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D E C I S I O N
of 28 February 2002

Case Number: T 0221/98 - 3.4.3

Application Number: 93100870.0

Publication Number: 0579897

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Language of the proceedings: EN

Title of invention:
Light-emitting device of gallium nitride compound semiconductor

Applicant:
TOYODA GOSEI CO., LTD.

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 123(2), 56

Keyword:
"Main request and auxiliary request II: inadmissible amendment (yes); auxiliary request I: inventive step (no); auxiliary request III: inventive step (yes); purposive selection"

Decisions cited:
T 0331/87

Catchword:
-

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Case Number: T 0221/98 - 3.4.3

D E C I S I O N
of the Technical Board of Appeal 3.4.3
of 28 February 2002

Appellant: TOYODA GOSEI CO., LTD.
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Decision under appeal: Decision of the Examining Division of the European Patent Office posted 20 October 1997 refusing European patent application No. 93 100 870.0 pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: R. K. Shukla
Members: M. Chomentowski
E. Lachacinski

Summary of Facts and Submissions

I. The European patent application No. 93 100 870.0 (Publication No. 0 579 897) was filed with 6 claims, claims 1, 4 and 6 being independent claims relating to a light-emitting device of gallium nitride compound semiconductor. Claim 1 had the following wording:

"1. A light-emitting device of gallium nitride compound semiconductor having an n-layer of n-type gallium nitride compound semiconductor ($Al_xGa_{1-x}N$, $x \geq 0$) and **an i-layer of i-type** gallium nitride compound semiconductor ($Al_xGa_{1-x}N$, $x \geq 0$) doped with a p-type impurity, characterized in that a Ni layer is formed in contact with said i-layer, said Ni layer functioning as an electrode therefor."
(Emphasis added by the Board)

Independent claim 4 differed from claim 1 in that the characterizing portion specified that the n-layer and the i-layer had their respective electrodes on the same surface, the electrode for the i-layer being made of Ni, Ag or Ti, or an alloy containing any of them.

Claim 6 differed from claim 4 in that it further specified that the electrode of the n-layer was made of Al or an alloy containing Al.

II. At the conclusion of the oral proceedings held before the examining division, the applicant was informed that the applicant's main request was not admissible under Article 123(2) EPC, and that the examining division intended to grant a patent on the basis of the applicant's auxiliary request filed during the oral proceedings.

In response dated 8 September 1997, the applicant requested a decision on the basis of the main request.

The application was refused by a decision of the examining division dated 20 October 1997 on the ground that the application as amended in the main request contained subject-matter extending beyond the content of the application as filed (Article 123(2) EPC).

Claim 1 of the main request had the following wording:

"1. A light-emitting device of gallium nitride compound semiconductor material having a first layer (5, 52) of gallium nitride compound semiconductor material ($Al_xGa_{1-x}N$, $x \geq 0$) doped with a p-type impurity, a second layer (3, 4) of n-type gallium nitride compound semiconductor material ($Al_xGa_{1-x}N$, $x \geq 0$), a first layer electrode (7, 13, 70) for said first layer (5, 52) and a second layer electrode (8, 80) for said second layer (3, 4), characterized in that said first layer electrode (7, 13, 70) comprises at least one of Ni, Ag, an alloy including Ni, an alloy including Ag, and an alloy including Ti and said second layer electrode (8, 80) comprises at least one of Al, Ti, an alloy including Al, and an alloy including Ti."

III. In the decision, the examining division reasoned essentially as follows:

Main request

Claim 1 of the main request no longer specifies an "i-layer of i-type gallium nitride compound semiconductor doped with a p-type impurity", as in the preamble of the claims 1, 4 and 6 as filed, but only "a first layer (5, 52) of gallium nitride compound semiconductor material ($Al_xGa_{1-x}N$, $x \geq 0$) doped with a p-type impurity". Since undoped gallium nitride

compounds show n-type conductivity, doping with p-impurities is necessary to obtain both i-type and p-type conductivity, whereby p-type conductivity can only be obtained by an additional irradiation with electrons. Doping with p-type impurities alone leads only to i-type material. Therefore, earlier only i-type and no p-type gallium nitride compounds were available. In the application documents as filed only i-type and n-type material is mentioned, and therefore it is concluded that the means for obtaining p-type gallium nitride compound semiconductor material was not yet known to the applicant at the filing date.

