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(71) Aanvrager(s):
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(74) Gemachtigde:
Geen.

(54) **A spectral imaging system to detect contamination.**

(57) The current invention consist of an optical inspection system that detects non-destructively, categorizes and quantifies contaminations (defined as presence of unwanted substances) in real time on biological and non-biological surfaces. The most important application is the detection of bacteria by using auto-fluorescence. By using a reference database of optical footprints for a variety contaminants the current innovation can enable rapid bacteria detection.

Applicant: Condi Food B.V. te Warmond, Nederland

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Title: A spectral imaging system to detect contamination

Description

Summary of the Invention

The present innovation develops the existing techniques to such specificity that an operational device for this purpose is produced. An example, but not limited to it, is the forensic industry where biological traces as blood DNA and hair samples are analysed only qualitatively: the presence or absence of a particular substance is only indicated without showing the exact chemical composition. With the current innovation an in situ chemical analysis of the object to be measured is possible. Another example is the food industry where, in order to detect the presence of unwanted bacteria, a laboratory analysis is necessary and the food needs to be stored multiple hours before the results are communicated.

The current invention presents a solution which can reduce that stand-by time drastically by immediately giving the

spectral fingerprint of contaminants from which, via algorithms, the microbiological contamination of the measured object can be deduced. The innovation offers an advanced sensor platform that combines hyperspectral imaging with embedded computer and customized scientific software, which makes possible to measure hygiene, via optical inspection methods, in order to prevent contamination related diseases and infections. Proactive direct observation of food condition can enable the use of monitoring techniques to identify and predict safety issues.

Field & Background

In the broadest sense this invention is related to the field of optical inspection systems applicable in multiple domains. More specifically this invention is considered a method and apparatus to detect and quantify microbiological contamination. Although the laboratory testing, which is the most common technique for bacteria detection, remains highly reliable it is also a costly technique in time and labour. In the food industry, time spent in waiting for the bacteria analysis means a costly stalling of products. In healthcare, where it can take days to elaborate the results, this delay can lead to unnecessary costs for a

temporary solution, such as broad spectrum antibiotics instead of narrow spectrum ones. The current innovation wants to overcome these drawbacks by using an optical measurement system to detect microorganisms that is continuous, non-destructive and in real time. By using spectroscopic measurements the hygiene, in this case defined as the absence of unintended matter in an object to be measure, can be determined. An example, but not limited to this, could be the presence of cleaning product residual in recycled product packages.

The detection of physical and chemical properties can be used for a wide array of applications. Although the usage of spectral imaging methods for different samples is not unique, the combination of camera developed for space applications combined together with the concentrated computer power open up the unique possibility for continuous real-time, optical, non-destructive inspection. In the current state of the art there is no device that can give direct real time feedback on the presence or absence of (unwanted) microbiological organisms.

Advantages

The current invention tackles the problems of current microorganism detection methods. No system so far can

optically monitor an entire object or sample in vivo, without using reagents (e.g. dyes). This real time measuring of microorganisms means there is direct feedback and no waiting time to obtain the results. The non-destructive nature of the invention, resulting from the redundancy of reagents or markers, brings forward the possibility for continuous measuring as opposed to sample based measurements. This means that in the present invention no marker for the excitation of luminescence molecules has to be added to the object that is going to be measured. The hyperspectral images are acquired on reflection and a large area can be scanned at once. The current invention detects the auto fluorescent emission using highly sensitive optical sensors, intense excitation light sources and appropriated filtering. The fluorescence spectral image is then analysed to discriminate the spectral features that characterize a particular microorganism.

Therefore, because the composition of the whole surface of the object can be directly measured, the limitation of having sampling point measurement can be overcome. Ergo, the full product is scanned in real time without having to depend on limited point-like measuring points on the object to be monitored [as is for example the case with Pa. No.

WO2014/180568 A1]. Small infected areas, as big as the pixel size of the camera, can be detected because of the 100% scanning of the surface of the product.

The application of this invention goes beyond the current monitoring of microorganisms and specifically bacteria in for example the medical sector as well as in the food industry. In these industries there are methods available for continuous in vivo monitoring of a potential bacterial infection site [Pub. No.:US2012/0143024 A1] but these methods can detect bacteria through fluorescence only if induced by markers.

The current innovation leaves behind the disadvantages of the previous methods by uniquely combining the continuous in vivo monitoring of the entire object that is to be measured with the non-destructive measurement; measuring without adding external materials as markers or dyes or any other intrusive exciting reagents.

