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D E C I S I O N
of 31 May 2006

Case Number: T 0753/03 - 3.4.02

Application Number: 99306968.1

Publication Number: 0984496

IPC: H01 L31/068

Language of the proceedings: EN

Title of invention:
Manufacturing method for a solar cell having a protection diode

Applicant:
E2V Technologies (UK) Limited

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56

Keyword:
"Novelty and inventive step: yes"

Decisions cited:
-

Catchword:
-

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Case Number: T 0753/03 - 3.4.02

D E C I S I O N
of the Technical Board of Appeal 3.4.02
of 31 May 2006

Appellant: E2V Technologies (UK) Limited
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Representative: Loveless, Ian Mark
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 28 March 2003 refusing European application No. 99306968.1 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: A. Klein
Members: M. Stock
C. Rennie-Smith

Summary of Facts and Submissions

I. The applicant has appealed against the decision of the examining division refusing European patent application number 99 306 968.1 on the ground that it did not meet the requirements of Articles 52(1) and 54 EPC. The examining division reasoned that the subject-matter of claim 1 as amended was not new. The following documents were cited:

D1: US-A-4 638 109

D2: US-A-4 481 378

D3: PATENT ABSTRACTS OF JAPAN vol. 007, no. 033 (E-157), 9 February 1983 & JP 57 184255 A

D4: WO 89 05521 A

In particular the examining division reasoned that the subject-matter of claim 1 was not new over document D1.

II. In a "Statement of Grounds of Appeal" the appellant has contradicted the argumentation of the examining division and requested to grant a patent on the basis of claims 1 to 14 underlying the impugned decision.

III. In a communication under Article 110(2) EPC the Board proposed the following amendments for consideration:

(i) Product-by-process claims are allowable only in exceptional cases if the product cannot be defined otherwise, see Case Law of the Boards of Appeal of the EPO, 4th edition 2001, chapter 6.3 at page 174.

This was evidently not the case for present claim 14 which should be cancelled, accordingly.

(ii) Documents D1 to D4 should be acknowledged in the description in a purely factual manner.

IV. By letter dated 17 May 2006 the applicant cancelled claim 14 and acknowledged documents D1 to D4 in the description. Pages 1 and 8, amended accordingly, were filed.

V. Claim 1 under consideration reads as follows:

"1. A method of manufacturing a solar cell arrangement including the step of:

forming a p-n junction in semiconductor material (2,3);

and characterised by the steps of:

separating the semiconductor material along a plane across the p-n junction to give an off-cut (9) and a main body (10);

electrically connecting the off-cut in reverse parallel across a main body such that the off-cut forms a protection diode for a solar cell comprising that main body; and

providing first and second electrically conductive contacts (7, 8) on the front and rear surfaces respectively of the semiconductor material."

Reasons for the Decision

1. *Article 123(2) EPC*

Present claim 1 differs from claim 1 as originally filed in that reference numerals have been added and in that it has been recast into a two-part form. Claims 2 to 13 correspond to the original claims. Therefore the claims do not extend beyond the application as originally filed.

2. *Article 52(1) EPC*

2.1 Novelty

2.1.1 According to the wording of present claim 1 the semiconductor material is separated along a plane across the p-n junction to give an off-cut and a main body, the off-cut being electrically connected in reverse parallel across a main body such that the off-cut forms a protection diode for a solar cell comprising that main body. This wording implies that there are two kinds of separate parts, namely diodes in the form of off-cuts and solar cells comprising a main body.

2.1.2 In contrast to that, D1, see Figure 5 with the connected description, discloses one kind of parts only, namely a semiconductor material with a p-n junction, having a main body, which is covered by transparent conductive film 5 and forms a solar cell, and contiguous with the main body an adjacent body, which is covered by metal electrode 12 and forms a protection diode for a solar cell comprising another main body.

2.1.3 In D1 any adjacent body contiguous with the main cannot be considered as an off-cut from this main body or another main body because every main body is monolithically formed with an adjacent body forming a protection diode for another main body. The step of cutting-off in D1 is related to the normal cutting of a wafer into a number of parts or units all having the same structure.

2.1.4 Therefore the subdivision of the semiconductor material into the solar cells and protection diodes made in the present application clearly differs from the subdivision made in D1.

2.1.5 The examining division argues in its decision that Figure 4 and 7 of D1 clearly show a main body consisting of a solar cell and a separate protection diode. It would be evident that these two elements are not formed on the same (contiguous) substrate because firstly Figures 4 and 7 show clearly the opposite, namely that the substrates for the cell and the diode are separated, and secondly because a common conductive (cf. column 3, line 37) substrate for the cell and the diode would not make sense in view of the resulting short circuit between the n-type layer 2 and the p-type layer 4 of the solar cell due to the wiring 10 (see Figure 4). Therefore, the protection diode would not remain attached to the main body, and the term "off-cut" was applicable for the protection diode.

2.1.6 This argumentation is, however, not convincing to the Board. Even though each diode is separated from the solar cell it protects, it cannot be considered as an

off-cut from a main body forming a solar cell because it is always contiguous with such a main body.

2.1.7 The subject-matter of claim 1 under consideration is thus novel over the prior art according to D1.

2.1.8 Moreover the Board is satisfied that the claimed subject-matter is also new when compared with the remaining prior art cited as will be apparent from the following discussion of inventive step.

2.2 Inventive step

2.2.1 For the assessment of an inventive step in the claimed subject-matter D1 is selected as the closest prior art in view of the fact that it discloses the concept of producing a solar cell and its protection diode from the same p-n junction in a semiconductor material and electrically connecting the diode in reverse parallel across the solar cell.

2.2.2 The difference of the claimed subject-matter over D1 resides in the feature that the diode is formed as an off-cut from a solar cell which is electrically connected in reverse parallel across the same or another solar cell. This solves the problem of providing the diode and its connection in a simple and thus economical way.

2.2.3 D1 does not hint towards the invention because it chooses a different subdivision leaving a diode and a solar cell in one unit and not separating them as according to the invention.

2.2.4 D2, see Figure 11 with the connected description, discloses protection diodes for solar cells in discrete or integral form. However, the diodes used do not employ the same layered structure as the corresponding solar cell and hence there are no diodes being off-cuts of the solar cell.

2.2.5 In D3 there is described a diode formed integrally with a solar cell and employing the same layers. However, the diode is separated from the main body of the solar cell by an insulating film 4 and not as an off-cut.

2.2.6 D4, see Figures 1 to 4 with the associated description, discloses a panel of solar cell matrices 10 fabricated from a single wafer, each matrix employing 49 solar cells 12 connected in series and one diode 50 having the same structure as the cells and being also connected in series as a blocking diode to prevent current from flowing back through cells 12 in the event of a failure of cells 12. Therefore the electrical connection and function of diodes 50 are different from the present invention where each solar cell has its own protection diode connected in reverse parallel to it. Thus D4 does not hint towards the claimed method.

2.2.7 Therefore the subject-matter involves an inventive step.

3. The dependent claims 2 to 13 are related to embodiments of the method of claim 1 and as such meet the requirements of the EPC. The description as far as indication of background art and disclosure of the invention are concerned is also in accordance with the EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to grant a patent in the following version:

Description:
Page 1 filed with letter of 17 May 2006.
Pages 2 to 5 as originally filed.

Claims:
No. 1 to 13 (first portion) filed with letter of 3 May 2002.
No. 13 (second portion) filed with letter of 17 May 2006.

Drawings:
Sheets 1/2 to 2/2 as originally filed

The Registrar: The Chairman:

M. Kiehl A. G. Klein