The wording of claim 1 does not restrict the conductivity of the layer doped with p-type impurity to i-type. Therefore, a layer of p-type gallium nitride compound semiconductor material would fall under the scope of this claim, while in the original application documents the material doped with a p-type impurity was always characterized as i-type. By deleting the feature of i-type conductivity, the scope of the claim has thus been extended and now goes beyond the contents of the application as filed.

The meaning of "i-type" and "p-doped" would not be understood as identical by a person skilled in the art because, in particular, p-doping may result in an n-type conductivity, which is reduced compared with the undoped, highly n-conductive state, in an i-type conductivity, and in a p-type conductivity when a further electron irradiation is carried out.

Therefore, Article 123(2) EPC was infringed by the applicant's main request. Thus, the applicant having requested a decision on this basis, the application was not allowable.

IV. In the decision under appeal, it was further observed that the content of document JP-A-4 068 579 (hereinafter D6), an English abstract of which was provided by the applicant, was relevant. The document described an ohmic electrode of a p-type gallium-nitride compound semiconductor layer in a light-emitting semiconductor device. Although the electrode is preferably made of aluminium, any of indium, gallium, nickel, copper, gold, silver, chromium, silicon and germanium or an alloy thereof could be used as well.

The following further prior art documents were cited in the examination proceedings:

D1 = Patent Abstracts of Japan, vol. 4, no. 36 (E-003);& JP-A-55 009 442;

D2 = Patent Abstracts of Japan, vol. 6, No. 254 (E-148);& JP-A-57 153 479;

D3 = EP-A-0 444 630;

D5 = JP-A-3 183 173; and

D6 = JP-A-4 068 579.

V. The applicant lodged an appeal against this decision on 14 November 1997 paying the appeal fee on the same day. A statement setting out the grounds of the appeal was filed on 24 February 1998 with letter dated 20 February 1998.

VI. During the oral proceedings of 28 February 2002 before the Board, the appellant (applicant) requested that the decision under appeal be set aside and a patent be granted on the basis of the following patent application documents:

Main request

Description: Pages 1 to 14 and 14a as filed;

Claims: No. 1 according to the Main request filed with appellant's letter dated 28 January 2002;
Nos. 2 to 13 according to the main request filed with applicant's letter dated 30 May 1997;

Drawings: Sheets 1/8 to 8/8 as filed;

Auxiliary request I

Claims: No. 1 according to the Auxiliary request I filed with appellant's letter dated 28 January 2002;
Nos. 2 to 13 according to Auxiliary request I filed with appellant's letter dated 20 February 1998;

Description and drawings as for the main request;

Auxiliary request II

Claims: Nos. 1 to 7 according to auxiliary request II filed with appellant's letter dated 20 February 1998;

Description and drawings as for the main request;

Auxiliary request III

Claims: Nos. 1 to 5 according to auxiliary request III filed during the oral proceedings.

Description and drawings as for the main request.

Claim 1 of the **main request** differs from claim 1 of the main request forming the basis of the decision of the examining division in its characterizing portion, and it has the following wording:

"1. A light-emitting device of gallium nitride compound semiconductor material having a first layer (5, 52) of gallium nitride compound semiconductor material ($Al_xGa_{1-x}N$, $x \geq 0$) doped with a p-type impurity, a second layer (3, 4) of n-type gallium nitride compound semiconductor material ($Al_xGa_{1-x}N$, $x \geq 0$), a first layer electrode (7, 13, 70) for said first layer (5, 52), and a second layer electrode (8, 80) for said second layer (3, 4),

characterized in that

said first layer electrode (7, 13, 70) comprises a layer of at least one of Ni, Ag, an alloy including Ni, an alloy including Ag, and an alloy including Ti **in contact with** said first layer and said second layer electrode (8, 80) comprises a layer of at least one of Al, Ti, an alloy including Al, and an alloy including Ti **in contact with** said second layer

Claim 1 of the **auxiliary request I** differs from claim 1 of the main request in that

(i) it specifies that the layer of gallium nitride compound semiconductor material doped with a p impurity is an **i-layer**,

(ii) the term "at least" is deleted from the expressions "at least one of Ni, Ag, ..." and "at least one of Al, Ti, ...",

(iii) the metal for the electrode layer in contact with the i-layer is restricted to one of Ni, Ag, an alloy including Ni, an alloy including Ag, and an alloy including Ti, and,

(iv) the metal for the electrode layer in contact with the second layer is specified as one of Al, Ti, an alloy including Al, and an alloy including Ti.

