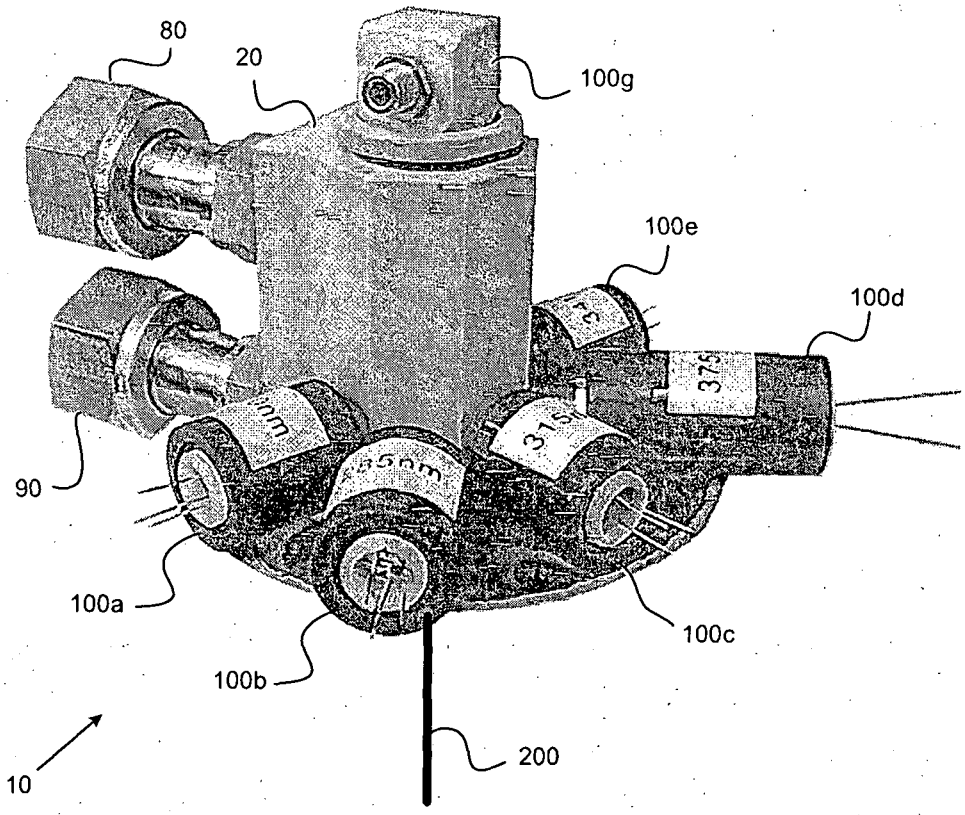

80
20
100g
100e
100d
90
100a
100b
100c
200
10

FIG. 1A

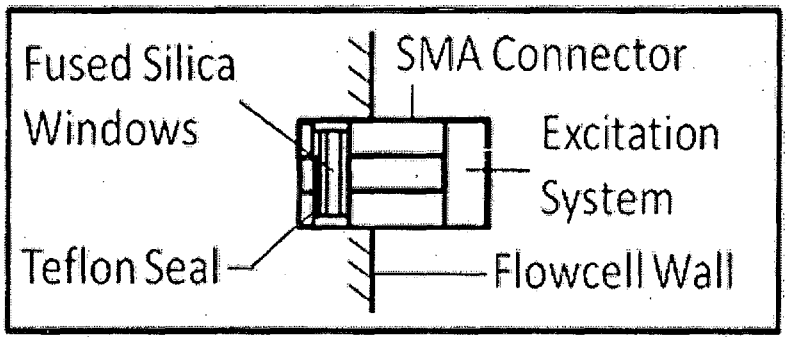

Fused Silica Windows
SMA Connector
Excitation System
Teflon Seal
Flowcell Wall
40

FIG. 2

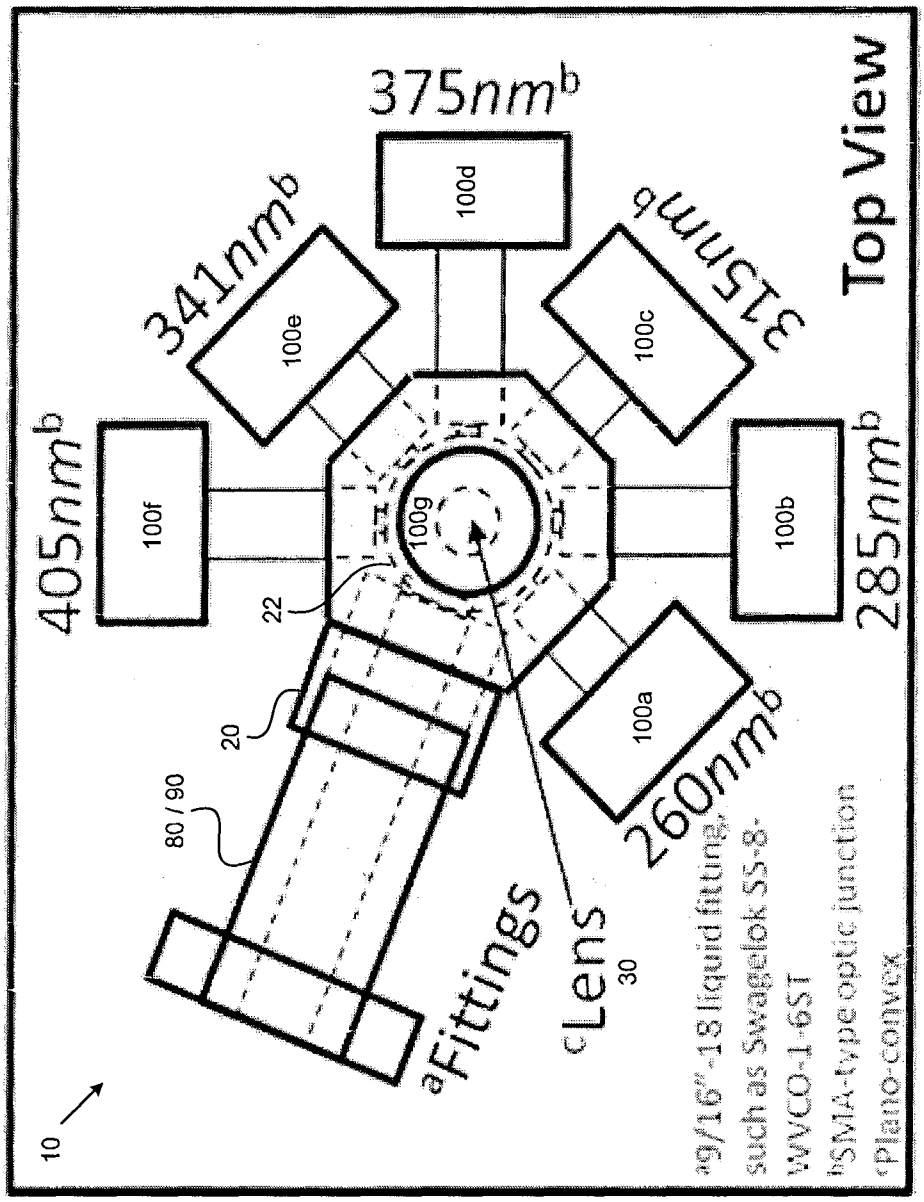

Top View
375nm[b]
341nm[b]
315nm[b]
405nm[b]
285nm[b]
260nm[b]
100d
100e
100c
100f
100b
100a
100g
22
20
80 / 90
10
[a]Fittings
[c]Lens
30
[a]9/16"-18 liquid fitting, such as Swagelok SS-8-VCO-1-6ST
[b]SMA-type optic junction
[c]Plano-convex

