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**Datasheet for the decision
of 11 May 2022**

Case Number: T 1748/19 - 3.4.02

Application Number: 11791952.2

Publication Number: 2580576

IPC: G01N21/63, B82B1/00, C12Q1/68, G01N33/543, B82Y15/00, G01N21/64, G01N21/77

Language of the proceedings: EN

Title of invention:
APPARATUS FOR SINGLE-MOLECULE DETECTION

Patent Proprietor:
Industrial Technology Research Institute

Opponent:
Pacific Biosciences Of California, Inc.

Headword:

Relevant legal provisions:
EPC Art. 54(1), 56, 100(c), 111(1), 123(2)
RPBA 2020 Art. 11
RPBA Art. 12(4)

Keyword:
Amendments - added subject-matter (yes) - main request
Admissibility of first auxiliary request (no)
Inventive step (no) - second to fourth auxiliary request
Remittal (yes) - special reasons for remittal - fifth auxiliary request

Decisions cited:

Catchword:

Beschwerdekammern
Boards of Appeal
Chambres de recours

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Case Number: T 1748/19 - 3.4.02

D E C I S I O N
of Technical Board of Appeal 3.4.02
of 11 May 2022

Appellant: (Patent Proprietor)	Industrial Technology Research Institute No. 195, Sec. 4 Chung Hsing Road Chutung Hsinchu 31040 (TW)
Representative:	Ter Meer Steinmeister & Partner Patentanwälte mbB Nymphenburger Straße 4 80335 München (DE)
Appellant: (Opponent)	Pacific Biosciences Of California, Inc. 1305 O'Brien Drive Menlo Park, CA 94025 (US)
Representative:	Mewburn Ellis LLP Aurora Building Counterslip Bristol BS1 6BX (GB)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 20 May 2019 concerning maintenance of the European Patent No. 2580576 in amended form.**

Composition of the Board:

Chairman	R. Bekkering
Members:	A. Hornung
	G. Decker

Summary of Facts and Submissions

I. Both the opponent and the patentee appealed against the interlocutory decision of the opposition division maintaining European patent No. 2 580 576 in amended form.

Opposition had been filed against the patent as a whole and based on the grounds for opposition under Article 100(a) EPC, together with Articles 54(1) and 56 EPC and Article 100(c) EPC.

The opposition division had found that the patent as amended according to a third auxiliary request then on file and the invention to which it related met the requirements of the EPC.

II. Oral proceedings before the board were held on 11 May 2022.

III. The patentee initially requested as a main request that the decision under appeal be set aside and that the patent be maintained as granted. Alternatively, it requested that the decision under appeal be set aside and that the patent be maintained in amended form on the basis of the claims according to one of the first to twenty-first auxiliary requests, all filed with the letter dated 31 January 2020.

In the course of the oral proceedings before the board, the patentee changed the order of the auxiliary requests.

As its final requests, the patentee requested as a main request that the decision under appeal be set aside and that the patent be maintained as granted. Alternatively, it requested that the decision under appeal be set aside and that the patent be maintained in amended form on the basis of the claims according to one of the new first to fifth auxiliary requests as specified during the oral proceedings on 11 May 2022, i.e. according to one of the ninth, fifth, sixth, seventh and eighth auxiliary requests in that order and as filed with the letter dated 31 January 2020, or according to one of the first to fourth or tenth to twenty-first auxiliary requests in that order and as filed with the letter dated 31 January 2020.

It is to be noted that the present second auxiliary request, i.e. the former fifth auxiliary request, corresponds to the third auxiliary request underlying the appealed decision found allowable by the opposition division.

IV. The opponent requested that the decision under appeal be set aside and that the European patent be revoked.

V. The following document relied on in the first-instance opposition proceedings will be referred to in the present decision:
D1: WO 2010/033193 A2.

VI. The patentee's written submissions are designated as follows:
P1: statement of grounds of appeal, filed with a letter dated 30 September 2019,
P2: letter dated 31 January 2020 (reply to the opponent's statement of grounds of appeal),
P3: letter dated 11 April 2022.

The opponent's written submissions are designated as follows:
O1: statement of grounds of appeal, filed with a letter dated 27 September 2019,

O2: letter dated 10 February 2020 (reply to the patentee's statement of grounds of appeal).

VII. Independent claim 1 according to the patentee's main request reads as follows (the features of claim 1 are preceded by the numbering **1** to **9**, as defined in the appealed decision, point 10):

"**1** A single molecule detection apparatus, comprising:
2 a) a waveguide comprising:
  3 a core layer; and
  4 a first cladding layer, wherein
  5 at least one nanowell is formed in at least the first cladding layer, and
  6 the core layer of the waveguide has a larger refractive index than the first cladding layer;
7 b) at least one light detector formed on or in a substrate,
8 wherein the at least one nanowell and the light detector are arranged at opposite sides of the waveguide; and
9 c) a light source".

- Independent claim 1 according to the first auxiliary request reads as follows:

"A single molecule detection apparatus, comprising:
a) a planar or channel waveguide on a substrate comprising:
  a core layer; and
  a first cladding layer, wherein
  at least one nanowell is formed in at least the first cladding layer, and the core layer of the waveguide has a larger refractive index than the first cladding layer;

b) at least one light detector formed on or in the substrate, wherein the at least one nanowell and the light detector are arranged at opposite sides of the waveguide; and
c) a light source".

- Independent claim 1 according to the second auxiliary request reads as follows:

"A single molecule detection apparatus, comprising:
a) a planar waveguide on a substrate comprising:
a core layer; and
a first cladding layer, wherein
at least one nanowell is formed in at least the first cladding layer, and the core layer of the waveguide has a larger refractive index than the first cladding layer;
b) at least one light detector formed on or in the substrate, wherein the at least one nanowell and the light detector are arranged at opposite sides of the waveguide; and
c) a light source".

- Independent claim 1 according to the third auxiliary request differs from claim 1 of the second auxiliary request in that the following feature, referred to as feature d) by the patentee in P2, page 4, is added at the end of the claim:

"wherein the light detector is a set of optical sensors that is capable of at least partially absorbing light incident thereon and generating output signals in response to the light; and wherein the optical sensors in one set have different sensitive wavelength bands".