Claim 1 of the **auxiliary request II** differs from claim 1 of the main request in that (i) it specifies that the i-type and the n-type layers are of $Al_xGa_{1-x}N$, $x \geq 0$, (ii) that the n-layer is under the i-layer and (iii) that the layer of the i-layer electrode formed directly on the i-layer is made of Ni, Ag, or an alloy containing any of them. The claim is in substance identical with claim 1 of the auxiliary request submitted before the examining division and thus differs from claim 4 as filed in that it does not specify that the respective electrodes are on the same surface and does not include Ti or an alloy containing Ti for making the electrode for the i-layer.

Claim 1 of the **auxiliary request III** specifies that the n-layer (3, 4) and the i-layer (5) have their respective electrodes formed on the same surface. In substance, it differs only in this respect from claim 1 of the auxiliary request II, and it reads as follows:

"A light-emitting device of gallium nitride compound semiconductor material having an i-layer (5, 52) of i-type $Al_xGa_{1-x}N$, $x \geq 0$, doped with a p-type impurity, an n-layer (3, 4) of n-type $Al_xGa_{1-x}N$, $x \geq 0$, thereunder, an i-layer electrode (7, 13, 70) for said i-layer (5, 52), and an n-layer electrode (8, 80) for said n-layer (3, 4),

characterized in that

said n-layer (3, 4) and said i-layer (5) **have their respective electrodes formed on the same surface,** and said i-layer electrode (7, 13, 70) comprises a layer (13, 71, 710) formed in contact with said i-layer (5, 52) and being made of Ni, or of Ag or an alloy thereof."
(Emphasis added by the Board)

Claims 2 to 5 of the Auxiliary request III are dependent device claims.

VII. The appellant submitted the following arguments in support of his requests:

Main request

The carrier concentration in a semiconductor functions as a standard of defining the conductivity type of the semiconductor. Taking into account various technical documents and technical explanations and corresponding curves and drawings filed before the oral proceedings, it can be concluded that it is not correct that gallium nitride exhibits an "i-type conductivity" before being treated by electron beam irradiation or thermal annealing as stated in the decision under appeal. That is, p-type conductivity can be obtained without any post-treatment, and the corresponding hole concentration of the layer is in a comparatively wide range, i.e. 10^{10} to $10^{18}/cm^3$. Depending on the documents considered, the term "π-type", i.e. a high resistivity with a p-type tendency, can be used with a meaning

similar to "i-type" or a meaning equivalent to p-type, whose hole concentration is about $10^{16}/cm^3$, whereby a layer with a hole concentration of 1 x 10^{14} to 1 x $10^{16}/cm^3$ after irradiation by electrons is disclosed as "p-type".

Accordingly, it is impossible to differentiate i-type conduction from p-type conduction on the basis of a hole concentration, and i-type conductivity doped with p-type impurity is in fact p-type. Thus, since it is generally known to people skilled in the art that doping of gallium nitride with a p-type impurity cannot result in a layer having n-type conductivity, and that a p-n gallium nitride light-emitting device is more effective than an i-n device, the skilled person reading the application as filed would understand that the light-emitting devices are not limited to those wherein the gallium nitride doped with p-type impurities is i-type. Therefore, Article 123(2) EPC is not infringed.

Moreover, according to **T 331/87**, OJ EPO 1991, 22, the replacement or **removal** of a feature from a claim may not violate Article 123(2) EPC provided the skilled person would directly and ambiguously recognize that

(1) the feature was not explained as being essential in the disclosure,

(2) it is not indispensable for the function of the invention in the light of the technical problem it serves to solve, and

(3) the replacement or removal requires no real modification of other features to compensate for the change.

The problem which is to be solved by the features of claim 1 is to improve the ohmic contact to the p-doped gallium nitride compound semiconductor material layer. It is solved by applying a layer of e.g. Ni or Ag on the p-doped layer. The feature that the p-doped layer is i-type, which was present in the original application, is not important for the solution of this problem. The skilled person knows that the performance of an i-n junction in a light-emitting device is inferior to a p-n junction, and he would therefore replace the i-layer by a p-layer.

Auxiliary request 1

Contrary to the i-n light-emitting device of claim 1, wherein a contact layer of one of Ni, Ag, an alloy including Ni, an alloy including Ag, and an alloy including Ti is in contact with the i-layer, the light-emitting device known from document D2 in particular comprises an electrode with a layer of Ti in contact with the i-layer. Thus, there is no teaching in document D2 for an alloy including Ti. The contact resistance of an ohmic contact is dependent upon both the specific metal and the i or p-conductivity type of the gallium nitride layer. Since the metals suggested in the prior art documents either are different or are for contact to a layer of a different conductivity type, the device of claim 1 is not obvious to a skilled person.

