PORTABLE LAB-ON-A-DISC SYSTEM FOR IN-SITU AQUATIC ENVIRONMENTAL MONITORING

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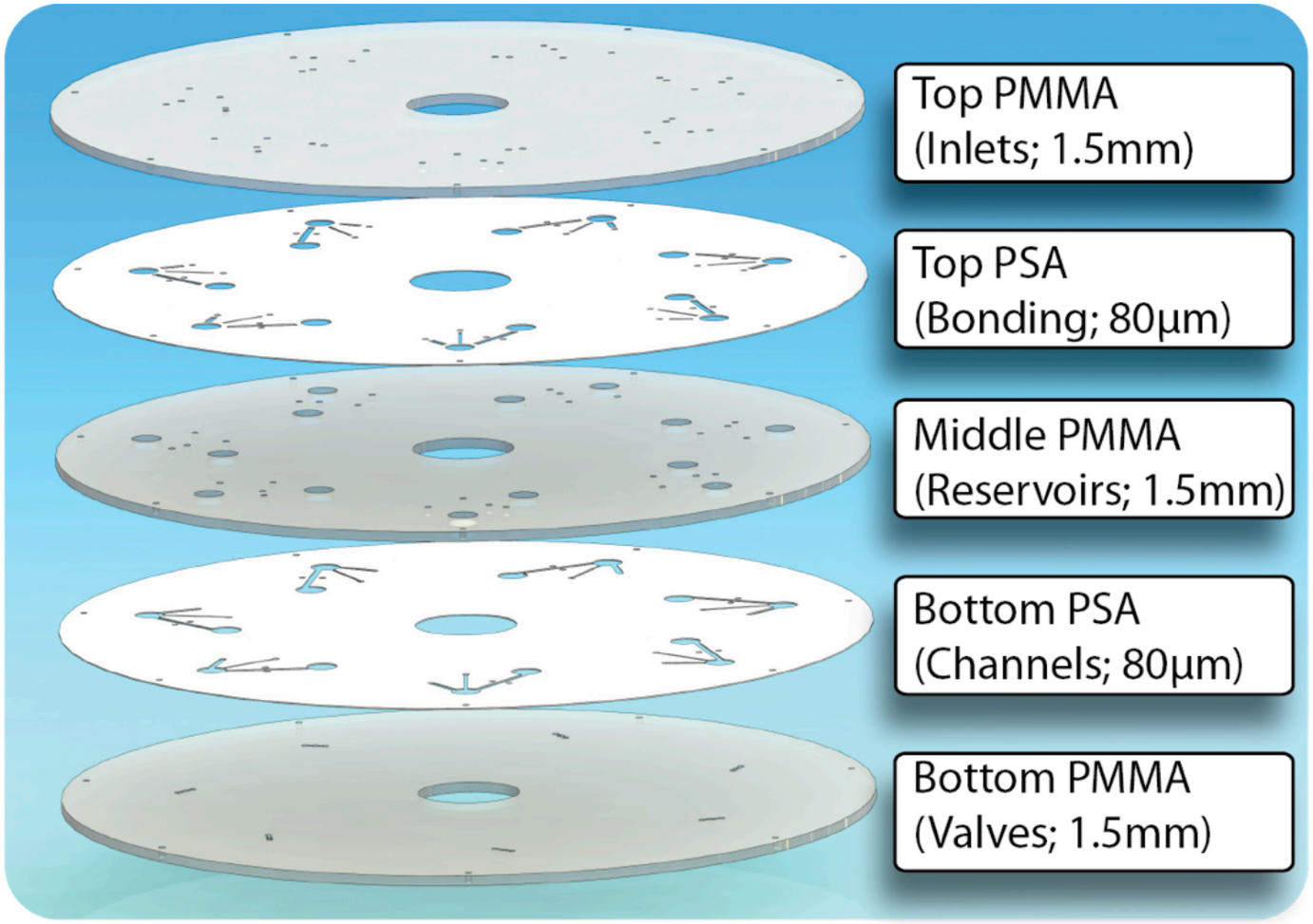
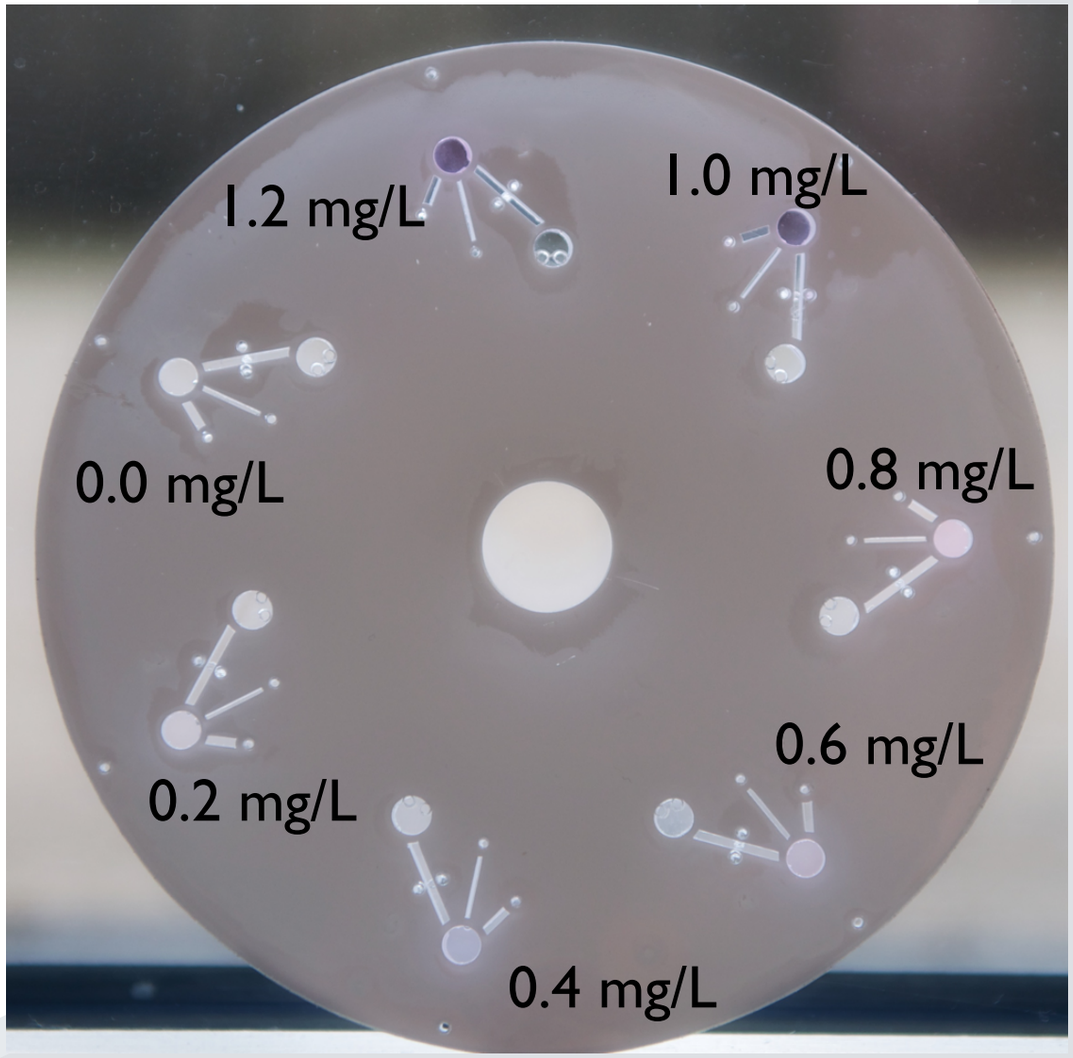
Presentation outline

