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5512490 : Optical sensor, optical sensing apparatus, and methods for detecting an analyte of interest using spectral recognition patterns

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ABSTRACT: The present invention is an optical detection and identification system and provides an optic sensor, an optic sensing apparatus and methodology for detecting and evaluating one or more analytes or ligands of interest, either alone or in admixture. The optic sensor of the system is comprised of a supporting member and an array formed of heterogeneous, semi-selective thin films which function as sensing receptor units and are able to detect a variety of different analytes and ligands using spectral recognition patterns.

U.S. REFERENCES: (No patents reference this one)

Patent	Inventor	Issued	Title
4582809	Block et al.	4 /1986	Apparatus including optical fiber for fluorescence immunoassay
4785814	Kane	11 /1988	Optical probe for measuring pH and oxygen in blood and employing a composite membrane
4822746	Walt	4 /1989	Radiative and non-radiative energy transfer and absorbance modulated fluorescence detection methods and sensors
4842783	Blaylock	6 /1989	Method of producing fiber optic chemical sensors incorporating photocrosslinked polymer gels
4919891	Yafuso et al.	4 /1990	Sensor with overcoating and process for making same
4925268	Iyer et al.	3 /1990	Fiber-optic physiological probes
4999306	Yafuso et al.	3 /1991	Composition, apparatus and method for sensing ionic components
5019350	Rhum et al.	5 /1991	Fluorescent polymers
5047627	Yim et al.	9 /1991	Configuration fiber-optic blood gas sensor bundle and method of making
5114864	Walt	5 /1992	Fiber optic sensors, apparatus, and detection methods using fluid erodible controlled release polymers for delivery of reagent formulations
5143853	Walt	9 /1992	Absorbance modulated fluorescence detection methods and sensors
5152287	Kane	10 /1992	Cross-linked fluorinated polymers for use in gas sensors
5244636	Walt et al.	9 /1993	Imaging fiber optic array sensors, apparatus, and methods for concurrently detecting multiple analytes of interest in a fluid sample
5244813	Walt et al.	9 /1993	Fiber optic sensor, apparatus, and methods for detecting an organic analyte in a fluid or vapor sample
5250264	Walt et al.	10 /1994	Method of making imaging fiber optic sensors to concurrently detect multiple analytes of interest in a fluid sample
5252494	Walt	10 /1993	Fiber optic sensors, apparatus, and detection methods using controlled release polymers and reagent formulations held within a polymeric reaction matrix
5298741	Walt et al.	3 /1994	Thin film fiber optic sensor array and apparatus for concurrent viewing and chemical sensing of a sample
5320814	Walt et al.	6 /1994	Fiber optic array sensors, apparatus, and methods for concurrently visualizing and chemically detecting multiple analytes of interest in a fluid sample

EXEMPLARY CLAIM(s): [Show all 6 claims](#)

What we claim is:

1. An optical sensor for detecting an analyte of interest in a fluid sample, said optical sensor comprising:

- a supporting member; and
- an optic array formed of multiple semi-selective sensing receptor units which differ in their constituent chemical formulations, which differ in their spectral characteristics, which are immobilized at different spatial positions on said supporting member for reactive contact with the fluid sample, and which react concurrently and semi-selectively but spectrally differently with an individual analyte of interest, each of said multiple semi-selective sensing receptor units of said optic array being comprised of
- a polymeric substance of predetermined chemical composition, and
- a semi-selective dye compound of predetermined chemical composition which has characteristic spectral properties, is disposed in admixture with said polymeric substance, and can react semi-selectively and spectrally differently over time with more than one analyte,
- (a) wherein said admixed dye compound absorbs light energy of a predetermined wavelength and, in the presence of said polymeric substance without an analyte able to react semi-selectively, yields a baseline spectral response over time which is optically detectable and recognizable as showing an absence of analyte, and
- (b) wherein said admixed dye compound absorbs light energy of a predetermined wavelength and, in the presence of said polymeric substance and at least one analyte of interest able to react semi-selectively, generates a modified spectral response over time which is optically detectable and recognizable as showing the spectral consequence of semi-selective reaction with the analyte of interest,
- said multiple semi-selective sensing receptor units of said optic array presenting a plurality of differing and alternative modified spectral responses after concurrent semi-selective reaction with the analyte of interest in the fluid sample, the spectral pattern formed collectively by said plurality of differing and alternative modified spectral responses resulting in spectral recognition progression pattern means by which to detect and identify that analyte of interest.