Auxiliary requests 1I and III

These requests are similar to the request considered as allowable by the examining division and are thus allowable.

Reasons for the Decision

1. The appeal is admissible.

2. *Main request*

2.1 The main request (see in particular claim 1) concerns a light-emitting device of gallium nitride compound semiconductor material having a first layer of gallium nitride compound semiconductor material doped with a p-type impurity, a second layer of n-type gallium nitride compound semiconductor material, a first layer electrode for the first layer, and a second layer electrode for the second layer, these electrodes comprising respective layers with specific metals and/or alloys in contact with the layers of gallium nitride.

The independent claims of the application **as filed**, ie, claims 1, 4 and 6, concern light-emitting devices of gallium nitride compound semiconductor having an n-layer of n-type gallium nitride compound semiconductor and **an i-layer of i-type** gallium nitride compound semiconductor doped with a p-type impurity.

This is also the case for the whole content of the application as filed (see the text and drawings) and, thus, claim 1 of the main request is distinguished therefrom *inter alia* by **the removal** of the feature "**an i-layer of i-type**".

2.2 The appellant has argued that according to **T 331/87**, OJ EPO 1991, 22, the replacement or **removal** of a feature from a claim is allowable if the three conditions mentioned therein are satisfied (cf. point IV of the Summary of Facts and Submissions, here above).

The following is to be noted in this respect:

Indeed, it has not been disputed that the feature that the first layer of the gallium nitride compound semiconductor doped with a p-type impurity is an i-layer of i-type is not explained in the application as filed as being essential, so that the condition (1) of T 331/87 is fulfilled.

From the whole content of the application as filed (see in particular page 1, penultimate paragraph to page 3, second paragraph, second line), it is derivable that the present invention addresses the problem or disadvantage of known light emitting diodes arising because of the electrode of aluminum being formed in direct contact with a layer **made i-type** by doping with a p-type impurity, this resulting in non-uniform emission of light from coarse dots rather than a uniform plane.

The appellant has argued that the definition of the present invention **cannot be interpreted** to comprise the case that first layer of gallium nitride semiconductor compound is **n-conductive** because, in particular, if the first layer were to be n-conductive by either no doping impurity at all or **only a small amount of p-type impurities, the device would not function as a light-emitting device**, so that the device of *inter alia* claim 1 does not comprise a n-conductive layer.

However, these arguments cannot convince for the following reasons:

Since it is admitted that the first layer of a device as defined in claim 1 of the present main request can be n-conductive if the mentioned p-type doping comprises **only a small amount of p-type impurities** and

that **such a device would not function as a light-emitting device**, then the feature of the application as filed that the first layer is i-type can be considered as **indispensable** for the function of the invention in the light of the technical problem it serves to solve in the sense that its removal leads *inter alia* to a device wherein the first layer is of n-type conductivity and which admittedly does not work.

It follows therefrom that the removal of the feature of the application as filed that the first layer is i-type also requires **real modification** of other features to compensate for the change in that sense that it is necessary to specify that the first layer is **not of n-type gallium nitride** compound semiconductor material.

Thus, since the conditions (2) and (3) in the above-mentioned decision T 331/87 are not fulfilled, it appears with respect to claim 1 of the present main request that the **removal** of the feature "**an i-layer of i-type**" from the main claims of the application as filed contravenes Article 123(2) EPC.

2.3 The appellant filed in preparation for the oral proceedings several technical publications showing inter alia that, before the filing date of the present application, it was generally known that doping with p-impurities was necessary to obtain both i-type and p-type conductivity, whereby p-type conductivity could also be obtained without an additional irradiation with electrons. In particular, it is derivable from the technical documents cited that specific process steps such as annealing can be necessary to obtain p-type.

However, there is no indication in the application as filed, which consistently discloses a first layer being i-type, that any such specific process step is carried

out, so that the relevant information in this respect was not derivable from the application as filed.

The appellant has also pointed out that document D4 (see the abstract) shows a device of the same type with a **p-type** first layer (5) doped with a p-type impurity (Zn), in contact with an Al layer (2), and characteristics of the device, in particular 30 mcd in light emission brightness being the same as the prior art characteristics mentioned in the application as filed (see page 11, second complete paragraph, second sentence).