- Independent claim 1 according to the fourth auxiliary request differs from claim 1 of the second auxiliary request in that the following features are added at the end of the claim:

"wherein the light detector is a set of optical sensors chosen from photoconductive type optical sensors, photovoltaic type optical sensors, APDs, p-n photodiodes, p-i-n photodiodes, or multi-junction photodiodes; and
wherein the optical sensors in one set have different sensitive wavelength bands".

- Independent claim 1 according to the fifth auxiliary request reads as follows:

"A single molecule detection apparatus, comprising:
a) a planar waveguide on a substrate comprising:
a core layer; and
a first cladding layer, wherein
a plurality of nanowells formed in at least the first cladding layer, and the core layer of the waveguide has a larger refractive index than the first cladding layer;
b) a plurality of light detectors formed on or in the substrate, wherein the plurality of nanowells and the plurality of light detectors are arranged at opposite sides of the waveguide; and
c) a light source,
wherein the plurality of nanowells forms a nanowell array,
wherein the plurality of light detectors forms a detector array,

wherein each light detector in the detector array corresponds to one nanowell in the nanowell array,
wherein each light detector is a set of optical sensors chosen from photoconductive type optical sensors, photovoltaic type optical sensors, APDs, p-n photodiodes, p-i-n photodiodes, or multi-junction photodiodes; and
wherein the optical sensors in one set have different sensitive wavelength bands".

Reasons for the Decision

1. Main request - Amendments

Claims 1, 16, 32 and 33 do not fulfil the requirement of Article 100(c) EPC in combination with Article 123(2) EPC.

1.1 Claim 1 as granted defines a light detector formed on or in a substrate. The only basis in the application as originally filed for forming a light detector on or in a substrate is to be found on page 8, lines 9 to 13, of the application as filed, in combination with figure 1. This passage of the description and the corresponding figure 1 describe a specific embodiment of the invention comprising a *planar* waveguide *formed on a substrate* (not shown in figure 1) and a light detector formed on or in *the* substrate.

In agreement with the appealed decision, point 11.4, the subject-matter of claim 1, comprising a light detector formed on an *unspecified* substrate, cannot directly and unambiguously be deduced from the passage on page 8 of the published patent application, since it misses the following three features of the embodiment shown in figure 1:

(a) the waveguide is a *planar* waveguide,
(b) the waveguide is *formed on a substrate*,
(c) the substrate on which the light detector is formed is the substrate *on which the waveguide is formed*.

It follows that the amendment of claim 1 represents an unallowable intermediate generalisation.

1.2 The counter-arguments submitted by the patentee are not found convincing.

1.2.1 Contrary to the patentee's statement in P1, page 4, last but two paragraph, that "[f]eature **7** of granted claim 1 defines that a light detector is formed on or in a substrate, which is originally disclosed (cf. page 8, line 13 as published)", the quoted passage does not disclose a light detector formed on an unspecific substrate but on that specific and unique substrate on which a planar waveguide is formed. For instance, certain embodiments falling under the scope of claim 1, such as a light detector formed on a substrate on which a *channel* waveguide is formed or on a substrate *detached* from the waveguide, cannot unambiguously be deduced from the quoted passage.

1.2.2 The patentee argued that "[o]n page 8 of the description as originally filed, each of the stated features is introduced as a permissive 'may' and so, the added feature **7** taken from line 13 on page 8 of the description as originally filed is to be considered as ***an optional feature compared to the other features of Fig. 1***" (P1, page 5, first paragraph; emphasis in original).

The board is not persuaded by this argument because the patent application uses the word "may" systematically in front of a verb, thereby voiding the word "may" from its conventional meaning of introducing an optional verb. For instance, in the expressions "[t]he detection apparatus consistent with the present disclosure *may* comprise at least one light source", "[t]he detection apparatus consistent with the present disclosure *may* comprise a waveguide" or "[t]he light source 102 *may* emit a light" (see patent application, page 6, lines 16 and 17; page 6, lines 22 and 23; page 8, line 14; emphasis added), the word "may", besides from rendering cumbersome the reading, is meaningless in view of the actual invention as defined in claim 1 as originally filed.

1.2.3 The patentee further argued that "**a CWG** [channel waveguide] **is just a special case of a PWG** [planar waveguide]" (emphasis in original) and that "a restriction of a general waveguide to a PWG-type does not even exclude a CWG-type" (P1, page 5, second paragraph).

The board cannot follow this argumentation since a planar waveguide and a channel waveguide are known in the art as being two separate types of waveguide in the sense that the expression "planar waveguide" would not be interpreted by the person skilled in the art as covering also a channel waveguide.

1.2.4 According to the patentee, "[a]n arrangement of a light detector on the substrate has neither been presented as inextricably linked with a specific waveguide (planar or channel) nor is such an inextricable link apparent for the person skilled in the art" (P1, page 4, last paragraph; P3, [11]). For the patentee, the specific type of waveguide (channel or planar) was irrelevant when it comes to the arrangement on the substrate.

The board is not convinced by the patentee's argument. As acknowledged by the patentee, a planar waveguide differs from a channel waveguide *inter alia* with respect to "the 'width' of the core layer which leads to a further restriction in the confinement of light in a further dimension" (P1, page 5, second paragraph; P3, [15]). In order to provide a waveguide in which the light wave is travelling over a wider width, the core layer and the cladding layer have to be modified. This modification of the core layer and the cladding layer implies that forming the nanowell in the cladding layer and the detector on or in the substrate on which the modified waveguide is formed has to be adapted to the modified core layer and cladding layer. In other words, a different width of the core layer affects the entire waveguide structure including the cladding layer in which a nanowell is formed, the core layer and the substrate on which the waveguide and on which or in which the light detector is formed. Therefore, the feature of a planar or channel waveguide is inextricably linked to the remaining features of the device of claim 1.

1.3 Independent claims 32 and 33 comprise subject-matter infringing Article 123(2) EPC for reasons corresponding to those given in point 1.1 above.