Method

The innovation provides a method of inspection by detecting microbiological organisms. Simultaneously the following phases are part of the innovation:

a) Acquire the (hyper)spectral image of the object to be measured.

b) Analyse the spectral image to determine whether there is an unwanted substance present on the object/product. A comparison is done between the measured spectra and spectrum of the uncontaminated sample.

c) In case a contamination is detected, the presence of typical molecules is identified. The fingerprint of the micro-organism is then evident and it can be classified.

d) Determine if the micro-organism state is still living or already dead

e) Determine what type of micro-organism is present, differentiating between prokaryotes (bacteria and archaea) and eukaryotes (for example fungi, parasites or plants).

f) Within the detection of prokaryotes and specifically bacteria the present invention discriminate between domains. This means that every phylum will be distinguished and within it every class and subclass.

g) In a final step distinction is made within a certain subclass. In order to identify the pathogen bacteria the micro-organism will be analysed to the level of bacteria serotype, the smallest possible level.

An example would be the detection of the dangerous salmonella Thompson bacteria on salmon. This caused a scandal in 2012 in the Netherlands. A scandal which can be prevented in the future with the current innovation. On a continuous basis the camera takes spectral images of all the salmons in the production line. In this particular application, the auto-fluorescence of certain bacterium molecules is used to discriminate among them.

Preferred Embodiment

Light

The inspection system works with a light source that illuminates the object to be measured and analyses the scattered light.

The light source is emitting either within the UV, the visible or IR range. The wavelength can be either monochromatic, indicating that only one wavelength is used, or pseudo monochromatic, meaning that more than one wavelength is used for the light source.

Camera Techniques

There are three types of spectral techniques that are suitable for this kind of measurements:

- The hyperspectral camera: a camera that divides the spectrum in 20 up to 200 bands.
- Multispectral camera: a camera which measures one or more specifically chosen broad bands.
- Imaging spectrometer. A camera that measure more spectra with a higher resolution: 200 up to 2000 bands.

Housing

The system is preferably enclosed in light-tight housing to minimise the effect of straight lights from the surrounding environment. In this light-tight environment, calibration measurements need to be acquired once, or once in certain interval of time. However, in case it is not possible to guarantee a light-tight environment, calibration procedures need to be followed in order to establish the correct reference for the analysis.

Contamination Detection

The elaborated (hyper)spectral image shows on a 2D spatial image where the contamination is. The spectral data are used to discriminate between the different kinds of contaminants while the spatial coordinates inform about the location of the unwanted material. A second measurement (for example after a treatment) can reveal if the

contamination is still present. The computational analysis of the results indicates which area is contaminated and for example which percentage of the surface is covered, and indicates the density or the concentration of the contaminants (g/cm2).

By first developing a model for the auto-fluorescence spectrum of the sample and reproducing the same measurement conditions, the deviation between the model and the measured sample is calculated. The deviation indicates whether contaminants are present which are not expected and/or wanted. A second model is used to analyses this micro-organism to determine which type and serotype it is comparing it to a reference micro-organism spectral database and to determine in which quantity and dispersion is present on the measured object.

So when a foreign microbiological presence is detected in the spectral image, an algorithm compares the datum to a reference database to determine the class, subclass and serotype of the measured contamination. Countermeasures can be taken immediately after the measurement to prevent safety issues.

The determination happens by means of measurements done on the spectral images of fluorescence, auto-fluorescence and, if present, contamination. This optical and contactless

fluorescence comes to pass by shining light on a surface and analysing the reflecting light by means of a spectral camera. The reflected light of an organic material has a specific spectrum which can be compared to and differentiated from the spectrum radiated from the same material without contamination. This means that in the case of contamination two analysis are performed. The first computation, which is run on every object that is measured, analyses whether there is any deviation between the measured spectrum and the reference one (the same non contaminated material). In case a contamination is found, a second analysis is run to match the deviation with certain known contaminant spectra. The procedure for the measurement is to compare the measured object to the clean one and only when a significant deviation is detected a second comparison is run. This second comparison will look for a match in the contaminant database to determine what type of contamination, for example which serotype of bacteria, can match the measured spectrum in the investigated object.

Measured Objects

The detection of micro-organisms is possible on one or more biological and non-biological objects. With non-biological

is meant material that does not live or has lived and that hasn't been taken from living material. The most prominent non-biological objects will be summed up beneath:

The detection of micro-organisms on:

- Working surfaces, tools or machines.
- Packing material.
- Medical instruments
- Implants (such as silicones)
- Floors, walls, ceilings and other forms of interior structures.
- Surfaces for forensic applications (sheets, cars, clothes, fabrics etc.)
- All non-biological agricultural material as for example artificial soil for mushrooms.
- Tubes, pipelines, sewers, cranes, barrels or tanks.