FIG. 1B

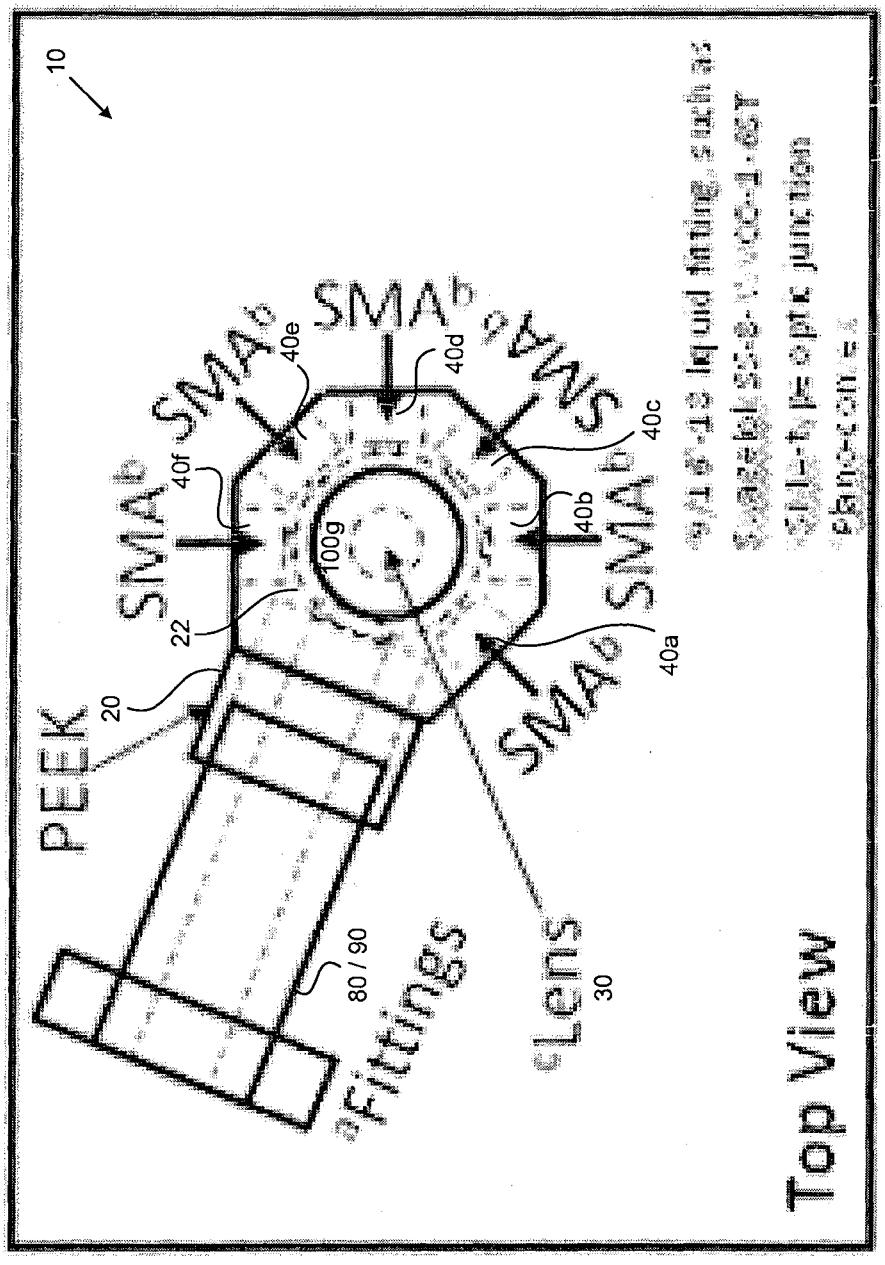

10
PEEK
20
SMA
22
SMA
40f
SMA
40e
SMA
40d
SMA
40c
SMA
40b
SMA
40a
100g
fittings
80 / 90
lens
30
Top View

FIG. 1C

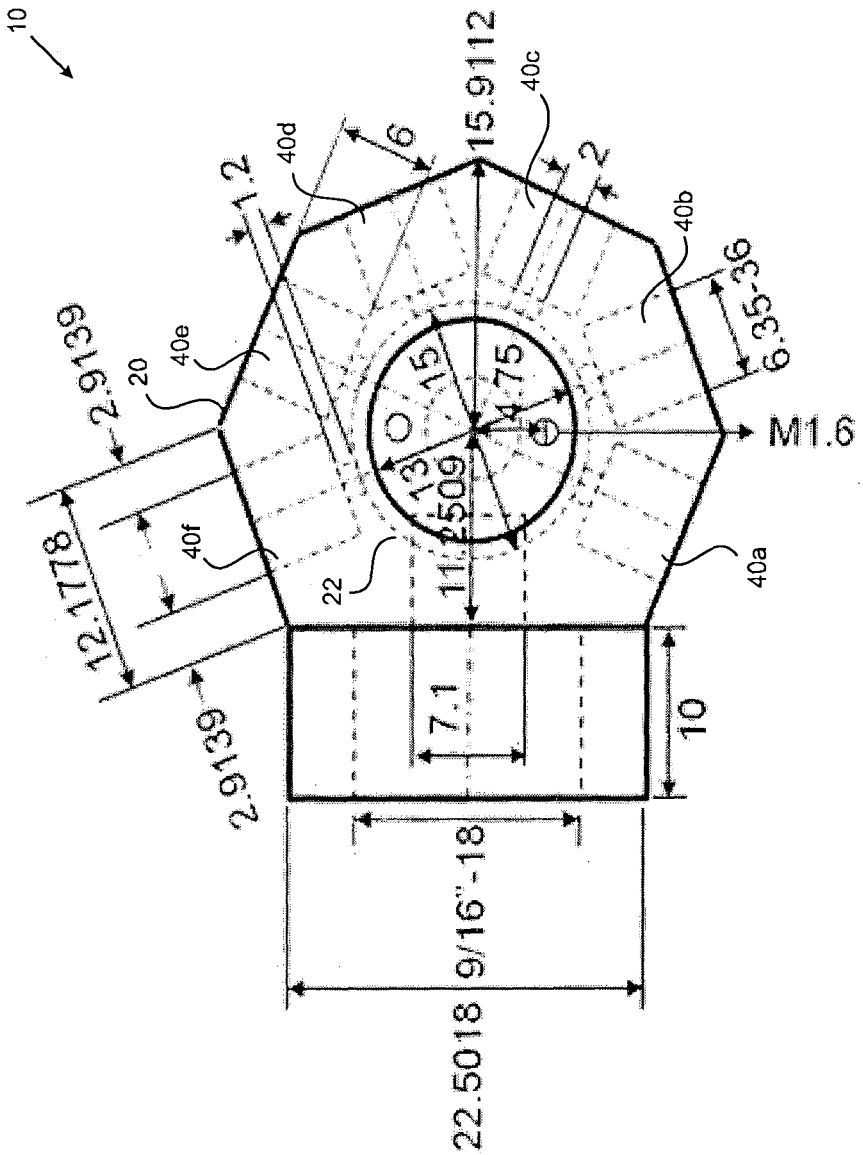

10
15.9112
40c
40d
6
1.2
2
40b
6.35-36
2.9139
20
40e
M1.6
4.75
15
13
11.2509
22
40a
12.1778
40f
2.9139
7.1
10
9/16"-18
22.5018

FIG. 1D

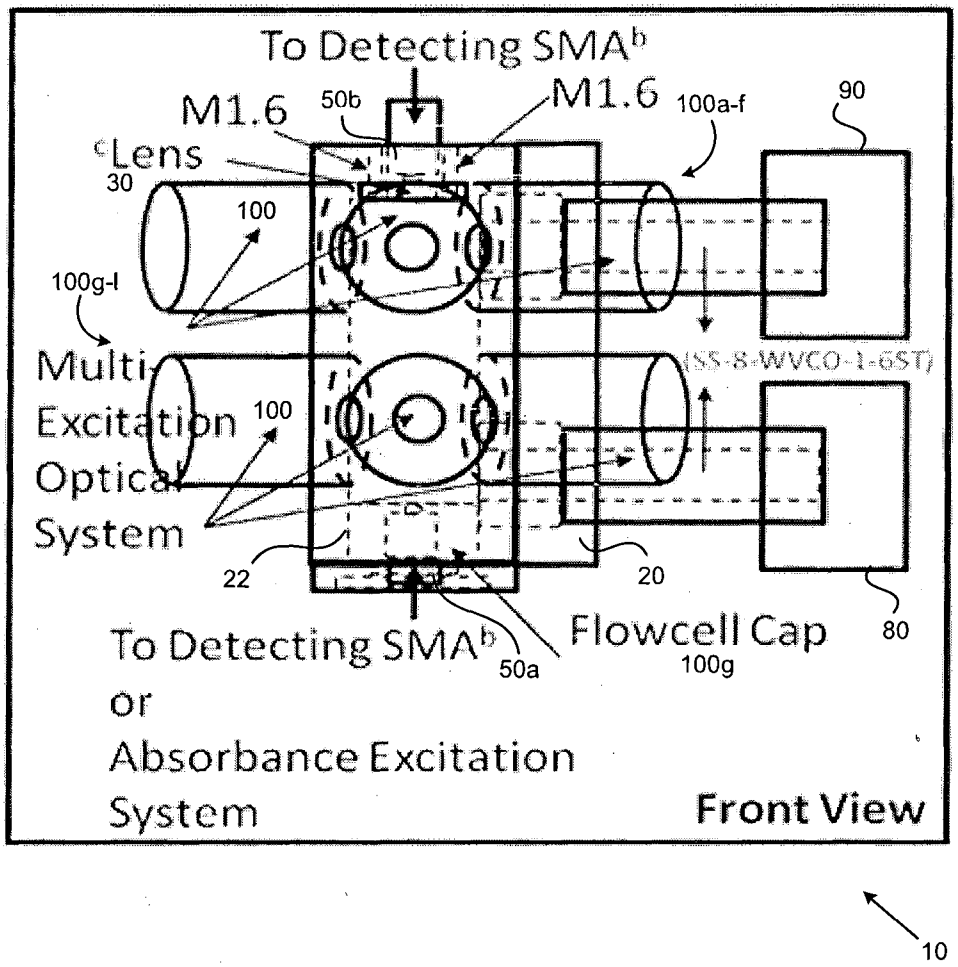

To Detecting SMA^b
M1.6
50b
M1.6
100a-f
90
^cLens
30
100
100g-l
Multi-
Excitation
Optical
System
100
(SS-8-WVCO-1-6ST)
22
20
To Detecting SMA^b
50a
Flowcell Cap
100g
80
or
Absorbance Excitation
System
Front View
10

FIG. 1E

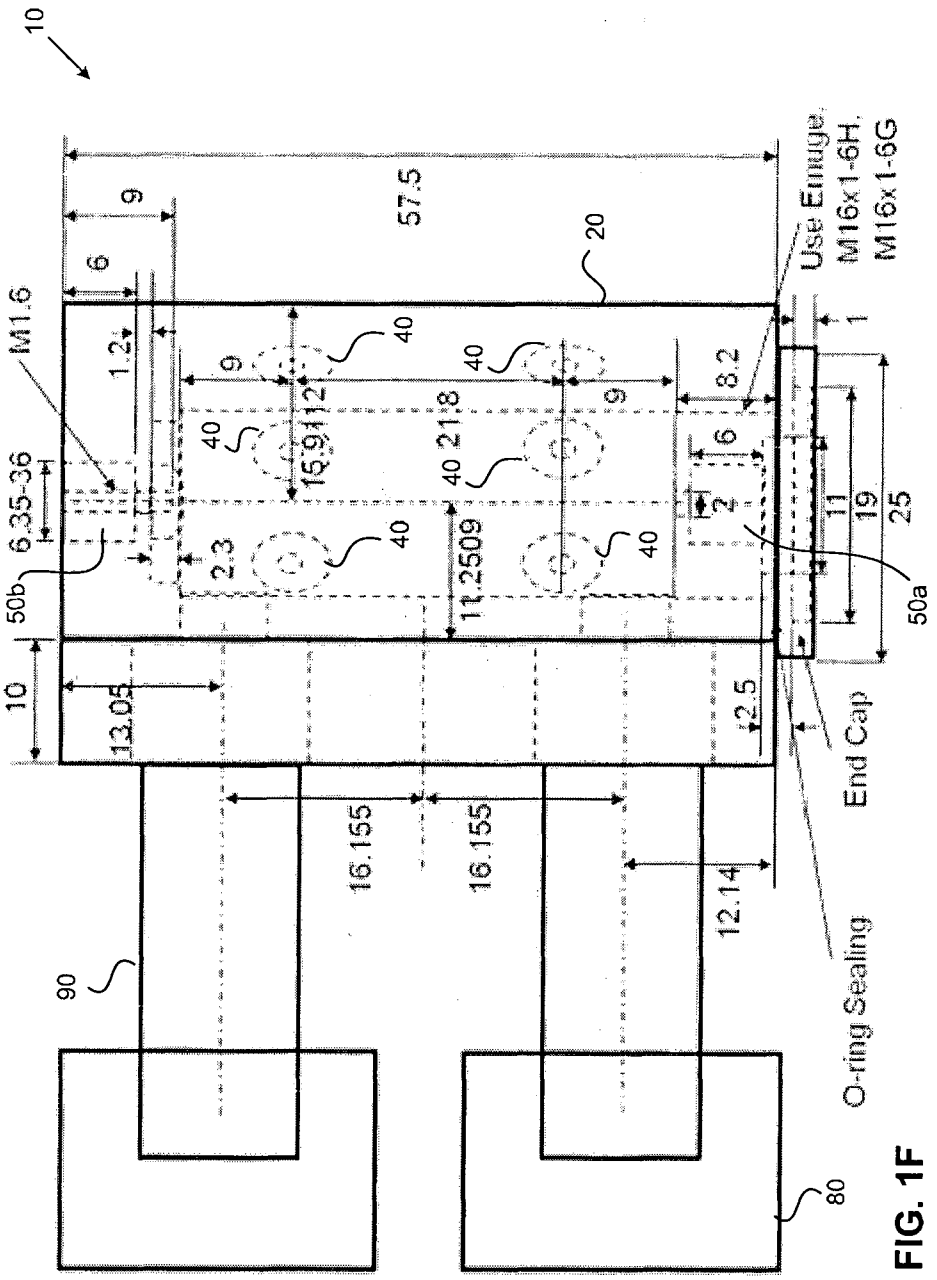

10
57.5
9
6
20
Use Emuge
M16x1-6H,
M16x1-6G
M1.6
1.2
9
40
40
9
8.2
1
6.35-36
50b
15.9112
21.8
6
2
11
19
25
50a
2.3
11.2509
10
13.05
2.5
End Cap
16.155
16.155
12.14
90
O-ring Sealing
80

