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Datasheet for the decision of 10 April 2018

Case Number: T 1132/13 - 3.4.03

Application Number: 05797533.6

Publication Number: 1792350

IPC: H01L33/00

Language of the proceedings: EN

Title of invention:
HIGH EFFICIENCY GROUP III NITRIDE LED WITH LENTICULAR SURFACE

Applicant:
Cree, Inc.

Headword:

Relevant legal provisions:
EPC 1973 Art. 54, 56, 84
EPC Art. 52(1), 123(2)

Keyword:
Amendments - added subject-matter (no)
Novelty - (yes) - after amendment
Inventive step - (yes) - after amendment

Decisions cited:

Catchword:

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Beschwerdekammern

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Case Number: T 1132/13 - 3.4.03

D E C I S I O N
of Technical Board of Appeal 3.4.03
of 10 April 2018

Appellant: (Applicant)	Cree, Inc. 4600 Silicon Drive Durham, NC 27703 (US)
Representative:	Isarpatent Patent- und Rechtsanwälte Behnisch Barth Charles Hassa Peckmann & Partner mbB Friedrichstrasse 31 80801 München (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 24 January 2013 refusing European patent application No. 05797533.6 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	T. Häusser
Members:	S. Ward
	W. Van der Eijk

Summary of Facts and Submissions

I. The appeal is against the decision of the Examining Division refusing European patent application No. 05 797 533 on the following grounds: the subject-matter of the main request (as then on file) did not meet the requirements of Article 84 EPC 1973 and was not new within the meaning of Article 54(1) and (2) EPC 1973; the subject-matter of auxiliary request 1 (as then on file) did not involve an inventive step within the meaning of Article 56 EPC 1973; and the subject-matter of auxiliary request 3 (as then on file) did not involve an inventive step within the meaning of Article 56 EPC 1973. Auxiliary requests 2, 4 and 5 (as then on file) were not admitted into the proceedings pursuant to Rule 137(3) EPC.

II. At the end of the oral proceedings held before the Board the appellant requested that the decision under appeal be set aside and that a patent be granted in the following version:
- claims 1-14 of its sole request, filed during oral proceedings at 13:30;
- description: pages 1-5, 5a and 6-15, filed during oral proceedings at 14:55;
- drawings: sheets 1/7-7/7 as published.

III. The following document is referred to:
D6: US 6 657 236 B1.

IV. Claim 1 reads as follows:

"A light emitting diode (20, 28, 34, 70) comprising: a substrate (21) of semiconducting or conducting material;

a Group III nitride-based light emitting region (37) on said substrate (21), wherein the light emitting region (37) is formed of one p-type layer of Group III nitride, one n-type layer of Group III nitride for current injection, and one light emitting layer (22) for recombination of carriers between the p-type layer and the n-type layer;
a lenticular surface (32) on a first side of said light emitting region (37) opposite to a second side of said light emitting region (37) that faces said substrate (21), wherein the lenticular surface (32) extends to and into the light emitting region (37),
a first ohmic contact (25) on the first side of said light emitting region (37) opposite to the second side that faces said substrate (21), wherein the lenticular surface (32) is arranged on other portions of the first side of said light emitting region (37) than the first ohmic contact (25);
wherein
said lenticular surface (32) is defined by a plurality of silicon carbide lenticular features which are directly positioned on the n-type or p-type layer of the Group III nitride-based light emitting region (37) and by a plurality of lenticular features that extend into said n-type or p-type layer of the Group III nitride-based light emitting region (37), but not into the light emitting layer (22); and
the light emitting diode (20, 28, 34, 70) further comprises a second ohmic contact (24) on an opposite surface of said substrate (21) from said light emitting region (37)."

V. The present sole request differs significantly from those on which the contested decision was based, hence the arguments of the Examining Division substantiating

its decision to refuse the application are no longer relevant and need not be repeated here.

Reasons for the Decision

1. The appeal is admissible.

2. *Main Request: Article 123(2) EPC*

2.1 Claim 1 is based on original claims 1, 3, 12 and 13, and the embodiment depicted in Fig. 3 and described in paragraph [0052] of the original description. The explanations given in the description of features common to all embodiments are considered to be part of the disclosure of the embodiment of Fig. 3.

The light emitting region (37) is formed of precisely three layers (one p-type, one n-type and a light emitting layer between them), as is the case in Figs. 1-4. The Board accepts the appellant's argument that the choice of the n-type layer as the uppermost layer, as shown in Figs. 1-4, is merely exemplary, and that the skilled person would understand that the p-type layer could equally be the uppermost layer (see original claim 13, in which no particular order is specified, and paragraph [0043]).

2.2 Dependent claims 2-14 are based on dependent claims as originally filed, with support also being provided by the description (e.g. paragraph [0055] for details of mesas/passivation layers).

2.3 The Board is therefore satisfied that the application according to the present request meets the requirements of Article 123(2) EPC.

3. *Clarity*

The clarity objections raised by the Examining Division (Reasons, point 1.1) under Article 84 EPC 1973 have been rendered moot by the amendments made to present claim 1.

4. *Novelty*

4.1 In the contested decision the subject-matter of claim 1 of the then main request was found to lack novelty (Reasons, point 1.2). In reaching this conclusion the Examining Division argued that the thin metallic "second spreading layer" (20) in Fig. 1 of D6 could be considered to form part of the claimed "Group III nitride-based light emitting region". Present claim 1 has been amended to exclude any such interpretation.