The detection of micro-organisms is also possible on biological surfaces.

With biological is meant everything that doesn't fall in the above category of non-biological. The most prominent biological objects will be summed up beneath:

- Wooden constructions
- Consumable goods: such as: meat, fish, poultry, sea food, vegetables, fruits and

processed consumables such as ready to eat meals.

- Resources such as barley, corn, fuel oil, glass, malt, rice, wheat, herbs and spices.
- Fluids: water, oil, diesel, vinegar and wine.
- Organic surfaces: humans and animals. For example on skin, wounds, or mucosa.
- Micro-organisms: the measuring of fungi and bacteria. This in order to determine whether there are pathogens present. For example unwanted fungi on cheese or souring bacteria in wine.

Criteria and Actions

These measurements on various surfaces open up the possibility to define criteria for hygiene. This can be binary criteria where a threshold is defined under which a product is considered clean and above the threshold it is considered contaminated. A more specific hierarchy of classification (for example a ranking from 1-10) can also be implemented. With this information a complete safety assessment can be done, assuring a 100% inspected product. This invention can result in immediate actions to confine any kind of contamination.

Figure Description and Example of Usage

Figure 1 depicts a non-limiting example of the setup used for the application showing the imaging system analysing a food sample.

Figure 2 is an example of the output of the hyperspectral camera. A monochromatic picture of a clean and contaminated sample can be reconstructed.

Referring to Figure 1, a spectral imaging system in accordance with an embodiment of the present invention is illustrated.

It consist of:

1) light source
2) Excitation filter
3) measured object
4) dicroic mirror
5) detection filter
6) hyperspectral camera
7) controller system
8) database

The operations of the invention runs as follows:

An excitation filter (2) selects ranges of wavelength of the light source (1) that illuminates the surface of the object to be measured (3), in this case (but not limited to) the surface of a fish. Detection means, in this example

and hyperspectral camera (6) collect the reflected light from the product and through a detection filter (5) the light is filtered. The output data of the measurement systems is communicated to the controller system (7), which contains the referential data-bases (8). The comparison to reference tables and thereby the identification of targets, for example the salmonella bacteria, can be done automatically. A warning advise is given in case of positive detection.

Figure 2 shows how the differences between a contaminated product and a non-contaminated product become visible in the monochromatic image the optical measurement system records. In figure 2a a monochromatic picture at a particular wavelength of the measured object (1) is taken without any contamination while in figure 2b the measured object (1) has been contaminated. Detection of the contaminants (2) is possible with the device described in figure 1 and contamination is clearly visible on the measured object.

Conclusies

1) Een spectraal beeldregistratiesysteem om verontreiniging te meten door gebruik te maken van optische methodes bestaande uit:

a) Een lichtbron die licht afgeeft in het spectrum van UV tot Near Infrared;

b) Detectie middelen voor het van het gemeten object terugkaatsende licht te detecteren;

c) Ten minste één spectraal filter element dat selectief een vooraf vastgestelde golflengte van licht doorlaat;

d) Een 'vision module' die focust op het te meten object en om ruimtelijke en spectrale data vast te leggen;

e) Controle middelen om het te meten object in een of meerdere geselecteerde golflengtes te scannen;

f) Een referentie database die de spectrale eigenschappen van vervuilende substanties verzameld; en,

g) Analyse middelen om gevonden afwijkingen te analyseren en te vergelijken met de referentie database om zo vast te stellen welke soort vervuiling aanwezig is op het gemeten object.

2) Een spectraal meetsysteem om verontreiniging te meten volgens claim 1 waar de oppervlakte van het te meten object ofwel biologisch ofwel niet-biologisch is.

3) Een spectraal meetsysteem om verontreiniging te meten zoals beschreven in claim 2 waar het gemeten gereflecteerde licht de auto-fluorescerende emissie is van het gemeten object.

4) Een spectraal meetsysteem om verontreiniging te meten volgens claim 1 waar de detectiemiddelen bestaan uit danwel een hyperspectraal camera, danwel een multispectraal camera danwel een imaging spectrometer.

5) Een spectraal meetsysteem om verontreiniging te meten zoals beschreven in claim 3 waar het registreren van het beeld en de analyse van de contaminatie gebeurt in real time.

6) Een spectraal meetsysteem om verontreiniging te meten zoals beschreven in claim 5 waar de gehele oppervlakte van het te meten object in één keer wordt gemeten.

7) Een spectraal meetsysteem om verontreiniging te meten zoals beschreven in claim 6 waarbij de verontreiniging bestaat uit een bacteriële verontreiniging.