1.4 Present claim 16 represents a kind of combination of claims 25 to 28 as originally filed. Each of the originally filed claims 26 to 28 is directly dependent on claim 25 only. Originally filed claims 25 to 28, therefore, define exactly three embodiments comprising the features of claims 25 and 26, claims 25 and 27 and claims 25 and 28, respectively. Present claim 16, however, in addition to these three embodiments, defines further embodiments due to the use of the expression "and/or" connecting the features of each of the originally filed claims 26 to 28. None of these further embodiments is directly and unambiguously derivable from the originally filed claims 25 to 28.

The patentee's counter-argument, according to which the embodiment comprising the features of the combination of originally filed claims 27 and 28 has a basis in originally filed claims 25 to 28 (P1, page 6, point c)), cannot be followed because a nanopatterned structure as defined in claim 28 comprising a hole as defined in claim 27 is not disclosed in the application as originally filed.

2. First auxiliary request

The first auxiliary request is not admitted into the proceedings (Article 12(4) RPBA 2007). It corresponds to the ninth auxiliary request filed with letter P2.

2.1 The first auxiliary request has been filed for the first time by the patentee with its letter of response to the opponent's statement of grounds of appeal. Claim 1 of the first auxiliary request differs from claim 1 of the main request in that feature **2** of claim 1 of the main request has been amended to define "a planar or channel waveguide on a substrate" instead of "a waveguide". Furthermore, feature **7** of claim 1 of the main request has been amended to define a light detector formed on or in *the* substrate, i.e. the substrate on which the planar or channel waveguide is formed, instead of a light detector formed on or in an unspecified substrate.

These amendments are intended, on the one hand, to overcome the objection of added subject-matter raised against claim 1 of the patent as granted (see point 1.1 above) and, on the other hand, to avoid limiting the claim to a *planar* waveguide as defined in claim 1 of the request found allowable by the opposition division, i.e. the present second auxiliary request.

However, since the objection of added subject-matter against claim 1 of the granted patent was an issue discussed throughout the entire first-instance opposition proceedings, the board is of the view that the patentee had ample opportunity during the first-instance opposition proceedings to amend claim 1 as considered appropriate by the patentee. Since the present amendments of claim 1 could and should have been filed during the first-instance opposition proceedings, the board exercises its discretion under Article 12(4) RPBA 2007 in not admitting the first auxiliary request into the proceedings.

2.2 The patentee, referring to P3, [20], argued that the present first auxiliary request "is a logical consequence after studying the [interlocutory decision] in section 11.4 in which - for the first time in the proceedings - 'a small room for generalization' is agreed upon and that (correctly) there is no inextricable link to the other features". The first auxiliary request was "filed to fill the 'small room for generalization'. Such a 'room' could not be derived from the oral debate in the first instance".

2.3 Contrary to the view of the patentee and of the opposition division, the board considers the type of the waveguide, i.e. planar or channel waveguide, to be inextricably linked to the remaining features of the structure of the device defined in claim 1 (see point 1.2.4 above).

Moreover, there is no evidence on file that the argumentation of the opposition division in the appealed decision on page 4, first paragraph, was not presented and discussed during the oral proceedings before the opposition division. On the contrary, since it must be assumed that the right to be heard was respected during the first-instance proceedings (no objection in this respect was raised by the patentee), it must also be assumed that the issue of added subject-matter has been entirely and thoroughly discussed during the oral proceedings between the parties and the opposition division.

In any case, the board is of the view that the necessity or at least the usefulness of the amendment of claim 1 according to the present first auxiliary request was not dependent on having been aware of the argumentation of the opposition division in the appealed decision on page 4, first paragraph. Indeed, the present amendment of claim 1 is simply a further evident attempt to overcome the objection of added subject-matter without limiting the claimed scope to exactly a *planar* waveguide. This confirms that claim 1 of the first auxiliary request could and should have been filed during the first-instance proceedings.

3. Second auxiliary request - novelty

The present second auxiliary request corresponds to the fifth auxiliary request filed with letter P2.

The subject-matter of claim 1 is novel over D1 (Article 54(1) EPC).

3.1 Novelty in view of the embodiment of figure 22 of D1

3.1.1 D1, [0155], figure 22, discloses a single molecule detection apparatus comprising:

- a) a planar waveguide (2204) formed on a substrate *[a waveguide has implicitly to be formed on a substrate; see e.g. [0053] or [0064], page 19, lines 19 and 20, disclosing "waveguides disposed upon or within the matrix"]*,
  - the waveguide comprising a core layer and a first cladding layer *[implicit disclosure; see also [0065], page 19, lines 29 and 30, describing a typical embodiment of a waveguide]*
  - wherein a nanowell (2202) is fabricated on top of the planar waveguide (2204) *[see [0155], page 61, lines 4 and 5]*
  - and wherein the core layer of the waveguide has a larger refractive index than the first cladding layer *[implicit disclosure: in order that a light wave propagates within a core layer, the core layer must have a higher index of refraction than the surrounding layer; see also [0065], page 19, lines 30 and 31, describing a typical embodiment of a waveguide]*,
- b) a light detector (2218) formed on a substrate *[see [0155], page 61, line 15; a light detector has implicitly to be formed on a substrate]*
  - wherein the nanowell (2202) and the light detector (2218) are arranged at opposite sides of the waveguide (2204) *[see figure 22]*,
- c) a light source (2206).

The apparatus of claim 1, therefore, differs from the device of figure 22 of D1 in that:

(a) the nanowell is formed in the first cladding layer of the waveguide (2204) *[corresponds to feature **5** of granted claim 1]* and

(b) the light detector is formed on or in that specific substrate on which the planar waveguide is formed.

3.1.2 Distinguishing feature (a)

The opponent argued that "claim 1 of the opposed patent only requires the presence of 'a first cladding layer' in which the 'at least one nanowell' is formed and this is met by single mask layer in Figure 22" (O1, point 5.18). During the oral proceedings, the opponent maintained that the top layer shown in figure 22 of D1 is a cladding layer and that it is implicit that the refractive index of a cladding layer is lower than the refractive index of the core layer. It referred to the corresponding generally valid statement in paragraph [0065] in D1.

