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[Continued on next page]

(54) Title: A SENSING SYSTEM AND METHOD THEREOF

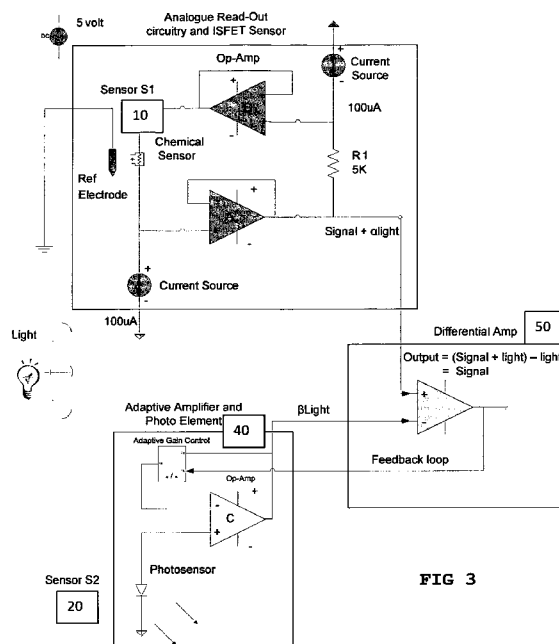


FIG 3

(57) Abstract: The present invention is a sensing system and method with substantially reduced or zero light effect. The arrangement of the system of the present invention comprises at least two sensors (10,20); whereby at least one sensor (20) is configured to detect light and one sensor (10) is configured for measuring samples; an analog read-out circuitry connected to at least one sensor (10), at least one adaptive gain control means (40) connected to the light sensor (20) for optimizing the output from the light sensor (20); and a differential amplifier (50); wherein the adaptive gain control means (40) is configured to optimize the output from both sensors (10, 20) for light compensation, by way of equalizing the light coefficient factor (β , α) by both sensors (10,20).



— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

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A SENSING SYSTEM AND METHOD THEREOF**Field of Invention**

5 The present invention relates generally to sensor devices, more particularly to a method for providing enhanced sensing capabilities for integrated wireless ion sensitive field effect transistor (ISFET) sensor devices.

10 Background of the Invention

The integrated ion sensitive field effects technology (ISFET) enables user to effectively sense and thus measure ion concentration in a solution. The recent technological
15 advancement in ISFETS and digital electronics has led to the development of low-voltage, low-power, multifunctional sensor nodes primarily to provide a more unambiguous a sensing output.

20 It is commonly known that for an attempt of sensing ion concentration in solution samples using an ISFET based device, the universal challenges in producing an accurate result based on the sensing are prominently influenced by external factors such as, but not limiting to, temperature, humidity, motion,
25 pressure and the mostly, for the case of ISFETS, is the

ambience light. As evident in the accompanying
light effect for a sensing output is approximately 100mVpp.

In order to partially resolve this increasingly unsettling
5 drawback, users have started to develop solutions based on
filtering out such disruption, for instance incorporating
filtering schemes. The light effect may be reduced to about 5%
from the original amount of interference as shown in **FIG 1**
(b), however it is often overlooked that the imperative
10 damaging factor is the shift in the DC level, which in many
cases would lead to the misinterpretation of the measuring
solution thus resulting to erroneous ion-concentrations
decision.

15 The number of studies conducted in order to further develop
the efficiency and enhance the capability of light filtering
has tremendously increased over the past few years. Such
studies may become solutions for complications or undesirable
characteristics as discussed previously. An exemplary of a
20 proposed solution surfaced was by means of black box enclosure
whereby this approach may aid in reducing the light effect
however taking into consideration that sensors are typically
involved for sensing and cramming these devices into a closure
may not be an expeditious solution. This is further unwieldy

in the event that the sensing period is extends
for analyzing drifts characteristics.

Whilst many prior art and technology substitutions may be
expedient and considerably enhanced in regards to the
5 enhancing ISFETS sensing capabilities, the current condition
or challenge of filtering unwanted ambience light disruption
to obtain better sensing clarity has yet to be thoroughly
resolved. A great majority of devices or methods which may be
able to provide at least half of the clarity in sensing and
10 does not disrupt the DC level are more often prohibitively
expensive.

As light sources vary, the level of interference varies. It is
therefore would be a great advantage is the ISFET device is
15 adapted to be versatile and portable in all conditions of
lights thereby providing better sensing capability with
reduced light disruption and reduced or zero shifts in direct
current (DC).