4.2 Moreover, present claim 1 requires that the lenticular features extend into the light emitting region, which is not disclosed in D6. The subject-matter of claim 1 is therefore new within the meaning of Article 52(1) EPC and Article 54 EPC 1973.

5. *Inventive Step*

5.1 The Board agrees with the appellant that the embodiment of Fig. 1 of document D6 represents the closest prior art. The following features of claim 1 are disclosed in D6:

A light emitting diode (10) comprising:

a substrate (24) of semiconducting or conducting material (e.g. SiC or GaN - see column 6, lines 16-28);
a Group III nitride-based (column 6, lines 4-5) light emitting region (12) on said substrate, wherein the light emitting region (12) is formed of one p-type layer (14) of Group III nitride, one n-type layer (15) of Group III nitride for current injection, and one light emitting layer (13) for recombination of carriers between the p-type layer and the n-type layer (column 5, lines 31-37);
a lenticular surface on a first side of said light emitting region opposite to a second side of said light emitting region that faces said substrate (column 5, lines 57-59),
a first ohmic contact (22) on the first side of said light emitting region opposite to the second side that faces said substrate, wherein the lenticular surface is arranged on other portions of the first side of said light emitting region than the first ohmic contact (see elements (22) and (26) in Fig. 1);
wherein
said lenticular surface is defined by a plurality of silicon carbide (see column 6, lines 29-38) lenticular features (light extraction elements or "LEEs", 26); and
the light emitting diode further comprises a second ohmic contact (28) on an opposite surface of said substrate from said light emitting region.

5.2 The distinguishing features of the claim may be grouped as follows:

(a) "the lenticular surface (32) extends to and into the light emitting region (37) ... said lenticular surface (32) is defined by a plurality of silicon carbide lenticular features which are ... positioned on the n-type or p-type layer of the

Group III nitride-based light emitting region (37) and by a plurality of lenticular features that extend into said n-type or p-type layer of the Group III nitride-based light emitting region (37), but not into the light emitting layer (22)"; and

(b) the plurality of silicon carbide lenticular features are **directly** positioned on the n-type or p-type layer of the Group III nitride-based light emitting region.

5.3 In relation to distinguishing feature (a), the Board's understanding of the argument of the appellant is as follows:

The lenticular features of the invention serve the purpose of efficiently extracting light from the LED in a similar manner to the light extraction elements (26) of D6, i.e they direct light out of the LED and reduce total internal reflection. The preferred material for the lenticular features is silicon carbide, which is seen as offering numerous advantages. For example, it is physically very hard (see paragraph [0009] of the description of the present application), and hence "the use of the more robust SiC for the lenticular features offers structural advantages". SiC presumably also offers a measure of protection for the underlying layers.

However, the use of SiC for the lenticular features also has drawbacks. For example, silicon carbide "requires high temperatures (on the order of about 1500-2000 °C) for epitaxial or sublimation growth" (also stated in paragraph [0009]), and processing steps carried out at such temperatures over an extended period may damage the device.

Accordingly, the technical problem, as seen by the appellant, is to provide an LED which profits from the advantages offered by silicon carbide lenticular features, while reducing the known drawbacks of working with this material. The Board sees this as a plausible technical problem.

5.4 According to distinguishing feature (a), the lenticular surface extends into the light emitting region, so that the lenticular arrangements are effectively distributed over two layers, being partly defined by silicon carbide lenticular features positioned on the light emitting region, and partly defined by lenticular features extending into the uppermost layer of the light emitting region.

The appellant contends that this solution allows the advantages of using SiC to be retained, while ensuring that the claimed lenticular features comprise a reduced amount of SiC compared with lenticular features of a similar size which are composed entirely of SiC (as disclosed in D6), so that the claimed device would require a correspondingly reduced processing time at the elevated temperatures required when working with SiC. The Board sees no reason to dispute this, and thus can accept the appellant's argument that distinguishing feature (a) represents a plausible solution to the technical problem posed above.

5.5 The Board does not find any disclosure elsewhere in D6 or in the other available prior art of features corresponding to distinguishing feature (a) of present claim 1, nor any hint which would lead the skilled person in this direction, either to solve the problem posed above or for any other reason. Hence, on the

basis of feature (a) alone, the subject-matter of claim 1 involves an inventive step within the meaning of Article 52(1) EPC and Article 56 EPC 1973.

5.6 For completeness, it is noted that claim 1 also differs from D6 in providing feature (b), according to which the plurality of silicon carbide lenticular features are positioned directly on the upper layer of the light emitting region. In D6 there is a thin metallic "second spreading layer (20)" between the LED structure (12) and LEEs (26).

In the light of the conclusion reached above in relation to feature (a), it is not necessary for the Board to investigate whether feature (b) makes any further inventive contribution, either separately or in combination with feature (a).

5.7 Claims 2-14 depend, directly or indirectly, on claim 1, and hence the subject-matter of these claims also involves an inventive step within the meaning of Article 52(1) EPC and Article 56 EPC 1973.

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 a patent in the following version:

   claims 1-14 of the sole request, filed during oral proceedings at 13:30;

   description: pages 1-5, 5a and 6-15, filed during oral proceedings at 14:55;

   drawings: sheets 1/7-7/7 as published.

The Registrar: The Chairman:

S. Sánchez Chiquero T. Häusser

Decision electronically authenticated