

SPITFIRE Doctoral Training Partnership (DTP)

Research Experience Placement Project 2019

Lead Supervisor:	Dr. Xize Niu
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University/Research Organisation:	University of Southampton
Department:	Faculty of Engineering and Physical Sciences
Project Title:	A portable droplet microfluidic sensor for continuous monitoring of phosphate in fresh water

Total Student Support Costs: £	Student will receive an hourly pay of £8.44 p.h. and is required to work for 30 hours a week over an 8 week period.
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Proposed Start Date: 1 July 2019/ or later	Proposed End Date: 23 Aug 2019/ or 8 weeks later
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Projects should run over the summer vacation and we recommend that projects will have terminated by 25 September 2019.

Brief Summary

This should include:

- *Project outline;*
- *Links to staff/School/Centre activity as appropriate;*
- *Supervisory arrangement;*
- *How space/equipment/supporting resource demands will be met;*
- *Elements of the project that will incorporate elements other than computer/modelling e.g. fieldwork and data collection;*
- *How the project will enhance the skills of the appointed student;*
- *Any intellectual property rights concerns that may arise from the work.*

In this project we will develop a portable droplet microfluidic based sampler and sensor, to monitor water quality continuously by detecting PO_4 in river water. This sensor will use novel microfluidic pump (recently developed within Dr. Niu's group) and droplet microreactors. The device miniaturises normal chemical assay processes and optical spectrometers into a highly integrated palm sized device. It is self-sustained and can continually collect sample fluids and run wet chemical assays within the device and collect the data, therefore it's expected to monitor water quality for days and even weeks, with a high temporal resolution. This project involves prototyping the device (by modifying a device already developed for monitoring of NO_2 and NO_3) and field testing. Phosphate blue method will be used for determining phosphate, based on the reaction of soluble orthophosphate with ammonium molybdate within an acid environment and a reducing agent. We will calibrate the interference of silicate and pH level of water samples to the reaction. We expect the interference of silicate could be mitigated by controlling the reaction time of the droplet microfluidics. Also the device will be calibrated at different temperatures to elucidate of effect of environmental temperature to the reaction.

Finally we will test the device at the bank of River Itchen on our established test site, following all of the safety regulations.

This project and testing result will provide initial data for proof of concept studies and be used for further grant applications to NERC and other funding agencies. Xize's group has recently successfully applied NERC grants for Nitrite and Nitrate sensors.

Measuring and monitoring water quality is a popular topic for our students. This project will be carried out mainly in Bioengineering lab at Highfield campus. It will provide a valuable chance for the young generation with hand-on experience on making and testing novel sensor technologies. Moreover, the experimental work will also be supported by Spin-out company SouthWestSensor Ltd. on microfluidics and electronics. Therefore the student(s) will have the chance to work with experienced engineers in water sensor industry.

Any new IP produced within this project will belong to UoS.

Please give an indicative timescale for the student's work over the length of the project:

This should include:

- *The broad tasks the student will undertake;*
- *An indicative timescale for these tasks.*

Within 8 weeks, the student will fabricate the device and test its fluidics property in the lab (4 weeks). Then calibrate the interference and temperature effects and tested the device in lab(3 weeks), and finally a report will be written (1 week).

Proposed procedure for appointing students, including selection criteria:

Please identify specific criteria that should be considered for the selection of placement students e.g. specific quantitative skills that may be required, subject knowledge etc. If a student has been pre-selected, or the research area has been led by the student, please provide the student's contact details, and a summary of their suitability for the SPITFIRE DTP REP programme.

The potential candidate shall have a strong interest on environmental monitoring, with solid background on Chemistry or Engineering (Electrical, Mechanical or Chemical), and very capable on experiments. Good communication, team work and effective time management are essential. For a 'chemist', experience on quantitative assays, sensor, and spectrometry is an advantage. For an engineering candidate, experience or mechanical design and fluidics or sensor device, is preferable.

The selection procedure includes short listing based on CV and application materials, and personal interview.