FIG. 1F

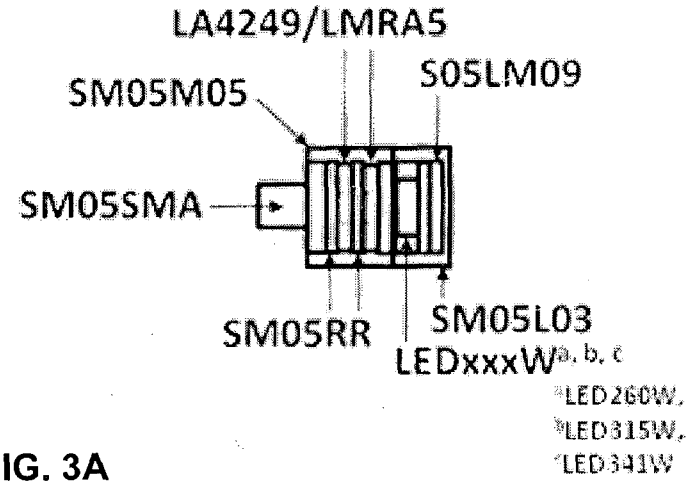

LA4249/LMRA5
SM05M05
S05LM09
SM05SMA
SM05RR
SM05L03
LEDxxxW[a, b, c]
[a]LED260W,
[b]LED315W,
[c]LED341W

FIG. 3A

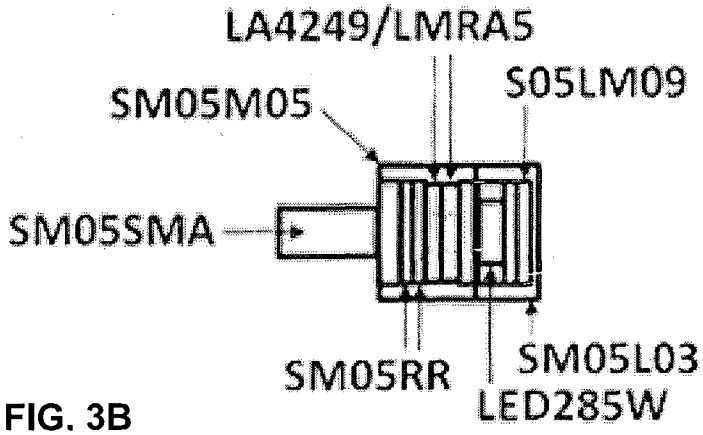

LA4249/LMRA5
SM05M05
S05LM09
SM05SMA
SM05RR
SM05L03
LED285W

FIG. 3B

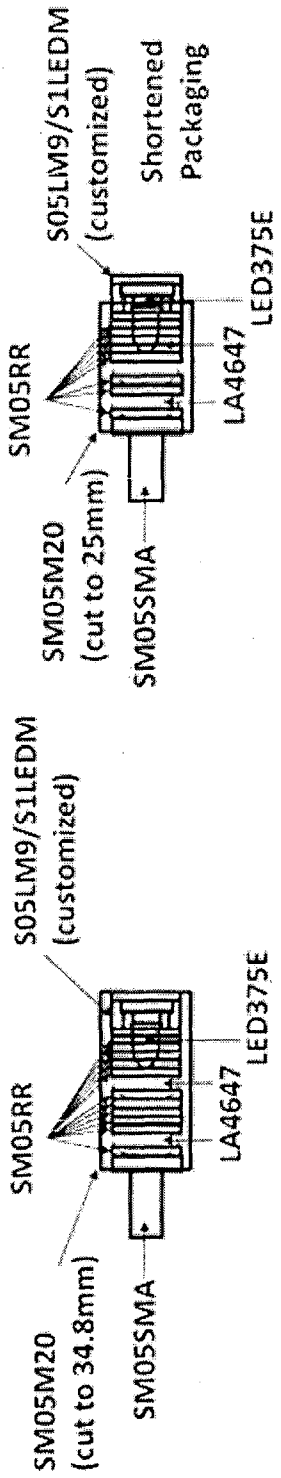

S05LM9/S1LEDM
(customized)
Shortened
Packaging
LED375E
SM05RR
LA4647
SM05M20
(cut to 25mm)
SM05SMA
S05LM9/S1LEDM
(customized)
SM05RR
LED375E
LA4647
SM05M20
(cut to 34.8mm)
SM05SMA

FIG. 3C

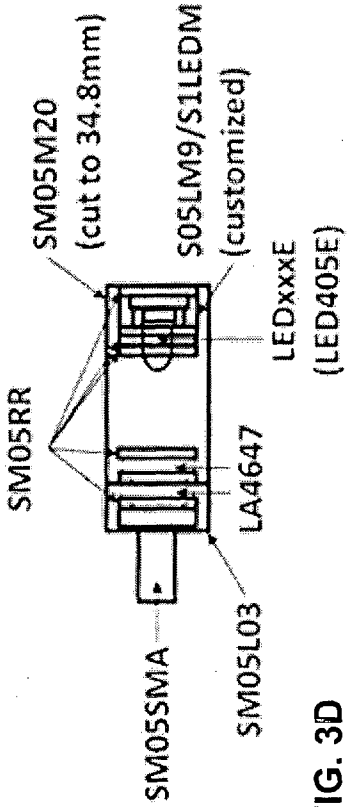

SM05M20
(cut to 34.8mm)
S05LM9/S1LEDM
(customized)
LEDxxxE
(LED405E)
SM05RR
LA4647
SM05SMA
SM05L03

FIG. 3D

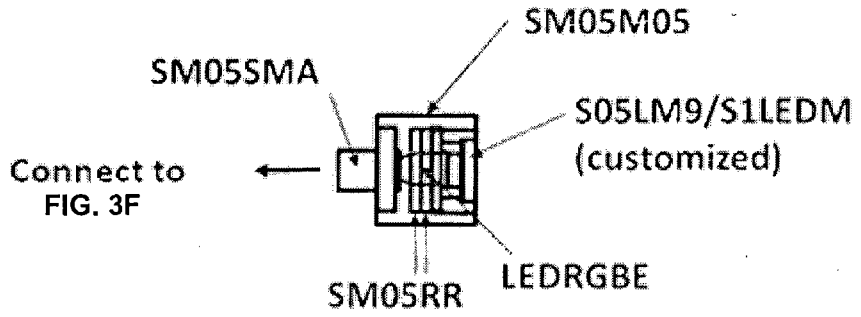

SM05M05
SM05SMA
S05LM9/S1LEDM
(customized)
Connect to
FIG. 3F
SM05RR
LEDRGBE

FIG. 3E

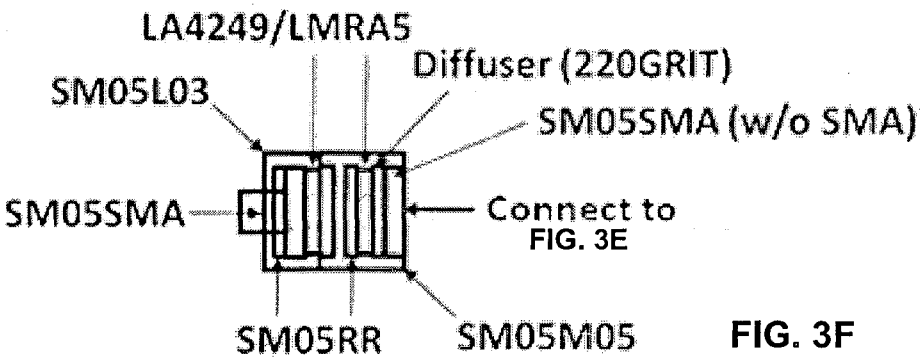

LA4249/LMRA5
Diffuser (220GRIT)
SM05L03
SM05SMA (w/o SMA)
SM05SMA
Connect to
FIG. 3E
SM05RR
SM05M05

FIG. 3F

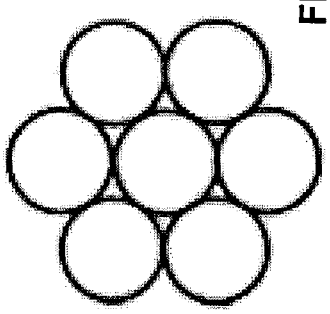


FIG. 4A

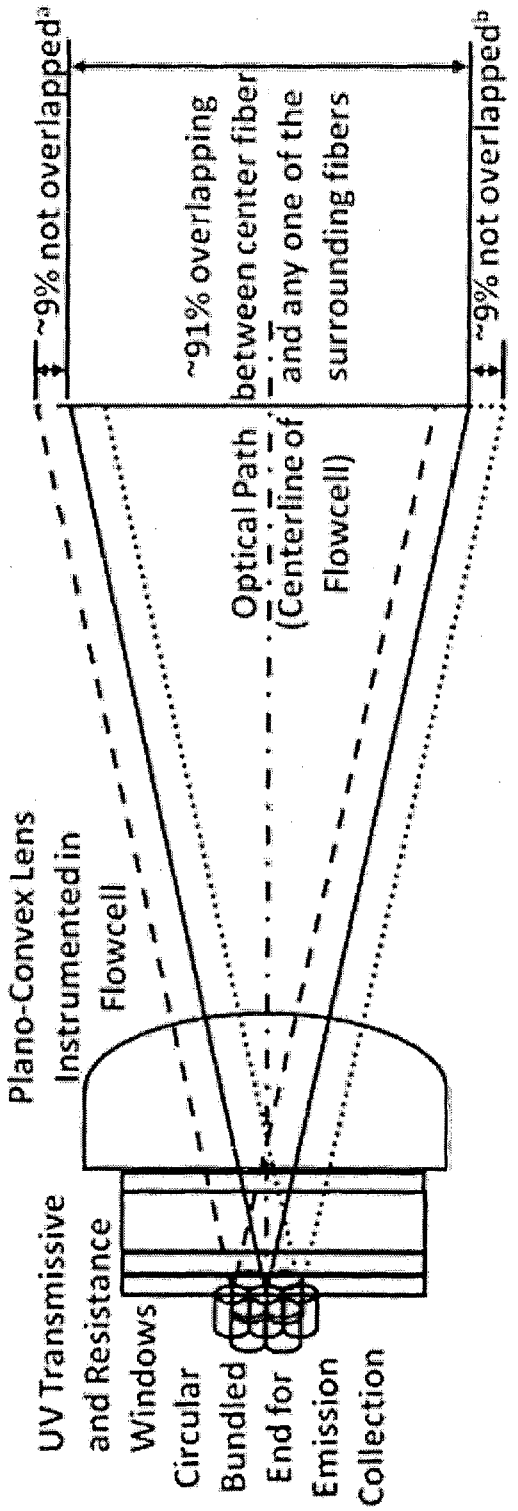

~9% not overlapped[a]
~91% overlapping between center fiber and any one of the surrounding fibers
~9% not overlapped[b]
Optical Path (Centerline of Flowcell)
Plano-Convex Lens Instrumented in Flowcell
UV Transmissive and Resistance Windows
Circular Bundled End for Emission Collection