20 Therefore the objective of the present invention is to provide
a system and method for providing light disruption immunity
for the sensing device, more particularly for ISFET devices,
whereby there is provided an adaptive gain control as part of
the sensing device.

It is yet another object of the present invention system and method for removing the alternating current (AC) and direct current (DC) components of the light effect.

5 Other objects of this invention will become apparent on the reading of this entire disclosure.

Summary of the Invention

10 In one aspect, the present invention discloses a sensing system comprising; at least two sensors (10, 20) ; whereby at least one sensor (20) is configured to detect light and one sensor (10) is configured for measuring samples; an analog read-out circuitry connected to at least one sensor (10), at
15 least one adaptive gain control means (40) connected to the light sensor (20) for optimizing the output from the light sensor (20); and a differential amplifier (50); wherein the adaptive gain control means (40) is configured to optimize the output from both sensors (10, 20) for light compensation,
20 by way of equalizing the light coefficient factor (β , α) by both sensors (10,20).

In another aspect of the present invention, a method for use in eliminating light interruption in a sensing system; said
25 method comprising the steps of: providing at least one sensor configured for measuring samples; providing at least one

sensor configured for detecting light; direct
both sensors to a differential circuit; optimizing the output
from the sensor for detecting light for light compensation
effect; equalizing the light gains from both sensors and
5 producing zero light effect signals.

Brief Description of the Drawings

Other objects, features, and advantages of the invention will
10 be apparent from the following description when read with
reference to the accompanying drawings. In the drawings,
wherein like reference numerals denote corresponding parts
throughout the several views:

15 **FIG 1 (a) and FIG 1 (b)** shows the effects of light in a
sensing arrangement and the effects of filtering the light
from the sample respectively;

FIG 2 shows the sensors arrangement involved in the system and
20 method in accordance to a preferred embodiment of the present
invention;

FIG 3 shows the overall view of the system and method in
accordance with a preferred embodiment of the present
25 invention.

Detailed Description of the Preferred Embodiments

5 In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the invention. However, it will be understood by those of ordinary skill in the art that the invention may be practiced without these specific details. In other
10 instances, well-known methods, procedures and/or components have not been described in detail so as not to obscure the invention. Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

15

Referring to FIG 2 and FIG 3, the arrangement of system and method of the present invention in accordance with a preferred embodiment of the present invention comprises at least two sensors (10, 20), at least one analog read-out circuitry (30),
20 at least one adaptive gain amplifier means and photo element (40) and differential amplifier circuit (50).

From the above and still referring to FIG 1, out of the two sensors (10, 20), at least one sensor is a chemical ISFET
25 sensor (10) and another sensor is a photo sensor (20). It should be noted that both of these sensors are placed and thus

connected to the components as mentioned above in the same environment thereby understandably these sensors (10, 20) shares the same light source. The first sensor, being the ISFET chemical sensor (10) is dipped into a chemical solution being a sample. The second sensor (20) being a light sensor or photo sensor is exposed to the light source. Accordingly, the output of the ISFET chemical sensor (10) is heavily inclined on the ion concentration of the solution with some degree (α) of light effects. The output of the second sensor (20) as the photo sensor is thoroughly influenced by light. The obtained outputs are suitably channeled to differential circuit, said differential circuit which is referred herein as the differential amplifier circuit (50).

In accordance with a preferred embodiment of the present invention, the differential circuit (50) comprises two input terminals - positive and negative, whereby the positive input is channeled from the first ISFET sensor (10) and the negative input is channeled from the second photo sensor (20).

The adaptive circuit which comprises the adaptive gain amplifier and photo element (40) is an automatic gain control and functions primarily to adjust the magnification β equal to α . In this process, the precise coefficients are vital as to the opposite magnitude of both signals will cancel each other, as modeled by the following equation:

α = light coefficient factor in sensor 1

β = light coefficient factor in sensor 2

S1 = Signal + α light

5 S2 = β light

Let assume $\alpha = \beta$

Output = S1 - S2

= (Signal + light) - light

= Signal

10

From the above the output of the differential circuit is a light free or zero light effects signal.

It is duly noted that the ISFET sensor (10) is configured to
15 detect at least the pH level of the solution, whereby the output is a level of ion concentration and as discussed previously, some light interference in the solution. Such condition typically causes significant DC shift, within the range of 50mV to 100mV. The second sensor (20) which detects
20 light provides output in the form of voltage level interference by the ambient light. Both signals are channeled to a differential amplifier (50).

