Lab-on-Chip Nitrate + Nitrite Analyser

Technology description

The lab on chip nitrate+nitrite analyser is an autonomous submersible sensor which performs a colourimetric nitrate + nitrite analysis (using the Griess assay and cadmium reduction) on a microfluidic chip. A custom designed pump and multiple solenoid valves process environmental samples, standards, and chemical reagents within the device. A custom electronics package controls the system, logs data, and provides communications. The sensor can operate at full ocean depth (6000 m) by using an oil-filled pressure-compensated housing. The system can also be easily configured to measure only nitrite.

Environments and platforms where technology has been demonstrated

Laboratory, estuaries, rivers, glacial meltwater, CTD casts, benthic landers, coastal & deep moorings, remote-operated vehicles, autonomous underwater vehicles, gliders, floats

Analytical performance

The sensor is under continual development but has been demonstrated to the following specifications

Max. sample rate:	5 minutes (un-calibrated) 15 minutes (fully calibrated)
Calibration method:	analysis of on-board standards
Limit of detection:	20 nM
Sample volume:	280 µL per measurement
Range of linearity:	0.025-1000 µM
Deployment depth:	to 6000 m
Endurance:	2000 measurements with a standard reagent housing
Temperature range:	0-35°C (can work to -2°C with low temperature reagents)

Power and communications requirements

Voltage range:	10 V to 16 V
Power consumption:	1.8 W (typ.)
Current draw (12 V):	155 mA average, 385 mA maximum
Output interface :	RS232, RS485, USB
Connector type :	IE55 6-way or SubConn MCIL8M

Dimensions and weight

Dimensions:	17 cm long, 15 cm diameter (without reagent housing)
	56 cm high, 20 cm diameter (sensor with reagent housing)
Weight in air:	3.6 kg (without reagent housing)
	6 kg (sensor with reagent housing)
Weight in water:	0.85 kg

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Key publications

- Beaton, A. D., Cardwell, C., Thomas, R., Sieben, V., Legiret, F., Waugh, E., Statham, P., Mowlem, M., Morgan, H., Lab-on-Chip Measurement Of Nitrate and Nitrite for In Situ Analysis of Natural Waters, *Environmental Science and Technology*, 46, **2012**

- Yücel M, Beaton AD, Dengler M, Mowlem MC, Sohl F, Sommer S, Nitrate and Nitrite Variability at the Seafloor of an Oxygen Minimum Zone Revealed by a Novel Microfluidic In-Situ Chemical Sensor. *PLoS ONE* 10, 7, **2015**

- Beaton, A. D., Wadham, J. L., Bagshaw, E. A., Hawkings, J. R., Lamarche-Gagnon, G., Mowlem, M., Tranter, M., High-resolution in situ measurement of nitrate in runoff from the Greenland Ice Sheet, *Environmental Science and Technology*, 51 (21), **2017**

- Birchill, A. J., Clinton-Bailey, G., Hanz, R., Mawji, M., Cariou, T., White, C., Ussher, S. J., Worsfold, P. J., Achterberg, E. P., Mowlem, M., Realistic measurement uncertainties for marine macronutrient measurements conducted using gas segmented flow and Lab-on-Chip techniques, *Talanta,* 200, **2019**

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