8) Een spectraal meetsysteem om verontreiniging te meten zoals beschreven in claim 7 waarbij het domein en de

subklasse van de bacterie tot op het niveau van het serotype wordt vastgesteld.

9) Een methode om microbiologische verontreiniging vast stellen met gebruik van een systeem zoals beschreven in claim 1, bestaande uit de volgende fases:

a) Het maken van een spectraal beeld van het te meten object;

b) Het analyseren van het beeld om vast te stellen of er afwijkende of ongewenste substantie op het gemeten object aanwezig is;

c) Het detecteren van de aanwezigheid van typische moleculen die kenmerkend zijn voor bepaalde micro organismes;

d) Het vaststellen of deze micro organismes nog levend zijn of al dood;

e) Het vaststellen welk type micro organisme aanwezig is, waarin onderscheid gemaakt wordt tussen prokaryoten en eukaryoten;

f) Binnen het detecteren van prokaryoten en specifiek bacteriën het onderscheiden tussen de verschillende domeinen om elk 'phylum' vast te stellen en daarbinnen elke klasse en subklasse; en,

g) Het binnen de subklasse vaststellen van het serotype om pathogene bacteriën te detecteren.

10) Een methode zoals omschreven in claim 9, die niet gebruik maakt van markers voor het optisch detecteren van verontreiniging.

11) Het gebruik van de methode zoals omschreven in claim 9, gebruikmakend van een systeem zoals beschreven in claim 1, in:

a) land- en tuinbouw

b) de voedsel- en warenindustrie

c) de farmacie

d) het medische werkveld

e) de bouw

f) het forensische werkveld

g) de wetenschap

h) vervoerders of transport

i) eventuele restgebieden die niet onder specificatie a t/m h vallen.

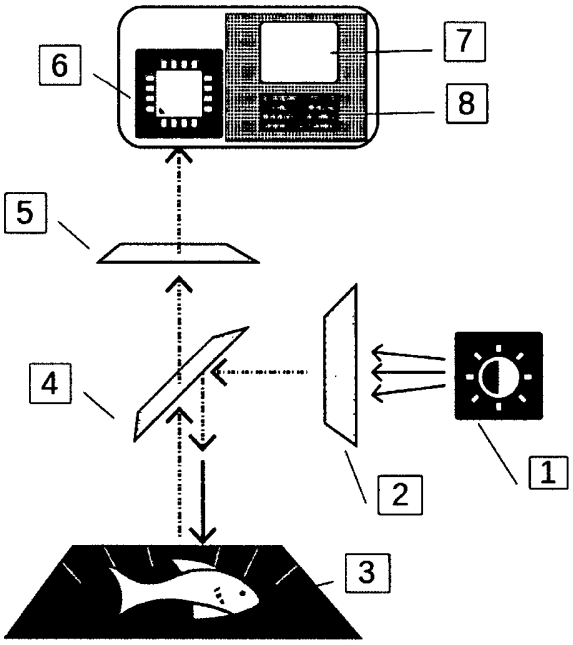

Figure 1

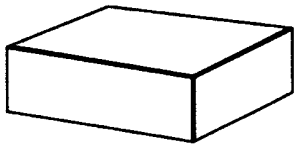

Figure 2a

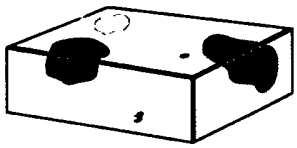

Figure 2b

Abstract: The current invention consist of an optical inspection system that detects non-destructively, categorizes and quantifies contaminations (defined as presence of unwanted substances) in real time on biological and non-biological surfaces. The most important application is the detection of bacteria by using auto-fluorescence. By using a reference database of optical footprints for a variety of contaminants the current innovation can enable rapid bacteria detection.

SAMENWERKINGSVERDRAG (PCT)

