitted by the applicant. However, on account of the fact that those arguments were based on the same claims and could - at a stretch - be regarded as an amplification of those already on file, the board is prepared to acknowledge that in the present case the requirement of Rule 68(2) EPC for a reasoned decision has been complied with. The weightier issue of compliance with Article 113(1) EPC will be considered below.

3. *Amendments*

3.1 Independent claims 1 and 7 faxed 11 May 2007, refer to "matching an incidence angle (theta)) of a laser beam (21) to an index of refraction of said dielectric" where the originally filed claims refer to "matching a transmission angle of a laser beam to an index of refraction of said dielectric". The description itself is generally in terms of the angle of incidence rather than the angle of transmission (see published application, col. 3, lines 36-39, 44-45, 50, 58, col. 4, lines 3, 15, etc.). Moreover, the skilled person would immediately understand the dependence of one on the other. In the board's view, therefore, the amendment merely clarifies that which is evident when reading the application as a whole, namely, that when performing the invention it is the angle of incidence which is chosen, rather than the angle of transmission which, of course, is itself determined by the angle of incidence and the refractive index of the material concerned. For these reasons the board concludes that the amendment does not introduce any matter extending beyond the application as filed.

3.2 The remaining amendments are of an editorial nature such as to bring the summary of the invention on page 2 into line with the revised claims, and to introduce reference signs into all the claims.

3.3 The board is therefore satisfied that the amendments made to the application do not contravene Art. 123(2) EPC.

4. *Clarity and support in the description*

4.1 The amendment from transmission angle to incidence angle is, as discussed in paragraph 3.1 above, supported by the description.

4.2 The examining division considered that subsequent to the introduction of the phrase "incidence angle", the passage "and transmitting a laser beam from a laser at said angle through said dielectric stack" should be deleted. In the view of the board, this amendment is unnecessary since the passage can readily be understood as referring to a beam which is transmitted through the stack, having been transmitted from the laser to be incident on the dielectric stack at the particular angle. Indeed, the omission of the cited text would be undesirable because in its absence an important distinguishing feature of the invention would be missing from the claim, which is that the beam passes through the dielectric stack before reaching the fuse.

5. *Background, closest prior art and objective technical problem*

5.1 Semiconductor integrated circuit arrays include redundant elements which can be invoked to select a desired customised array configuration by ablating (ie opening or blowing) fusible links in the semiconductor circuit unit elements by a laser beam. D1, the undisputed closest prior art in this case is an example of such laser ablation. Fig. 6 of D1 shows a fuse 28 located below a multilayer dielectric stack 20 to 38 which is blown by a laser (not shown) penetrating the layers over the fuse. It is common ground that the

laser is to be understood as normally incident through the opening or fuse window 40.

5.2 The objective technical problem addressed by the invention of claims 1 and 7 is, in general, to improve fuse blow yield and specifically to reduce the variation of power absorption ie process sensitivity to dielectric stack thickness variation. The claimed invention achieves this aim by providing for the laser beam to be applied to the dielectric stack overlaying the fuse at an angle of incidence at which the coupling of the laser beam to the stack is improved and overall sensitivity to stack variation reduced.

6. *Inventive step*

6.1 The appellant applicant's arguments on inventive step have been set out in detail at VIII above. The board finds these arguments a convincing refutation of the objections raised by the examining division in the communications referred to in the decision under appeal and will therefore be brief.

6.2 The main weakness the board sees in the argument of the examining division on inventive step is the justification it gives for combining the primary document D1 and the secondary document D2. It appears to the board that the examining division was somewhat hasty in making the jump from imputing knowledge of D2 to the person skilled in the art - which is plausible - to assuming that this person would seriously study this particular secondary document D2, amongst many thousands falling in this category, in detail to search and find the claimed solution to the problem. Although,

with the benefit of hindsight, analogies can be seen in the solutions, *a priori* D2 is concerned not with blowing a fuse underneath a dielectric stack, but with controlling the E-vector orientation of a laser welding or cutting beam where the beam and workpiece are in relative motion. As the appellant applicant implies, it may be that at least subconsciously the examining division was misled by the antagonym "fuse" into regarding D2 as being more closely related to the problem of blowing buried fusible links than it is.

6.3 The board judges that the invention as claimed in claims 1 and 7 of the main request is to be considered as involving an inventive step as required by Art. 56 EPC.

7. *Procedural issues.*

The board has no reason to believe that the examining division's failure to take into account the applicant's letter dated 24 December 2003 was anything other than accidental. Nevertheless, it constituted an objective substantial procedural violation touching as it does a fundamental procedural principle in the EPC viz the right of a party to present comments and to have those comments be seen to be taken into account (Article 113(1) EPC). Since the applicant was obliged to file this appeal to ensure that these arguments were heard the board judges it equitable that the appeal fee be reimbursed (Rule 67 EPC).

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to grant the patent on the basis of the main request (point III above).

3. The appeal fee is reimbursed.

Registrar | Chair

S. Sánchez Chiquero | R. G. O'Connell