

**Internal distribution code:**

- (A)  Publication in OJ  
(B)  To Chairmen and Members  
(C)  To Chairmen  
(D)  No distribution

**D E C I S I O N**  
**of 20 September 2005**

**Case Number:** T 0896/02 - 3.4.02

**Application Number:** 98102389.8

**Publication Number:** 0844511

**IPC:** G02F 1/35

**Language of the proceedings:** EN

**Title of invention:**

Optical wavelength converting device for second harmonic generation

**Patentee:**

MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.

**Opponent:**

Fuji Photo Film Co., Ltd.

**Headword:**

-

**Relevant legal provisions:**

EPC Art. 84, 100(c), 114(2), 123(2)

**Keyword:**

"Late-filed documentary evidence submitted during oral proceedings - admissibility (no)"

"Extension of subject-matter (no)"

"Amended claims supported by the description (yes)"

**Decisions cited:**

-

**Catchword:**

-



Case Number: T 0896/02 - 3.4.02

**D E C I S I O N**  
of the Technical Board of Appeal 3.4.02  
of 20 September 2005

**Appellant:** MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.  
(Proprietor of the patent) 1006, Oaza Kadoma  
Kadoma-shi  
Osaka (JP)

**Representative:** Senior, Alan Murray  
J.A. KEMP & CO.  
14 South Square  
Gray's Inn  
London WC1R 5JJ (GB)

**Respondent:** Fuji Photo Film Co., Ltd.  
(Opponent) No. 210, Nakanuma Minami Ashigara-shi  
Kanagawa, 250-01 (JP)

**Representative:** Klunker, Schmitt-Nilson, Hirsch  
Winzererstrasse 106  
D-80797 München (DE)

**Decision under appeal:** Decision of the Opposition Division of the  
European Patent Office posted 20 June 2002  
revoking European patent No. 0844511 pursuant  
to Article 102(1) EPC.

**Composition of the Board:**

**Chairman:** A. G. Klein  
**Members:** F. J. Narganes-Quijano  
C. Rennie-Smith

## Summary of Facts and Submissions

- I. The appellant (patent proprietor) has lodged an appeal against the decision of the opposition division revoking European patent No. 0844511 (based on European patent application No. 98102389.8 filed as a divisional application of European patent application No. 93307997.2 published as EP-A-0592226).

The opposition filed by the respondent (opponent) against the patent was based on the ground for opposition under Article 100(c) EPC. The respondent alleged in particular that claims 1 and 9 of the patent granted on a divisional application both referred to the inclination angle of the "C-crystal axis" instead of the "-C-crystal axis" and that claim 1 omitted the feature according to which the inverted-polarization layers are formed by exchanging positive ions included in the ferroelectric substrate for H<sup>+</sup> ions, and that for these reasons the corresponding subject-matter extended beyond the content of the earlier application as filed.

The opposition division revoked the patent on the grounds that the amendments to the claims according to the then valid request of the appellant did not overcome the grounds for opposition under Article 100(c) EPC and, in addition, contravened Article 123(2) EPC.

- II. In its statement setting out the grounds of appeal the appellant requested that the decision under appeal be set aside and the patent be maintained in amended form.
- III. By a summons dated 13 April 2005 the parties were summoned to oral proceedings on 20 September 2005. In a

communication accompanying the summons, and with reference to an objection previously raised by the respondent during the written proceedings with regard to claim 1 of the appellant's main request directed to an optical wavelength converting device, the Board expressed its preliminary non-binding opinion that the essential technical features of the device itself would not appear to be affected by whether or not the formation of the inverted-polarization layers by proton exchange is carried out by thermal processing. In its communication the Board indicated that any new submission should be filed promptly, at least one month before the date set for oral proceedings, and that late submissions would run the risk of not being considered by the Board.

IV. Oral proceedings were held before the Board on 20 September 2005 attended by both parties.

During the oral proceedings the respondent submitted copies of a patent application and two scientific articles in support of its argumentation. The appellant objected to the introduction of the documents during the oral proceedings.