FIG. 4B



FIG. 4C

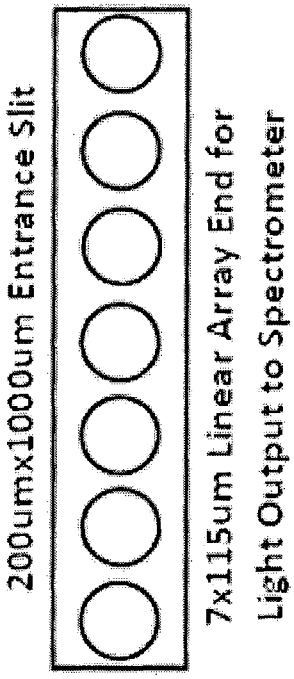

200umx1000um Entrance Slit
7x115um Linear Array End for
Light Output to Spectrometer

FIG. 4D

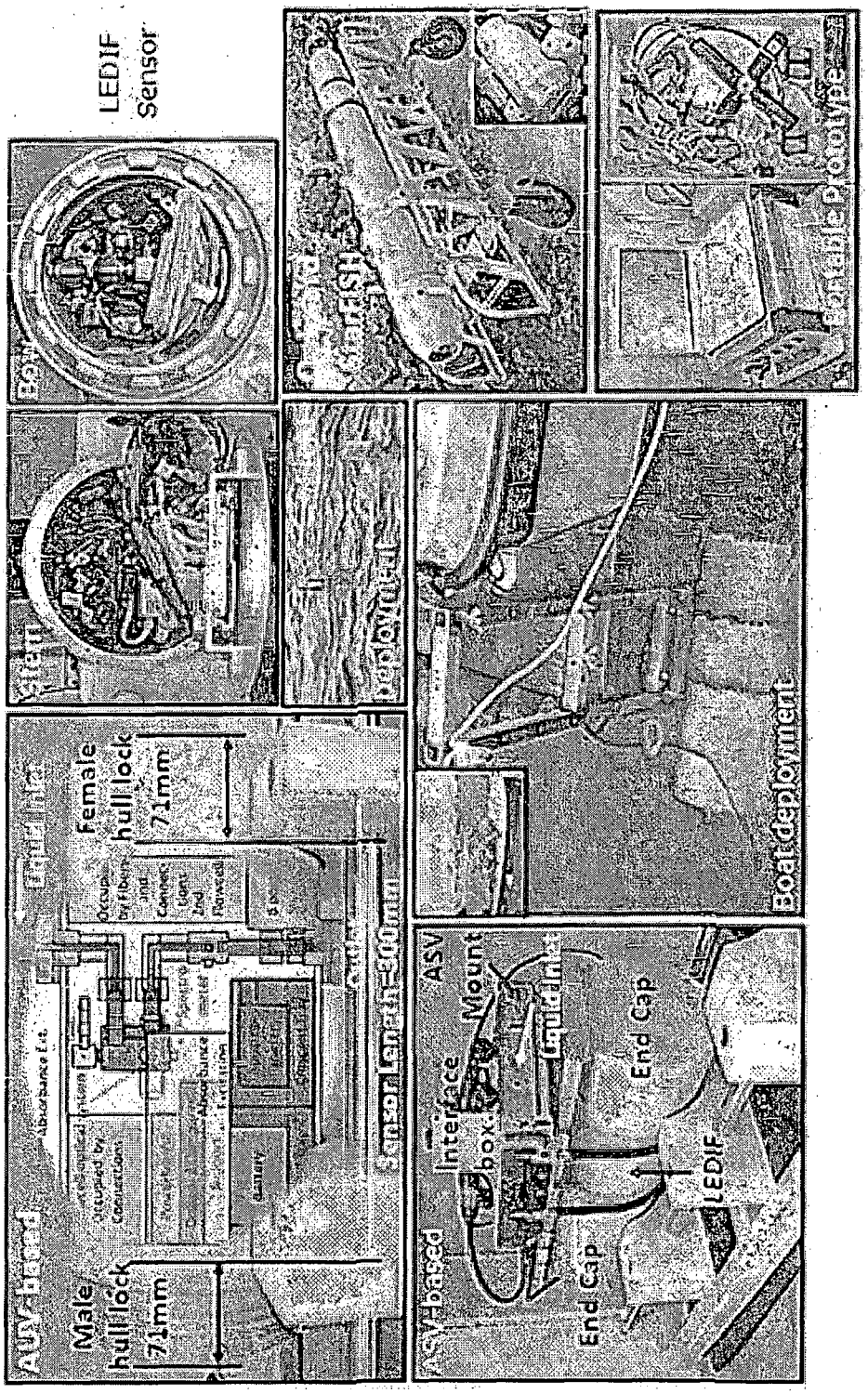

LEDIF
Sensor
Female
hull lock
71mm
Male
hull lock
71mm
Deployment
Boat deployment
ASV
Interface
box
Mount
End Cap
End Cap
LEDIF

FIG. 5A

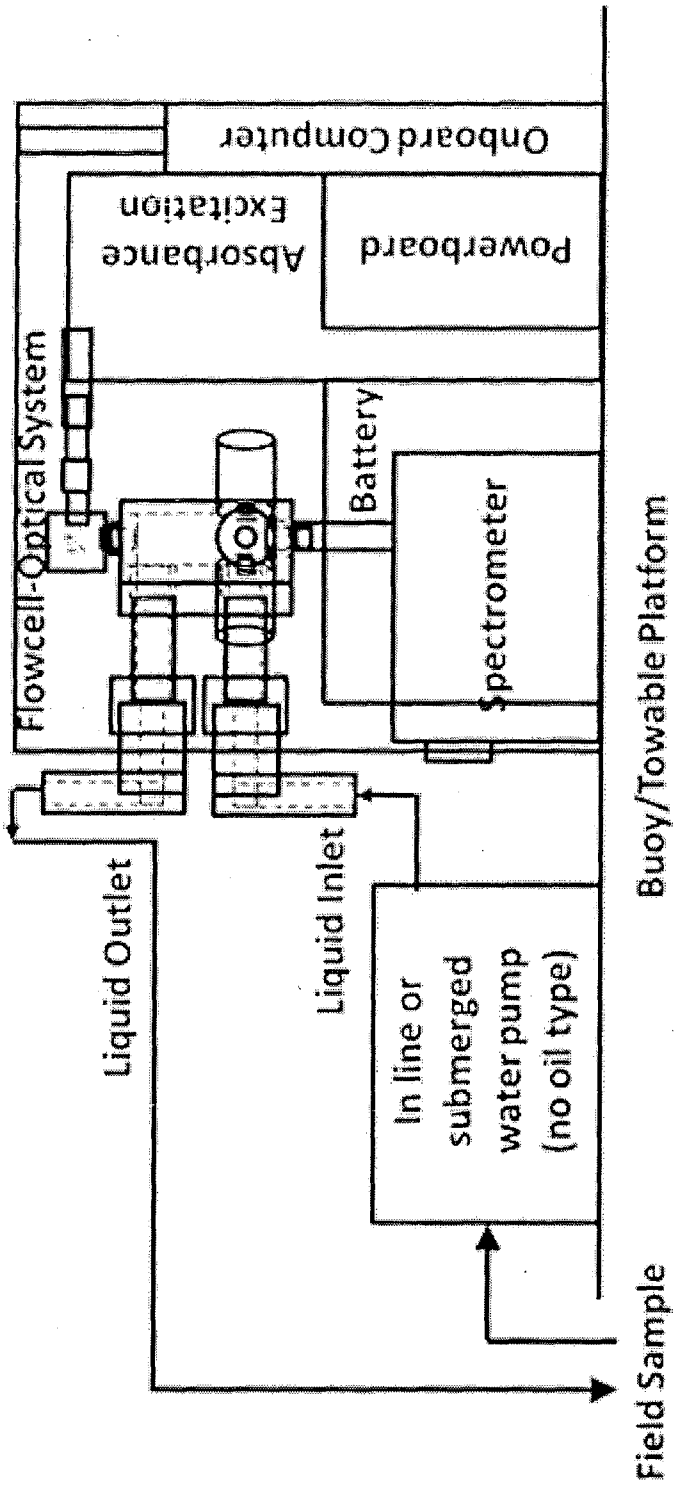

Onboard Computer
Powerboard
Absorbance Excitation
Flowcell-Optical System
Battery
Spectrometer
Buoy/Towable Platform
Liquid Outlet
Liquid Inlet
In line or submerged water pump (no oil type)
Field Sample

FIG. 5B

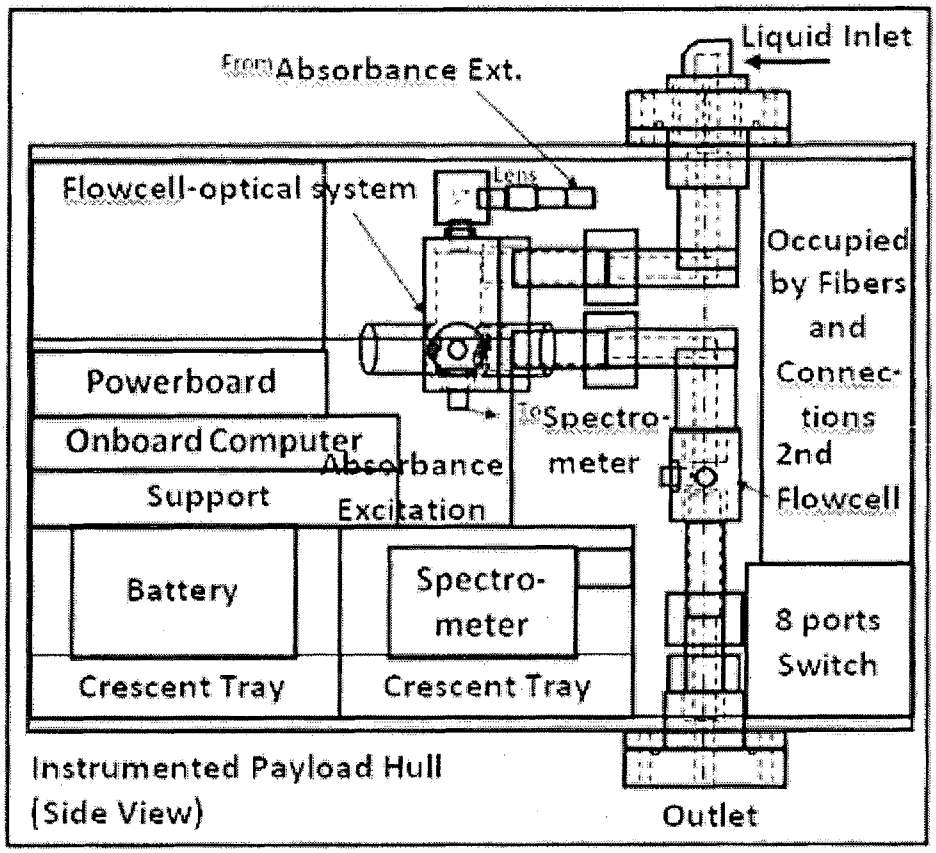

Liquid Inlet
From Absorbance Ext.
Lens
Flowcell-optical system
Occupied by Fibers and Connec-tions
Powerboard
To Spectro-meter
Onboard Computer
Absorbance Excitation
2nd Flowcell
Support
Battery
Spectro-meter
8 ports Switch
Crescent Tray
Crescent Tray
Instrumented Payload Hull
(Side View)
Outlet