RAPPORT BETREFFENDE NIEUWHEIDSONDERZOEK VAN INTERNATIONAAL TYPE

IDENTIFICATIE VAN DE NATIONALE AANVRAGE	KENMERK VAN DE AANVRAGER OF VAN DE GEMACHTIGDE
Nederlands aanvraag nr. **1041809**	Indieningsdatum **11-04-2016**
	Ingeroepen voorrangsdatum **09-10-2015**
Aanvrager (Naam) **Condi Food B.V.**	
Datum van het verzoek voor een onderzoek van internationaal type **08-10-2016**	Door de Instantie voor Internationaal Onderzoek aan het verzoek voor een onderzoek van internationaal type toegekend nr. **SN67503**
I. CLASSIFICATIE VAN HET ONDERWERP (bij toepassing van verschillende classificaties, alle classificatiesymbolen opgeven)	
Volgens de internationale classificatie (IPC) **G01N21/64;G01N21/94;C12Q1/04;G01J3/28;G01N33/12**	
II. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK	
Onderzochte minimumdocumentatie	
Classificatiesysteem	Classificatiesymbolen
IPC	**G01N;G01J;FC12Q**
Onderzochte andere documentatie dan de minimum documentatie, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen	
III. ☐ **GEEN ONDERZOEK MOGELIJK VOOR BEPAALDE CONCLUSIES**	(opmerkingen op aanvullingsblad)
IV. ☐ **GEBREK AAN EENHEID VAN UITVINDING**	(opmerkingen op aanvullingsblad)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 1041809

A. CLASSIFICATIE VAN HET ONDERWERP
INV. G01N21/64 G01N21/94 C12Q1/04 G01J3/28 G01N33/12
ADD.

Volgens de internationale Classificatie van octrooien (IPC) of zowel volgens de nationale classificatie als volgens de IPC.

B. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte minimum documentatie (classificatie gevolgd door classificatiesymbolen)
G01N G01J C12Q

Onderzochte andere documentatie dan de minimum documentatie, voor dergelijke documenten, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

Tijdens het onderzoek geraadpleegde elektronische gegevensbestanden (naam van de gegevensbestanden en, waar uitvoerbaar, gebruikte trefwoorden)
EPO-Internal, WPI Data, FSTA, INSPEC

C. VAN BELANG GEACHTE DOCUMENTEN

Categorie *	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X	WO 2015/137828 A1 (VERITIDE LTD [NZ]) 17 september 2015 (2015-09-17) * bladzijde 1 * * bladzijde 5, regels 24-36 * * bladzijde 13, regel 12 - bladzijde 20, regel 27; figuren 2, 6, 7 *	1-11
X	US 2014/267684 A1 (NELSON MATTHEW [US] ET AL) 18 september 2014 (2014-09-18) * alineas [0005], [0011] - [0014], [0022] - [0036]; figuren 1A,1B,1C *	1-11
X	US 2011/117025 A1 (DACOSTA RALPH SEBASTIAN [CA] ET AL) 19 mei 2011 (2011-05-19) * alineas [0001], [0011], [0012], [0021], [0022], [0025], [0064], [0070], [0084], [0103], [0119], [0207] - [0208], [0258] *	1-11

-/--

[X] Verdere documenten worden vermeld in het vervolg van vak C.

[X] Leden van dezelfde octrooifamilie zijn vermeld in een bijlage

* Speciale categorieën van aangehaalde documenten

"A" niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft

"D" in de octrooiaanvrage vermeld

"E" eerdere octrooi(aanvrage), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven

"L" om andere redenen vermelde literatuur

"O" niet-schriftelijke stand van de techniek

"P" tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur

"T" na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvrage, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding

"X" de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur

"Y" de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht

"&" lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie

Datum waarop het onderzoek naar de stand van de techniek van internationaal type werd voltooid	Verzenddatum van het rapport van het onderzoek naar de stand van de techniek van internationaal type
15 maart 2017	

Naam en adres van de instantie	De bevoegde ambtenaar
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Duijs, Eric

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ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 1041809

C. (Vervolg). VAN BELANG GEACHTE DOCUMENTEN

Categorie *	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X	CARRASCO O ET AL: "Hyperspectral imaging applied to medical diagnoses and food safety", OPTOMECHATRONIC MICRO/NANO DEVICES AND COMPONENTS III : 8 - 10 OCTOBER 2007, LAUSANNE, SWITZERLAND; [PROCEEDINGS OF SPIE , ISSN 0277-786X], SPIE, BELLINGHAM, WASH, deel 5097, 1 januari 2003 (2003-01-01), bladzijden 215-221, XP002486476, DOI: 10.1117/12.502589 ISBN: 978-1-62841-730-2 * bladzijden 215,216 * * bladzijde 218, laatste alinea - bladzijde 220, laatste alinea * -----	1-11
X	PARK B ET AL: "Acousto-optic tunable filter hyperspectral microscope imaging method for characterizing spectra from foodborne pathogens", TRANSACTIONS OF THE AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS, AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS. ST.JOSEPH, MI, US, deel 55, nr. 5, 1 januari 2012 (2012-01-01), bladzijden 1997-2006, XP009179445, ISSN: 0001-2351, DOI: 10.13031/2013.42345 * samenvatting * * bladzijde 1997, linker kolom - bladzijde 2000, linker kolom * * bladzijde 2003 * * bladzijde 2006 * -----	1-11