As discussed previously, the adaptive gain control (40) of the
25 photo sensor (20) aids to optimize the output of the appropriate light compensation effectively, by way of

equalizing the β gain and α gain of the a
result, the method of the present invention allows the better
sensing capability for the ISFET sensor (10) due to the
cancellation of light effect, thus producing zero light effect
5 signals.

As will be readily apparent to those skilled in the art, the
present invention may easily be produced in other specific
10 forms without departing from its essential characteristics.
The present embodiments is, therefore, to be considered as
merely illustrative and not restrictive, the scope of the
invention being indicated by the claims rather than the
foregoing description, and all changes which come within
15 therefore intended to be embraced therein.

Claims

1. A sensing system comprising; at least two sensors (10,
20) ; whereby at least one sensor (20) is configured to
5 detect light and one sensor (10) is configured for
measuring samples; an analog read-out circuitry connected
to at least one sensor (10), at least one adaptive gain
control means (40) connected to the light sensor (20) for
optimizing the output from the light sensor (20); and a
10 differential amplifier (50); wherein the adaptive gain
control means (40) is configured to optimize the output
from both sensors (10, 20) for light compensation, by way
of equalizing the light coefficient factor (β , α) by both
sensors (10,20).
- 15 2. The sensing system as claimed in Claim 1 wherein at least
one sensor (10) is configured to detect ion
concentrations in a solution sample and one sensor (20)
is configured to detect light (20).
3. The sensing system as claimed in Claim 1 wherein the
20 differential amplifier (50) comprises two input
terminals, one input terminal which is the positive
terminal for input from the chemical sensor (10) and the
second input terminal which is the negative terminal for
input from the light sensor (20).

4. The sensing system as claimed in Claim
output from the differential amplifier (50) is zero light
effect signals.

5. A method for use in eliminating light interruption in a
5 sensing system; said method comprising the steps of:

providing at least one sensor configured for
measuring samples;

providing at least one sensor configured for
detecting light;

10 directing output from both sensors to a differential
circuit;

optimizing the output from the sensor for detecting
light for light compensation effect;

equalizing the light gains from both sensors and

15 producing zero light effect signals.

6. The method as claimed in Claim 5 wherein the step
equalizing the light gains from both sensors is performed
taking into consideration the light coefficient factors
20 (α, β) for both sensors.

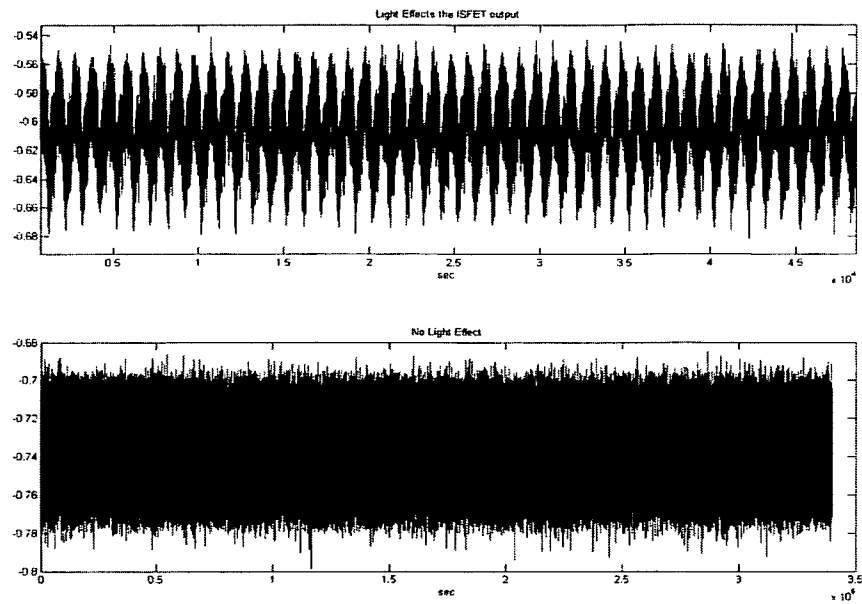


FIG 1 (a)