- Centrifugal platform design
- Centrifugal micro-fluidic analysis system (CMAS)
- Mechanism of the nitrite detection
- Sequence of the Experiment
- Validation of the system - UV/VIS
- Validation of the method - CMAS
- Real water sample analysis (nitrite detection)

Centrifugal Platform for Nitrite Detection

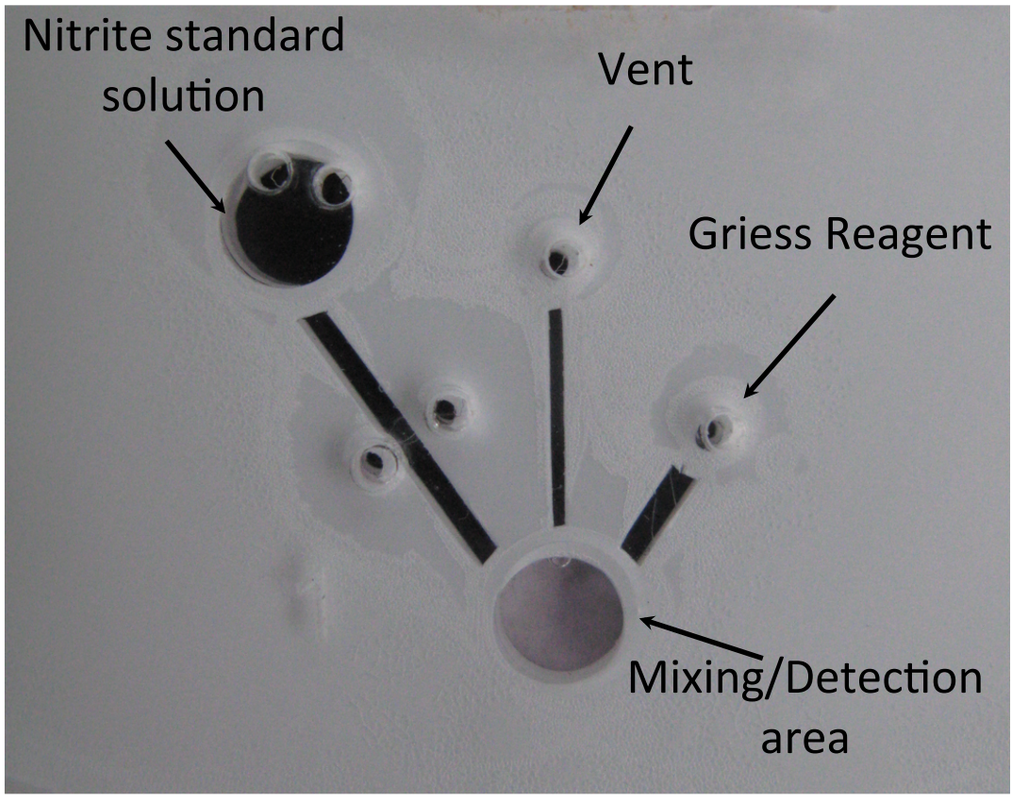


Assembly of the micro-fluidic CD



Lab-on-a-Disc

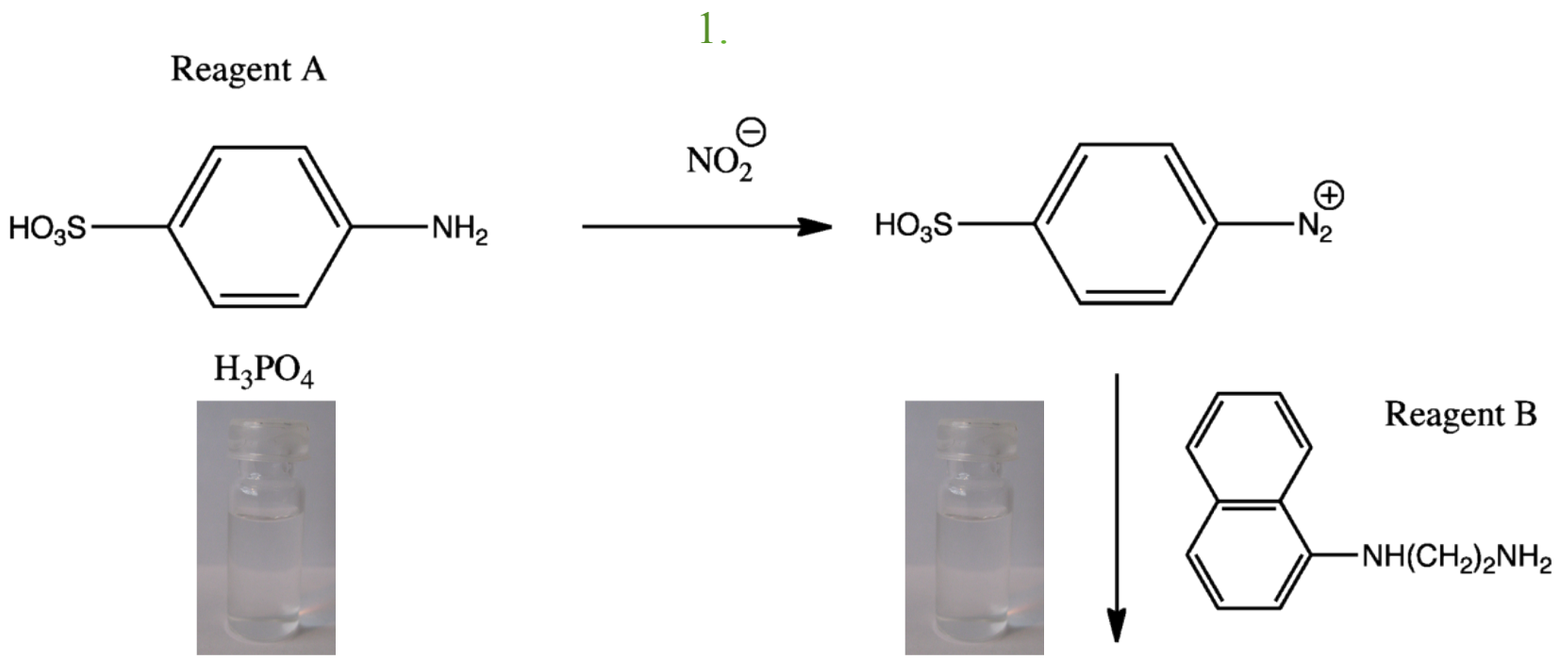
