[redacted] [redacted]

RCloud Tasking Form – Part B: Statement of Requirement (SoR)

Title of Requirement	***PHD 1: Bio-SERS- Detection of Pathogens Using Bionanosensors*** ***PHD 2: Ultrasensitive Analysis of Coded Nanoparticles Using Infrared Raman Scattering***
Requisition No.	**PHD 1: RQ0000019635 –** [redacted] **PHD 2: RQ0000019758 –** [redacted]
SoR Version	**1.0**

1.	**Statement of Requirements**
1.1	**Summary and Background Information**

PHD 1 Bio-SERS- Detection of Pathogens Using Bionanosensors.

Summary: The aim of this PhD is to develop a novel, rapid, sensitive and multiplexed optical bionanosensor for the detection of bacteria in different environments.

Background: Rapid detection of bacteria is crucial for the health of the general public as the threat of infectious disease is dramatically increasing as a result of bacteria developing resistance to antimicrobial drugs. Major threats to human health from bacterial infections have led to urgent demands to develop highly efficient strategies for isolating and detecting microorganisms in clinical samples, the environment or for food safety. Bacteria are commonly detected using traditional culture techniques followed by microscopy, luminescence, enzyme-linked immunosorbent assay (ELISA) or the polymerase chain reaction (PCR) to allow definitive identification and speciation of the bacteria. These tests generally take over 24 h due to the culture step followed by sample preparation and analysis. Lateral flow tests using antibody functionalised gold nanoparticles exist for some pathogens, however high concentrations of bacteria are needed and they tend not to perform well with complex sample types. Hence, there is an urgent requirement for the pathogen to be identified quickly and with high confidence levels and a clear need for a point of use (POU) multiplexed sensor.

The major research aim is to develop a novel, rapid, sensitive and multiplexed optical bionanosensor for the detection of bacteria in different environments using a point of use POU detection strategy for the isolation, concentration and detection of multiple pathogens. A specific assay using enhanced Raman scattering and a portable device, with a simple user interface for data interpretation will enable the detection and identification of specific bacteria. Different options including, magnetic capture and paper fluidic based approaches will be investigated. This will be used for sensitive and specific detection of multiple pathogens, without the need for an enrichment culture step, which is rapid and compatible with different sample matrices e.g. cultures, liquids, swaps etc. Extension of use of this new bionanosensor into other areas where there is a requirement for rapid bacterial detection that is simple enough to be carried out by non-scientists is a further benefit of this approach.

PHD 2: Ultrasensitive Analysis of Coded Nanoparticles Using Infrared Raman Scattering

Summary: The aim of this PhD is to develop the surface enhanced Raman scattering technique to carry out detection of coded nanoparticles

Background: Surface enhanced Raman scattering is an extremely sensitive and selective technique that is rapidly emerging as an effective method for ultrasensitive analysis. It offers an increased enhancement over normal Raman scattering therefore is ideal for the detection of trace amounts of analyte and, because of the molecularly specific spectra obtained, it is ideal for detecting analytes in mixtures. The sensitivity of SERS also lends itself to stand off detection and detection at depth due to the intense signals which can be obtained from specially synthesised labels as well as ones which are commercially available. These labels, in combination with nanoparticles, can be used as coded labels due to their unique vibrational spectra allowing labelling of products in areas such as brand protection as well as security applications.

This project proposes to develop the technique and labels required to carry out detection of coded nanoparticles using excitation wavelengths above 785 nm e.g.1064 nm or higher if possible. This will require synthesising different types of metal nanoparticles which have absorbances towards the infrared region of the electromagnetic nanoparticles.

The aim is to develop a tagging system using SERRS active labels which will allow SERRS signals to be detected in the infrared. It will also involve the development of SERRS labels which are stable to harsh environments where they will be required to retain their vibrational response for sustained periods of time with diminishing the signal. This will involve encapsulation of dye labelled nanoparticles in silica, polymer or varnish.

1.2 Requirement

Objectives: PHD 1: Bio-SERS- Detection of Pathogens Using Bionanosensors

Develop a rapid, sensitive and multiplexed optical bionanosensor for the detection and identification of bacteria. This will involve using the inherent sensitivity of enhanced Raman scattering combined with portable Raman instrumentation for optical readout.

(1) Creation of a proof of concept assay for single bacteria detection
(2) Optimisation of sensitivity and specificity of the assay
(3) Further development of the assay for the detection of multiple target bacteria
(4) Evaluation with different sampling formats (swabs, direct from culture etc)
(5) Proof of concept testing with complex samples

Objectives: PHD 2: Ultrasensitive Analysis of Coded Nanoparticles Using Infrared Raman Scattering

(1) To explore the synthesis of metal nanoparticles with red shifted absorbances. This will involve synthesising nanoparticles with different sizes, shapes and shell structures.

(2) To evaluate possible labels, both commercially available and synthesised in-house for use with 785 nm laser excitation and above with the synthesised nanoparticles to give maximum SERS enhancement.