The appellant requested that the decision under appeal be set aside and the patent be maintained on the basis of claims 1 and 9 and description pages 5 to 7 amended according to the main or the auxiliary request submitted with its letter dated 27 June 2005 together with description pages 2 to 4 and 8 to 23, claims 2 to 8 and 10 to 26 and Figures 1 to 37 of the patent as granted.

The respondent requested the dismissal of the appeal.

At the end of the oral proceedings the Board gave its decision.

- V. Claims 1 and 9 amended according to the main request read as follows (the amendments to claims 1 and 9 as granted being underlined by the Board):

"1. An optical wavelength converting device, comprising:  
a ferroelectric substrate (42) having an upper surface, spontaneous polarization of the ferroelectric substrate being directed toward a +C-crystal axis direction of the C-crystal axis perpendicular to an X-Y crystalline plane defined by an X-crystal axis and a Y-crystal axis as (001) crystalline plane in Miller indices;  
a plurality of inverted-polarization layers (43) arranged at regular intervals in an upper surface region of the ferroelectric substrate, polarization of the inverted-polarization layers being directed toward a -C-crystal axis direction of the C-crystal axis and the inverted polarisation layers being formed by exchanging positive ions in the ferroelectric substrate for H<sup>+</sup> ions; and  
an optical waveguide (44) crossing alternate rows of the inverted-polarization layers and the ferroelectric substrate positioned between the inverted-polarization layers, a part of fundamental waves transmitting through the optical waveguide being converted into second harmonic waves, and a refractive index of the optical waveguide being higher than that of the ferroelectric substrate to confine the fundamental and the second harmonic waves in the optical waveguide,

wherein the ferroelectric substrate is made of ferroelectric substance selected from a group including substantially pure  $\text{LiTaO}_3$  crystal, and substantially pure  $\text{LiNbO}_3$  crystal characterised in that: the group further includes  $\text{LiTaO}_3$  crystal doped by  $\text{MgO}$ ,  $\text{Nb}$  or  $\text{Nd}$ , and  $\text{LiNbO}_3$  crystal doped by  $\text{MgO}$ ,  $\text{Ta}$  or  $\text{Nd}$ , the optical waveguide extends along the Y-crystal axis, and the  $-C$ -crystal axis direction is inclined at an angle ranging from 60 to 85 degrees with respect to the normal of the upper surface of the ferroelectric substrate toward the X-crystal axis."

"9. A method of manufacturing an optical wavelength converting device, comprising the steps of: preparing a ferroelectric substrate (42) having an upper surface, spontaneous polarization of the ferroelectric substrate being directed toward a  $+C$ -crystal axis direction of a C-crystal axis perpendicular to an X-Y crystalline plane defined by an X-crystal axis and a Y-crystal axis as (001) crystalline plane in Miller indices; arranging first masks (47) on the upper surface of the ferroelectric substrate at regular intervals; immersing the ferroelectric substrate with the first masks in a phosphoric acid solution to exchange positive ions of the ferroelectric substrate not covered with the first masks for  $\text{H}^+$  ions of the phosphoric acid solution, a plurality of proton exchange regions (43) arranged at the regular intervals being formed in an upper region of the ferroelectric substrate not covered with the first masks; thermally processing the ferroelectric substrate and the proton exchange regions to diffuse the  $\text{H}^+$  ions densified in the proton exchange regions into the

ferroelectric substrate at a first diffusion speed and diffuse heavy ions of the ferroelectric substrate into the proton exchange regions at a second diffusion speed lower than the first diffusion speed, the proton exchange regions being charged with negative electricity, the ferroelectric substrate surrounding the proton exchange regions being charged with positive electricity, and an electric field having a component directed in a -C-crystal axis direction being induced because of a difference in electricity between the proton exchange regions and the ferroelectric substrate to form inverted-polarization kernels having inverted polarization directed in the -C-crystal axis direction in boundary regions between the proton exchange regions and the ferroelectric substrate;