1

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Informatie over leden van dezelfde octrooifamilie

Nummer van het verzoek om een onderzoek naar de stand van de techniek: NL 1041809

In het rapport genoemd octrooigeschrift	Datum van publicatie	Overeenkomend(e) geschrift(en)	Datum van publicatie
WO 2015137828 A1	17-09-2015	AU 2015230052 A1	27-10-2016
		CN 106461555 A	22-02-2017
		EP 3117203 A1	18-01-2017
		US 2017002394 A1	05-01-2017
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US 2011117025 A1	19-05-2011	CA 2724973 A1	26-11-2009
		CA 2891990 A1	26-11-2009
		CN 102099671 A	15-06-2011
		CN 104939806 A	30-09-2015
		EP 2291640 A1	09-03-2011
		JP 2011521237 A	21-07-2011
		JP 2015057600 A	26-03-2015
		US 2011117025 A1	19-05-2011
		US 2016045114 A1	18-02-2016
		WO 2009140757 A1	26-11-2009

WRITTEN OPINION

File No.	Filing date *(day/month/year)*	Priority date *(day/month/year)*	Application No.
SN67503	11.04.2016	09.10.2015	NL1041809

International Patent Classification (IPC)
INV. G01N21/64 G01N21/94 C12Q1/04 G01J3/28 G01N33/12

Applicant
Condi Food B.V.

This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ 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 with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the application
- ☒ Box No. VIII Certain observations on the application

	Examiner
	Duijs, Eric

Application number

WRITTEN OPINION

NL1041809

Box No. I Basis of this opinion

1. This opinion has been established on the basis of the latest set of claims filed before the start of the search.

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ on paper

   ☐ in electronic form

   c. time of filing/furnishing:

   ☐ contained in the application as filed.

   ☐ filed together with the application in electronic form.

   ☐ furnished subsequently for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty	Yes:	Claims	
	No:	Claims	1-11
Inventive step	Yes:	Claims	
	No:	Claims	1-11
Industrial applicability	Yes:	Claims	1-11
	No:	Claims	

2. Citations and explanations

see separate sheet

Application number

WRITTEN OPINION

NL1041809

Box No. VII Certain defects in the application

see separate sheet

Box No. VIII Certain observations on the application

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

D1 WO 2015/137828 A1 (VERITIDE LTD [NZ])

D2 US 2014/267684 A1 (NELSON MATTHEW [US] ET AL)

D3 US 2011/117025 A1 (DACOSTA RALPH SEBASTIAN [CA])

D4 CARRASCO O ET AL: "Hyperspectral imaging applied to medical diagnoses and food safety", OPTOMECHATRONIC MICRO/ NANO DEVICES AND COMPONENTS III : 8 - 10 OCTOBER 2007, LAUSANNE, SWITZERLAND; [PROCEEDINGS OF SPIE , ISSN 0277-786X], SPIE, BELLINGHAM, WASH, deel 5097, 1 januari 2003 (2003-01-01), bladzijden 215-221, XP002486476, DOI: 10.1117/12.502589 ISBN: 978-1-62841-730-2

D5 PARK B ET AL: "Acousto-optic tunable filter hyperspectral microscope imaging method for characterizing spectra from foodborne pathogens", TRANSACTIONS OF THE AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS, AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS. ST.JOSEPH, MI, US, deel 55, nr. 5, 1 januari 2012 (2012-01-01), bladzijden 1997-2006, XP009179445, ISSN: 0001-2351, DOI: 10.13031/2013.42345

2 **Lack of novelty and lack of inventive step**

The present application does not meet the criteria of patentability, because the subject-matter of **claims 1-11** is not new, and because the subject-matter of **claims 1-11** does not involve an inventive step:

2.1 **Independent SYSTEM claim 1**:

