

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference RPA2010-1	FOR FURTHER ACTION		See Form PCT/IPEA/416
International application No. PCT/US2010/022715	International filing date(<i>day/month/year</i>) 01 FEBRUARY 2010 (01.02.2010)	Priority date (<i>day/month/year</i>) 30 JANUARY 2009 (30.01.2009)	
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Applicant EGALON, CLAUDIO OLIVEIRA			

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36. 2. This REPORT consists of a total of <u>4</u> sheets, including this cover sheet. 3. This report is also accompanied by ANNEXES, comprising: a. ☒ (sent to the applicant and to the International Bureau) a total of <u>6</u> sheets, as follows: ☒ sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions). ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box. b. ☐ (<i>sent to the International Bureau only</i>) a total of (indicate type and number of electronic carrier(s)) _____, containing a sequence listing, in electronic form only, as indicated in the Supplemental Box relating to Sequence Listing (see Section 802 of the Administrative Instructions).	CORRECTED VERSION
4. This report contains indications relating to the following items: ☒ Box No. I Basis of the report ☐ Box No. II Priority ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability ☐ Box No. IV Lack of unity of invention ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement ☐ Box No. VI Certain documents cited ☐ Box No. VII Certain defects in the international application ☒ Box No. VIII Certain observations on the international application	

Date of submission of the demand 11 DECEMBER 2010 (11.12.2010)	Date of completion of this report 28 FEBRUARY 2011 (28.02.2011)
Name and mailing address of the IPEA/KR  Korean Intellectual Property Office Government Complex-Daejeon, 139 Seonsa-ro, Seo- gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer Kim, Hye Won  Telephone No. 82-42-481-5456

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

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Box No. I Basis of the report

1. With regard to the **language**, this report is based on:

- ☒ the international application in the language in which it was filed.
- ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3(a) and 23.1(b)).
- ☐ publication of the international application (under Rule 12.4(a)).
- ☐ international preliminary examination (under Rules 55.2(a) and/or 55.3(a)).

2. With regard to the **elements** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

- ☐ the international application as originally filed/furnished
- ☒ the description:
pages 1-23 as originally filed/furnished
pages* _____ received by this Authority on _____
pages* _____ received by this Authority on _____
- ☒ the claims:
pages _____ as originally filed/furnished
pages* _____ as amended (together with any statement) under Article 19
pages* 24-27, 27/1, 27/2 received by this Authority on 11/DEC/2010(11/12/2010)
pages* _____ received by this Authority on _____
- ☒ the drawings:
pages 1/8-8/8 as originally filed/furnished
pages* _____ received by this Authority on _____
pages* _____ received by this Authority on _____
- ☐ the sequence listing - see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets _____
- ☐ the sequence listing (*specify*): _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since either they are considered to go beyond the disclosure as filed, or they were not accompanied by a letter indicating the basis for the amendments in the application as filed, as indicated in the Supplemental Box (Rules 70.2(c) and (c-bis)):

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets _____
- ☐ the sequence listing (*specify*): _____

5. ☐ This report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 70.2(e)).6. ☒ This report has been established taking into consideration the arguments and/or comments of the applicant on the written opinion of the International Searching Authority, received by this Authority on 11/12/20107. ☐ Supplementary international search report(s) from Authority(ies) _____ have been received and taken into account in drawing up this report (Rule 45bis.8(b) and (c)).

* If item 4 applies, some or all of those sheets may be marked "superseded."

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-35	YES
	Claims	NONE	NO
Inventive step (IS)	Claims	1-35	YES
	Claims	NONE	NO
Industrial applicability (IA)	Claims	1-35	YES
	Claims	NONE	NO

2. Citations and explanations (Rule 70.7)

D1: WO 2006-116590 A1(EGALON, C. O.) 02 November 2006

I. Novelty and Inventive Step

The subject matters of independent claims 1,25 differ from D1 in a sensitive optical fiber having at least one exposed core region in direct contact with the environment. And it is not obvious to a person skilled in the art by the document.

The claims 1,25 do not require a sensitive chemical indicator on bare core, the bare core directly exposed to the environment which can make measurements based on scattering, fluorescence and absorption.

In contrast, D1 requires sensitive cladding for measuring, and the degree and character of the light produced from or absorbed by the sensitive cladding can be affected by an environmental chemical in contact with the cladding.

As a result, the bare core directly contacted with measurand appears to make a difference in the result from D1.