The board, however, follows the patentee's view according to which feature (a) is missing in figure 22 of D1 (P1, page 10, fourth paragraph). Indeed, in D1, [0155], first sentence, it is clearly stated that the nanoholes (2202) "are fabricated on top of a planar or channel waveguide 2204". Since a waveguide comprises *inter alia* a cladding layer, the nanoholes in D1 are formed on top of the cladding layer instead of being formed in the cladding layer as defined in claim 1. Moreover, even though the layer of figure 22 of D1, in which the nanowells are formed, could formally be considered to be the first cladding layer of claim 1, D1 does not disclose that the refractive index of the layer with the nanowells in figure 22 of D1 is lower than the one of the core layer so as to constitute effectively a cladding layer.

3.1.3 Distinguishing feature (b)

The opponent quoted paragraph [0053] of D1 (O1, point 5.17), but probably meant quoting paragraph [0052] which reads "**Figure 22** schematically illustrates an embodiment of an integrated optical device comprising a waveguide substrate, a plurality of integrated microarrays, and a detector" (see D1, [0052]; emphasis in original). The opponent also referred to paragraphs [0154] and [0155] of D1 describing the embodiment of figure 22 as being an integrated device comprising a waveguide, nanowells and sensors. The opponent further submitted that "when the word 'integrated' is used in D1, it means that the components are integrated into a single substrate" (O1, point 5.21) and that "D1 teaches to build an integrated device with all of the elements of the claims by depositing multiple layers onto a substrate" (O1, point 3.44; O2, page 2, last paragraph) and concluded that the subject-matter of claim 1 was anticipated by D1, figure 22. Furthermore, according to the opponent, "the term 'substrate' is so broad that it could include any structure of an otherwise integrated device, without limitation on the materials from which it was made or the presence of other elements of the device" (see O1, point 5.8).

The board is not convinced by the opponent's arguments for the following reasons:

(i) As submitted by the patentee (P1, page 9, point iii) to page 11; P2, points [37] and [45] to [49]), "an 'integrated optical system' according to Figs. 22/23 of D1 is merely achieved by a two-step approach, namely (1) separately manufacturing of the individual layer (waveguide, detector) and (2) assembling the layers". D1 remained silent about how the individual layers are exactly assembled to form the integrated optical system. Therefore, D1 could not disclose feature b). The board concurs with the patentee's view.

(ii) Paragraphs [0154] and [0155] of D1, in combination with figure 22, do not clearly disclose a layered device, wherein all the layers (waveguide, microlens arrays, photodetectors) are formed on the same substrate. In view of [0154] disclosing that "the layers of the device are manufactured separately by different process" and that "[a]fter fabrication, the layers are aligned with one another during assembly of the device", it must be concluded that each layer is formed on its own substrate and that these individual substrates are assembled subsequently in an unspecified manner without necessarily requiring a common substrate. Paragraphs [0154] and [0155] leave open the question whether the various layers are formed on a common substrate. Since novelty is not a question of obviousness or likelihood, feature (b) is not disclosed in figure 22.

(iii) The board takes note of the various opinions on the meaning of the hachured portions in figure 22:

- According to the opposition division, on the one hand, "[i]t is not clear what sort of material this layer is made of but it qualifies as a 'substrate' in the sense of claim 1" (appealed decision, point 14.10). On the other hand, "the waveguide 2204 is not formed on a substrate but appears to be held by some sort of scaffold. It is not clear whether this scaffold would qualify as a 'substrate' in the sense of claim 1 but it is in any case not the same substrate as the one on that the light detectors are formed" (appealed decision, point 18.1).

- The opponent is of the view that the layer below the detector 2218 in figure 22 represents a substrate.

- According to the patentee, "there is also no hint in D1, that the hatched areas at the bottom of Figs.22/23 are such a substrate" (P1, page 11, second paragraph), but are "to be considered as a manufacturing belts in a fabrication process of the optical layer" which "**cannot be considered as a substrate of the integrated device as claimed**" (P1, page 11, third paragraph; emphasis in original). See also P2, page 12, third and fourth paragraphs; page 14, second to fourth paragraphs.

In view of these opinions, the board comes to the conclusion that neither the hachured vertical portions shown in figure 22 between the waveguide layer and the photodetector layer, nor the hachured horizontal portion below the photodetector layer represents unambiguously a substrate. D1 actually remains silent about the meaning of these hachured portions in figure 22.

(iv) While the term 'substrate' is indeed very broad, the board is not convinced that this term is so broad as to include *any* structure. Indeed, a substrate is to be understood as a base or a foundation over which another item can be arranged. Not any structure fulfils this ability. For instance, the vertical and horizontal hachured portions in figure 22 do not unambiguously qualify as being substrates since their exact physical constitution is unknown in D1.

It follows that feature (b) is not directly and unambiguously disclosed in the embodiment of figure 22 of D1.

3.1.4 In conclusion, the subject-matter of claim 1 differs from the embodiment of figure 22 of D1 in that it comprises features (a) and (b) defined in point 3.1.1 above. The opponent's counter-arguments are not found convincing (see points 3.1.2 and 3.1.3 above).

3.2 Novelty in view of the embodiment of figure 23 of D1

The embodiment shown in figure 23 of D1 does not disclose more features of claim 1 than the embodiment of figure 22 of D1. In particular, paragraph [0156] describing the embodiment of figure 23, discloses neither that the array of nanoholes is formed in the cladding layer of the waveguide (2312), nor that the waveguide (2312) and the sensor array (2306) are formed on the same substrate.

The opponent presented no additional arguments in favour of lack of novelty in view of the embodiment of figure 23 of D1 going beyond those submitted already with respect to the embodiment of figure 22 of D1.

3.3 Novelty in view of the embodiment of figure 15 of D1

The embodiment shown in figure 15 of D1 discloses a nanowell formed in the cladding layer, i.e. feature (a). However, it does not disclose feature (b) because the photodetector (1518) is detached from the waveguide substrate instead of being formed on a common substrate as claimed.