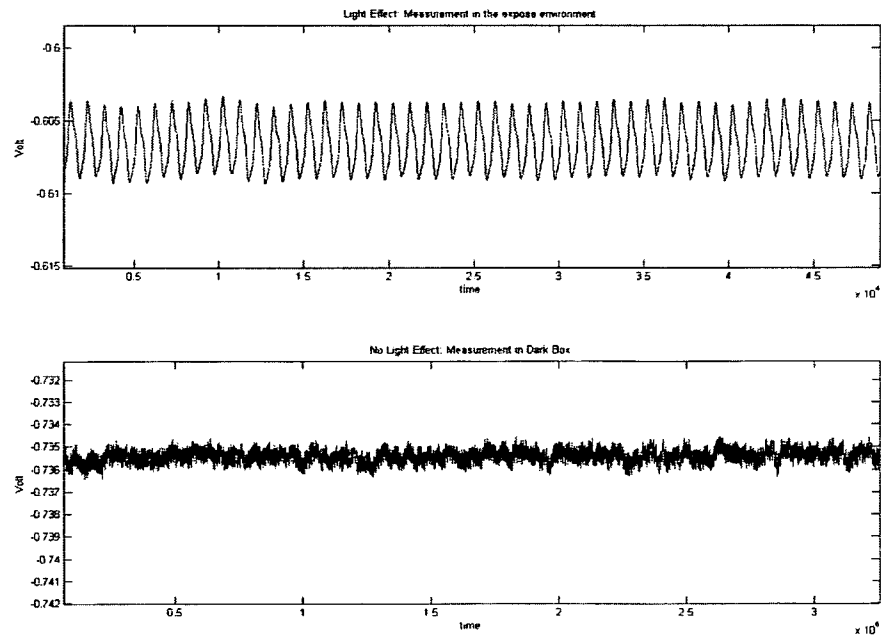
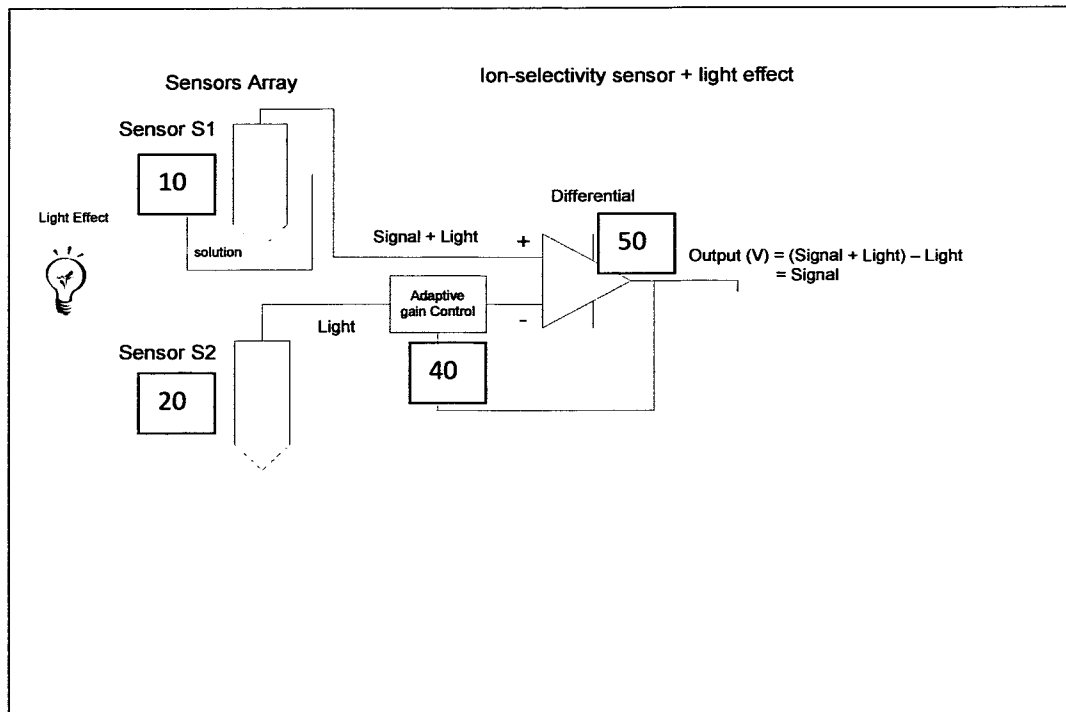
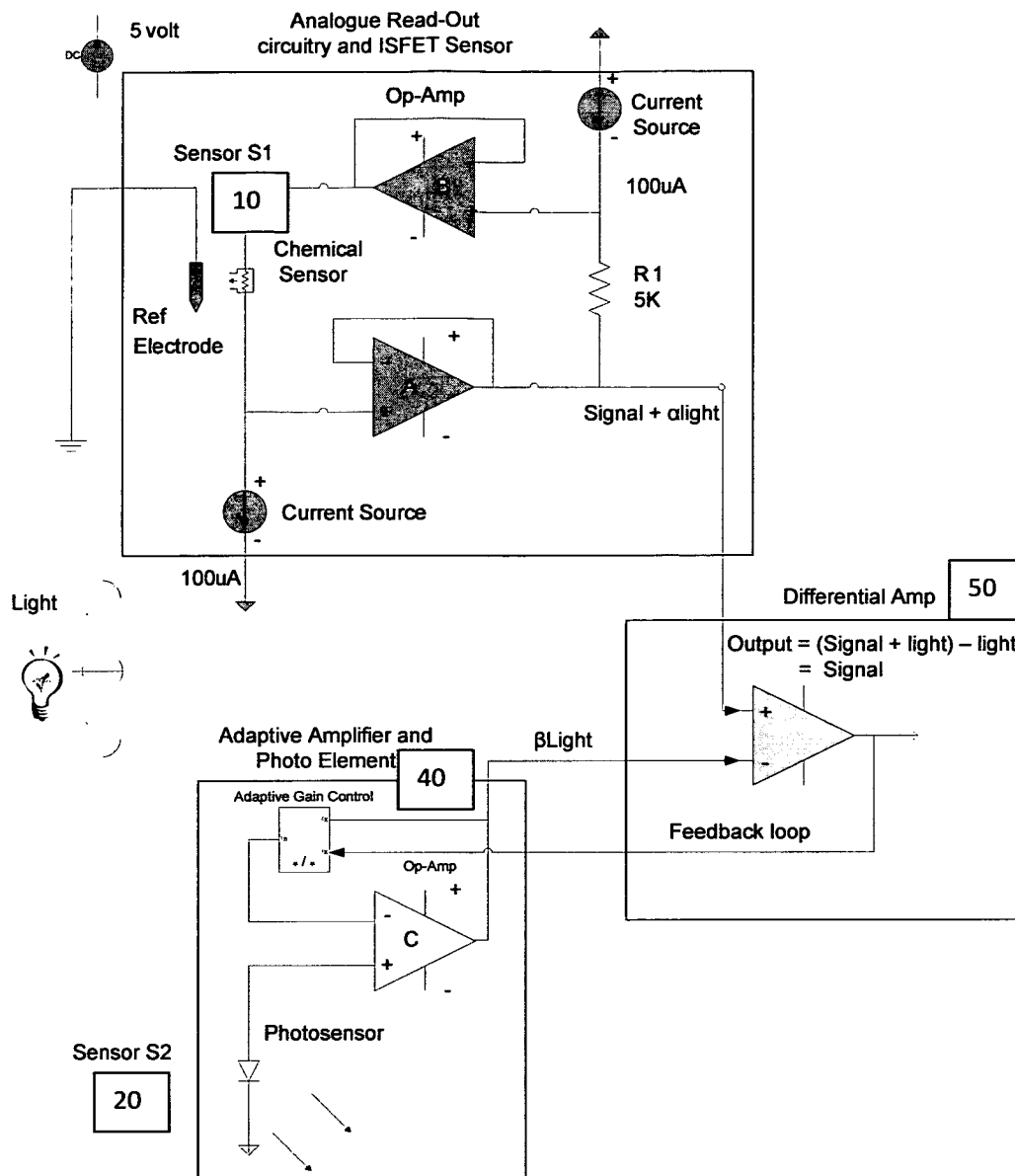