Accordingly, claims 1,25 meet the requirements of novelty and inventive step set forth in PCT Article 33(2) and (3).

Claims 2-24, 31-35 and 26-30 are dependent on claims 1 and 25 respectively and therefore meet the requirements of PCT Article 32(2) and (3).

II. Industrial Applicability

The subject matters of claims 1-35 are industrially applicable under PCT Article 33(4).

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

- 1) Claim 22 relates to sensing system, but claim 33 dependent on claim 22 relates to illumination optical fiber. As claim 33 does not clearly define the matter for which protection is sought this claim does not meet the requirements of PCT Article 6.
- 2) Claim 35 is worded in reference to an apparatus consistent with that of claim 3. However an apparatus consistent with that of claim 3 is unclear what it means.

PCT/US2010/022715**What is claimed is:**

1. (Amended) A sensing system comprising:
a sensitive optical fiber (98),
having first (120) and second (118) termini,
having a core (106),
being configured as to be locatedable in an environment which contains substances that chemiluminesce, phosphoresce, fluoresce, scatter or absorb light,
and having at least one exposed core region (92) in direct contact with the environment and acting as a sensitive region of the fiber, in which said sensitive optical fiber is optically affected by the environment;
at least one probing light source (100) producing a probing light which interacts with a measurand medium in the environment of said sensitive region for generating therefrom a modified probing light as substantially aided by said measurand medium interacting with the environment and;
which is substantially coupled into said core as an optical signal (104).
2. (New) The sensing system of claim 1 further comprising
a detector (108) optically coupled with said first terminus (120) of said sensitive optical fiber for reception of the light signal upon exiting said first terminus (120), for measuring an intensity of the light signal over a given range of wavelengths and for correlating the intensity with an electric signal.
3. (New) The sensing system of claim 2 further comprising
a signal processor (110) in data communication with said detector (108);
whereby the electric signal is correlated to a quantity of the measurand being measured.
4. The sensing system of claim 3 further comprising a display in data communication with said signal processor and a power supply (114) configured to provide power to said probing light source, said signal processor, and a display.
5. The sensing system of claim 3 further comprising a display in data communication with said signal processor and a power supply (114) configured to

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provide power to said probing light source, said detector, said signal processor, and a display.

6. The sensing system of claim 1 in which:

said sensitive optical fiber has at least two of its cladding sections removed (92) with at least one exposed core region (92) in direct contact with the environment to provide at least two sensitive regions;

said probing light source illuminates each sensitive region individually, one at a time; and

said probing light optically interacts individually with the environment in each said sensitive region such that a modified probing light is generated therefrom, each such modification having been substantially affected by the measurand medium (93) in the environment.

7. The sensing system of claim 1 in which:

said sensitive optical fiber has at least two of its cladding sections removed (92) with at least one exposed core region (92) in direct contact with the environment to provide at least two sensitive regions;

said probing light sources illuminate two or more sensitive regions simultaneously; and

said probing light optically interacts with the environment in each said sensitive regions such that a modified probing light is generated therefrom, each such modification having been substantially affected by the measurand medium (93) in the environment.

8. The sensing system of claim 1 in which said probing light source illuminates each sensitive region individually, one at a time.

9. The sensing system of claim 1 in which the light source is positionable at any distance from said sensitive region sufficient as to enable said sensitive region to be illuminated.

10. (Amended) The sensing system of claim 1 in which said sensitive region is absent from any chemical indicator.

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11. The sensing system of claim 1 in which said sensing fiber (98) comprises a fiber including its original fiber cladding (116).
12. (Amended) The sensing system of claim 11 in which said sensing fiber (98) includes a sensitive film (99) coated over said original fiber cladding.
13. The sensing system of claim 1 in which the measurand medium comprises one of color, turbidity, analyte and refractive index.
14. The sensing system of claim 1 wherein the environment is located between one of said fiber core and the light source and behind said fiber core.
15. The sensing system of claim 1 wherein said fiber core is surrounded by the environment.
16. (Amended) The sensing system of claim 1 wherein the optical interaction of the probing light with the measurand medium results in one of light absorption, scattering, fluorescence, phosphorescence and chemiluminescence.
17. (Amended) The sensing system of claim 13 wherein said analyte chemically interacts with the environment, thus producing a change in color of the environment.
18. The sensing system of claim 1 wherein said sensitive optical fiber comprises a refractometer to discriminate among environments of different refractive indices.
19. The sensing system of claim 1 wherein said sensitive optical fiber is operable to determine the level of a liquid in contact with the sensor.
20. The sensing system of claim 1 whereas said sensing system is a multi point optical fiber sensor in which each said sensing point is capable of detecting different measurands.