FIG. 6A

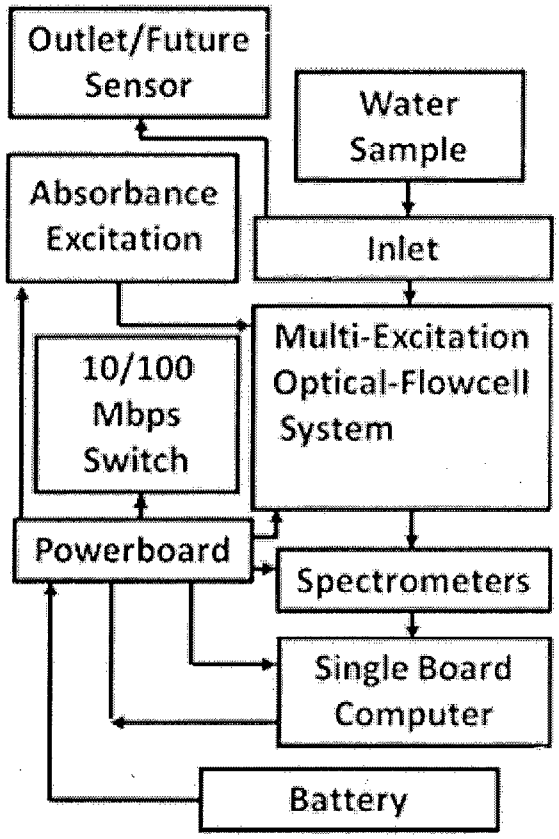

Outlet/Future Sensor
Water Sample
Absorbance Excitation
Inlet
10/100 Mbps Switch
Multi-Excitation Optical-Flowcell System
Powerboard
Spectrometers
Single Board Computer
Battery

FIG. 6B

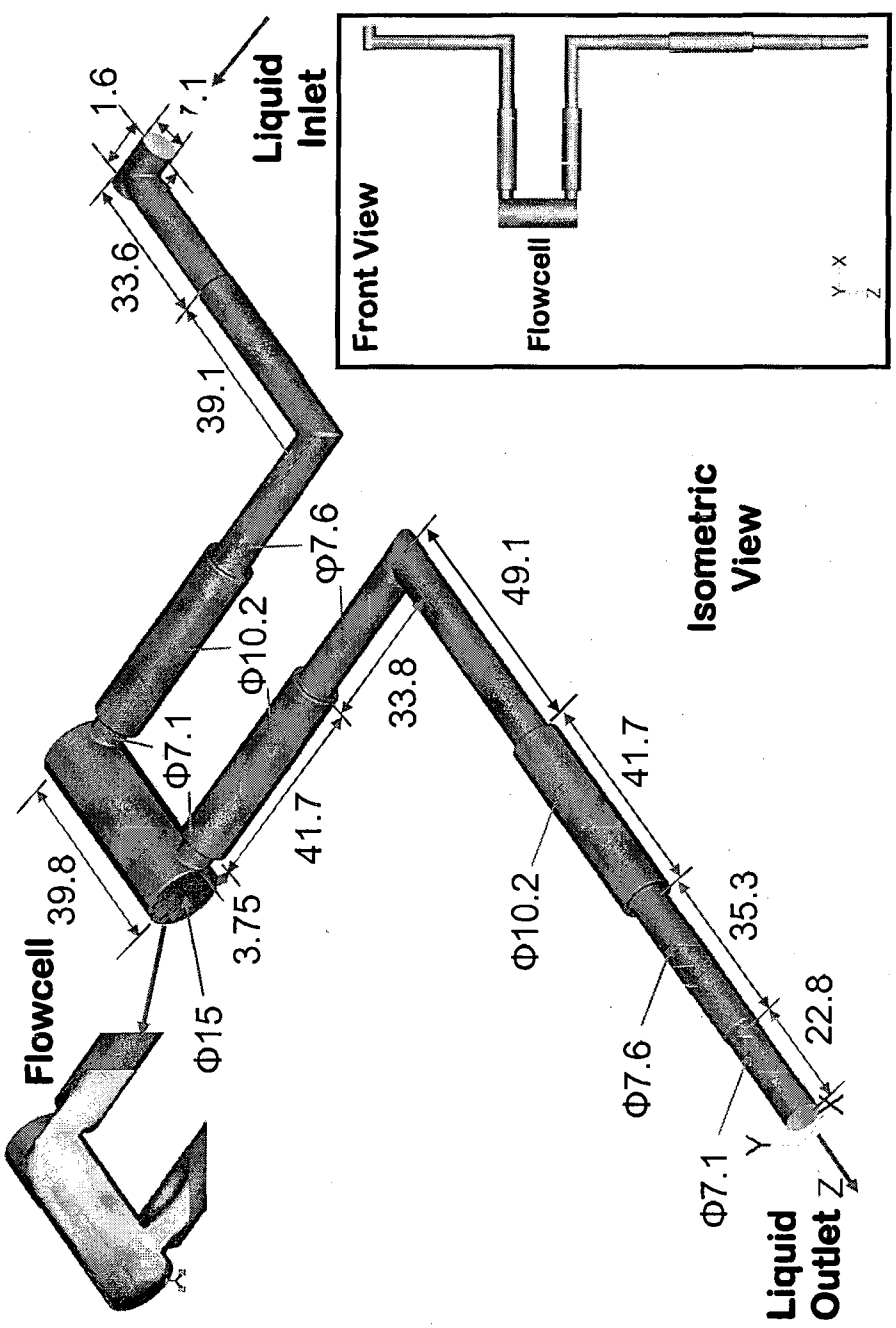

Liquid Inlet
Front View
Flowcell
Y X Z
1.6
7.1
33.6
39.1
Φ7.6
Φ10.2
Φ7.1
33.8
49.1
Isometric View
41.7
39.8
41.7
3.75
Φ10.2
35.3
Flowcell
Φ15
Φ7.6
22.8
Φ7.1
Y
Z
Liquid Outlet

FIG. 7

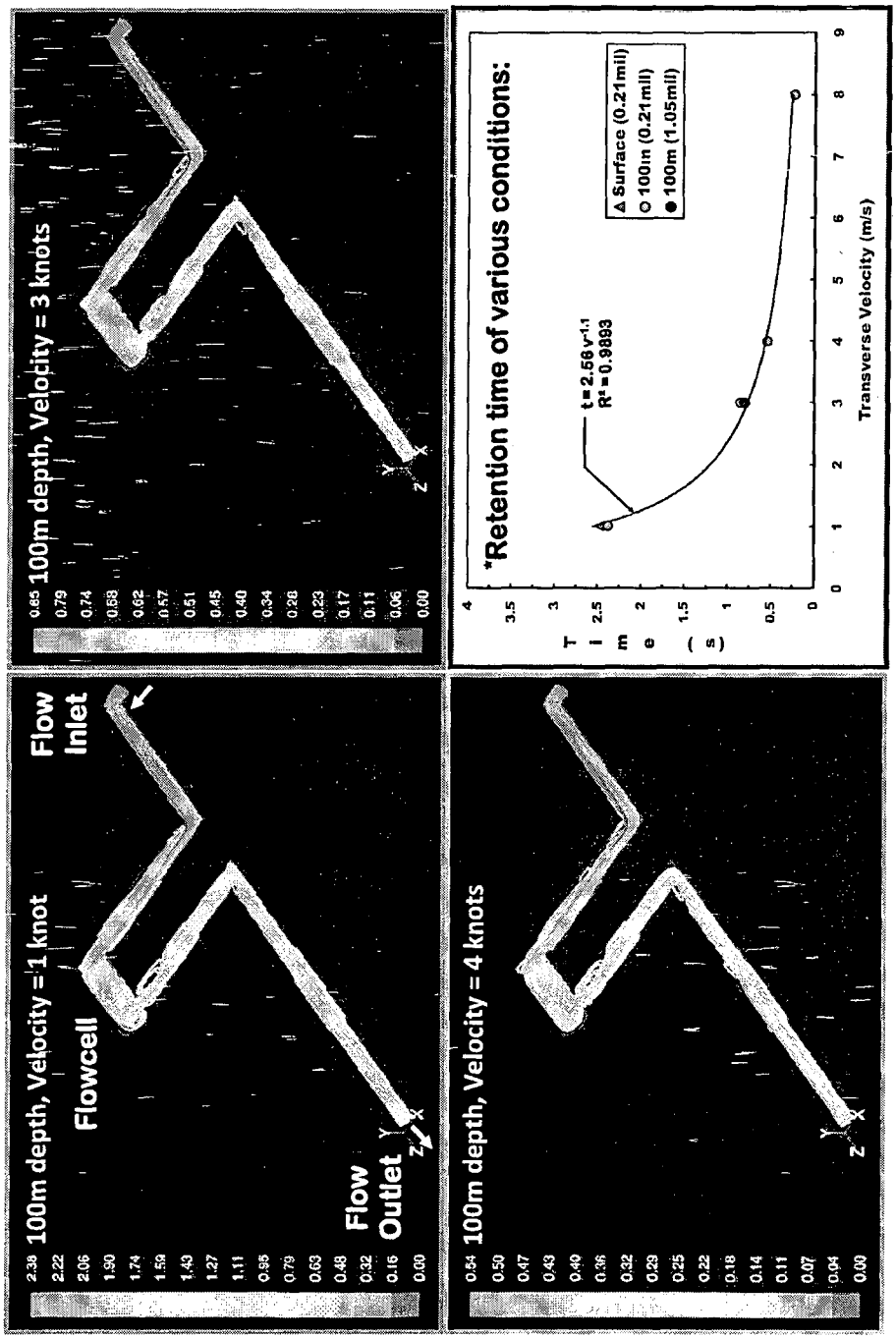

100m depth, Velocity = 1 knot
Flow Inlet
Flowcell
Flow Outlet
100m depth, Velocity = 3 knots
100m depth, Velocity = 4 knots
*Retention time of various conditions:
Δ Surface (0.21mil)
○ 100m (0.21mil)
● 100m (1.05mil)
t=2.56v^-1.1
R²=0.9893
Time (s)
Transverse Velocity (m/s)