continuing to thermally process the ferroelectric substrate and the proton exchange regions to grow the inverted-polarization kernels, the proton exchange regions and the ferroelectric substrate positioned under the proton exchange regions being changed to a plurality of inverted-polarization regions (43) arranged at the regular intervals of which inverted polarization is directed in the -C-crystal axis direction opposite to the +C-crystal axis direction;

and

forming an optical waveguide (44) which crosses alternate rows of the inverted-polarization layers and the ferroelectric substrate positioned between the inverted-polarization layers, fundamental waves transmitting through the alternate rows of the optical waveguide being converted into second harmonic waves, and a refractive index of the optical waveguide being higher than that of the ferroelectric substrate to

confine the fundamental and second harmonic waves in the optical waveguide, characterised in that the step of preparing a ferroelectric substrate includes the steps of selecting ferroelectric substance as a material of the ferroelectric substrate from the group consisting of pure LiTaO<sub>3</sub> crystal, LiTaO<sub>3</sub> crystal doped by MgO, Nb or Nd, pure LiNbO<sub>3</sub> crystal and LiNbO<sub>3</sub> crystal doped by MgO, Ta or Nd; and forming the ferroelectric substance out of the ferroelectric substance to incline the Z-crystal axis direction at an angle ranging from 60 to 85 degrees with respect to the normal of the upper surface of the ferroelectric substrate toward the X-crystal axis, and the step of forming an optical waveguide includes the step of extending the optical waveguide along the Y-crystal axis."

Dependent claims 2 to 8 and 10 to 26 all refer back to claims 1 and 9, respectively.

The wording of the claims amended according to the auxiliary request is not relevant to the present decision.

VI. The arguments of the appellant in support of its requests were substantially the following:

The respondent has failed to submit in due time the documents filed during the oral proceedings and for this reason they should not be admitted into the proceedings.



Claims 1 and 9 amended according to the present main request have a clear basis in both the application as filed and the earlier application.

The objection of lack of support raised by the respondent does not emerge from the amendments themselves and, since clarity is not a ground for opposition, the objection is not valid. In any case, the embodiments of the application describe thermal processing only as one way in which the proton exchange can be carried out and, in addition, it is well known to the skilled person that proton exchange can be carried out in other alternative ways. Consequently, the thermal processing step is not an essential feature of the device defined in amended claim 1 of the main request.

VII. The arguments of the respondent in support of its requests can be summarized as follows:

The documents submitted during the oral proceedings do not constitute prior art as such. In addition, the documents had only been found shortly before the oral proceedings and were submitted in reply to the communication accompanying the summons in which the Board expressed its preliminary opinion on the objection of lack of support of the amended claims.

The patent specification as granted (paragraph [0039]) describes the process in which proton exchange regions are changed to inverted-polarization regions through thermal process. Thermal processing is also clearly described in the different embodiments as a necessary feature in the formation of the inverted-polarization

layers (paragraphs [0069] to [0084] and [0104] to [0124] of the patent specification) and process claim 9 as granted discloses the thermal processing step as an essential feature. Since the device is the result of a specific process disclosed in the patent and thermal processing constitutes an essential feature of the process, the feature is also essential in the definition of the device. The amended feature of claim 1 according to which the inverted-polarization layers are formed by exchanging positive ions in the substrate for H<sup>+</sup> ions, however, fails to specify the thermal processing step. In addition, the thermal processing step may have an influence on the characteristics of the resulting device and the use of alternative processing techniques may result in devices having different characteristics. Consequently, the amended claim 1 is not supported by the application as filed and, in addition, does not contain all the information required for obtaining the device, thus resulting in lack of clarity (Article 84 EPC). These objections are raised with regard to the features incorporated in the amended claims and are therefore admissible.

### **Reasons for the Decision**

1. The appeal complies with the requirements mentioned in Rule 65(1) EPC and is therefore admissible.
  
2. *Admissibility of late-filed documentary evidence*

During the oral proceedings before the Board the respondent submitted three documents as documentary

evidence in support of its allegation that the use of thermal processing in the manufacture of the device of claim 1 of the main request, and in particular in the formation of the inverted polarization layers of the device by exchanging positive ions in the ferroelectric substrate for H<sup>+</sup> ions, may have an impact on the characteristics of the device. The appellant for its part objected to the introduction of the documents into the proceedings at such a late stage of the proceedings.