2.1.1 **D1** discloses

Een spectraal beeldregistratiesysteem (FIG. 2; p. 1, l. 5-13) om verontreiniging te meten door gebruik te maken van optische methodes bestaande uit:
a) Een lichtbron 120 (p. 13, l. 27-35: "light source 120 ... between approximately 350nm and 700nm"; p. 16, l. 31-34) die licht afgeeft in het spectrum van UV tot Near Infrared;
b) Detectie middelen 110 (p. 13, l. 37 - p. 14, l. 10: "detector 110 ... receive the emitted fluorescence"; p. 16, l. 36-39) voor het van het gemeten object 200 (p. 13, l. 14) terugkaatsende licht te detecteren;
c) Ten minste één spectraal filter element (p. 17, l. 11-26: "optical filter") dat selectief een vooraf vastgestelde golflengte van licht doorlaat;
d) Een 'vision module' 115, 116, 117, 118 (p. 17, l. 1-9: "camera lens 115 ... beam splitter 116 ... two image sensors 117/118") die focust op het te meten object 200 en om ruimtelijke (p. 16, l. 33-34) en spectrale (p. 17, l. 11-16) data vast te leggen;
e) Controle middelen 119 (p. 17, l. 34-35) om het te meten object 200 in een of meerdere geselecteerde golflengtes te scannen;
f) Een referentie database (p. 18, l. 24-36: "memory component ... predetermined information ... relating to the fluorescence behaviour of each of the one or more substances or contaminants") die de spectrale eigenschappen van vervuilende substanties verzameld; en,

g) Analyse middelen 119 (p. 18, l. 7-8; p. 20, l. 15-18) om gevonden afwijkingen te analyseren en te vergelijken met de referentie database om zo vast te stellen welke soort vervuiling aanwezig is op het gemeten object.

Hence the subject-matter of **claim 1** is not new in view of **D1**.

2.1.2 **D2** also discloses

Een spectraal beeldregistratiesysteem 100 (FIGs. 1A, 1B, 1C; par. 23) om verontreiniging (par. 22: "bacteria") te meten door gebruik te maken van optische methodes bestaande uit:

a) Een lichtbron 180 die licht afgeeft in het spectrum van UV tot Near Infrared (par. 33, 35; implicitly disclosed in par. 24);
b) Detectie middelen 106, 120a (FIG. 1A; par. 25: "hyperspectral subsystem 106") voor het van het gemeten object terugkaatsende licht (par. 5: "fluorescence"; par. 24, 36: "emitted") te detecteren;
c) Ten minste één spectraal filter element 115 (FIG. 1A; par. 25, 34) dat selectief een vooraf vastgestelde golflengte van licht doorlaat;
d) Een 'vision module' 106 (FIG. 1A) die focust op het te meten object en om ruimtelijke en spectrale data vast te leggen;
e) Controle middelen 135 (FIG. 1A; par. 34) om het te meten object in een of meerdere geselecteerde golflengtes te scannen;
f) Een referentie database (par. 30: "reference database") die de spectrale eigenschappen van vervuilende substanties verzameld; en,
g) Analyse middelen 135 (FIG. 1A; par. 25, 30, 34: "identify") om gevonden afwijkingen te analyseren en te vergelijken met de referentie database om zo vast te stellen welke soort vervuiling aanwezig is op het gemeten object.

Hence the subject-matter of **claim 1** is not new in view of **D2**.

2.1.3 **D3** (par. 1, 11: "fluorescence", "real-time", "imaging", "bacterial contamination"; par. 12: "light source", "detector"; par. 21, 22, 25: "meat", "autofluorescence", "bacterial"; par. 62: "bacterial contamination ... food"; par. 64: "multi-spectral"; par. 70: "light sources ... camera ... filters"; par. 84: "multispecral, hyperspectral"; par. 103: "autofluorescence ... bacteria"; par. 119: "live and dead bacteria"; par. 207-208: "look-up table ... identified"; par. 258: " real-time detection, identification and monitoring of level of bacterial and other microbial meat contamination/adulteration of food products") also discloses the subject-matter of **claim 1** which is therefore also not new in view of **D3**.

2.1.4 **D4** (abstract; chapters 1, 2 and 4) and **D5** (abstract; p. 1997, left col. - p. 2000, left col.; p. 2003) also disclose the subject-matter of **claim 1** which is therefore also not new in view of **D4 or D5**.

2.2 **Independent METHOD claim 9**:

2.2.1 The subject-matter of **claim 9** is not new in view of **D5** (p. 2003: "serotypes", "live bacteria ... live and dead cells"; p. 2006: "classifications").

2.2.2 **D1** discloses

Een methode om microbiologische verontreiniging vast stellen met gebruik van een systeem zoals beschreven in claim 1 (see the comments given above for claim 1), bestaande uit de volgende fases (for fases a), b), see the comments given above for claim 1) :
c) Het detecteren van de aanwezigheid van typische moleculen die kenmerkend zijn voor bepaalde micro organismes (p. 5, l. 24-36: "illuminating ... contaminant ... light emitted from the ... contaminant ... contaminant(s) to be determined may be... bacteria"; p. 14, l. 1-10: "Chlorophyll ... fecal contamination ... fluoresce").