FIG. 8A

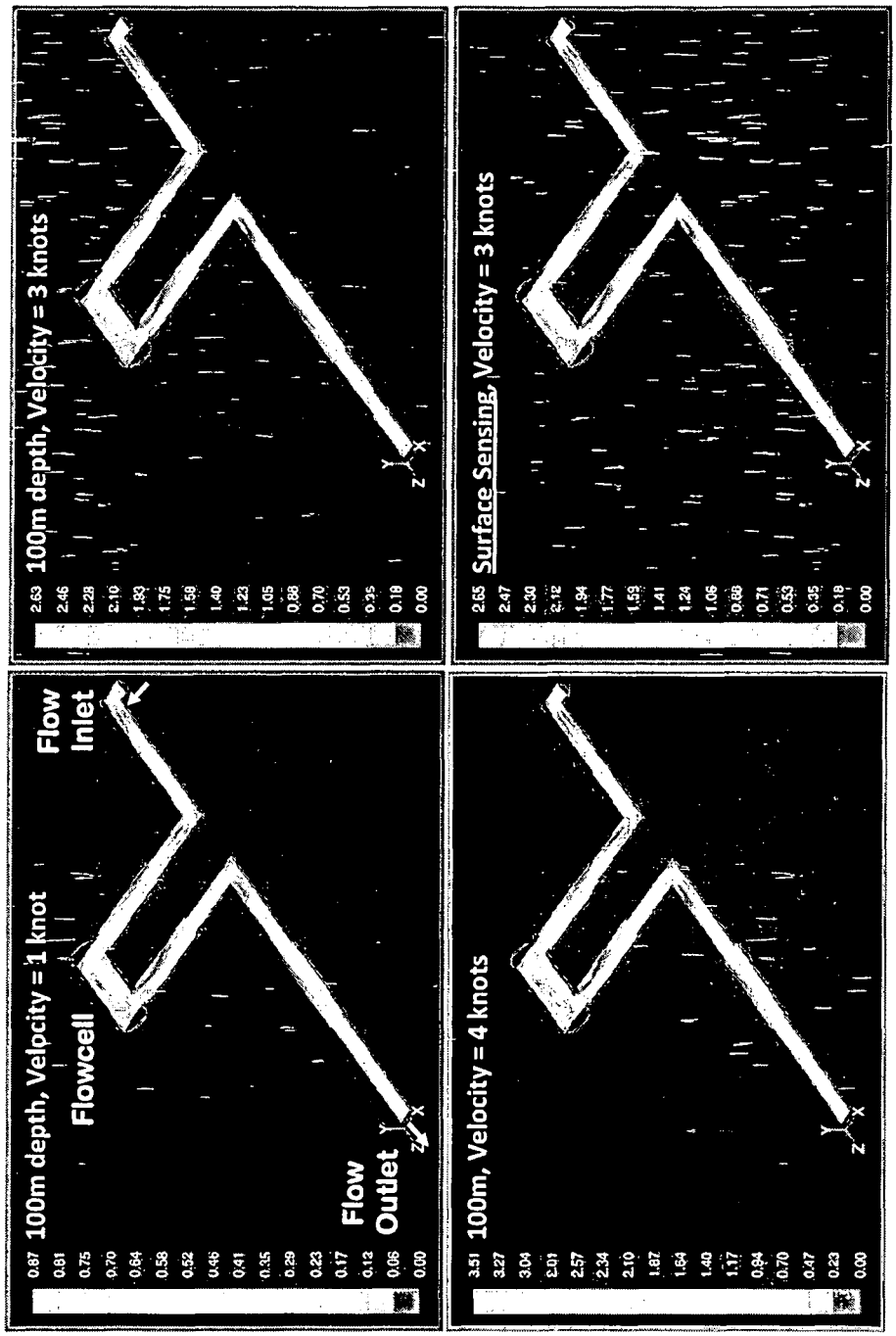

100m depth, Velocity = 1 knot
Flowcell
Flow Inlet
Flow Outlet
100m depth, Velocity = 3 knots
100m, Velocity = 4 knots
Surface Sensing, Velocity = 3 knots

FIG. 8B

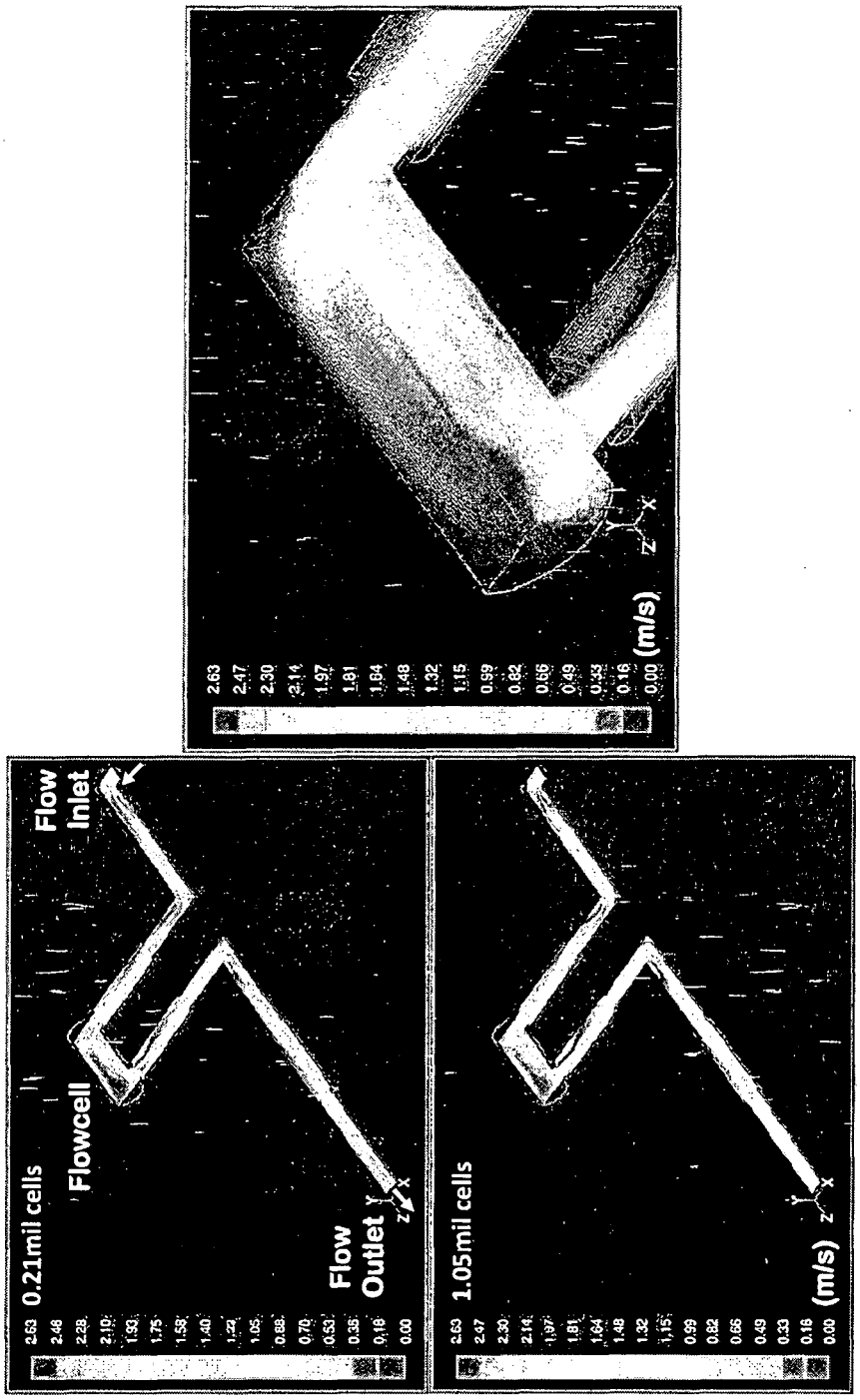

Flow Inlet
Flowcell
Flow Outlet
0.21mil cells
1.05mil cells
(m/s)
2.63
2.47
2.30
2.14
1.97
1.81
1.64
1.48
1.32
1.15
0.99
0.82
0.66
0.49
0.33
0.16
0.00

FIG. 8C

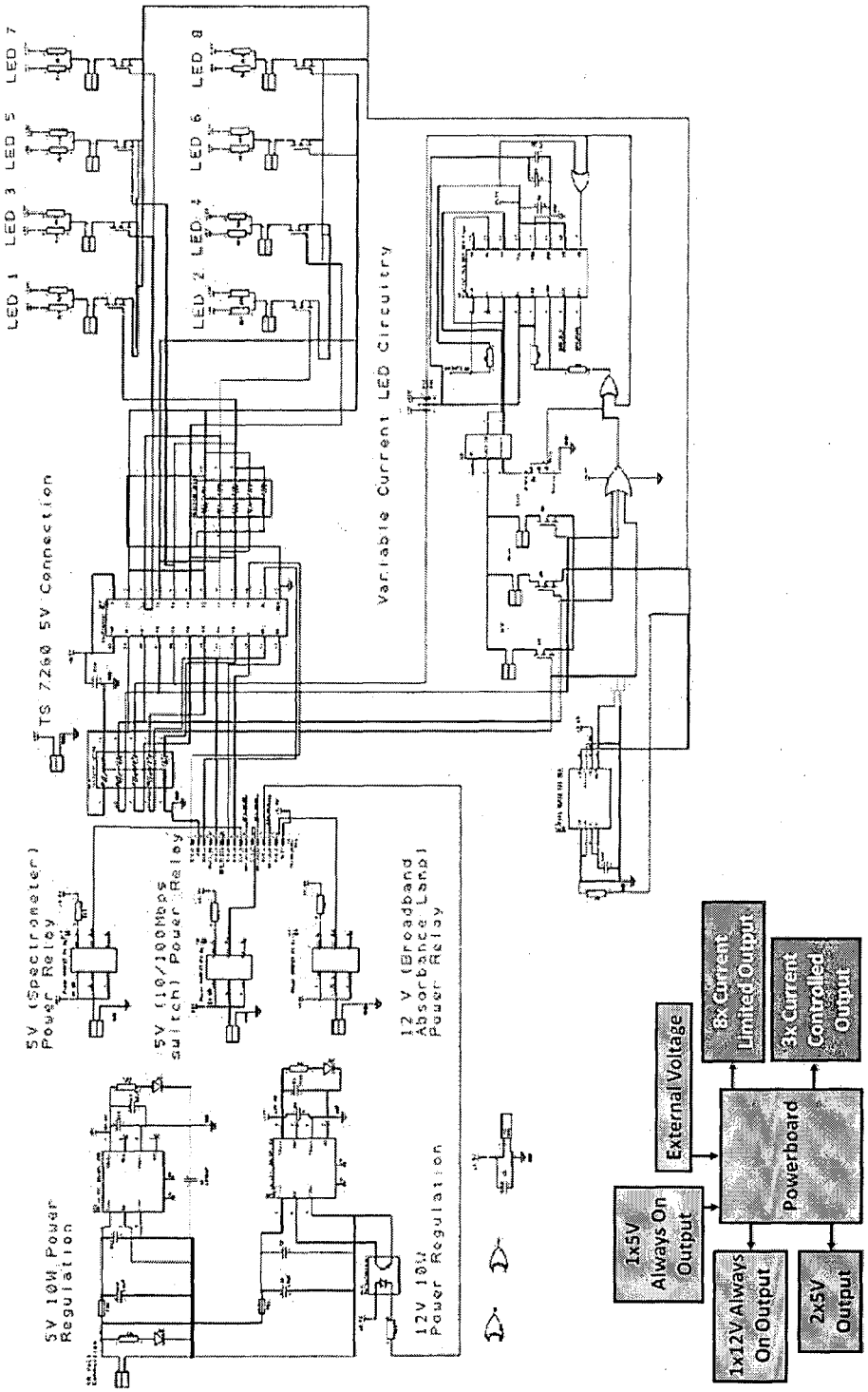

LED 1
LED 3
LED 5
LED 7
LED 2
LED 4
LED 6
LED 8
Variable Current LED Circuitry
TS 7260 5V Connection
5V (Spectrometer) Power Relay
5V (10/100Mbps switch) Power Relay
12 V (Broadband Absorbance Lamp) Power Relay
5V 10W Power Regulation
12V 10W Power Regulation
External Voltage
8x Current Limited Output
2x Current Controlled Output
1x5V Always On Output
Powerboard
1x12V Always On Output
2x5V Output

