IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**SERS detection of pathogens in water**	
Project Number	**IMURA0911**	
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Research Clusters:	**Research Themes:**
Highlight which of the Academy's CLUSTERS this project will address? *(Please nominate JUST **one.** For more information, see www.iitbmonash.org)*	**Highlight which of the Academy's Theme(s) this project will address?** *(Feel free to nominate more than one. For more information, see www.iitbmonash.org)*

1	*Material Science/Engineering (including Nano, Metallurgy)*	***1***	*Advanced computational engineering, simulation and manufacture*
2	*Energy, Green Chem, Chemistry, Catalysis, Reaction Eng*	2	*Infrastructure Engineering*
3	*Math, CFD, Modelling, Manufacturing*	3	*Clean Energy*
4	*CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control*	4	*Water*
5	*Earth Sciences and Civil Engineering (Geo, Water, Climate)*	5	*Nanotechnology*
6	*Bio, Stem Cells, Bio Chem, Pharma, Food*	6	*Biotechnology and Stem Cell Research*
7	*Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng*	7	*Humanities and social sciences*
8	*HSS, Design, Management*	8	Design

The research problem

Monitoring water quality in the 21st century is a growing challenge because of the large number of pathogens that can make their way into our waters. Rapid identification and diagnosis of bacteria and other microorganisms is a great challenge for drinking water safety due to the increasing frequency of pathogenic infections. Methods of pathogen analysis and knowledge of their chemical toxicity in water supplies requires time consuming culturing and staining to identify and quantify the pathogen. Techniques like the Polymerize Chain Reaction and other genetic based approaches are expensive and require highly trained personnel. Vibrational spectroscopy offers the possibility of phenotypic identification based on unique molecular fingerprints. Raman spectroscopy is a non-destructive tool to characterize the biochemical fingerprints of bacterial cells and its signal can be improved by surface-enhanced Raman scattering (SERS). Thus, Raman scattering has a huge potential in fast diagnosis of pathogens in drinking water, with low cost and high reproducibility. We plan to develop a novel fast diagnosis method to detect aquatic pathogens using novel patterned mesh coated in gold and silver to produce a plasmonic surface. With chemical co-precipitation synthesis using surface glucose reduction, the nano-mesh will have high efficiency to capture bacterial cells for SERS analysis.

Project aims

1. Develop a SERS active carbon nano mesh capable of capturing bacteria.
2. Determine SERS Limit of Detection and capture efficiency of the mesh.
3. Build artificial intelligent models to identify and quantify two main pathogens *E. coli* and *S. aureaus in water*

Expected outcomes

By this project, we expect to find an efficient and cost effective way to fabricate patterned substrate as efficient sensing platform for biological contamination. *Students will publish high quality research outputs in journal and academic conferences.*

How will the project address the Goals of the above Themes?

Project directly falls into the theme of "water" and “nanotechnology” as it deals with pathogen detection using nanotechnology based technique.

Capabilities and Degrees Required

BTech, MTech, MSc in EE, Physics, Chemistry, Material Science, Green Energy, Laser, Optics, ME, CE, ESE or any other relevant field. Experience in surface patterning/preparation, optics or dispersion science would be preferred.

Necessary Courses

BB653 Experimental Techniques in Biomedical Engineering
ES 639 Physico-Chemical Treatment Technologies
MM718 Laser processing & nanostructures
MM734 Electrical Properties of Materials

Potential Collaborators

Please visit the IITB website www.iitb.ac.in OR Monash Website www.monash.edu to highlight some potential collaborators that would be best suited for the area of research you are intending to float.

Select up to **(4)** keywords from the Academy’s approved keyword list **(available at http://www.iitbmonash.org/becoming-a-research-supervisor/)** relating to this project to make it easier for the students to apply.

Water, Nanoscience, Smart manufacturing, Sensor networks