The subject-matter of **claim 9 differs** from this known method in that
d) Het vaststellen of deze micro organismes nog levend zijn of al dood;
e) Het vaststellen welk type micro organisme aanwezig is, waarin onderscheid gemaakt wordt tussen prokaryoten en eukaryoten;
f) Binnen het detecteren van prokaryoten en specifiek bacteriën het onderscheiden tussen de verschillende domeinen om elk 'phylum' vast te stellen en daarbinnen elke klasse en subklasse; en,
g) Het binnen de subklasse vaststellen van het serotype om pathogene bacteriën te detecteren.

In **D1** the skilled person identifies the type and presence of "bacteria". It would be obvious for the skilled person to use more improved identification algorithms and larger databases that allow further identification of the type of bacteria, viability and/or class. He would arrive at the subject-matter of **claim 9** without involving an inventive step.

2.2.3 The subject-matter of **claim 9** is also obvious in view of **D2** (par. 22: "bacteria"; par. 27: classifying") or **D3**.

2.3 **Independent USE claim 11**:

D1, D2, D3, D4 and D5 disclose

Het gebruik van de methode zoals omschreven in claim 9, gebruikmakend van een systeem zoals beschreven in claim 1 (see the comments given above for claims 1 and 9), in:

a) land- en tuinbouw (**D3**, par. 258: "horticulture")

b) de voedsel- en warenindustrie (**D1**, p. 1, l. 5-13; **D2**, par. 11; **D3**, par. 258; **D5**, abstract: "foodborne")

c) de farmacie

d) het medische werkveld (**D3**, par. 264)

e) de bouw

f) het forensische werkveld (**D3**, par. 268)

g) de wetenschap

h) vervoerders of transport

i) eventuele restgebieden die niet onder specificatie a t/m h vallen.

2.4 Dependent **claims 2-8 and 10** do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of novelty and/or inventive step:

-- **Claim 2**: not new, see **D1** (p. 1, l. 7: "meat samples"); not new, see **D2** (par. 11: "food"); not new, see **D3** (par. 62: "bacterial contamination ... food");

-- **Claims 3, 10**: not new, see **D1** (p. 5, l. 24-36: "illuminating ... contaminant ... light emitted from the ... contaminant ... contaminant(s) to be determined may be... bacteria"; p. 14, l. 1-10: "Chlorophyll ... fecal contamination ... fluoresce"); not new, see **D3** (par. 21, 22, 25: "meat", "autofluorescence", "bacterial"; par. 103: "autofluorescence ... bacteria");

-- **Claim 4**: not new, see **D1** (FIG. 2: detector with multi-spectral cameras 117, 118); not new, see **D2** (FIG. 1A: feature 120a); not new, see **D3** (par. 84: "multispecral, hyperspectral");

-- **Claim 5**: not new, see **D1** (p. 1, l. 5; p. 13, l. 12-18: "real time"); not new, see **D2** (par. 32); not new, see **D3** (par. 1, 11: "real-time");

-- **Claim 6**: not new, see **D1** (FIG. 2; p. 16, l. 31-34);

-- **Claim 7**: not new, see **D1** (p. 5, l. 24-36: "illuminating ... contaminant ... light emitted from the ... contaminant ... contaminant(s) to be determined may be... bacteria"); not new, see **D2** (par. 22); not new, see **D3** (par. 1, 11: "bacterial contamination"; par. 21, 22, 25: "bacterial"; par. 62: "bacterial contamination ... food"; par. 103: "autofluorescence ... bacteria"; par. 119: "live and dead bacteria"; par. 258: " real-time detection, identification and monitoring of level of bacterial and other microbial meat contamination/ adulteration of food products");

-- **Claim 8**: no new in view of **D5** (p. 2003: "serotypes", "live bacteria ... live and dead cells"; p. 2006: "classifications"); obvious in view of **D1** (p. 5, l. 24-36: "illuminating ... contaminant ... light emitted from the ... contaminant ... contaminant(s) to be determined may be... bacteria"; p. 18, l. 24-36: "memory component ... predetermined information ... relating to the fluorescence behaviour of each of the one or more substances or contaminants"); obvious in view of **D2** (par. 27: "classifying").

Re Item VII

Certain defects in the application

3 The relevant background art disclosed in **D1, D2, D3, D4 and D5** is not mentioned in the description, nor is this document identified therein.

4 The features of the claims are not provided with **reference signs** placed in parentheses.

Re Item VIII

Certain observations on the application

5 In view of the vague wording "i) eventuele restgebieden die niet onder specificatie a t/m h vallen" used in **claim 11**, the scope of the claim is not clear. It appears that the use of the method according to claim 9, utilizing a system as in claim 1, in **every existing field**, is claimed.