FIG. 9

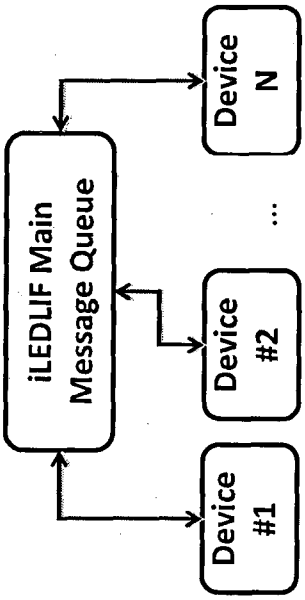


FIG. 10

```
Spec1 SetBoxcar 4                    'This will set the box car of the spectrometer to 4 pixels.
Spec1 SetIntegration 1000            'This will set the integration time of the spectrometer to 1 second.
LEDArray1 TurnOffLED                 'This will ensure that all LEDs have been turned off.
THIS WAIT ScanComplete Spec1 Scan    'This will wait until the scan finishes before executing the next command.
THIS DO 2                            'This will repeat the subsequent command loop twice—1st loop.
THIS WAIT LEDon LEDArray1 TurnonLED 1 'This will wait until LED 1 is turned on before executing the next command.
THIS WAIT ScanComplete Spec1 Scan    'This will wait until the scan finishes before executing the next command.
THIS DO 5                            'This will repeat data acquisition for 5 LED wavelengths—2nd loop.
THIS WAIT LEDon LEDArray1 NextLED    'This will turn on the next (subsequent wavelength, such as 285nm) LED. It will wait
                                     until the LED is on before executing the next command.
THIS WAIT ScanComplete Spec1 Scan    'This will wait until the scan finishes before executing the next command.
THIS LOOP                            'End of 2nd loop.
LEDArray1 TurnOffLED                 'This will turn off the LED at the end of the 2nd loop.
THIS LOOP                            'End of 1st loop.
```

FIG. 11

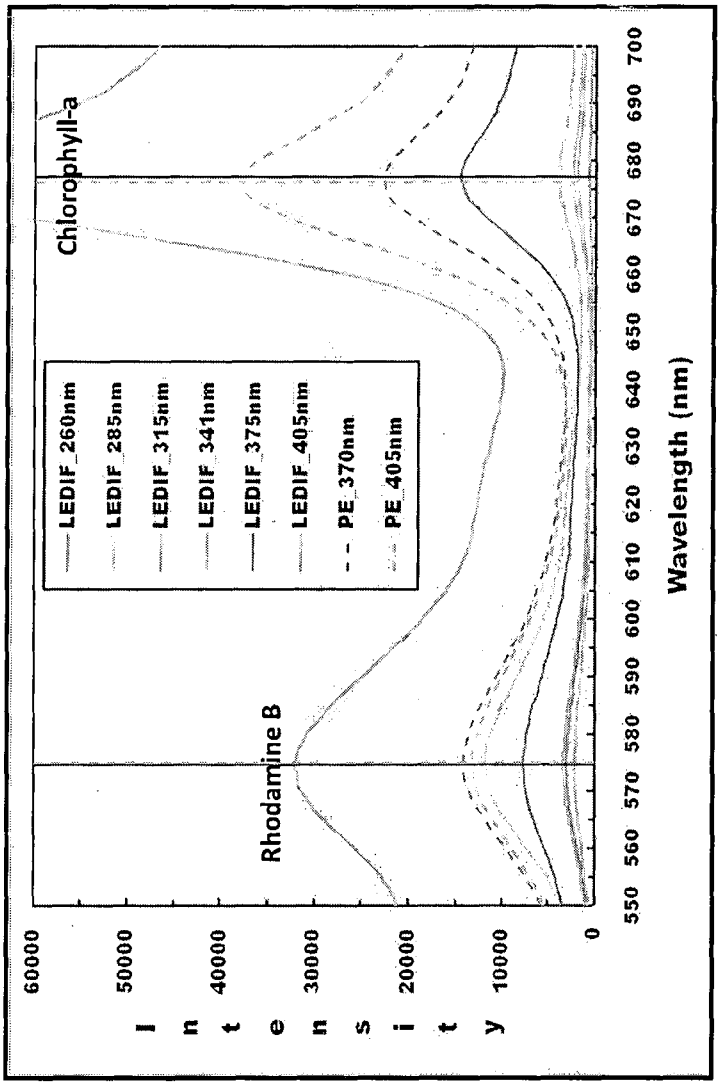

Chlorophyll-a
Rhodamine B
LEDIF_260nm
LEDIF_285nm
LEDIF_315nm
LEDIF_341nm
LEDIF_375nm
LEDIF_405nm
PE_370nm
PE_405nm
Intensity
60000
50000
40000
30000
20000
10000
0
550 560 570 580 590 600 610 620 630 640 650 660 670 680 690 700
Wavelength (nm)

FIG. 12A

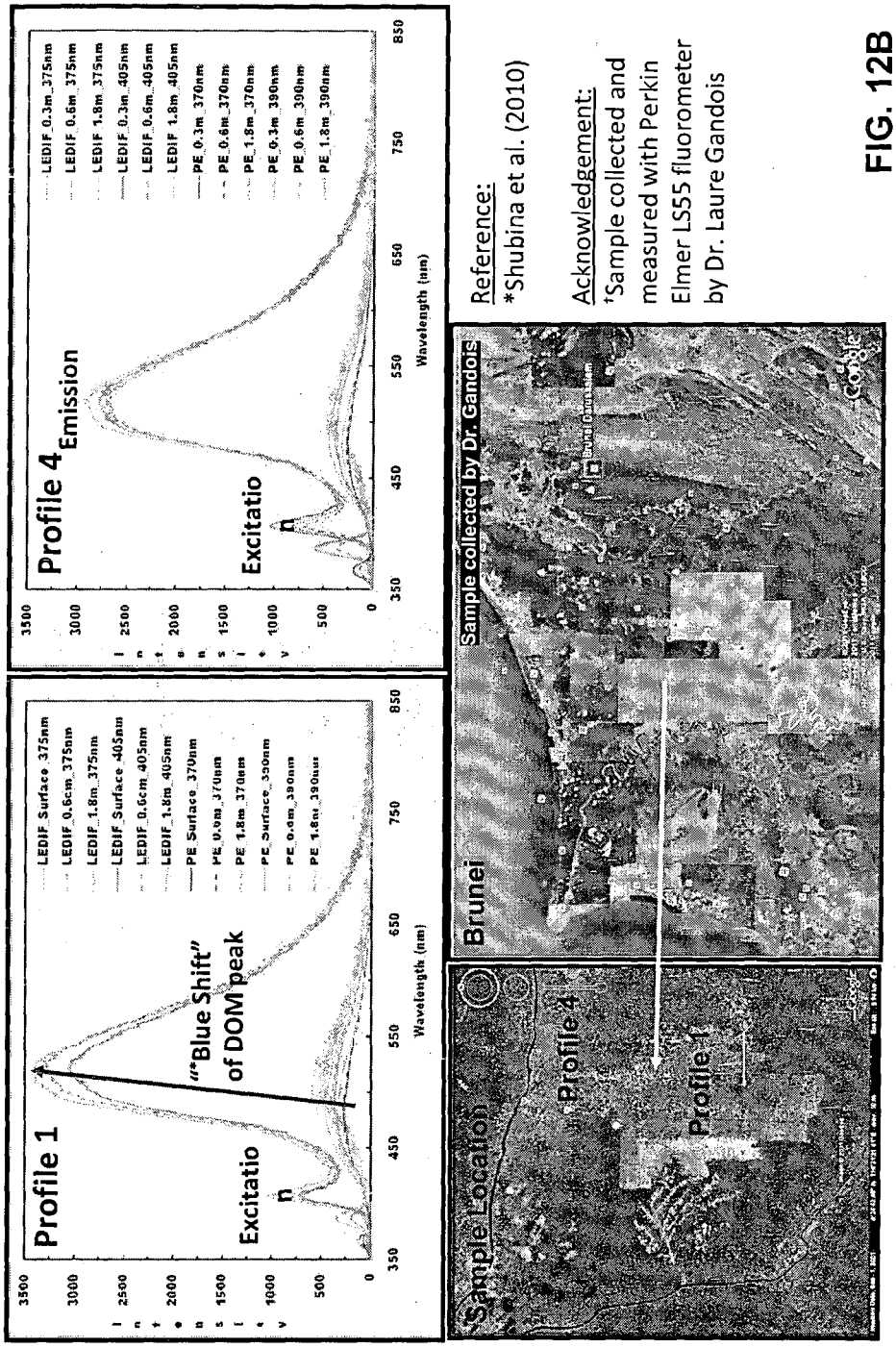
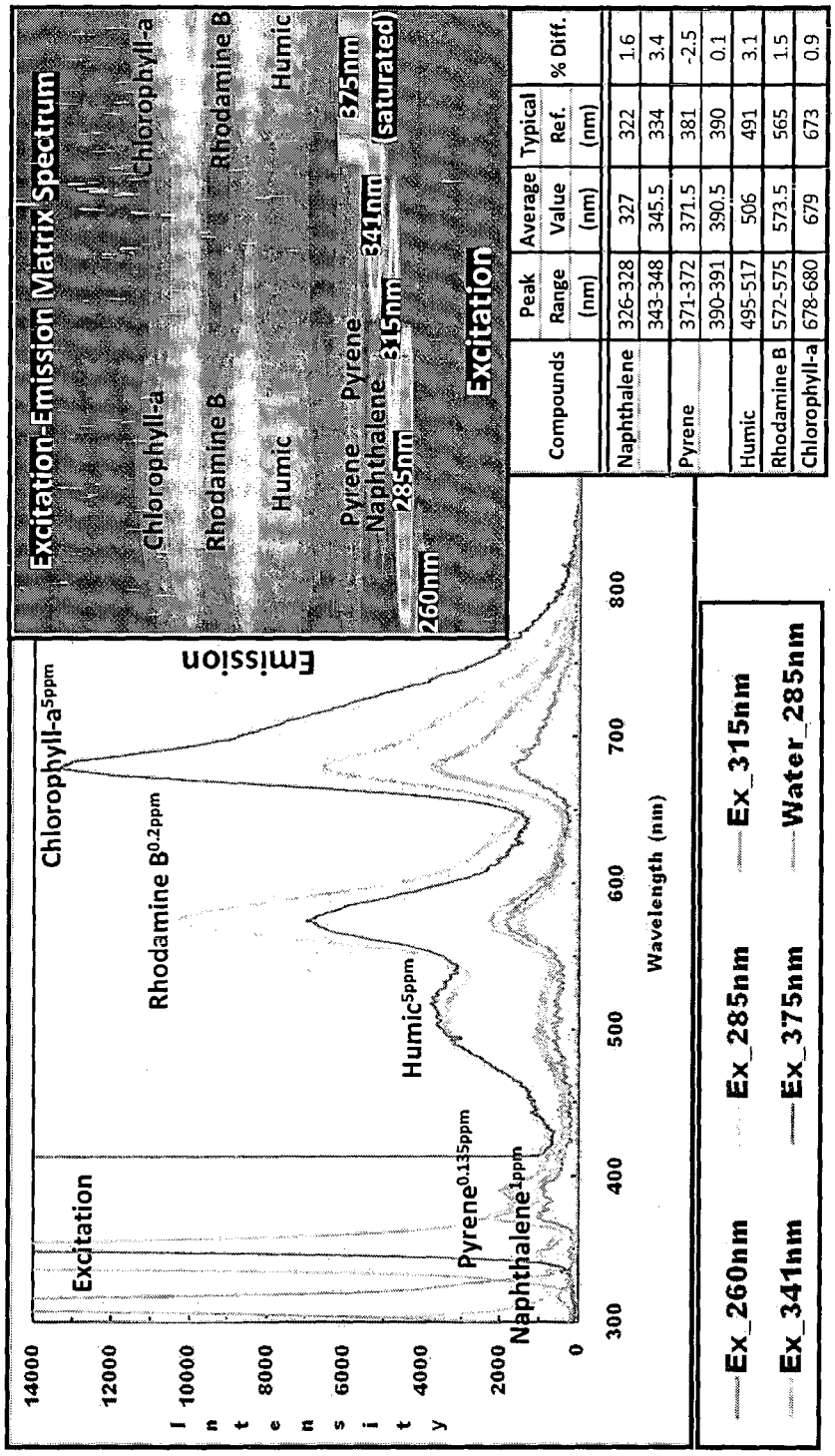
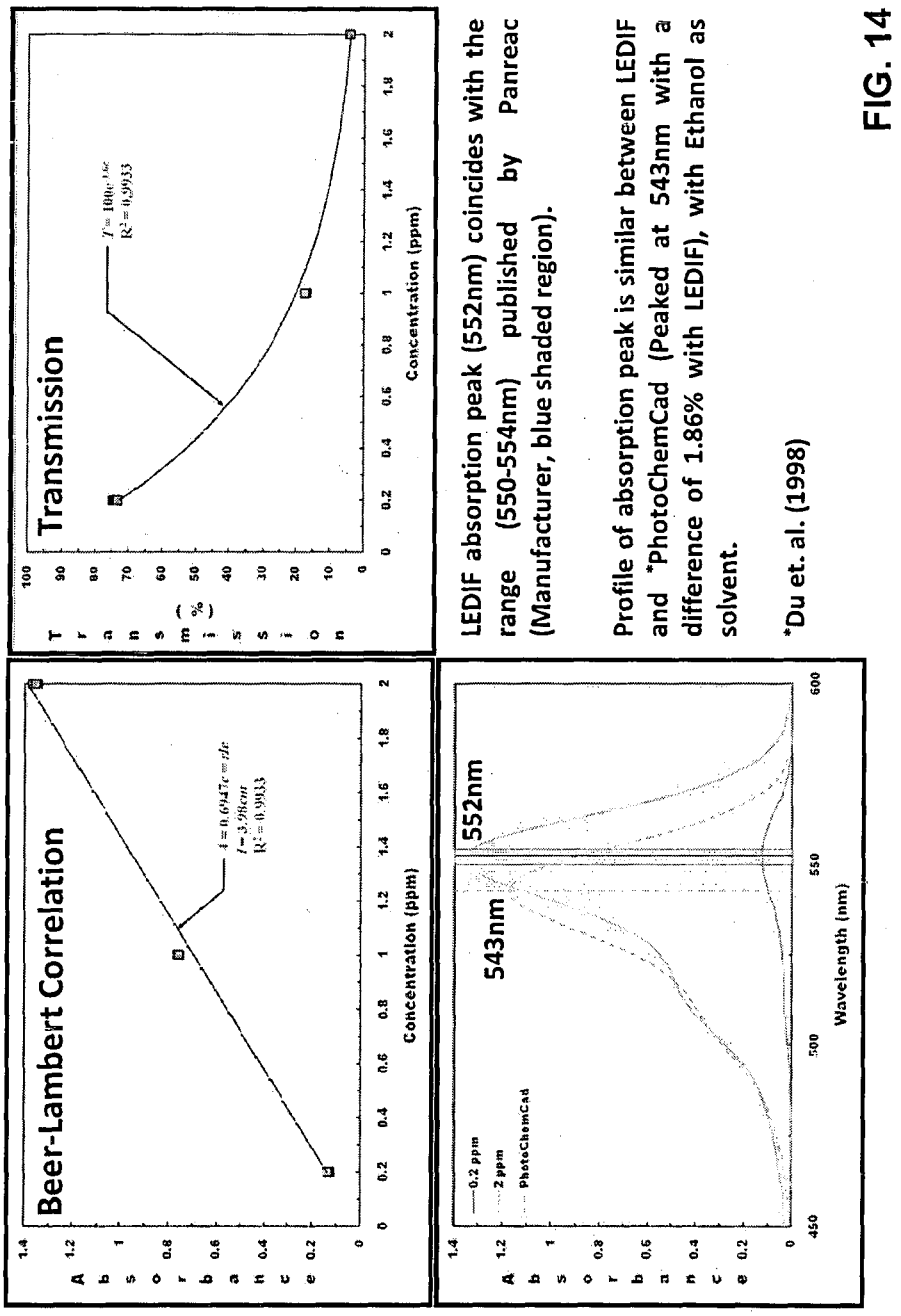

