The optimisation of an autonomous phosphate sensor for remote continuous monitoring

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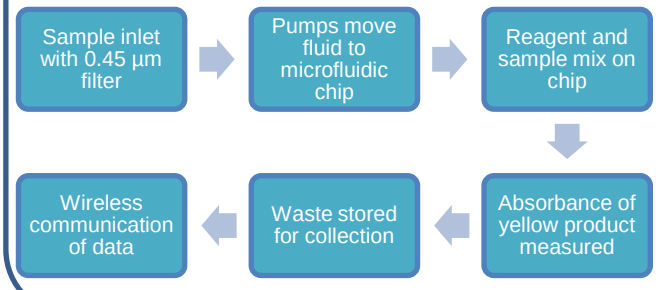
Introduction

Phosphorus (P) is a growth limiting nutrient. When P levels increase, excessive growth of algae occurs, leading to hypoxic waters and subsequent death of aquatic animals. The EU Water Framework Directive states that rivers should not exceed phosphate levels of 0.1 mg L^{-1}. An affordable network of phosphate sensors for continuous, real-time monitoring, providing temporal and spatial variations in phosphate levels is essential for the management of water quality. An automated phosphate sensor has been developed in DCU, which will be optimised in order to improve the limit of detection, making it fit for use in rivers.

The phosphate sensor



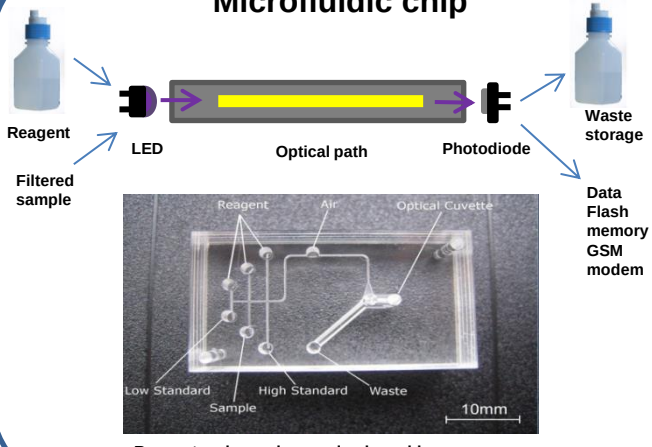
Electronics and GSM modem in lid

Microfluidic chip on top plate

Pumps mounted on top plate

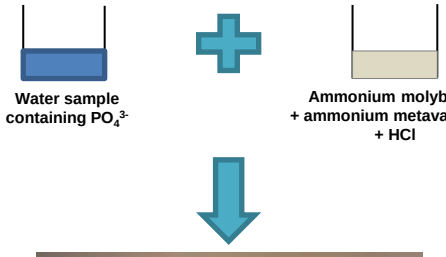
Reagent bottles and battery in base

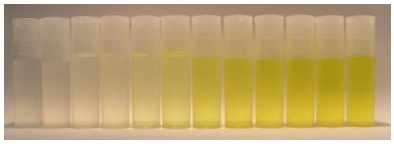
Microfluidic chip



- Reagent and sample are mixed on-chip.
- Absorbance is measured in the optical cuvette.

Optimised chemistry





Vanadomolybdophosphoric acid

Conclusion

This P sensor utilises the molybdenum yellow method for optical detection of phosphate. The LOD of 0.2 mg L^{-1} PO_4 limits the applicability of this sensor to waters with higher levels of phosphate such as effluent in waste water treatment plants or waters known to be polluted.

To improve the LOD the microfluidic chip was optimised. The reduction in LOD will allow the sensor to be used in more diverse water environments such as rivers and lakes, with lower concentrations of phosphate.

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