The respondent maintained that the documents were not really prior art and that, for this reason alone, the documents should be admitted into the proceedings. However, the issue of the admissibility under Article 114(2) EPC of facts and evidence not submitted in due time applies generally to any form of evidence and is not confined to any particular category of evidence, let alone to prior art produced for the assessment of patentability under Article 52(1) EPC. Consequently, the admissibility under Article 114(2) EPC of the documents submitted by the respondent during the oral proceedings must be addressed in the present case.

The respondent argued that the documents were filed in reply to the Board's preliminary view expressed in the communication accompanying the summons to oral proceedings and that filing them during the oral proceedings was justified by the fact that the documents were found shortly before the oral proceedings.

However, the respondent's objection relating to the absence in claim 1 as amended according to the

appellant's main request of a reference to thermal processing had already been raised in the respondent's letter dated 20 January 2003. In addition, the appellant had already challenged that objection in its letter dated 8 September 2003 and, in its communication accompanying the summons dated 13 April 2005, the Board only expressed its preliminary opinion on the respondent's objection without developing the matter substantively. Nonetheless, the respondent did not avail itself of the opportunity to reply in writing to the appellant's letter of 8 September 2003 or to the Board's communication dated 13 April 2005, let alone to find and file any documentary evidence in support of its case in due time. Moreover, in the Board's communication, the parties were expressly warned that submissions filed after the one-month time limit before the date set for oral proceedings would run the risk of not being taken into consideration by the Board (point III above).

In these circumstances, and since the respondent has offered no adequate reason or justifiable excuse for the late submission of the documents, the Board can see no particular reason why the documents could not have been filed in due time. In addition, the appellant - which expressly opposed the admissibility of the documents - was surprised by the unexpected production of the documents during the oral proceedings and consideration of the evidence by the Board would have put the appellant in a situation in which insufficient time and opportunity was available to him to appraise the new evidence and comment on its content. Thus, in the Board's view, the new documentary evidence was tendered too late for its introduction to be fair to

the other party, in that taking account of it would have given rise to unbalanced treatment of the parties and would therefore have been contrary to a proper and fair procedure.

For these reasons, the Board, in the exercise of the discretion conferred upon it under Article 114(2) EPC, decided during the oral proceedings to disregard the documentary evidence submitted by the respondent during the oral proceedings.

3. *Main request - Amendments*

- 3.1 Claims 1 and 9 amended according to the main request of the appellant both differ from the respective claims 1 and 9 as granted in that the expression "the C-crystal axis" in the last paragraph of the claims has been replaced by "the -C-crystal axis direction". Claim 1 has been further amended by incorporation of the feature "the inverted polarisation layers being formed by exchanging positive ions in the ferroelectric substrate for H<sup>+</sup> ions".

These amendments have been made in order to meet the grounds for opposition under Article 100(c) EPC invoked by the respondent and are therefore admissible (Article 57a EPC). In addition, the amendments are based on the application as filed (Figures 15 and 25 and the corresponding description in column 25, line 32 *ff.* and column 33, line 4 *ff.*, and column 8, line 5 *ff.* of the publication of the divisional application as well as the corresponding passages of the earlier application) and do not extend the scope of

protection and therefore comply with the requirements of Articles 123(2) and (3) EPC.

The objections under Article 123(2) EPC considered by the opposition division in the reasons for the revocation of the patent (point I above) related to features incorporated by way of amendment in the then valid claims. These features, however, are absent in the claims amended according to the present main request and consequently those objections no longer apply.

The statements of invention on pages 5 to 7 of the description of the patent specification have been amended to make them consistent with the subject-matter of amended claims 1 and 9 (Article 84 and Rule 27(1,c) EPC).

- 3.2 During the appeal proceedings the respondent has raised an objection of lack of support of claim 1 amended according to the main request on the grounds that the claim fails to specify that the formation of the inverted-polarization layers by proton exchange is carried out by thermal processing.