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21. The sensing system of claim 1 whereas said sensing system is a multi point optical fiber sensor in which each said sensing point is illuminated by a plurality of light sources of different wavelengths to detect a plurality of measurands.

22. (Amended) The sensing system of claim 1, wherein said probing light is transmitted by an illumination optical fiber, said illumination fiber having a plurality of dielectric mirrors (180), said illumination fiber being positioned parallel to said sensitive optical fiber, said dielectric mirrors illuminating at an angle said sensitive region of said sensitive optical fiber at discrete positions, wherein a probing light source introduces a probing light into a monochromator, said monochromator filtering the probing light to a specified wavelength, said probing light at a specified wavelength being axially introduced to said illumination optical fiber, said probing light at a specified wavelength propagating to its specified dielectric mirrors having similar wavelength characteristics, and said specified dielectric mirror redirecting the probing light at an angle towards said sensitive region of said sensitive fiber, wherein each of said dielectric is designed to couple light from said bound mode core of said illumination optical fiber into radiation modes at specific wavelengths, and wherein the radiation modes of a specific wavelength illuminate said sensitive region.

23. (Amended) The illumination optical fiber of claim 22 wherein at least one section of said illuminated fiber has its cladding removed, said section with a removed cladding is side illuminated by a plurality of probing light sources that couple their light into the core of the illumination fiber as bound and leaky modes for illuminating said sensitive fiber.

24. (New) The sensing system of claim 1 whereas each said sensitive region is illuminated by a plurality of light sources of different wavelengths to detect a single measurand.

25. (New) An illumination fiber (144) comprising
an optical fiber having first (120) and second (118) termini,
having a core (106) and at least one exposed core region (92),
at least one probing light source (100) producing a probing light,

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said probing light side illuminates said exposed core region, and is substantially coupled into said core as an illumination light (150).

26. (New) The illumination fiber of claim 25 further comprising a tapered core (107), diverging towards one of the directions of propagation of the light, to increase the amount of illumination light that propagates towards that direction.

27. (New) The illumination fiber of claim 25 further comprising a tapered core (107), diverging towards both directions of propagation of the light, to increase the amount of illumination light that propagates in both directions.

28. (New) The illumination fiber of claim 25, having one of at least one dielectric mirror (180) and at least one long period grating along its length, said each dielectric mirror and long period grating capable of redirecting light of said probing light source within an specific wavelength range to the outside of said illumination fiber.

29. (New) The illumination fiber of claim 26 further comprising one of at least one dielectric mirror (180) and at least one long period grating along its length, said each dielectric mirror and long period grating capable of redirecting light of said probing light source within an specific wavelength range to the outside of said illumination fiber.

30. (New) The illumination fiber of claim 27 further comprising one of at least one dielectric mirror (180) and at least one long period grating along each direction of propagation of the light, said each dielectric mirror and long period grating capable of redirecting light of said probing light source within an specific wavelength range to the outside of said illumination fiber.

31. (New) The sensing system of claim 1 further comprising a tapered core (107), diverging towards the direction of propagation of the light, to increase the amount of optical signal that is guided towards the fiber end.

32. (New) The sensing system of claim 2 further comprising a second detector (108) optically coupled with said second terminus (118) of said optical fiber for

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reception of the light signal upon exiting said second terminus (118), for measuring an intensity of the light signal over a given range of wavelengths and for correlating the intensity with an electric signal.

33. (New) The illumination optical fiber of claim 22, in the absence of the monochromator, wherein at least one section of said illuminated fiber has its cladding removed, said section with a removed cladding is side illuminated by a plurality of probing light sources that couple their light into the core of the illumination fiber as bound and leaky modes for illuminating said sensitive fiber.

34. (New) The sensing system of claim 1 whereas said sensing system is a multi point optical fiber sensor in which each said sensing point is illuminated by a plurality of light sources simultaneously of different wavelengths to detect a plurality of measurands.

35. A method of measuring a property of a substance comprising:
providing an apparatus consistent with that of claim 3;
applying at least one substance to be tested to at least one exposed core region;
energizing at least one probing light source to illuminate the at least one exposed core region;
detecting and measuring light being emitted from a terminus of the apparatus;
comparing the light measurement with previously taken measurements with substances of known properties.