Single Micro-fluidic Design

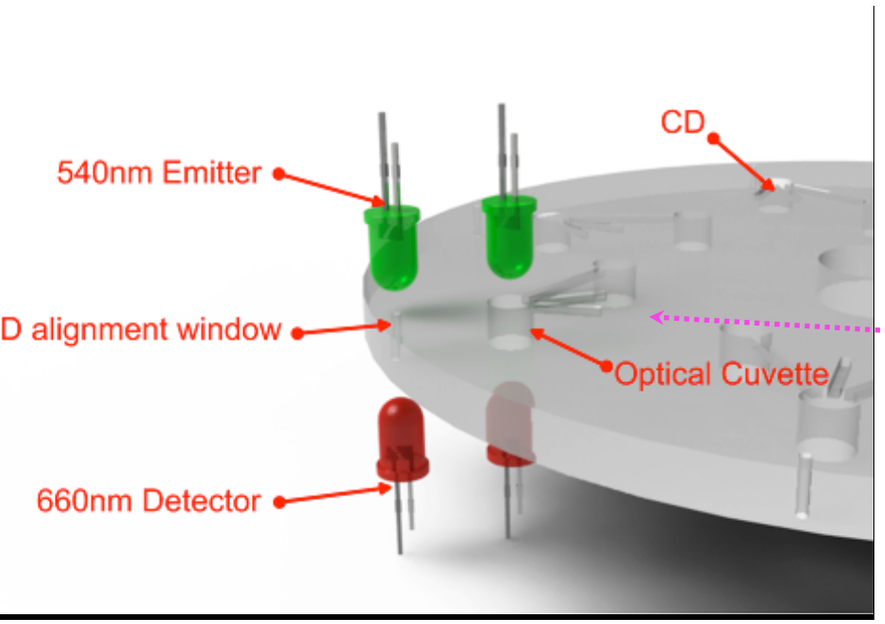


- Standard solution/Sample reservior - 31.5 uL
- Air vent (bubble prevention)
- Griess Reagent reservoir - 2.1 uL
- Microchannels - 1000 um width
- Mixing/Detection area - 33.5 uL

Single chip consisting of three chambers.

Mechanism of the Nitrite Detection





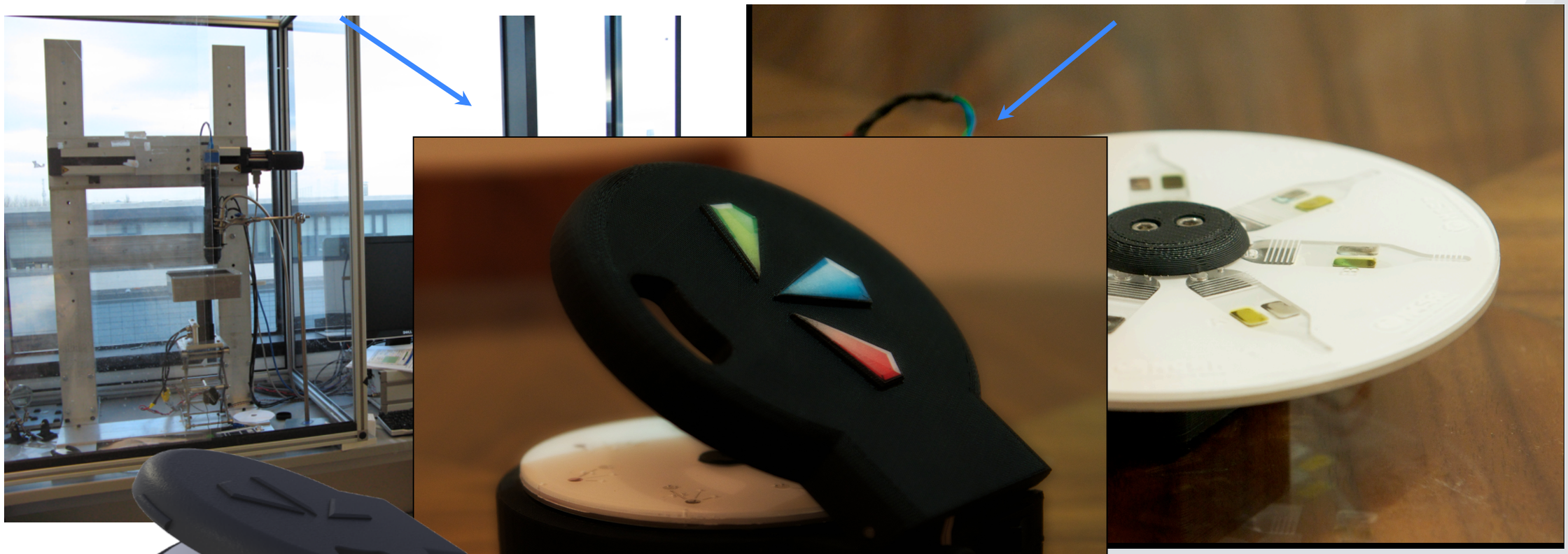
1. sulfanilic acid (Reagent A) $\xrightarrow{NO_2^-}$ diazonium salt