The opponent's argument that figure 15 is schematic and that "there is no disclosure in the description of the figure to support the idea that they *[sic]* two elements are detached" (O1, point 5.10) is not found convincing since the description of figure 15 does not disclose either that the two elements are formed on the same substrate. The further argument of the opponent (O1, points 5.12 and 5.13) that the skilled person would realise from the overall disclosure of D1 that the embodiment of figure 15 could be manufactured as an integrated optical device, as generally taught in D1, is also not convincing because this argument amounts to the question of inventive step but not of novelty.

3.4 Novelty in view of the general disclosure of D1

According to a further line of argumentation of the opponent, the subject-matter of claim 1 was anticipated by the general disclosure of D1. The opponent referred to various passages of D1, including paragraphs [0006], [0007], [0029], [0064] to [0067], [0101], [0154] and [0157].

The board is not persuaded by this line of argumentation because it refers to a large number of different passages in the description of D1, without showing that each cited passage relates to the same embodiment. Combining features from different passages not clearly relating to a single embodiment is a matter of evaluating inventive step of the claimed subject-matter but not novelty.

4. Second auxiliary request - inventive step

The subject-matter of claim 1 does not involve an inventive step over D1 (Article 56 EPC).

4.1 Lack of inventive step

4.1.1 A feasible starting point for assessing inventive step is the embodiment shown in figure 22 of D1. The device of claim 1 differs from that embodiment by the distinguishing features (a) and (b) as defined in point 3.1.1 above.

4.1.2 Distinguishing feature (a)

According to chapter 1 of the patent (paragraphs [0019] to [0062], the invention relates to the detection of a single molecule placed in the bottom of a nanowell formed in the cladding layer of a waveguide. The single molecule is detected by detecting the fluorescent light emitted by the single molecule after having been excited by the evanescent light escaping from the waveguide core. The evanescent light forms a tiny excitation zone outside the core layer.

Due to the distinguishing feature (a), the analyte region in the bottom of the nanowell is positioned closer to the waveguide core and, hence, a higher light intensity is illuminating the analyte. This technical effect is also acknowledged by the patentee (see e.g. P2, page 17, the two last paragraphs). The objective technical problem solved by feature (a) is, therefore, the adjustment of the relative position of the analyte region and the waveguide core, so that the reactants in the nanowell receive an adequate or higher illumination intensity. As explained by the opponent during oral proceedings, according to [0067] of D1, D1 is concerned with a similar problem: "in order for an analyte of interest to be illuminated by the waveguide it must be disposed near enough the waveguide core to be exposed to the evanescent field". Disposing the analyte "near enough" means disposing it sufficiently close to the waveguide core to receive the desired level of illumination intensity. In particular, D1, [0067], teaches the possibility of nanowells which "extend through a waveguide cladding surrounding the waveguide core, or may extend into the core of the waveguide". Therefore, starting from the configuration of figure 22 of D1 where the nanowell is formed *on top* of the waveguide, just like in the embodiment shown in figure 4B of D1, it is obvious for the skilled person, in case that the analyte was not illuminated with sufficiently high intensity, to solve the objective technical problem by implementing the solution taught in paragraphs [0067], [0078] and [0079] of D1 and shown in figure 5 of D1, namely forming a nanowell *in* the waveguide cladding to bring the analyte closer to the core waveguide, thereby arriving at feature (a) without exercising inventive skills.

4.1.3 Distinguishing feature (b)

Distinguishing feature (b) defines that the light detector is formed on or in the substrate on which the waveguide is formed. In the patent description, no particular technical effect is related to feature (b). As submitted by the opponent during the oral proceedings, no technical effect is related to feature (b) going beyond the general technical effect of defining of how to integrate in a concrete manner the light detector and the waveguide into a single integrated device. The objective technical problem solved by feature (b) is, therefore, the integration of the light detector and the waveguide into a single integrated device.

Starting from the embodiment described in paragraphs [0154] and [0155] of D1 and shown in figure 22, the skilled person is taught that the individual layers in figure 22 are fabricated separately and then aligned with one another during assembly of the layers in order to form a single unit device. However, D1 is silent about how the individual layers are effectively assembled in figure 22. Hence, the skilled person is naturally confronted with the objective technical problem defined above of finding out how to realise effectively the detection device of figure 22 in a single integrated device.

In order to solve this problem, the skilled person would consider wafer-level techniques as disclosed in D1, [0156], referring to wafer-level lens arrays, and in D1, [0157], reciting that "[s]ince all the layers [of] a device comprising integrated optical components (e.g. as described above) can be made at the waveguide substrate level, the device can be (...) scaled to extremely high multiplex". By applying wafer-level techniques to the layers of figure 22, the skilled person would replace assembling the individual layers on distinct substrates of the single integrated device of D1, figure 22, by assembling them on a single substrate on which all the layers are formed via wafer-level techniques.

It follows that the distinguishing feature (b) does not involve an inventive step.

4.2 Patentee's counter-arguments

4.2.1 According to the patentee, the waveguide of D1 "always requires a supporting structure, e.g. a housing. There must be a buffer or a structure connecting the waveguide and sensor, or even air gaps between the waveguide substrate and the arrangement of the sensor in D1's housing" (P2, page 18, first paragraph; see also, P1, page 12, third paragraph). The patentee inferred therefrom that the skilled person would not derive the claimed device from D1.

The board is not convinced by this argument. First of all, D1 does not disclose that the waveguide requires a supporting structure or a housing. But even if D1 were to disclose a housing in which the various layers on distinct substrates of figure 22 were arranged, the skilled person would find it obvious to derive the claimed device from D1. Indeed, assembling separate substrates in a housing implies a certain number of steps, such as aligning, fixing, controlling, these steps potentially increasing the manufacturing costs, manufacturing errors and the size of the device. In order to reduce cost, manufacturing error and size, the skilled person would be motivated to provide a more integrated detection apparatus by considering wafer-level techniques as explained in point 4.1.3 above.