(3) Evaluate matrices which can be used to protect or encapsulate the labelled nanoparticles and protect them from the environment.

(4) To develop a coding scheme which will allow unique spectral signatures to be used to identify the SERS coded nanoparticles. This will involve multiplexing of different combinations of coded nanoparticles.

Proposed Payment Plan PhD 1- Redacted under FOI Exemption

Proposed Payment 1 : End of PhD year 1 Redacted under FOI Exemption

Proposed Payment 2 : End of PhD year 2 Redacted under FOI Exemption

Proposed Payment 3 : End of PhD year 3 Redacted under FOI Exemption

Proposed Payment 4 : End of PhD year 3.5 and delivery of Final Thesis Redacted under FOI Exemption

Proposed Payment Plan PhD 2 – Redacted under FOI Exemption

Proposed Payment 1 : End of PhD year 1 Redacted under FOI Exemption

Proposed Payment 2 : End of PhD year 2 Redacted under FOI Exemption

Proposed Payment 3 : End of PhD year 3 Redacted under FOI Exemption

Proposed Payment 4 : End of PhD year 3.5 and delivery of Final Thesis Redacted under FOI Exemption

NOTE: Redacted under FOI Exemption

Additional Definitions

"PhD Year" A consecutive twelve (12) Month period during the Term, commencing on the date that the Authority formally confirms approval of the student in writing

Research Workers – PhD 1 – PO Redacted under FOI Exemption

Redacted under FOI Exemption

Research Workers – PhD 2 – PO Redacted under FOI Exemption

Redacted under FOI Exemption

1.3	**Options or follow on work**
	a. In addition to the Research and Development Services detailed in Section 1.2, the Contractor hereby grants to the Authority the irrevocable option to undertake additional Research and Development Services with a maximum limit of liability of Redacted under FOI Exemption in accordance with the terms and conditions set out in this contract, it being agreed that the Authority has no obligation to exercise such options. b. The Authority shall have the right to exercise the options detailed by no later than March 2026. Should the Authority wish to exercise the option, the Authority's Representative (Commercial) shall approach the Contractor requesting a quotation for the additional Research and Development Services. Following agreement of pricing and dates, the Authority's Representative (Commercial) will issue a formal Contract Amendment. c. The Authority shall not be obliged to exercise the option(s). Where the Authority does identify a requirement, Redacted will request that the supplier provides a detailed proposal when each additional task arises and this will undergo technical and commercial review.

1.4	**Contract Management Activities**
	Redacted under FOI Exemption [redacted]
1.5	**Health & Safety, Environmental, Social, Ethical, Regulatory or Legislative aspects of the requirement**
	To be the responsibility of the Contractor to identify and action appropriately as required.

1.6	Deliverables & Intellectual Property Rights (IPR) These shall apply to both PhD 1 and PhD 2				
Ref.	**Title**	**Due by**	**Format**	**Expected classification (subject to change)**	**What information is require**
D1-3	Annual Progress Reports.	*T0+12 Months and every 12 months thereafter*	*Summary Report – University template*	[redacted]	
D4	Final Thesis	T0+42 months	*Final Report - University template*	[redacted]	

[redacted]

Deliverable	Required?	Delivery Date *(Expressed as weeks / months f*
Start of PhD programme and kick-off meeting	☒	October 2022
Year 1 - Quarterly progress meetings with [redacted]	☒	January 2023, April 2023, July 2023, October 202
Year 1 - Annual progress report	☒	September 2023
Year 2 - Quarterly progress meetings with [redacted]	☒	January 2024, April 2024, July 2024, October 202
Year 2 - Annual progress report	☒	September 2024
Year 3 - Quarterly progress meetings with [redacted]	☒	January 2025, April 2025, July 2025, October 202
Year 3 - Annual progress report	☒	September 2025
Year 4 - Quarterly progress meetings with [redacted]	☒	January 2026, April 2026, July 2026, October 202
Year 4 – Delivery of PhD Thesis	☒	March 2026

[redacted] [redacted]

1.7	**Deliverable Acceptance Criteria**
	• Redacted under FOI Exemption [redacted]

2	**Evaluation Criteria**
2.1	Method Explanation
	Evaluating this based on technical compliance and affordability.
2.2	Technical Evaluation Criteria
	Confirmation that the proposal fully meets the Authority's Statement of Requirement. Pass/Fail
2.3	Commercial Evaluation Criteria
	The commercial evaluation shall be based on the following Pass / Fail questions: Tenderer has submitted a commercially compliant bid. Has the bidder submitted one (1) completed copy of RCloud Form Part C – Task Response Form (Firm priced proposal within a budget of [redacted] for each PhD) Pass/Fail Labour rates and price as per single source rates uploaded to R Cloud Pass/Fail Completion of Research Workers Forms Pass/Fail Completion of Statement Relating to Good Standing Pass/Fail Confirm acceptance of R Cloud Version 4 Terms and Conditions Pass/Fail Completion of DEFFORM 711 Pass/Fail A fail on any of the above questions will result in your proposal being excluded from further evaluation and consideration.