RELATED U.S. APPLICATIONS: **none**

FOREIGN APPLICATION PRIORITY DATA: **none**

FOREIGN REFERENCES: **none**

OTHER REFERENCES:

- Olness, D. et al, Report (1984) UCID-20047 Chem. Abstracts AN 1986:490265 (Abstract Only).
- Smardzewski, Talanta (1988), 35(2) 95-101 Abstract Only.
- Yokoyama, K. & F. Ebisawa, Anal. Chem. 65:673-677 (1993).
- Patrash, S. J. & E. T. Zellers, Anal. Chem. 65:2055-2066 (1993).
- Grate et al., Anal. Chem. 65:1868-1881 (1993).

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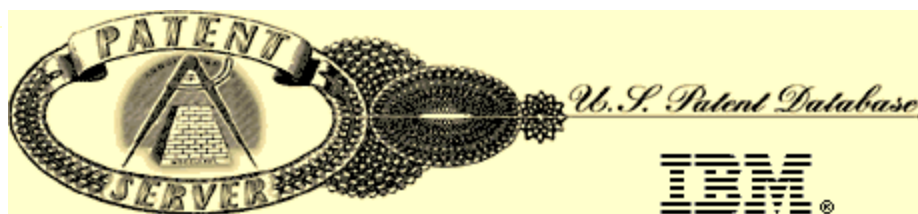
PRIMARY/ASSISTANT EXAMINERS: **Snay; Jeffrey R.;**



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5512490 : Optical sensor, optical sensing apparatus, and methods for detecting an analyte of interest using spectral recognition patterns

6 CLAIMS

What we claim is:

1. An optical sensor for detecting an analyte of interest in a fluid sample, said optical sensor comprising:
 - o a supporting member; and
 - o an optic array formed of multiple semi-selective sensing receptor units which differ in their constituent chemical formulations, which differ in their spectral characteristics, which are immobilized at different spatial positions on said supporting member for reactive contact with the fluid sample, and which react concurrently and semi-selectively but spectrally differently with an individual analyte of interest, each of said multiple semi-selective sensing receptor units of said optic array being comprised of
 - o a polymeric substance of predetermined chemical composition, and
 - o a semi-selective dye compound of predetermined chemical composition which has characteristic spectral properties, is disposed in admixture with said polymeric substance, and can react semi-selectively and spectrally differently over time with more than one analyte,
 - o (a) wherein said admixed dye compound absorbs light energy of a predetermined wavelength and, in the presence of said polymeric substance without an analyte able to react semi-selectively, yields a baseline spectral response over time which is optically detectable and recognizable as showing an absence of analyte, and
 - o (b) wherein said admixed dye compound absorbs light energy of a predetermined wavelength and, in the presence of said polymeric substance and at least one analyte of interest able to react semi-selectively, generates a modified spectral response over time which is optically detectable and recognizable as showing the spectral consequence of semi-selective reaction with the analyte of interest,
 - o said multiple semi-selective sensing receptor units of said optic array presenting a plurality of differing and alternative modified spectral responses after concurrent semi-selective reaction with the analyte of interest in the fluid sample, the spectral pattern formed collectively by said plurality of differing and alternative modified spectral responses resulting in spectral recognition progression pattern means by which to detect and identify that analyte of interest.
2. An optical sensor for detecting a first analyte of interest which is intermixed with at least one other analyte of interest in a fluid sample, said optical sensor comprising:
 - o a supporting member; and
 - o an optic array formed of multiple semi-selective sensing receptor units which differ in their constituent chemical formulations, which differ in their spectral characteristics, which are immobilized at different spatial positions on said supporting member for reactive contact with the fluid sample, and which react concurrently and semi-selectively but spectrally differently with an individual analyte of interest, each of said multiple semi-selective sensing receptor units of said optic array being comprised of
 - o a polymeric substance of predetermined chemical composition, and
 - o a semi-selective dye compound of predetermined chemical composition which has characteristic spectral properties, is disposed in admixture with said polymeric substance, and can react semi-selectively and spectrally differently over time with more than one analyte,
 - o (a) wherein said admixed dye compound absorbs light energy of a predetermined wavelength and, in the presence of said polymeric substance without an analyte able to react semi-selectively, yields a baseline spectral response which is optically detectable and recognizable as showing an absence of analyte, and
 - o (b) wherein said admixed dye compound absorbs light energy of a predetermined wavelength and, in the presence of said polymeric substance and a first analyte of interest able to react semi-selectively, generates a first modified spectral response over time which is optically detectable and recognizable as showing the spectral consequence of semi-selective reaction with the first analyte of interest, and
 - o (c) wherein said admixed dye compound absorbs light energy of a predetermined wavelength and, in the presence of said polymeric substance and at least a second analyte of interest able to react semi-selectively, generates a second modified spectral response which is optically detectable and recognizable as showing the spectral consequence of semi-selective reaction with the second analyte of interest,
 - o said multiple semi-selective sensing receptor units of said optic array presenting a plurality of differing and alternative modified spectral responses after semi-selective reaction with each of said first and second analytes of interest, the spectral pattern formed collectively by said plurality of differing and alternative modified spectral responses for each of said first and second analytes of interest resulting in individual spectral recognition progression pattern means by which to detect and identify each of the analytes of interest in the fluid sample.
3. An optical sensing apparatus for detecting an analyte of interest in a fluid sample, said optical sensing apparatus comprising:
 - o a supporting member; and
 - o an optic array formed of multiple semi-selective sensing receptor units which differ in their constituent chemical formulations, which differ in their spectral characteristics, which are immobilized at different spatial positions on said supporting member for reactive contact with the fluid sample, and which react concurrently and semi-selectively but spectrally differently with an individual analyte of interest, each of said multiple semi-selective sensing receptor units of said optic array being comprised of
 - o a polymeric substance of predetermined chemical composition, and
 - o a semi-selective dye compound of predetermined chemical composition which has characteristic spectral properties, is disposed in admixture with said polymeric substance, and can react semi-selectively and spectrally differently with more than one analyte,
 - o (a) wherein said admixed dye compound absorbs light energy of a predetermined wavelength and, in the presence of said polymeric substance without an analyte able to react semi-selectively, yields a baseline spectral response over time which is optically detectable

