NEXT GENERATION AUTONOMOUS CHEMICAL SENSORS: LOW COST NUTRIENT DETECTION FOR WATER QUALITY MONITORING

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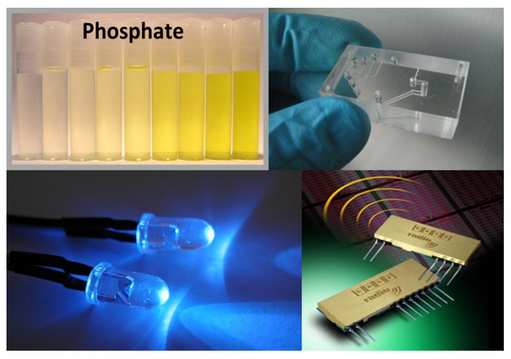
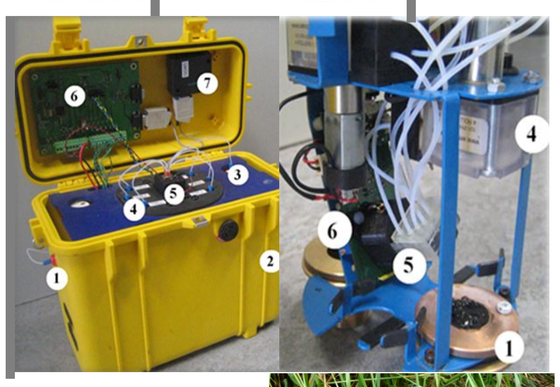
Microfluidic technology has potential as a solution to the increasing demand for environmental monitoring; through minimization of reagents, standard solutions, and power consumption. These efforts will lead to the **development of compact autonomous instruments** for in **situ continuous monitoring** of remote locations over long deployable lifetimes. There is therefore a growing need for **low cost**, reliable systems which can be deployed in sufficient numbers to ensure that data on **key water quality parameters** is available at the appropriate geographic and temporal densities to allow stakeholders to make well-informed decisions on **the management and protection of our environmental waters.**



Our approach is to combine

- **Colorimetric** chemical assays
- **Microfluidic** systems: Advantages
- **Low cost** LED/photodiode-based optical detection systems
- **Wireless** communications.

Systems Development



(1) Sample inlet; (2) Enclosure; (3) Reagent storage; (4) Pumps; (5) Microfluidic detection system; (6) Control board; (7) Communications.

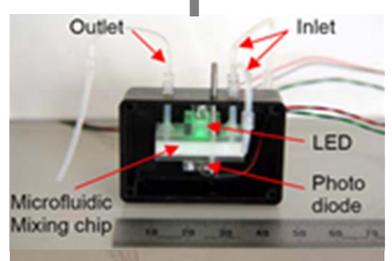
Continued effort to-

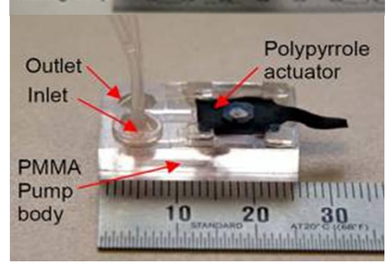
✓Minimize reagent consumption and waste generation

✓Minimize power consumption, allowing long battery lifetimes

✓Allow the development of compact devices which are easy to transport and deploy

✓Enhance sensitivity, reproducibility, and speed for certain assays

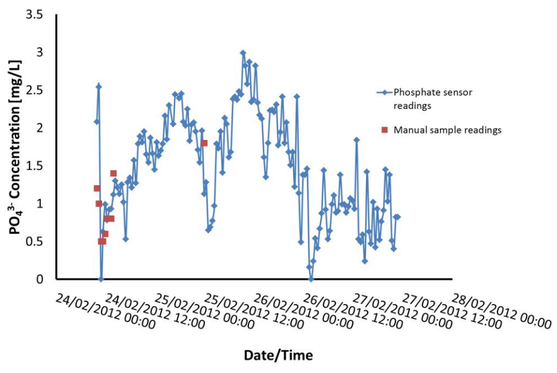




Shows a Bench top instrument based on polypyrrole actuator pump and optical detection in a microfluidic chip.

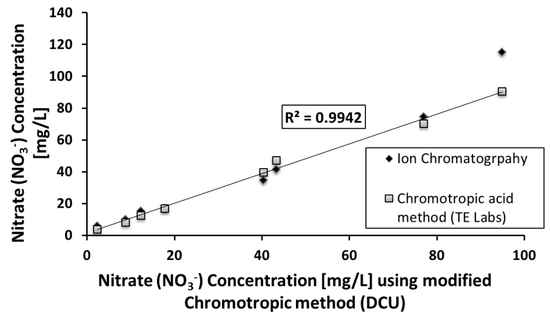
Targets and Optimisation/Simplification of Methods

Phosphate



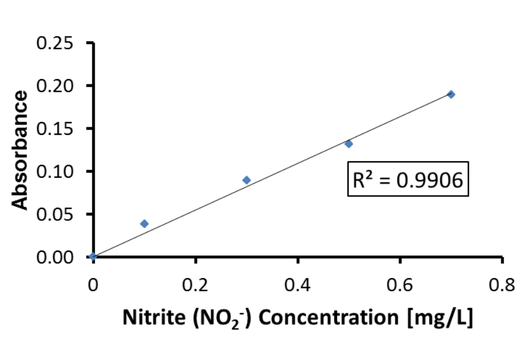
Data from a phosphate analyzer trial at Broadmeadow Water Estuary, Co. Dublin.