2. diazonium salt + N-(1-naphthyl)ethylenediamine (Reagent B) ⟶ azo dye

"Nitrate/nitrite reduction tests, In: Biochemical tests for identification of medical bacteria", J. MacFaddin, 348, 3rd ed. Lippincott Williams & Wilkins, Philadelphia, (2000)

Centrifugal Micro-fluidic Analysis System (CMAS)

CLARITY
clarity-centre.org



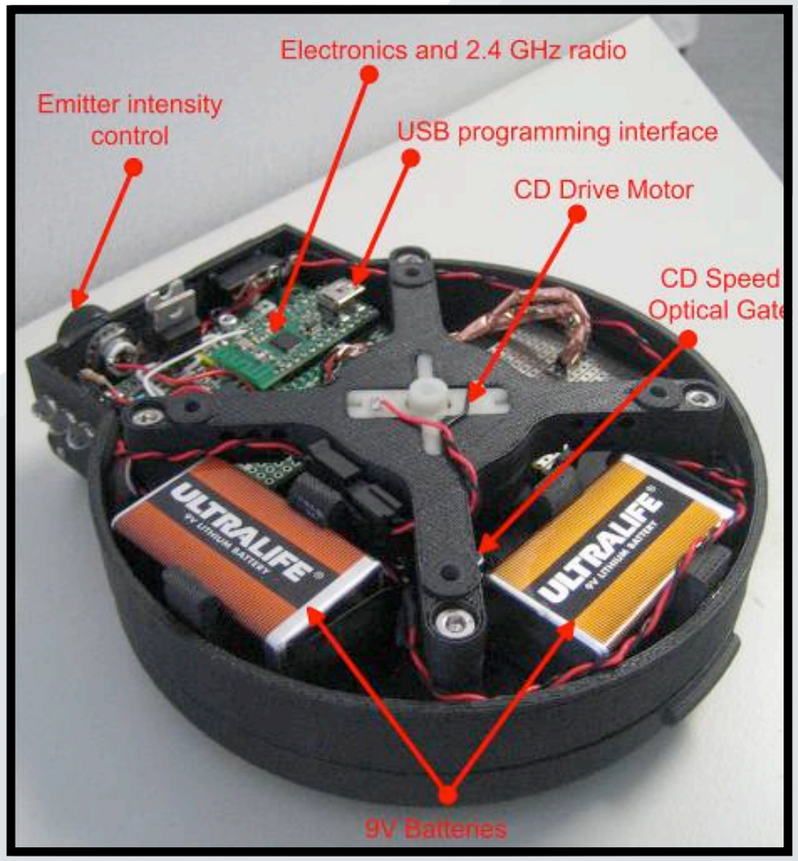
Fl ling)

tric Analysis

Spinning + Colorimetric Analysis

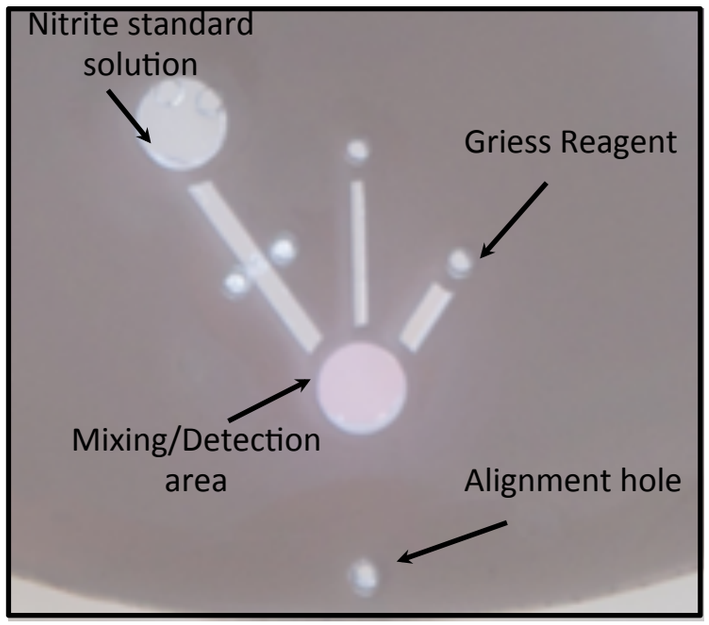
Centrifugal Micro-fluidic Analysis System (CMAS)

- Low cost single use micro-fluidic device.
- Multiple samples analysis in a single micro-fluidic device.
- Multiplexing capabilities (pH, turbidity, nitrite,...).
- Portable system: sample analysis at the point of care.
- Wireless communication system.