Moreover, in the present case, it is not relevant *how* the skilled person would concretely implement wafer-level techniques to arrive at an integrated chip having all layers formed on a common substrate. What is relevant is the mere desire to provide a fully integrated chip with layers having a common substrate. Indeed, neither claim 1, nor the description, nor figure 1 of the patent discloses any details about how to realise a concrete structure according to claim 1. On the contrary, on page 8, line 12, of the patent application as filed, it is explicitly stated that the allegedly inventive common substrate is *not* shown. Therefore, it is to be assumed that the concrete realisation of an integrated chip with layers having a common substrate, as claimed, is a matter of routine design activity for the skilled person.

4.2.2 The patentee argued that the hint received from paragraphs [0156] and [0157] of D1 to use wafer-level techniques did not teach the skilled person to provide the waveguide and the light detector on a same substrate (P3, [37] to [44]).

The board is not persuaded by this argument. The disclosure in [0157] that all layers are made at the waveguide substrate level and that the alignment of the lens arrays in the integrated optics devices is achieved using microlithography techniques, together with the disclosure in [0154] that the detector device is a single unit, constitute a clear hint for the skilled person to provide the waveguide and the light detector on a same substrate. Indeed, a manufacturing method consisting in assembling such microscopic layers with their respective substrates independently in a housing would be highly inefficient, as explained in point 4.2.1 above.

4.2.3 The patentee argued that "starting from D1, a person skilled in the art has been faced with the objective technical problem of providing a single molecule detection apparatus having higher sensitivity and compacter *[sic]* design" (P1, page 13, first paragraph). Moreover, the patentee submitted that features (a) and (b) had a synergistic technical effect of increasing the sensitivity of the claimed device.

The board concurs with the opposition division and the opponent (O1, point 3.20) that there is no convincing evidence that the technical effect of the distinguishing feature (b) is "a higher sensitivity (...) because the distance between detector and waveguide was shorter" (appealed decision, point 19.4). Feature (b) is mentioned only once in the patent description, namely in paragraph [0028] of the patent, without indicating that forming the waveguide on a substrate and the detector on or in the substrate increases the sensitivity. It is acknowledged that the distance between the bottom of the nanowell and the waveguide core is reduced by feature (a), thereby allowing the molecule to be illuminated with a higher intensity and increasing the sensitivity of the device. However, this effect has been taken into account when formulating the objective technical problem related to feature (a) (see point 4.1.2 above). Contrary to the patentee's submission, feature (b) does not provide a further technical effect going beyond that of feature (a). Feature (b) does not automatically have the effect of increasing the sensitivity by decreasing the distance between the fluorescent molecule in the nanowell and the light detector. Indeed, whether the light detector is formed on or in the substrate on which the waveguide is formed does not imply that the distance there between is decreased so as to increase the sensitivity. Whether the distance between the fluorescent molecule and the light detector is effectively decreased depends on the concrete structure and dimensions of the waveguide, the light detector and the common substrate. In the absence of any concrete specification of the structure of the waveguide, the light detector and the common substrate, the board cannot see any additional technical effect related to the combination of features (a) and (b) going beyond the individual technical effects of features (a) and (b), explained in points 4.1.2 and 4.1.3 above. The patentee did also not submit any additional technical effect due specifically to the combination of features (a) and (b).

4.2.4 The patentee argued during oral proceedings that the embodiment of figure 5 of D1, showing a nanowell extending into the core of the waveguide, related exclusively to a channel waveguide, whereas claim 1 specified a planar waveguide. Since channel waveguides and planar waveguides were of fundamentally different nature, the teaching relating to the embodiment of figure 5 did not apply to a planar waveguide as claimed.

As submitted by the opponent during oral proceedings, D1, [0067], page 21, lines 10 to 12, discloses that the concept of nanowells extending into the waveguide core is applicable to both channel and planar waveguides.

4.2.5 During oral proceedings, the patentee argued that the detection device of claim 1 provided a highly sensitive detector device without requiring notch filters, micro-lens arrays or light blocking mask layers as disclosed in the device of figure 22 of D1. According to the patentee, laser light escaped as parasitic light from the waveguide of D1. In order to improve the detection of the weak fluorescent signal, D1 required the use of notch filters and light blocking mask filters to block parasitic laser light and the use of micro-lens arrays for collecting the weak fluorescent signal. Instead of these means, the invention provided a detector comprising, on the one hand, features (a) and (b) and, on the other hand, an optimised design of the waveguide. Contrary to the waveguide of D1, which let laser light escape from the waveguide as parasitic light, the wave propagation within the waveguide core according to the invention was optimised so as to avoid laser light escaping from the waveguide core as parasitic light - except at those places where nanowells extend into the waveguide core. In support of this argument, the patentee made two drawings on a flip chart (see the annex to the minutes of the oral proceedings) and referred to an optimised total internal reflection within the waveguide.

The opponent requested not to admit this new line of argumentation of the patentee into the proceedings. However, it can be left open whether this new line of argumentation is admitted into the proceedings. Indeed, this argumentation of the patentee is not considered to be relevant by the board because it assumes that the nanowells are formed *on* the substrate as shown in figure 22 of D1. However, as explained in point 4.1.2 above, the skilled person would obviously provide a detection device in which the nanowells extend in the cladding layer or the core layer. Moreover, the patentee's arguments are not convincing from a technical point of view since an optimised propagation in a waveguide core depends on a number of parameters of the waveguide (refractive indices; widths and thicknesses of the layers) which are undefined in present claim 1. Therefore, the patentee's submission that the waveguide in claim 1 has an optimised design is not based on corresponding features of claim 1. Still further, as submitted by the opponent, the wording of claim 1 does not even exclude the use of notch filters, micro-lens arrays or light blocking mask layers in the device of claim 1.

4.2.6 The patentee argued that the embodiment of figure 22 of D1 did not represent the closest prior art because it did not relate to a similar purpose as the claimed device and because the embodiment of figure 15 of D1 had more features in common with the claimed invention (see P3, [24] to [31]).