Nitrate



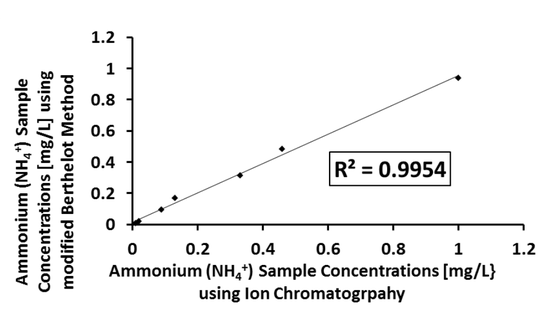
A simplified chromotropic acid method was developed eliminating several steps previously associated with this method and validated to produce a low cost technique for the direct determination of nitrate in water.

Nitrite



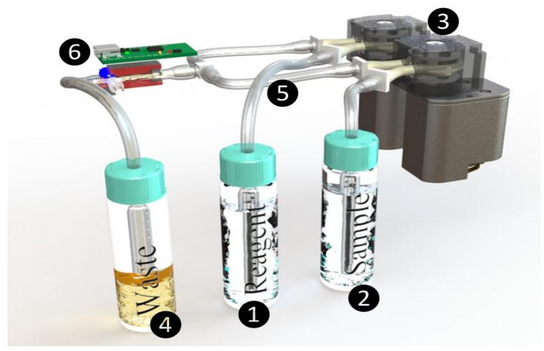
Linear response to sample nitrite obtained using Griess reagent, measured using a 540nm LED light source and a single photodiode detector in a benchtop nitrite detection system.

Ammonia

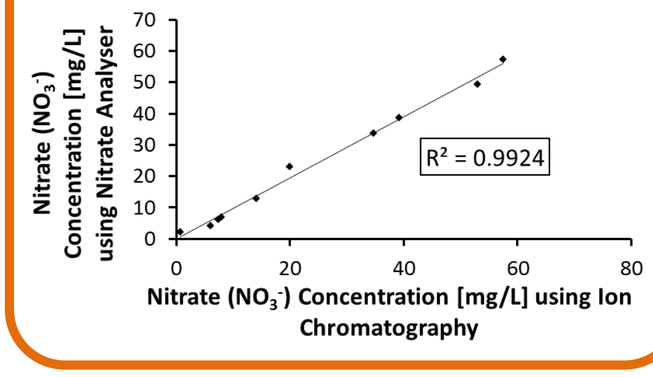


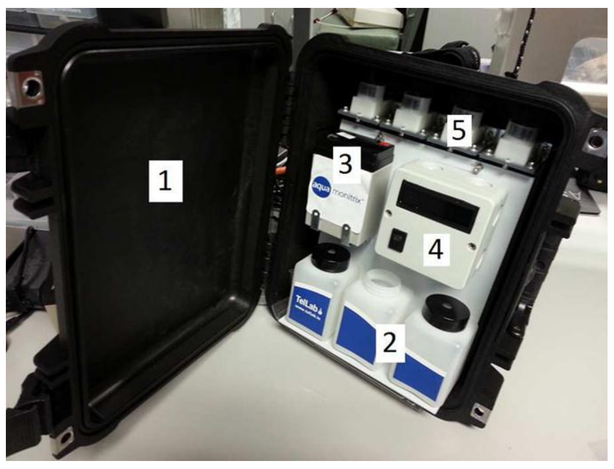
Linear response of ammonia sample concentrations obtained by a simplified variation of Berthelot method (reducing the number of reagents and elimination of toxic substances) as a function of ammonia sample concentrations obtained using the standard method, ion chromatography.

Integration of Chemistry into Autonomous Sensing Platform



Nitrate analyser (1) Reagent storage (2) Sample storage (3) Peristaltic micro pumps containing Santropene® tubing (4) Waste storage (5) Tygon® tubing (6) PEDD flow cell



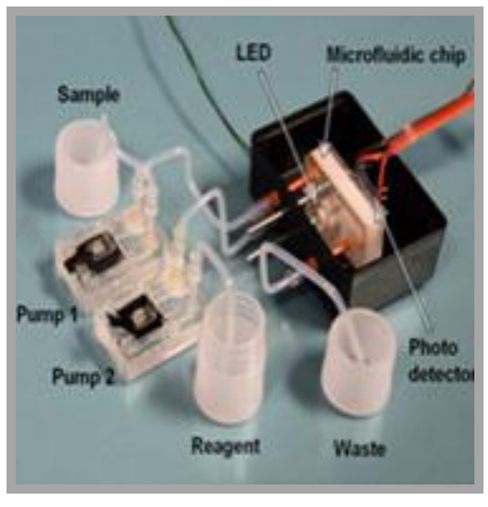


Integrated ammonia analyser (1) Waterproof housing (2) reagent and standard containers (3) 12V battery (4) optical detector (5) motors for syringe pump array.

A low cost, rapid monitoring system for ammonia was developed employing the simplified Berthelot reagent. Work is now focussed on field deployments of the analyser.

Future Work- Futuristic Matchbox Analyser

- Work has begun on the investigation of polymer actuators to control liquid in a microfluidic manifold.
- The goal is to integrate polymer actuator valves into the microfluidic chip, which will significantly drive down the overall cost of the platform replacing conventional pumps and valves.



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