Sequence of the Experiment

1. Loading the samples and reagent

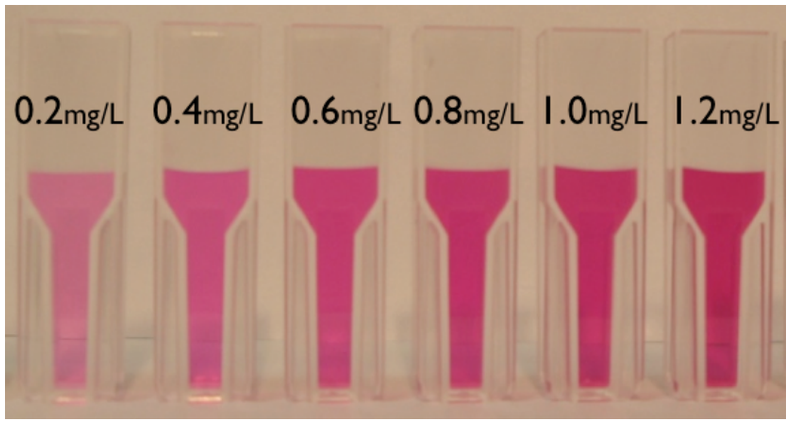


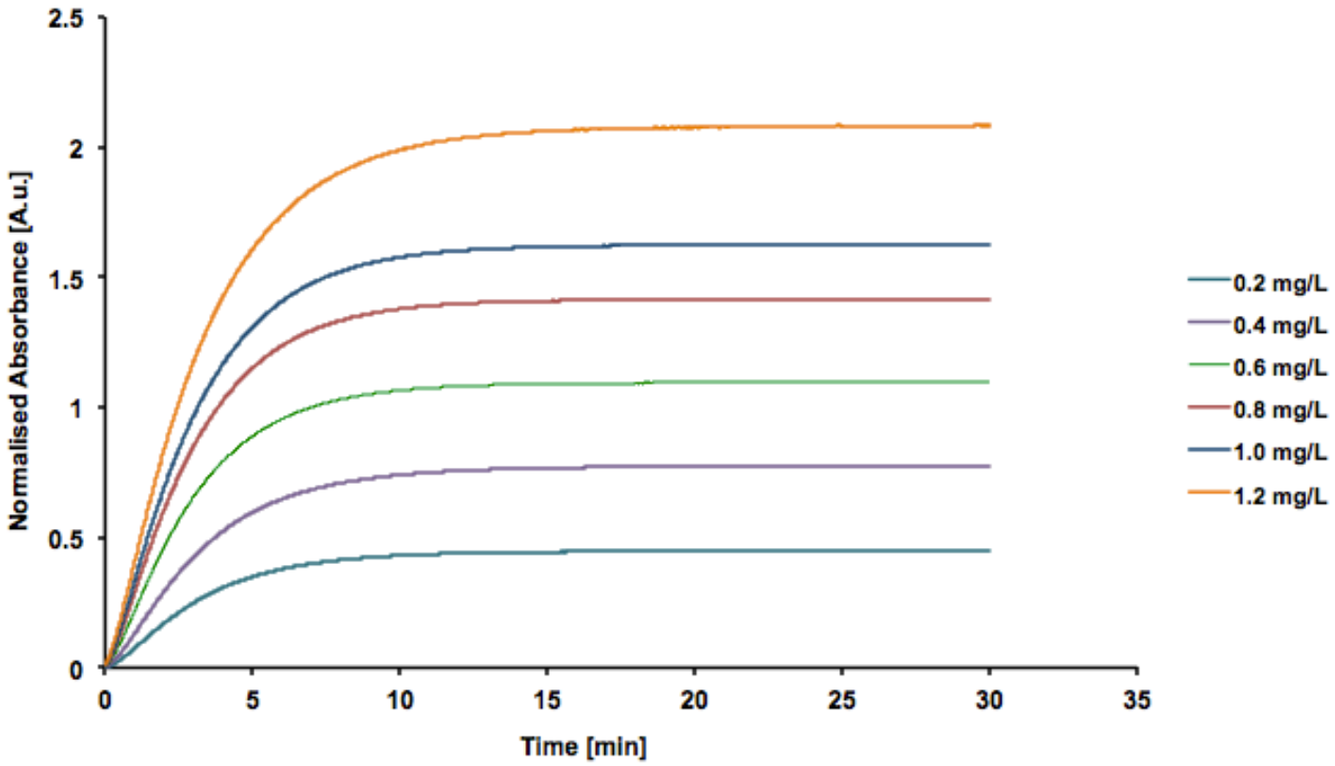
4. Detection

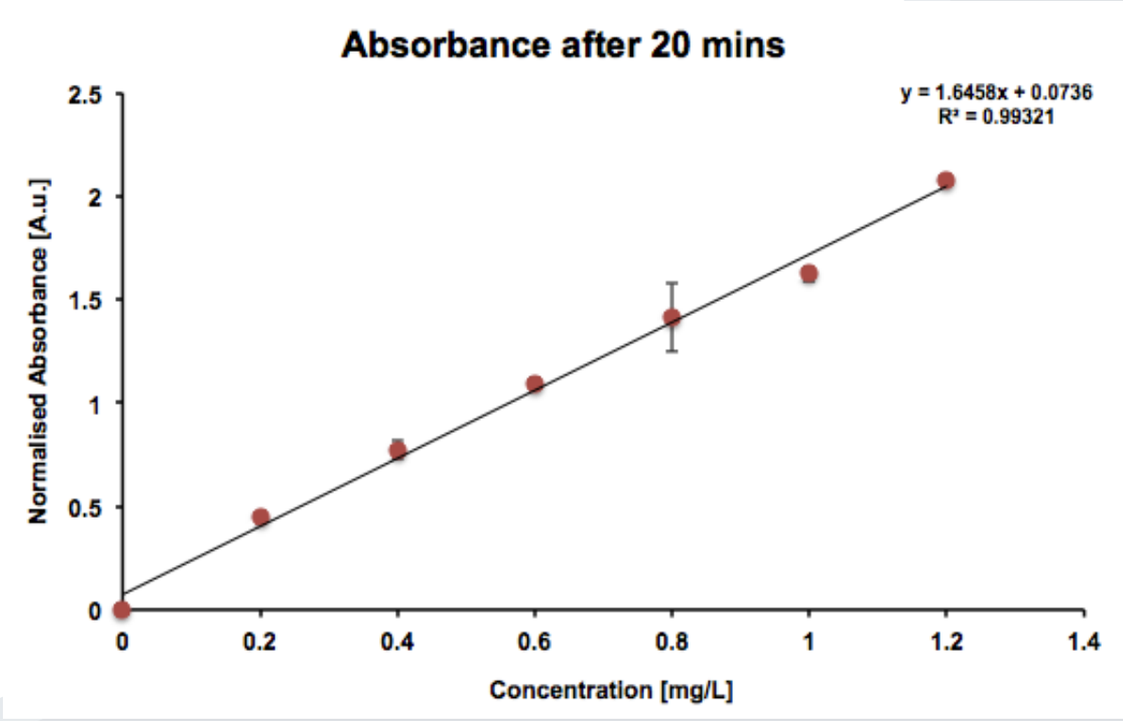
2. Spinning of the CD
(1000 rpm, 90 s)