FIG 1 (b)

**FIG 2**



INTERNATIONAL SEARCH REPORT

International application No.

PCT/MY2011/000026

A. CLASSIFICATION OF SUBJECT MATTER Int. Cl. G01N 27/414 (2006.01) G01D 3/028 (2006.01) According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPODOC, WPI (Keywords: CHEMFET, ISFET, Feedback, Compensate, Light, Photon and similar terms)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/0077116 A1 (HSIUNG et al.) 22 April 2004 See figures 2, 7, 9 and 11, paragraphs 7, 37, 39, 49	1-6
A	JP 2009236502 A (TOYOHASHI UNIVERSITY OF TECHNOLOGY) 15 October 2009 See Abstract and figures	
☐ Further documents are listed in the continuation of Box C ☒ See patent family annex		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "E" earlier application or patent but published on or after the international filing date "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "O" document referring to an oral disclosure, use, exhibition or other means "&" document member of the same patent family "P" document published prior to the international filing date but later than the priority date claimed		
Date of the actual completion of the international search 01 August 2011		Date of mailing of the international search report 12.08.2011
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. +61 2 6283 7999		Authorized officer MATTHEW FELLEW AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : +61 2 6283 2041

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/MY2011/000026

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member	
US	2004077116	US	6897081
JP	2009236502	NONE	
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.			
END OF ANNEX			