However, document D4 is not mentioned in the application as filed. Moreover, the conventional device mentioned in the application as filed (see the passage cited above) in this respect is specified as having an i-type layer. There is no indication either that p-n devices were disclosed in the application as filed.

Moreover, it is to be noted that light-emitting devices of gallium nitride including an i-type layer are the subject-matter of eg document D3 (see in particular column 1, lines 19 to 42), which specifies that the device comprises no p-n junction but is made by joining the i-layer and n-layer, and of documents D1 and D2.

Thus, for the reader of the application as filed, there was no reason to consider that the p-doped i-layer could be a layer of a conductivity type different from i-type.

2.4 Therefore, the main request does not satisfy the requirement of Article 123(2) EPC that a European patent application may not be amended in such a way that it extends beyond the content of the application as filed.

3. *Auxiliary request I*

3.1 Claim 1 of the auxiliary request I specifies that the layer of gallium nitride compound semiconductor material doped with a p impurity is a i-type layer; the device can comprise, in contact with the **i-layer**, an alloy including Ti, and, in contact with the other layer, Al or an alloy including Al.

A light-emitting device of gallium nitride compound semiconductor material is known from document D2 (see the abstract) having an i-layer (3) of gallium nitride compound semiconductor material, a second layer (2) of n-type gallium nitride compound semiconductor material, an electrode (44) for the i-layer (3), and a second layer electrode (55) for the second layer (2); the electrode (44) for the i-layer comprises a layer (4') of Ti in contact with the i-layer.

It is to be noted that, from document D2, it is not derivable how the i-layer is obtained. However, it is generally known to people skilled in the art, for instance from document D4 (see the abstract) or document D3 (see column 2, lines 13 to 23; column 7, lines 19 to 37, column 8, lines 7 to 12 and Figure 1; see also column 9, lines 25 to 32 and Figure 9), that gallium nitride compound semiconductor material of i-type can be obtained by doping the material with a p-type impurity, Zn.

It is also to be noted that it is not directly and unambiguously derivable from the abstract of document D2, which is the material for the electrode layer in contact with the n-type region. However, for the same type of device, an Al layer in contact with a n-type

layer of a gallium nitride i-n junction device is known from any of the documents D1 (see the abstract) or D3 (see column 7, lines 26 to 28; Figure 1).

Thus, this information can be used in an obvious way to complete the device of document D2.

However, it is not derivable from document D2 that an alloy of titanium can be used in place of Ti as the material of the electrode layer in contact with the i-layer of the device.

Starting from document D2, the main problem to be solved is to find an alternative material for the material of the electrode layer in contact with the i-layer of the device.

In document D2, it is stated that electrode (44) on the i-type gallium nitride layer (3) has an underlayer which is made of metal (Ti) which repels solder but well adheres to crystal surface. In this respect, it is to be noted that, in the application as filed, no information is made available showing, for the electrode layer in contact with the i-layer, any advantage of titanium alloys as compared to titanium, and these materials are thus derivable as being equivalent.

The appellant has not provided any specific argument in this respect.

Thus, since titanium and alloys containing e.g. a large amount of titanium can be understood as having similar properties, there was at least an incentive to try such materials for the electrode in contact with the i-type layer in the device known from D2.

Therefore, having regard to the state of the art, the subject-matter of claim 1 of the auxiliary request I is obvious to a person skilled in the art and it thus lacks an inventive step in the sense of Article 56 EPC.

4. *Auxiliary request II*

In claim 1 of the auxiliary request II, the i-layer electrode comprises a layer formed directly on said i-layer and being made of Ni, Ag, or an alloy containing any of them.

Thus, the claim can concern a device wherein the i-layer electrode comprises a layer formed directly on said i-layer and being made of an alloy containing Ni, wherein moreover the n-layer and the i-layer have their respective electrodes which are either on the same surface of the device, or on opposite surfaces.

In the application as filed,

- there are embodiments wherein a Ni layer is formed in contact with the i-layer of the device, said Ni layer functioning as an electrode therefor (see claim 1), whereby Ag or Ti or an alloy thereof may replace the Ni underlayer (see page 9, last paragraph to page 10, second paragraph and Figures 3f and 4g; page 11, second paragraph, three first lines).

- in specific further embodiments, the electrode for the i-layer of the device is made of Ni, Ag or Ti, or an alloy containing any of them, i.e. also an alloy including Ni (see claims 4 and 6).

In these specific further embodiments, as well as in all the embodiments shown in the drawings, the n-layer and the i-layer have their respective electrodes on the same surface.