3. Alignment of CD

Validation of the method - UV/Vis spectroscopy

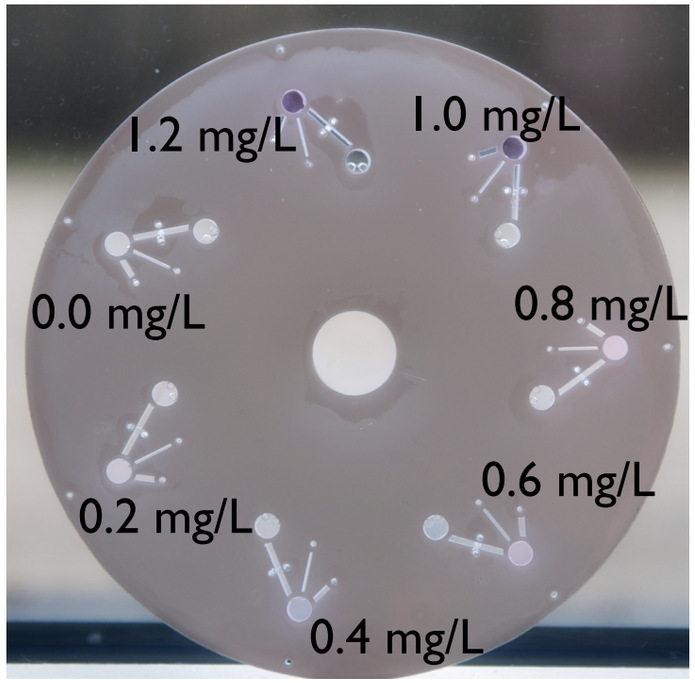


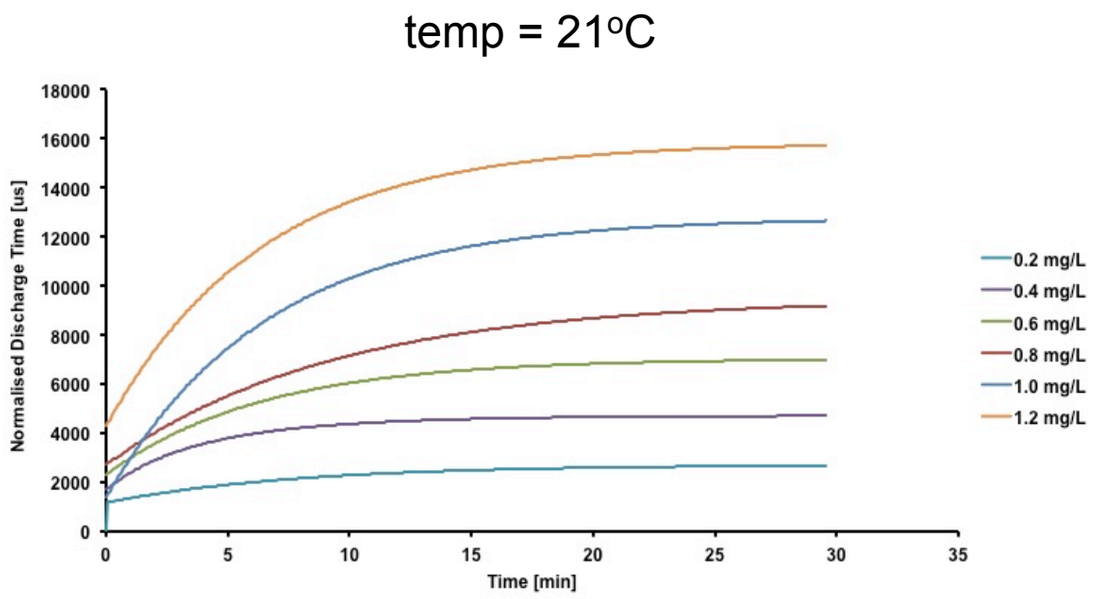


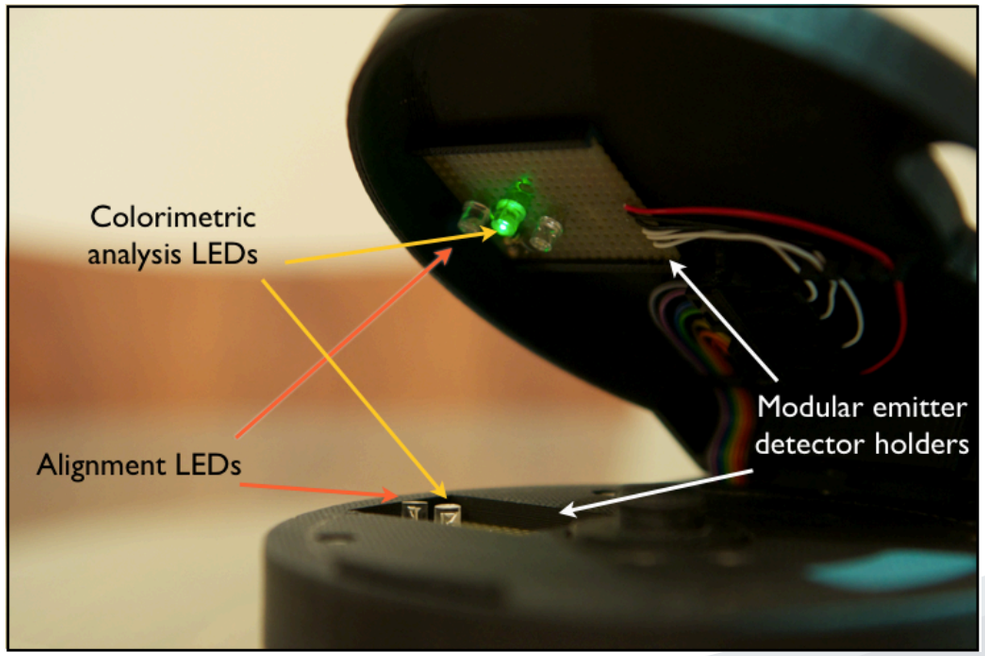


Study of the colour formation between NO_2 and Griess reagent (n = 2) (left side) and absorbance versus nitrite Griess reagent complex concentration (right side) using a UV-Vis spectrometer.