This objection raised by the respondent can be interpreted as an objection of lack of support in the description in the sense of Article 84 EPC, second sentence as well as an objection of lack of support in the application as filed (Article 123(2) EPC).

The objection relates to the feature introduced into claim 1 according to which the inverted polarization layers are formed by exchanging positive ions in the

ferroelectric substrate for H<sup>+</sup> ions and therefore arises out of the amendments themselves. Accordingly, contrary to the appellant's submissions, the Board is competent to examine pursuant to Article 102(3) EPC whether the amendment complies with the requirements of the EPC and in particular with those set forth in Articles 84 and 123(2) EPC (see "Case Law of the Boards of Appeal" EPO, 4th ed. 2001, chapter VII, section C-10.2).

Contrary to the respondent's contention, as long as a claim directed to a device specifies the essential structural and functional technical features of the device itself, none of the provisions of Articles 84 and 123(2) EPC calls for the claim to contain in addition information required for manufacturing the device. The issue of lack of support raised by the respondent therefore depends in the present case on whether the functional and structural features of the device are affected by whether or not the formation of the inverted-polarization layers by proton exchange is carried out by thermal processing.

It has not been disputed by the parties that thermal processing is disclosed in the original application and in the patent specification as essential in the method of manufacture of the device (claim 9 and paragraphs [0039], ([0069] to [0084], and [0121] to [0124] of the patent specification and the corresponding passages of the application as filed). However, as submitted by the appellant and not disputed by the respondent, the exchange of positive ions by H<sup>+</sup> ions can also be carried out by alternative processing methods other than thermal processing. In addition, the respondent has not identified any passage of the disclosure of the

application and of the patent or advanced any technical argument in support of its allegation that the manufacture of the device by thermal processing instead of other alternative processing techniques would influence the characteristics of the device itself. On the contrary, it appears to the Board that it is immaterial for the device itself whether the proton exchange process in the ferroelectric substrate is carried out by thermal processing or by some other alternative processing technique as long as the proton exchange process results in inverted polarization layers having the functional and structural features defined in claim 1.

Thus, in view of the above and in the absence of evidence or technical arguments to the contrary, the Board concludes that the thermal processing step does not result in any essential structural or functional feature of the device other than those already defined in the amended claim 1. Accordingly, the fact that amended claim 1 does not specify the thermal processing step does not lead to lack of support in the description of the patent in the sense of Article 84 EPC, second sentence or to lack of support in the application as filed (Article 123(2) EPC).

- 3.3 The Board is therefore satisfied that the amendments made to the patent according to the main request of the appellant are admissible and comply with the requirements of the EPC.



4. *Main request - Article 100(c) EPC*

The objections raised by the respondent in substantiating the sole ground for opposition under Article 100(c) EPC (point I above) are clearly met and overcome by the replacement of the expression "the C-crystal axis" by "the -C-crystal axis direction" in the last paragraph of claims 1 and 9 and by the incorporation in claim 1 of the feature relating to the inverted polarisation layers being formed by exchanging positive ions in the ferroelectric substrate for H<sup>+</sup> ions according to the appellant's main request.

In addition, since the amendments to claims 1 and 9 overcome the ground for opposition under Article 100(c) EPC and also comply with the requirements of Article 123(2) EPC (point 3.1 above), claims 1 and 9 amended according to the main request also overcome the reasons given by the opposition division for the revocation of the patent.

5. In view of the foregoing, the Board concludes that neither the reasons for the revocation nor the ground for opposition under Article 100(c) EPC prejudice maintenance of the patent as amended according to the main request of the appellant.

## 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 maintain the patent on the basis of the following documents:
  - claims 1 and 9 according to the main request as filed with the letter dated 27 June 2005 and claims 2 to 8 and 10 to 26 as granted,
  - description pages 5 to 7 according to the main request as filed with the letter dated 27 June 2005 and description pages 2 to 4 and 8 to 23 of the patent specification, and
  - Figures 1 to 37 of the patent specification.

The Registrar:

The Chairman:

P. Martorana

A. G. Klein