Profile 1
"Blue Shift" of DOM peak
Excitation
Wavelength (nm)
Profile 4
Emission
Excitation
Wavelength (nm)
Sample Location
Brunei
Profile 4
Profile 1
Sample collected by Dr. Gandois
Reference:
*Shubina et al. (2010)
Acknowledgement:
†Sample collected and measured with Perkin Elmer LS55 fluorometer by Dr. Laure Gandois

FIG. 12B



Compounds	Peak Range (nm)	Average Value (nm)	Typical Ref. (nm)	% Diff.
Naphthalene	326-328	327	322	1.6
	343-348	345.5	334	3.4
Pyrene	371-372	371.5	381	-2.5
	390-391	390.5	390	0.1
Humic	495-517	506	491	3.1
Rhodamine B	572-575	573.5	565	1.5
Chlorophyll-a	678-680	679	673	0.9

FIG. 13



LEDIF absorption peak (552nm) coincides with the range (550-554nm) published by Panreac (Manufacturer, blue shaded region).

Profile of absorption peak is similar between LEDIF and *PhotoChemCad (Peaked at 543nm with a difference of 1.86% with LEDIF), with Ethanol as solvent.

*Du et. al. (1998)

FIG. 14

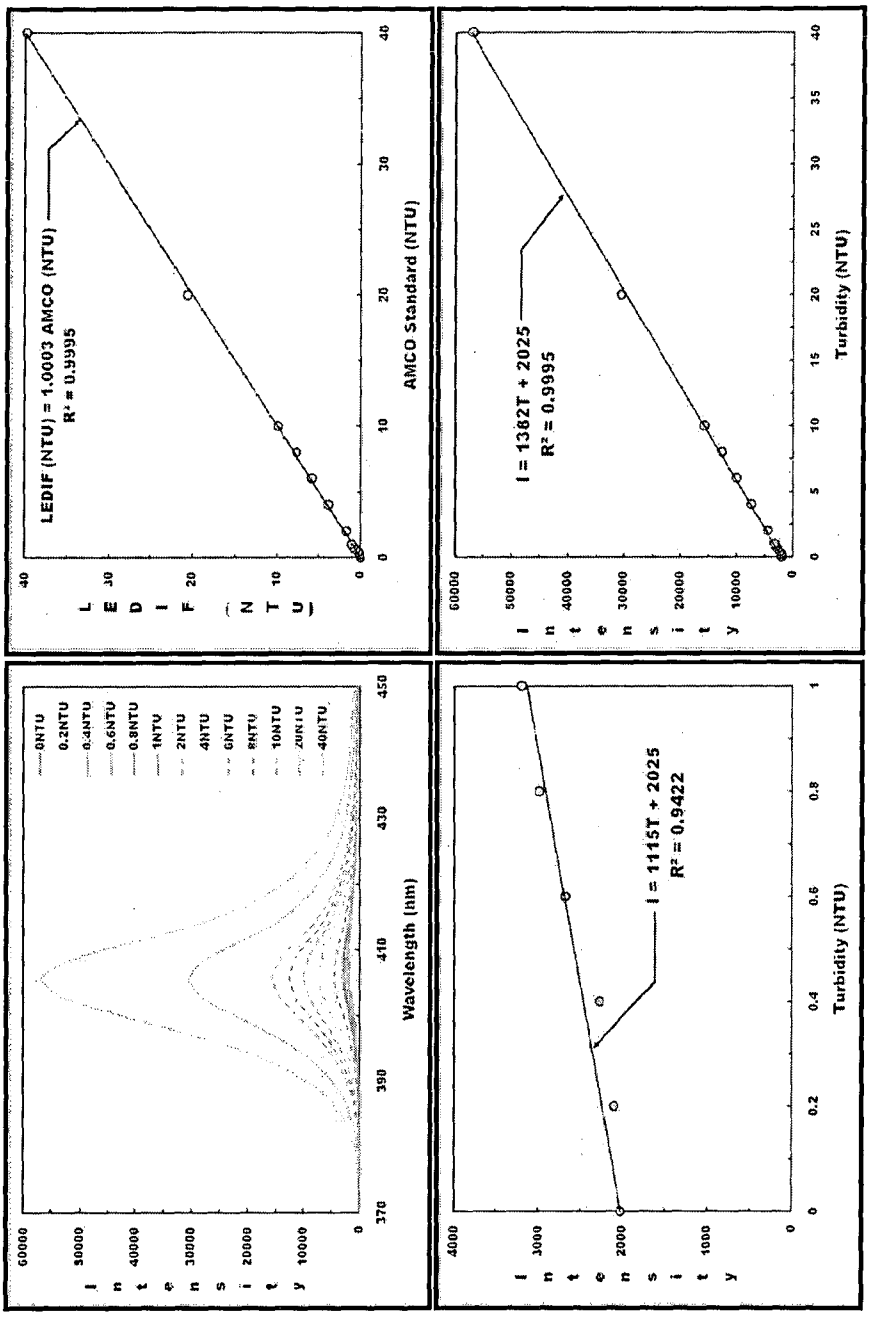

LEDIF (NTU) = 1.0003 AMCO (NTU)
R² = 0.9995
LEDIF (NTU)
AMCO Standard (NTU)
I = 1382T + 2025
R² = 0.9995
Intensity
Turbidity (NTU)
I = 1115T + 2025
R² = 0.9422
Intensity
Turbidity (NTU)
0NTU
0.2NTU
0.4NTU
0.6NTU
0.8NTU
1NTU
2NTU
4NTU
6NTU
8NTU
10NTU
20NTU
40NTU
Intensity
Wavelength (nm)

FIG. 15