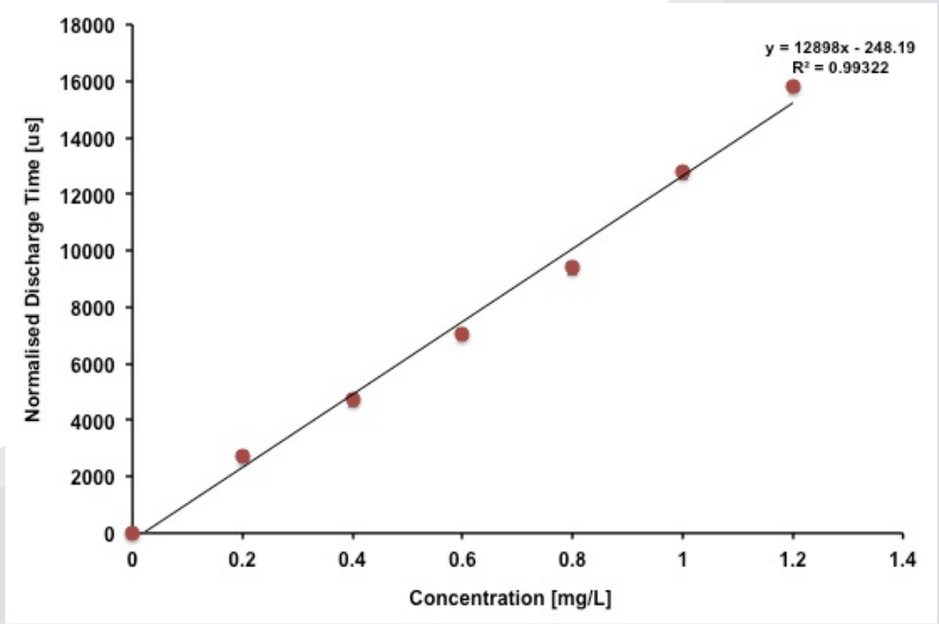
Validation of the method - CMAS





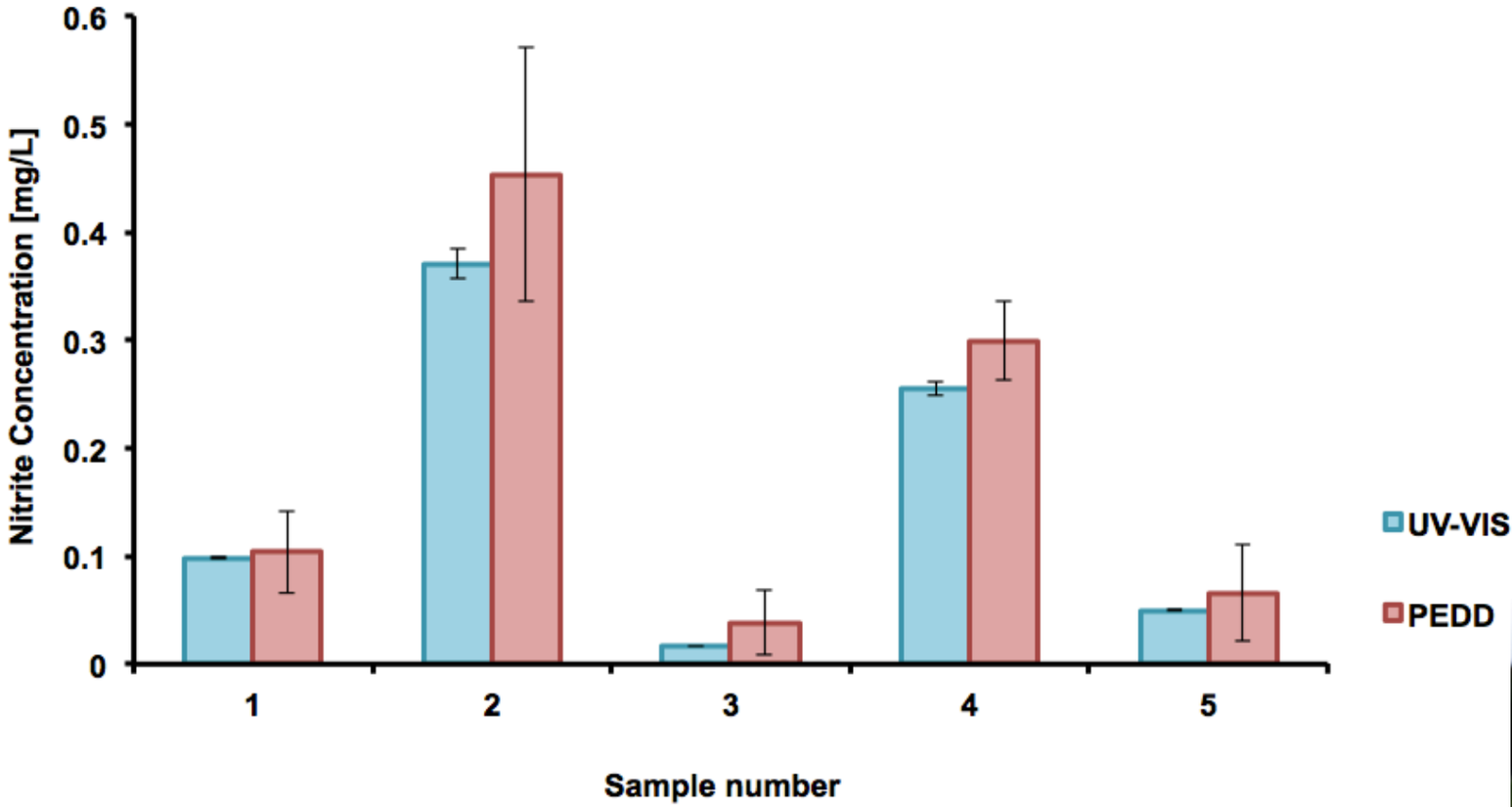


Configuration of the paired LEDs for the alignment of the CD and the colorimetric analysis.