The board is not convinced by this argument. The embodiment of figure 22 of D1 represents at least a possible starting point for assessing inventive step. The embodiment of figure 22 relates to the same technical field as the invention, namely the optical detection of single molecules by illuminating them via evanescent light escaping from a light wave propagating within a waveguide, and addresses *inter alia* the same problem as distinguishing feature (a), i.e. optimising the level of illumination intensity of the molecule to be detected (see e.g. figure 5 of D1). While the board acknowledges that the embodiment of figure 15 of D1 might also be considered to represent a plausible starting point for assessing inventive step (see the board's preliminary opinion in point 11.3.4 (a) in the communication annexed to the summons to oral proceedings), it is of the opinion that the embodiment of figure 22 of D1 represents the "most promising springboard" towards the invention. In any case, before an inventive step of the subject-matter of claim 1 could be acknowledged, all prior art documents potentially representing the "closest" prior art, therefore including also the embodiment of figure 22, would have to be considered.

4.2.7 It follows that none of the patentee's counter-arguments in favour of inventive step is found convincing by the board.

5. Third auxiliary request

Present third auxiliary request corresponds to the sixth auxiliary request filed with letter P2.

5.1 Admission

5.1.1 When asked by the board during oral proceedings, the opponent stated that it had no objection to the admittance of the patentee's third auxiliary request into the proceedings. The board also saw no reason to hold the fourth auxiliary request inadmissible under Article 12(4) RPBA 2007.

5.1.2 Similarly, after having objected at the beginning of the discussion about the third auxiliary request to the admission of the opponent's arguments concerning lack of inventive step of the subject-matter of claim 1 of the third auxiliary request, the patentee later on retracted its objection in view of the opponent's written submission in O1, point 5.55, according to which feature d), as defined in P2, page 4, was disclosed in D1, [0057] and [0058]. The board also had no objection to admit the opponent's argumentation concerning lack of inventive step into the proceedings.

5.2 Inventive step

The subject-matter of claim 1 does not involve an inventive step over D1 (Article 56 EPC).

5.2.1 Claim 1 of the third auxiliary request differs from claim 1 of the second auxiliary request in that it comprises feature d) as defined in P2, page 4. According to feature d), the light detector is made of a set of optical sensors absorbing light and generating output signals thereof, wherein the optical sensors in one set have different sensitive wavelength bands.

5.2.2 It is undisputed that D1, figure 22, discloses a plurality of optical sensors (2218), i.e. a set of optical sensors, absorbing light and generating output signals thereof as defined in claim 1. However, D1 is silent about the sensitive wavelength bands of the optical sensors in one set. The objective technical problem could, therefore, be formulated as providing a set of optical sensors suitable for a desired application of the detector.

5.2.3 As submitted by the opponent during oral proceedings, D1 was generally related to the technical field of monitoring nucleic acid reactions by using fluorescent labels for identifying the different nucleotides forming the basic building blocks of nucleic acids. This required optical sensors capable of detecting the different wavelengths specific of the different nucleotides. Therefore, it was implicit that the optical sensors of the detector (2218) of figure 22 had different sensitive wavelengths bands as defined in claim 1.

More precisely, during oral proceedings, the opponent referred to D1, paragraphs [0057], [0058], [0156], [0163] and [0164]. As argued by the opponent, the skilled person was taught by the disclosure of D1 as a whole, in particular by paragraphs [0057] and [0058], that the detector of D1 was generally set up to be used in "nucleic acid array-based methods. (...) For example, a single polymerase enzyme can be immobilized on a substrate and monitored as it incorporates differentially labeled nucleotides into a nascent nucleic acid strand by illuminating the substrate surface where the polymerase is bound and detecting a sequence of fluorescent emissions from the reaction site that corresponds to the sequence of nucleotides incorporated by the polymerase" (D1, [0057]). Nucleic acids were composed of nucleotides and contained four different bases, "where each type of base bears an optically detectable label that is distinguishable from the other bases" (D1, [0164]). The method used e.g. "four color fluorescent detection systems, to identify which base was incorporated in the process" (D1, [0164]).

5.2.4 The board agrees with the opponent's argumentation submitted during oral proceedings and concludes that feature d), if novel at all, does not contribute to the inventive step of the subject-matter of claim 1. Indeed, in order to render suitable the single molecule detection apparatus shown in figure 22 of D1 for monitoring nucleic acids reactions, the skilled person, in view of D1, paragraphs [0057], [0058], [0156], [0163] and [0164], would necessarily implement a set of optical sensors having different sensitive wavelength bands.

5.2.5 The patentee submitted the following counter-arguments:

(a) Nowhere in D1, in particular, not in the paragraphs cited by the opponent, was it mentioned that the optical sensors "have different sensitive wavelengths bands" as claimed in feature d). For instance, in paragraph [0156], D1 disclosed that "fluorescent light of differing wavelengths can be spread to facilitate detection of the individual wavelengths". The mere fact that fluorescent light was spread did not imply that the optical sensors "have different sensitive wavelengths bands".

The board is not convinced by this argument. As submitted by the opponent, since D1 discloses that the fluorescent signal light emitted by labelled molecules is spread into different wavelengths, it is implicit that the detector must be able to detect this signal light composed of more than one wavelength. In order to detect a signal having more than one wavelength, the optical sensors (2218) composing the detector must "have different sensitive wavelengths bands".

(b) The patentee further argued that the detector of figure 22 of D1 comprises a notch filter (2214) positioned in front of the optical sensors (2218). D1 did not disclose that different wavelength bands were able to pass through the notch filter. Therefore, in D1, due to the notch filter positioned in front of the optical sensors, "the optical sensors in one set [do not] have different sensitive wavelengths bands" as claimed. Moreover, according to claim 1, each set of optical sensors detected a different wavelength band without requiring spectral spreading and filtering of light as was the case in D1.