However, there is no basis in the application as filed for a light-emitting device of gallium nitride compound semiconductor material with a n-layer and an i-layer wherein an i-layer electrode comprises a layer formed directly on said i-layer and which is made of **an alloy containing Ni**, and wherein the n-layer and the i-layer have their respective electrodes which are **not on the same surface**.

Therefore, the auxiliary request II does not satisfy the requirement of Article 123(2) EPC.

5. *Auxiliary request III*

5.1 Admissibility of the amendments

Claim 1 of the auxiliary request III specifies that the n-layer (3, 4) and the i-layer (5) of the light-emitting device have their respective electrodes formed on the same surface and is otherwise similar to claim 1 of the auxiliary request II.

A light-emitting device according of claim 1 is disclosed in particular in independent claim 4 of the application as filed.

Since moreover the further claims of the auxiliary request III are only dependent claims for devices comprising particular features which have a basis in the original disclosure, the request satisfies the requirement of Article 123(2) EPC.

5.2 Inventive step

A light-emitting device is known from document D4 (see the abstract of the PAJ and the abstract provided with applicant's letter dated 30 May 1997) having a p-type layer (5) of gallium nitride $Al_xGa_{1-x}N$, $x = 0$, doped with Zn, and an n-layer (4) of a gallium nitride compound thereunder, an electrode (6) for said Zn-doped p-layer (5), and an n-layer electrode (7) for said n-layer (4), whereby said p-layer electrode (6) is in contact with the p-layer (5) and is made of Al. Other metallic compositions, e.g. Ni, Ag and alloys thereof, are mentioned for the electrode (6) on the p-layer (5).

As set forth here above (cf. item 2.3 of the reasons), Zn is a p-type impurity in gallium nitride.

In the opinion of the Board, document D4 represents the closest prior art in that sense that it also concerns a gallium nitride light-emitting device and that the same metallic materials are cited for the electrode of the layer doped with p-type impurities.

As regards the disclosure in document D4, the appellant argued as follows:

All the examples of document D4 consistently use aluminium for the metal of the electrode in contact with the layer doped with p-type impurities. Although this document mentions several other metals, e.g. Ni or Ag or alloys thereof as materials of this electrode, a specific combination of an electrode of Ni, Ag or an alloy thereof in contact with a p-doped i-type GaN layer is not disclosed in document D4.

The Board agrees with the above submissions, since in document D4, the Zn-doped layer (5) is a p-type layer, and not an i-type layer and, although it can be derived

from document D4 that Ni, Ag or alloys thereof can be substituted for Al for a p-type layer, there is however no such indication for an i-type layer.

In the patent application in suit, the light-emitting patterns of light-emitting devices with Al, Ni and Ag as the electrode material for the i-type layer are shown in Figures 5A, 5B and 5C respectively. It follows from a comparison of these patterns that with Ni and Ag as the electrode material, the light is emitted uniformly from a plane rather than from dots as in the device with Al electrode (see Figure 5A).

The appellant submitted that although document D4 mentions Ni and Ag as substitute for Al as an electrode material, there is no hint in the document that Ni or Ag as an electrode material in contact with an i-type layer would provide uniform light-emission from a plane. The Board accepts this submission and finds that the choice of Ni, Ag or alloys thereof as in the claimed subject-matter was a purposive selection with a view to improving light-emission characteristics of the device, and therefore would not have been obvious from the teaching of document D4.

The abstract of document D2 only discloses Ti for the electrode layer in contact with the i-type GaN layer. The abstract of document D5 is not relevant since the conductivity type of the gallium nitride layer (105) in contact with the conductive layer (106) is not specified, and also this GaN layer (105) is adjacent to a light-emitting layer (104) of a different material, i.e., silicon carbide layer. Moreover, the material of the conductive layer (106) is not indicated either, so that the device is different from the device of claim 1.

For the foregoing reasons, the Board comes to the conclusion that the subject-matter of claim 1 of the auxiliary request III is not obvious to a person skilled in the art and thus involves an inventive step in the sense of Article 56 EPC.

Therefore, claim 1 is patentable in the sense of Article 52(1) EPC. Since the remaining claims are dependent device claims concerning specific embodiments, they are also patentable for the same reasons.

The description, however, needs to be adapted to the claims.

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 on the basis of claims 1 to 5 of the Auxiliary request III filed during the oral proceedings, and the description to be adapted to the claims.

The Registrar: The Chairman:

D. Spigarelli R. K. Shukla