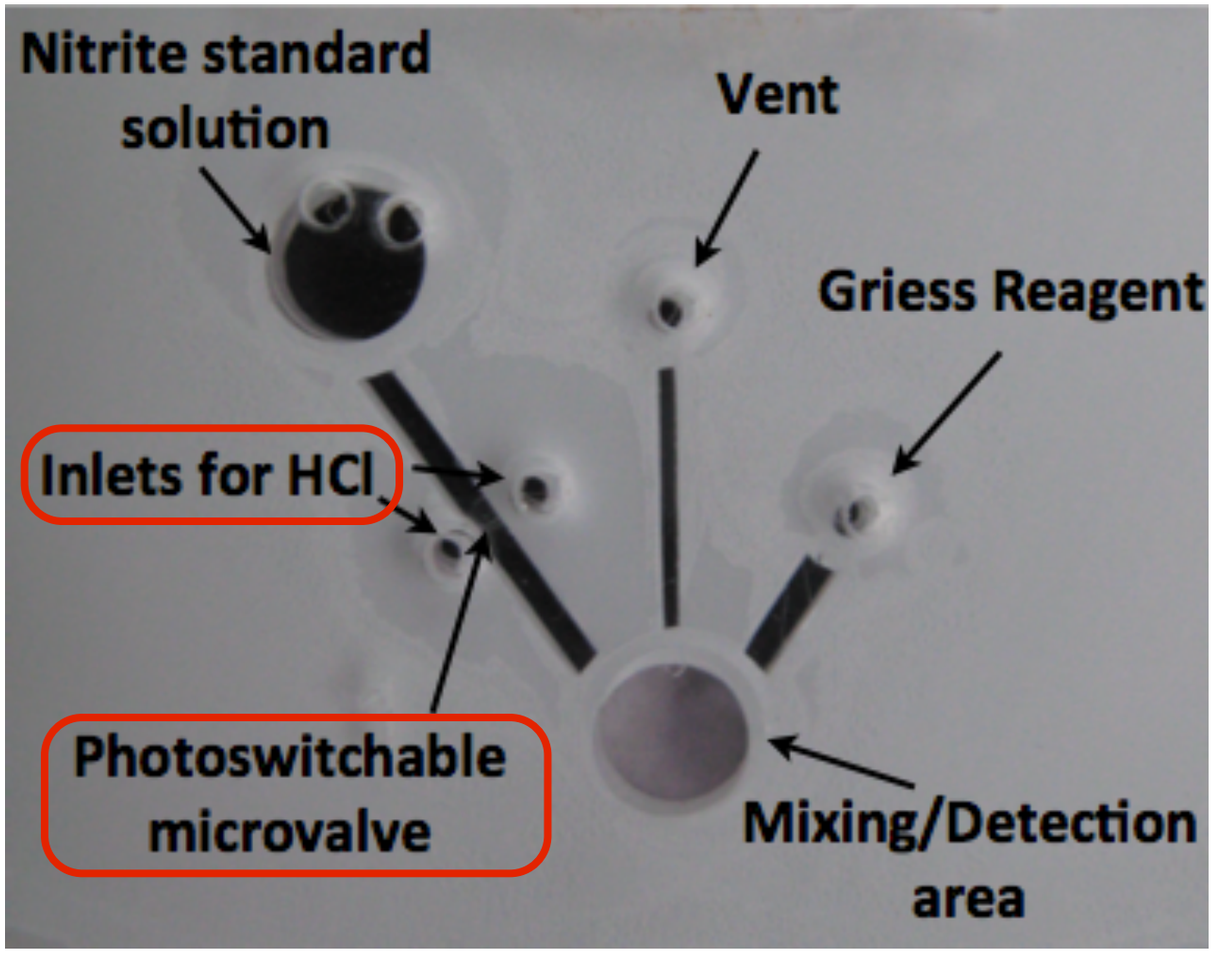
Study of the colour formation between NO_2 and Griess reagent (n = 2) and absorbance versus nitrite Griess reagent complex concentration using and the CMAS system.

Nitrate detection in real water samples

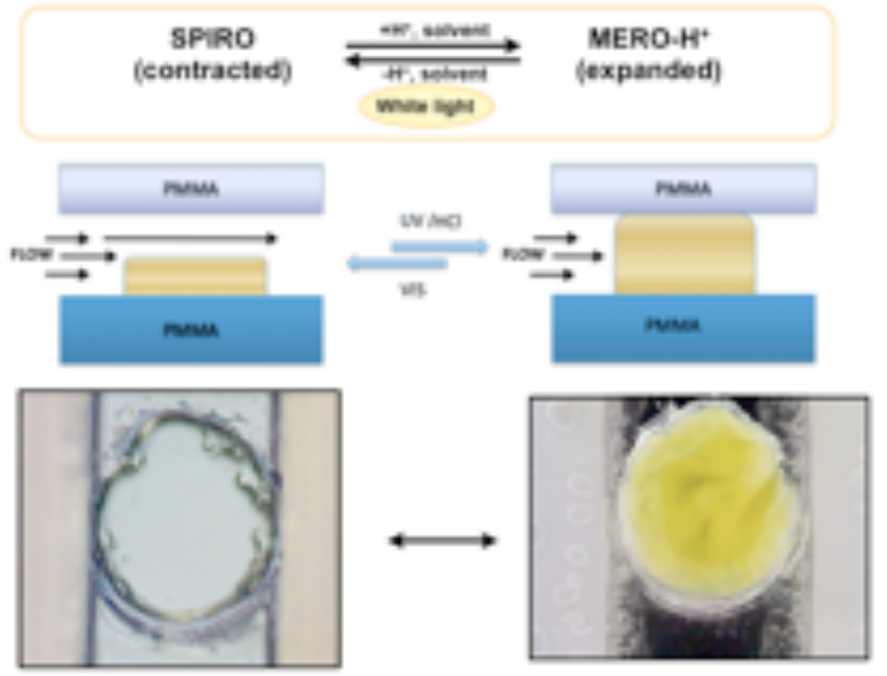


Water nitrite analysis using a bench-top UV-VIS spectrometer and the CMAS device and a map of the sampling places (n = 3).

Single Micro-fluidic Design: Future work



Single chip consisting of three chambers.



Scheme of the photo-switchable polymer matrix.
Schematic of the valve actuation.
Ionogel micro-valve in opened (left) and closed (right) state.

Conferences and training

Conferences

- LOAC EC, Lab-on-a-Chip European Congress, 28-29 March 2012, Edinburgh, Scotland (POSTER)
- ICEST2012, 6th International Conference on Environmental Science and Technology 2012, June 25-29, 2012, Houston, USA (ORAL)
- ESOF, The Euroscience Open Forum, 11-15 July 2012, Dublin, Ireland
- SESEH 2012, Sino-European Symposium on Environment and Health, 20-25 Aug 2012, Galway, Ireland (ORAL)
- MicroTAS 2012, The 16th International Conference on Miniaturized Systems for Chemistry and Life Sciences, 28 OCt - 1 Nov, 2012, Okinawa

Short Courses

- Workshop: “Sensing: Changing the way we live our lives”, DCU, 21 Nov 2011, Dublin, Ireland
- Stats and data processing course, 13-14 March 2012, DCU, Dublin, Ireland
- CMA Analytical Workshop 2012, 24-26 April, Trinity, Dublin, Ireland
- Cambridge Certificate in Advanced English English Course (CAE), Jan - Aug 2012

Publications

Patent: CMAS

- N.D.A – Patent in 1 week.
- Submitted 25/04/12
- Patent Application Number: 1207239.3

Publications

- B. Ziółkowski[1], M. Czugala[1], D. Diamond, Integrating stimulus responsive materials and microfluidics – The key to next generation chemical sensors, JIMSS, Submitted.
- M. Czugala, R. Gorkin, V. F. Curto, J. Ducree, F. Benito-Lopez, D. Diamond Novel optical sensing system based on wireless paired emitter detector diode device for Lab-on-a-Disc water quality measurements, Lab on a Chip (in preparation, Submitted May 2012)

Acknowledgements

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