- and recognizable as showing an absence of analyte, and
 - o (b) wherein said admixed dye compound absorbs light energy of a predetermined wavelength and, in the presence of said polymeric substance and at least one analyte of interest able to react semi-selectively, generates a modified spectral response over time which is optically detectable and recognizable as showing the spectral consequence of semi-selective reaction with the analyte of interest,
 - o said multiple semi-selective sensing receptor units of said optic array presenting a plurality of differing and alternative modified spectral responses after concurrent semi-selective reaction with the analyte of interest in the fluid sample, the spectral pattern formed collectively by said plurality of differing and alternative modified spectral responses for an analyte of interest resulting in spectral recognition progression pattern means by which to detect and identify that analyte of interest;
 - o means for introducing a fluid sample to said optic array for semi-selective reactive contact;
 - o means for introducing light energy of a predetermined wavelength to said multiple semi-selective sensing receptor units of said optic array; and
 - o computerized optical detection and evaluation means for optically detecting said plurality of differing and alternative modified spectral responses generated by said semi-selective sensing receptor units and for evaluating said resulting spectral recognition progression pattern means to determine the presence of that analyte of interest in the fluid sample.
4. An optical sensing apparatus for detecting a first analyte of interest which is intermixed with at least one other analyte of interest in a fluid sample, said optical sensing apparatus comprising:
- o a supporting member; and
 - o an optic array formed of multiple semi-selective sensing receptor units which differ in their constituent chemical formulations, which differ in their spectral characteristics, which are immobilized at different spatial positions on said supporting member for reactive contact with the fluid sample, and which react concurrently and semi-selectively but spectrally differently with an individual analyte of interest, each of said multiple semi-selective sensing receptor units of said optic array being comprised of
 - o a polymeric substance of predetermined chemical composition, and
 - o a semi-selective dye compound of predetermined chemical composition which has characteristic spectral properties, is disposed in admixture with said polymeric substance, and can react semi-selectively and spectrally differently over time with more than one analyte,
 - o (a) wherein said admixed dye compound absorbs light energy of a predetermined wavelength and, in the presence of said polymeric substance without an analyte able to react semi-selectively, yields a baseline spectral response over time which is optically detectable and recognizable as showing an absence of analyte, and
 - o (b) wherein said admixed dye compound absorbs light energy of a predetermined wavelength and, in the presence of said polymeric substance and a first analyte of interest able to react semi-selectively, generates a modified spectral response over time which is optically detectable and recognizable as showing the spectral consequence of semi-selective reaction with the analyte of interest, and
 - o (c) wherein said admixed dye compound absorbs light energy of a predetermined wavelength and, in the presence of said polymeric substance and at least a second analyte of interest able to react semi-selectively, generates a second modified spectral response over time which is optically detectable and recognizable as showing the spectral consequence of semi-selective reaction with the second analyte of interest,
 - o said multiple semi-selective sensing receptor units of said optic array presenting a plurality of differing and alternative modified spectral responses after concurrent semi-selective reaction with each of the first and second analytes of interest, the spectral pattern formed collectively by said plurality of differing and alternative modified spectral responses for each of the first and second analytes of interest resulting in individual spectral recognition progression pattern means by which to detect and identify each of the analytes of interest in the fluid sample;
 - o means for introducing a fluid sample to said optic array for semi-selective reactive contact;
 - o means for introducing light energy of a predetermined wavelength to said multiple semi-selective sensing receptor units of said optic array; and
 - o computerized optical detection and evaluation means for optically detecting said plurality of differing and alternative modified spectral responses generated by said semi-selective sensing receptor units and for evaluating said resulting spectral recognition progression pattern means individually to determine the presence of each of the analytes of interest in the fluid sample.
5. An optical method for detecting an analyte of interest in a fluid sample, said optical method comprising the steps of: providing an optical sensor comprised of
- o a supporting member; and
 - o an optic array formed of multiple semi-selective sensing receptor units which differ in their constituent chemical formulations, which differ in their spectral characteristics, which are immobilized at different spatial positions on said supporting member for reactive contact with the fluid sample, and which react concurrently and semi-selectively but spectrally differently with an individual analyte of interest, each of said multiple semi-selective sensing receptor units of said optic array being comprised of
 - o (a) a polymeric substance of predetermined chemical composition, and
 - o (b) a semi-selective dye compound of predetermined chemical composition which has characteristic spectral properties, is disposed in admixture with said polymeric substance, and can react semi-selectively and spectrally differently over time with more than one analyte,
 - (i) wherein said admixed dye compound absorbs light energy of a predetermined wavelength and, in the presence of said polymeric substance without an analyte able to react semi-selectively, yields a baseline spectral response progression over time which is optically detectable and recognizable as showing an absence of analyte, and
 - (ii) wherein said admixed dye compound absorbs light energy of predetermined wavelength and, in the presence of said polymeric substance and an analyte of interest able to react semi-selectively, generates a modified spectral response over time which is optically detectable and recognizable as showing the spectral consequence of semi-selective reaction with the analyte of interest,
 - o said multiple semi-selective sensing receptor units of said optic array presenting a plurality of differing and alternative modified spectral responses after concurrent semi-selective reaction with the analyte of interest, the spectral pattern formed collectively by said plurality of differing and alternative modified spectral responses resulting in spectral recognition progression pattern means by which to detect and identify that analyte of interest;
 - o introducing the fluid sample to said optical sensor for semi-selective reactive contact;
 - o introducing light energy of a predetermined wavelength to said multiple semi-selective sensing receptor units of said optical sensor;
 - o optically detecting said plurality of differing and alternative modified spectral responses generated over time by said semi-selective sensing receptor units of said optical sensor collectively to form said resulting spectral recognition progression pattern means; and
 - o evaluating said resulting spectral recognition progression pattern means using computerized means to determine the presence of that analyte of interest in the fluid sample.
6. An optical method for detecting a first analyte of interest which is intermixed with at least one other analyte of interest in a fluid sample, said method comprising the steps of:
- o providing an optical sensor comprising:

- a supporting member; and
- an optic array formed of multiple semi-selective sensing receptor units which differ in their constituent chemical formulations, which differ in their spectral characteristics, which are immobilized at different spatial positions on said supporting member for reactive contact with the fluid sample, and which react concurrently and semi-selectively but spectrally differently with an individual analyte of interest, each of said multiple semi-selective sensing receptor units of said optic array being comprised of
 - (a) a polymeric substance of predetermined chemical composition, and
 - (b) a semi-selective dye compound of predetermined chemical composition which has characteristic spectral properties, is disposed in admixture with said polymeric substance, and can react semi-selectively and spectrally differently over time with more than one analyte,
 - (i) wherein said admixed dye compound absorbs light energy of a predetermined wavelength and, in the presence of said polymeric substance without an analyte able to react semi-selectively, yields a baseline spectral response over time which is optically detectable and recognizable as showing an absence of analyte, and
 - (ii) wherein said admixed dye compound absorbs light energy of a predetermined wavelength and, in the presence of said polymeric substance and a first analyte of interest able to react semi-selectively, generates a first modified spectral response over time which is optically detectable and recognizable as showing the spectral consequence of semi-selective reaction with the first analyte of interest, and
 - (iii) wherein said admixed dye compound absorbs light energy of a predetermined wavelength and, in the presence of said polymeric substance and at least a second analyte of interest able to react semi-selectively, generates a second modified spectral response over time which is optically detectable and recognizable as showing the spectral consequence of semi-selective reaction with a second analyte of interest,
- said multiple semi-selective sensing receptor units of said optic array presenting a plurality of differing and alternative modified spectral responses after concurrent semi-selective reaction with each of the first and second analytes of interest, the spectral pattern formed collectively by said plurality of differing and alternative modified spectral responses for each of the first and second analytes of interest resulting in individual spectral recognition progression pattern means by which to detect and identify each of the analytes of interest;
- introducing the fluid sample to said optical sensor for semi-selective reactive contact;
- introducing light energy of a predetermined wavelength to said multiple semi-selective sensing receptor units of said optical sensor;
- optically detecting said plurality of differing and alternative modified spectral responses generated by said semi-selective sensing receptor units of said optical sensor collectively to form individual resulting spectral recognition progression pattern means; and
- evaluating said resulting spectral recognition progression pattern means individually using computerized means to determine the presence of each of the analytes of interest in the fluid sample.



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