The board concurs with the opponent that claim 1 does not specify any details about how "the optical sensors in one set [are arranged in order to] have different sensitive wavelengths bands" as claimed. Therefore, it does not matter how the optical sensors of D1 are arranged concretely in the detector of D1 as long as they are able to detect the signal light having more than one wavelength. This capacity of the optical sensors of D1 is clearly implied by the disclosure in D1, paragraphs [0057], [0058], [0156], [0163] and [0164], as recited by the opponent. Concerning the patentee's argument that claim 1 defines a *plurality* of sets of optical sensors, the board notes that claim 1 is not limited to a light detector comprising a *plurality* of different sets of optical sensors, since claim 1 merely defines "a set of optical sensors" and "optical sensors in one set".

6. Fourth auxiliary request

The fourth auxiliary request corresponds to the seventh auxiliary request filed with letter P2.

6.1 Admission

The board sees no reason to hold the fourth auxiliary request inadmissible under Article 12(4) RPBA 2007.

6.1.1 The opponent requested not to admit the fourth auxiliary request into the proceedings because claim 1 defined subject-matter not converging with the subject-matter of claim 1 of the higher-ranking requests and because the present fourth auxiliary request corresponded to the fourth auxiliary request filed during first-instance proceedings with the letter dated 31 January 2019 and which was later withdrawn.

6.1.2 The board cannot follow the opponent's submissions.

First of all, claim 1 of the fourth auxiliary request comprises substantially all the relevant features of claim 1 of the third auxiliary request. Indeed, the feature omitted from claim 1 of the third auxiliary request "is capable of at least partially absorbing light incident thereon and generating output signals in response to the light" merely defines inherent properties of any optical detector. Therefore, omitting this feature does not mean that claim 1 of the fourth auxiliary request defines diverging subject-matter.

Secondly, as explained by the patentee during oral proceedings, the present fourth auxiliary request was never withdrawn during first-instance proceedings. Actually, it is identical to the fifth auxiliary request filed with the letter of 22 March 2019, replacing the fourth auxiliary request previously filed with the letter dated 31 January 2019. The only difference between these two versions of sets of claims lies in the deletion of dependent claim 8 defining redundantly that the light detector comprises a set of optical sensors.

6.2 Inventive step

The subject-matter of claim 1 does not involve an inventive step over D1 (Article 56 EPC).

6.2.1 Claim 1 of the fourth auxiliary request differs from claim 1 of the third auxiliary request essentially in that it comprises feature e) as defined in P2, page 4. According to feature e), the light detector is a set of optical sensors chosen from photoconductive type optical sensors, photovoltaic type optical sensors, APDs, p-n photodiodes, p-i-n photodiodes, or multi-junction photodiodes.

6.2.2 The board concurs with the opponent that feature e) merely represents a long list of well-known possibilities for implementing an optical detector comprising a set of optical sensors. According to the description of the patent, no additional or surprising technical effect is related to any of these types of detectors going beyond that of detecting optical signals in general. D1, [0156], discloses CCD and CMOS sensors which are well-known alternatives to the types of photodetectors defined in feature e). Depending on the actual technical circumstances, the skilled person would select the most adequate type of optical detectors from the list of well-known optical detectors without the exercise of inventive skills.

6.2.3 The patentee argued that D1 did not disclose any of the types of photodetectors defined in feature e). Actually, these photodetectors were specifically selected for being the most suitable to be used in a single molecule detection apparatus as claimed. In particular, the photodetectors defined in feature e) enabled a better integration of the claimed apparatus and allowed detecting very low signal intensities.

The board is not convinced by this argument. As submitted by the opponent, the patent discloses in paragraph [0024] a long list of detectors, including CCD and CMOS sensors, without making any distinction between the different types of photodetectors with respect to their suitability for being used in the claimed device or with respect to their capability of detecting very low signal intensities.

7. Fifth auxiliary request

The present fifth auxiliary request corresponds to the eighth auxiliary request filed with letter P2.

7.1 Admission

The board sees no reason to hold the fifth auxiliary request inadmissible under Article 12(4) RPBA 2007.

7.1.1 According to the opponent, the fifth auxiliary request should not be admitted into the proceedings because it defines newly claimed subject-matter. Since it had not been filed during first-instance proceedings, the issues relating to the fifth auxiliary request had never been discussed until now.

7.1.2 The board cannot follow the opponent's reasoning. Since the opposition division upheld the patent on the basis of a higher-ranking request, there was no compelling reason for the patentee for filing the present request during first-instance proceedings. Moreover, the fifth auxiliary request was filed in time with the patentee's letter of reply to the opponent's statement of grounds of appeal and claim 1 of the fifth auxiliary request is converging with respect to the subject-matter of claim 1 of the fourth auxiliary request. Therefore, the board sees no reason to hold the fifth auxiliary request inadmissible under Article 12(4) RPBA 2007.

7.2 Amendments

During the oral proceedings before the board, doubt arose concerning the basis of the amendments of claim 1 (Article 123(2) EPC). In particular, the combination of features "a plurality of light detectors", "each light detector is a set of optical sensors" and "the optical sensors in one set have different sensitive wavelength bands" did not appear to be unambiguously derivable from the set of claims as originally filed. If disclosed at all in the patent application as originally filed, then corresponding passages in the description and/or the figures as originally filed would have to be found.

7.3 Remittal

In view of the facts that

(a) the fifth auxiliary request was filed for the first time during appeal proceedings and, hence, no discussion on the fifth auxiliary request took place during first-instance proceedings,

(b) claim 1 of the fifth auxiliary request has been substantially amended with respect to claim 1 as considered allowable by the opposition division, i.e. with respect to claim 1 of the present second auxiliary request,

(c) doubt arose during the oral proceedings before the board concerning the basis of the numerous amendments made in claim 1 in the original patent application and

(d) a thorough debate on patentability of the subject-matter of claim 1 to take place for the first time during oral proceedings before the board runs counter the primary object of the appeal proceedings to review the decision under appeal in a judicial manner,

the board comes to the conclusion that the fifth auxiliary request represents a fresh case justifying a remittal of the case to the opposition division for further prosecution (Article 111(1) EPC; Article 11 RPBA 2020).

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 for further prosecution.

The Registrar: The Chairman:

A. Voyé R. Bekkering

Decision electronically authenticated